SOIL AND WATER PROTECTION USING CONSERVATION TILLAGE IN NORTHERN AND CENTRAL EUROPE

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Abstract
SOWAP is an acronym for a project called Soil And Water Protection Using Conservation Tillage in Northern and Central Europe which aims to assess the viability of a more "conservation-oriented" agriculture in the UK, Belgium and Hungary. SOWAP works at the farm scale, with detailed monitoring taking place at the plot level. The conservation tillage systems tested by the project will be applied at field sites in the three countries. Local variations and farmer/land owner preference will be considered and documented, making use of the WOCAT methodology. The consultation and participation by all stakeholders is critical to the success of SOWAP. Economic aspects as well as environmental benefits will be assessed for the conventional practice, for a conservation tillage practice devised by SOWAP in co-operation with the farmer and for a SOWAP "appropriate practice" crop solution. The impact of three cultivation practices will be compared on run-off plots by measuring sediment and water run-off, loss of soil nutrients/fertilizers, and pesticide losses. Secondly, separate areas of the monitoring sites will be used to assess the impacts of the practices on soil ecology and soil physical-chemical properties, with particular emphasis on reduction of off-site pollution, enhancement of soil structure and carbon sequestration and increase of biodiversity, due to conservation practices Further assessments will be made of the impacts on larger species e.g. birds and fish.

Keywords: soil conservation, water protection, minimum tillage, documentation, evaluation, WOCAT

Introduction
Agricultural production can often have negative impacts on the environment, and there is considerable concern about the sustainability of conventional land-use practices on arable land in Northern and Central Europe. Various research studies have demonstrated the environmental damage which can result from unsustainable use of land resources, particularly inappropriate cultivation practices. Even though soil loss rates in Europe are generally much lower than in the tropics and subtropics there is growing concern about the effects of surface runoff and sediment transport on the water resources. Conventional land preparation and crop agronomy requires many field operations, especially for winter cereals in the UK and sugar beet in Belgium. This is associated with aggregate breakdown, which significantly increases soil erosion susceptibility, surface sealing and capping which in turn encourages production of surface runoff. These processes combined result in increased soil losses, sediment concentrations and runoff volumes. The eroded sediments, including chemical contaminants, are then transported to water bodies, deteriorating its quality by turbidity. Chemicals in the runoff also pollute these water bodies. Many studies have shown the sensitivity of aquatic ecosystems (flora and fauna) to even low levels of water pollution by sediment. There is, in Europe, a considerable gap between what is known about the principles behind soil conservation practices and what is applied in practice.

Now, a major new European project called SOWAP (**SO**il and **WA**ter **P**rotection Using Conservation Tillage In Northern And Central Europe), is addressing the environmental, economic and social concerns arising from conventional agriculture. SOWAPs mission is "to find and demonstrate ways of better managing the land". Working initially in the UK, Belgium and Hungary over a period of three years (2003 -2006), SOWAP is testing a range of site-specific soil management methods, based on the concept of conservation tillage. It examines the economics of tillage operations as well as effects on soil erosion, as well as pesticide and fertiliser run-off. Additional effects on birds, earthworms and aquatic invertebrates are some of the biodiversity indicators the project will investigate. The project brings together organisations and institutions of widely differing backgrounds, from commercial (agro-business), academic (soils, erosion, terrestrial and aquatic ecology), environmental organisations, GO's and NGO's, and farmers. Besides benefiting from a solid internal Internet-based communication structure, the project partners also gather twice a year during a plenary project meeting to discuss progress and problems.

Materials and Methods
As outlined above, a wide range of aspects of "conservation tillage" will be studied under the project. These are listed below in summary (source: www.sowap.org), after which the documentation and dissemination theme will be highlighted in more detail. SOWAP defines conservation tillage as "those practices specifically intended to reduce

soil disturbance during seedbed preparation. The objective is to improve soil structure and stability. Conservation tillage encompasses a range of tillage practices up to and including – but not exclusively - "Zero (no) Tillage".

Soil Erosion
The EU Communication "Towards a Thematic Strategy for Soil Protection" states that: "Soil is a vital resource increasingly under pressure. For sustainable development, it needs to be protected" (European Commission, 2002). SOWAP seeks to meet this objective by promoting better management of the soil and thereby limiting soil erosion.

Small scale soil erosion plots will be used to:
- compare conventional, farmer and SOWAP practice
- measure sediment, pesticide and nutrient loss and runoff from these systems

Visual erosion surveys and rainfall simulation trials will also be undertaken on these plots.

Aquatic Ecology
Soil disturbance produced by tillage creates high runoff rates and high sediment loads being deposited into streams, ditches and ponds. This results in reduced water clarity, enhanced levels of nutrients, organics, pesticides and bedloads. SOWAP will study the effects of 'minimum' tillage on:
- stream biodiversity (fish, invertebrates and plants)
- water chemistry and sediment loading

and assess other tools to reduce the burden of agricultural pollutants on freshwaters.

Birds & Terrestrial Ecology
Key biological indicators will be identified to assess the impacts of differing land management practices on ecosystem sustainability. Counts of foraging farmland birds in winter and during the breeding season will be undertaken. Of particular interest is the comparison of UK agriculture with the currently lower intensity agriculture of Hungary. The abundance and availability of seed and invertebrate food resources will be used as indicators for biodiversity, while earthworm numbers will also be used as important indicators of soil 'health'.

Soil Microbiology
The soil microbiology component of the project will monitor specific soil biological indicators. The work will involve micro and macro biological survey recording indicator species and communities/populations thereby assessing levels of bio-diversity in the soil. Details on microbial biomass and community structure and function will add to the complex picture of biological activity in the soil under the different management regimes.

Agronomy
It is important to understand and disseminate the different soil management practices used to cultivate the soil and grow the crops. To facilitate this , various assessments e.g. crop cover, date of emergence, disease prevalence, weed incidence will be made during the season and over the three year duration of the project, thereby taking into account the farm's crop rotation.

Economics
The economic viability of the practices employed will be key to their successful uptake by farmers inside and outside the project. Project farmers will be encouraged to keep farming calendars throughout the project duration, noting economic inputs (costs of land preparation, treatment application, cultivations and management practice, harvesting costs, marketing costs, transport, variable and fixed costs, gross margins) and outputs (yields).

Documentation and Dissemination
According to the European Conservation Agriculture Federation the relatively slow uptake of conservation agriculture (table 1) can be largely attributed to insufficient transfer of technology and lack of awareness. In a survey by the German member federation, it was revealed that almost 50% of the farmers considered ploughing necessary to produce crops (ECAF, 2004).

One criterion for the success of the SOWAP project is the potential for independent assessment of the environmental and economic benefits of the cultivation practices being used, and a suitable manner for transmitting this information.

Table 1. Estimation of surface under Conservation Agriculture and Direct Drilling in different European Countries (data obtained from ECAF National Associations).

	Surface under Conservation Agriculture (ha)	% Agrarian Surface	Surface under No-Till (ha)	% Agrarian Surface
Belgium	140.000	10%		
Ireland	10.000	4%	100	0,3%
Slovakia	140.000	10%	10.000	1%
Switzerland	120.000	40%	9.000	3%
France	3.000.000	17%	150.000	0,3%
Germany	2.375.000	20%	354.150	3%
Portugal	39.000	1,3%	25.000	0,8%
Denmark	230.000	8%		
United Kingdom	1.440.000	30%	24.000	1%
Spain	2.000.000	14%	300.000	2%
Hungary	500.000	10%	8.000	0%
Italy	560.000	6%	80.000	1%
TOTAL	**10.054.000**		**960.250**	

SOWAP will build upon the work of the World Overview of Conservation Approaches and Technologies programme (WOCAT). ISRIC (World Soil Information), as a member of the WOCAT Management Group, represents WOCAT within the SOWAP project, and will be responsible for the documentation and dissemination task. During the past decade WOCAT has developed and tested a standard method to document, monitor and evaluate SWC know-how, and to disseminate it around the globe in order to facilitate exchange of experience. A set of three comprehensive questionnaires and a database system have been developed to document all relevant aspects of SWC technologies and approaches, including costs and benefits, uptake, area coverage, etc. A SWC technology is defined by WOCAT as: "the agronomic, vegetative, structural or management measures (or combinations of these) that control soil degradation and enhance productivity in the field. A SWC approach constitutes "the ways and means of support that help to introduce and implement, adapt and apply a SWC technology in the field" (WOCAT, 2004).

The database which contains over 300 technology case studies and more than 200 approaches from 40 countries (though not all have been validated or completed yet) is used by a worldwide variety of government departments, project staff, scientists and extension workers, to promote such practices. WOCAT disseminates its information via the Internet, CDs and workshops that provide a basis for personal contacts with other specialists for immediate exchange of experience. (Liniger et al. 2002a, b, Van Lynden et al 2002,)

The WOCAT method will first of all, but not exclusively, be used to document and evaluate the tested SOWAP practices. In order to enable a broader comparison, other practices, not tested within the SOWAP field sites, will also be documented and evaluated to the extent that human resources, time, and funds permit.

At the field level the WOCAT questionnaires offer SWC experts, technicians and extension workers a common framework and methodology to documenting and evaluate their own experience. One proven benefit of filling in the questionnaires is that it provides an in-depth analysis and evaluation of one's own SWC activities. SWC institutions, planners, co-ordinators and decision-makers at the national and regional planning levels need to obtain and maintain an overview of SWC activities. WOCAT helps to efficiently consolidate and apply relevant SWC knowledge that is available in their working areas (Liniger and Schwilch 2002, Liniger H.P. et al. 2004).

Together with the aforementioned WOCAT channels of dissemination, SOWAP will also independently develop a dissemination - or in more fashionable terms: upscaling - strategy. For such a strategy first of all the target groups have to be identified, as well as the type and contents of the information required by these beneficiaries. The target groups identified in the SOWAP project document cover a very wide range of institutional and professional backgrounds and interests (SOWAP, 2002). Three major levels of dissemination can be distinguished:

– local: farmers, land owners and estate managers, local policy makers and advisory organisations

– national: farmer organisations, agricultural advisory organisations, national policy makers and advisory organisations, researchers and academia, industry.
– EU: policy makers at EU level

These beneficiaries may have different as well as overlapping information needs and interests, and so will be addressed through a variety of dissemination means. For example the needs of farmers and field based organisations will be met through workshops and field visits, whereas technicians and researchers will be addressed via technical documents and scientific papers. The general public and policy makers are more likely to be influenced by brochures and leaflets, TV, radio and written press. Further dissemination tools are a project Website, electronic newsletter, and papers or posters presented at conferences such as ISCO.

The dissemination process does not just entail copying a success story from one place to another, but includes awareness creation about all the site-specific elements that need to be given consideration. This is or at least should be obvious for bio-physical conditions, but is often less so for socio-economic conditions and the human environment, in which the technology can be newly applied. Dissemination should therefore be an interactive process with active involvement of the target beneficiaries, rather than one-way traffic.

Results and Discussion

The four major deliverables for this project will be:

a) Provide demonstrations of appropriate practices in soil management for local farmers
b) Provide a soil erosion monitoring network for the EU, which could be used within the "Thematic Strategy for Soil Protection"
c) Provide an EU database on available conservation agriculture practices, and suitable methods for their implementation and dissemination
d) Provide practical field solutions to demonstrate sustainable farming practices to extension workers, academia and policy makers

Sites have been obtained in each of the countries for demonstration purposes. In the UK there are two sites, one in West Somerset and a second on the Leicestershire/Rutland Border. A single site has been located in Belgium and a further two in Hungary (Figure 1). These sites form the key demonstration areas. Along with these demonstration sites, other cooperating farmers and farmer organisations have been identified, where demonstrations and comparisons between various land manage practices can been tested. The research sites for erosion, aquatic ecology and terrestrial ecology do not necessarily coincide. Each erosion site has a weather station with data being directly accessible from the SOWAP Website. This can be queried for past erosion events or weather data per day or per month.

In Hungary where conservation tillage is in its initial stages, there is a good opportunity for SOWAP to develop and test its practices. Due to the efforts of the Hungarian Academy of Sciences and the local Syngenta representatives the project will be able to promote the development of soil and water protection in this country. However, this has meant that implementing farmer-led options for soil management could not take place, as the conservation tillage concept has not as yet been widely applied there at the farm level. Thus comparison made in the field is merely between conventional agronomic practices and SOWAP practices.

The project in the UK has already started to organise workshops and open days for farmers, agronomists and extension workers, and these will start to show up on the Website diary over the next few months. Tremendous support has been given to the project in bringing these workshops into being by local organisations such as the National Trust, the Farm Wildlife and advisory Group (FWAG) and the Allerton Trust.

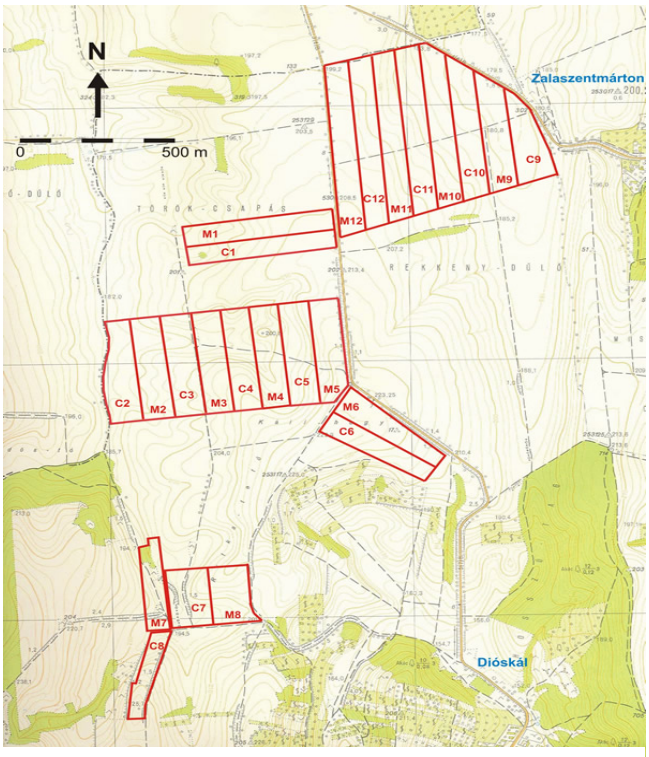

Figure 1. Layout of the SOWAP site at Dioskal, Hungary

The organisation of workshops and open days will start in both Hungary and Belgium after the media launch of the projects in these countries during the spring of 2004, although preparations for such events are well in hand. Data collection has started, and further refinement of all economic and agronomic data to be collected was discussed at the plenary meeting of the project in February 2004 in Leuven.

Concepts for "Appropriate Management Practices" were partially implemented on all demonstration sites after the 2003 harvest.

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