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Монография содержит информацию о самых современных методологиях и результатах в ландшафтных исследованиях. Она может быть использована в качестве руководства для исследователей, преподавателей, студентов и всех, кого интересует тема ландшафтной науки и смежных дисциплин. Монография является особо ценной информационной базой для лиц, принимающих решения на различных уровнях, от местных до международных органов по принятию решений. Приведенная в монографии информация представляет собой современный уровень ландшафтной науки в очень краткой форме.

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This monograph shall inform you about up to date methodologies and recent results in landscape research. It is intended as a guide for researchers, teachers, students, decision makers, stakeholders interested in the topic of landscape science and related disciplines. It provides information basis for decision makers at various levels, from local up to international decision bodies, representing the top level of landscape science in a very short form.

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Chapter IV/12: CONSERVATION AGRICULTURE, SUSTAINABLE LANDSCAPE USE AND LANDSCAPE PROTECTION

Глава IV/12: Ресурсосберегающее сельское хозяйство, устойчивое использование и охрана ландшафтов

Ádám Kertész*; Balázs Madarász

DOI 10.25680/6888.2018.70.59.277

* Email: **kertesza@iif.hu**

Research Center for Astronomy and Earth Sciences, Hungarian Academy of Sciences, Budaörsi út 45, 1112 Budapest, Hungary.

ABSTRACT. Because of population growth the global demand for food is rapidly increasing. As a result agriculture is expanding and becoming more intensive therefore it is very important that farming activities are sustainable for the landscape and environment friendly. The aim of this paper is to present the positive role of conservation agriculture in sustainable landscape use and landscape protection. Conservation agriculture is beneficial for the soil, preserves SOM, soil structure, soil moisture and it is an effective tool against soil erosion. It seeks to preserve biodiversity in terms of both flora and fauna. Activities such as Integrated Crop, Weed, and Pest Management form part of Conservation Agriculture. Results of a case study near Lake Balaton, Hungary highlight the main advantages of CA for the soil, for biodiversity and for the landscape as a whole.

Резюме. Вследствие роста населения глобальная потребность в продовольствии быстро растет. Это приводит к расширению и интенсификации сельскохозяйственного производства, поэтому важно, чтобы технологии обеспечивали устойчивость ландшафта и были благоприятными для окружающей среды. Цель этой главы — представить положительную роль ресурсосберегающего сельского хозяйства в устойчивом использовании ландшафтов и охране ландшафтов. Ресурсосберегающее сельское хозяйство является полезным для почвы, сохраняет органическое вещество, структуру почвы, почвенную влагу и эффективно защищает от эрозии почвы. Оно ставит целью сохранение биоразнообразия флоры и фауны. Такие подходы, как интегрированное растениеводство и защита сельскохозяйственных культур, являются частью ресурсосберегающего сельского хозяйства. Результаты исследования в окрестностях озера Балатон, Венгрия, показывают главные положительные эффекты ресурсосберегающего сельского хозяйства для почвы, биоразнообразия и ландшафта в целом.

KEYWORDS: landscape protection, conservation agriculture, soil erosion, biodiversity
Ключевые слова: охрана ландшафта, ресурсосберегающее сельское хозяйство, эрозия почв, биоразнообразие

INTRODUCTION

The requirement for sustainable land use and an increasing need of landscape protection are burning issues of the near future because of the growing importance of global processes including global warming, land use and land cover change, population growth, land degradation etc.

According to worldometers.info [7] world population will reach 7,6 billion in 2018 and the forecast for 2050 is 9,8 billion. Only 14,6 % is the population share of Europe and Northern America, 85,4 % live in on the other continents representing the third world with a very high population growth. The demand for food will rise with population increase. World agriculture will have to produce more and more food. New areas will be used for agriculture by changing the present use of land and as it is well known land use change means in most cases deforestation leading to enhanced land degradation risk. The already existing agricultural areas will be used more intensively. The possible impact of intensified and expanded agricultural activities on the soils and landscapes has to be addressed properly. At least the present quality of soils should be preserved and the landscapes be protected.

As mentioned above, food supply will be extremely important in the near future. Malthus and Ricardo overemphasized the role of population increase and took no notice of technological development [4]. Food supply risk is not a real problem if technological changes as part of a state-of-the art, complex and dynamic socio-economic environment are taken into account.

Presently 11 % (1.5 billion ha) of the Earth's land surface (13.4 billion ha) are used for crop production (arable land and land under permanent crops), representing 36 % of the estimated land area suitable for

crop production. [1]. Suitable land may not mean a piece of land with ideal conditions. On the contrary, the territories not yet used for agriculture dispose in most cases of modest capabilities that is the reason why they have not been used yet. As mentioned above, the solution can be either to use areas with bad endowments or to change land use, e.g. by deforestation. Another possibility is to use existing arable land more intensively. All the three solutions are unfavourable for the environment. Reserves of good quality cultivable land diminish very quickly.
The objective of this paper is to demonstrate how conservation agriculture contributes to sustainable landscape use and landscape protection also by supporting biodiversity.

THE EFFECTS OF AGRICULTURE ON LANDSCAPE DEVELOPMENT

Human society is a major landscape forming agent and the landscapes of the developed world are transformed by human activities. The effects of industry plants, urban areas, transport lines are much more evident because they alter the landscape radically, replace green areas with concrete and the change can be irritating. One is inclined to forget that agriculture and even forestry reverse and transform the original natural conditions of landscapes. The alteration caused by agriculture and forestry is less eye striking than that of the above mentioned human activities, as the landscape remains green, covered by vegetation for.

Table 1 – Agriculture in Hungary, in Europe and in the World [6]

Area	Agricultural land (% of land area)		Agricultural employment (% of total employment)	
	1961	**2014**	**1992**	**2014**
Hungary	78.7	59.1	11.3	4.7
EU	54.7	43.8	5.2	4.7
World	36.0	37.5	34.7[1]	29.4[2]

[1]Data from 2005, no data available from 1992
[2]Data from 2010, no data available from 2014

The effects of agriculture on landscape development and functioning are at least as important as the effects of other human activities. In addition to that it has to be emphasized that the percentage of agricultural areas is much higher than that of other land use categories and so the effect is manifested on a very large territory (Table 1). In Europe including Hungary the agricultural area diminished considerably during the last 50 years. In the world the area used for agriculture has increased in the same period and the explanation for that is simply the growing demand for food in the third world. The trends shown in Table 1 on the percentage of people employed in agriculture are more or less similar in the EU and in the world, i.e. a decrease in Europe and in the world. In Hungary, however, a slow increase started lately. In 2016 5.0 % were employed in agriculture [5].

CONSERVATION AGRICULTURE

According to the FAO definition „Conservation Agriculture (CA) is an approach to managing agro-ecosystems for improved and sustained productivity, increased profits and food security while preserving and enhancing the resource base and the environment. CA is characterized by three linked principles, namely: (1) continuous minimum mechanical soil disturbance, (2) permanent organic soil cover, (3) diversification of crop species grown in sequences and/or associations."[1]. CA combines profitable agricultural production with environmental benefits and so it is a well applicable tool for Sustainable Land Management (SLM).
The initial development of conservation agriculture was a response to severe land degradation problems in the first half of the twentieth century in the Americas. The introduction of reduced tillage was a real bottom-up story. It started on agricultural fields and it spread from the land managers to the administrative and scientific levels [3]. As it is well known the Soil Conservation Service of the United States was founded in 1935 because of the damage caused be dust blows in the western central area of the USA.

Conservation Agriculture (CA) is practised over 100 million ha (in 2011 the estimation is 125 million ha, 9 % of cropland) around the world [3] under various ecological conditions. The estimated value of 2004 was only 45 million ha. The greatest extension and percentage values are in North and South America, South Africa, Australia and New Zealand. More than half the area where CA is practised is located in the developing world. The area of CA has been increasing at an annual rate of 7 M ha during the last ten years.

CA is an important land management strategy, particularly in regions where soil erosion is a major problem and where the retention of soil moisture is an important goal. Retaining water in the soil is important for agricultural production, but equally so in mitigating floods and drought.

There is an increase in the application of CA in Europe although it has developed slower and its extension is not as large as in other parts of the world. According to FAO [1] data CA fields cover an area of 1 311 900 ha in Europe, just a bit more than 1 % of arable land.

CASE STUDY: THE SOWAP PROJECT

The SOWAP (SOil and WAter Protection) project, co-funded (50-50%) by EU LIFE and Syngenta involved several partners from the EU[1] (2003-2006). After 2006 the project has continued on the Hungarian project site and will continue further. The objective is to assess the viability of conservation agriculture and to compare it with conventional arable farming systems. The use of appropriate chemicals is tested, and their potential for off-site contamination assessed, to ensure that any suggested approaches are environmentally sound.

The main study topics of the project include (1) Soil erosion, (2) Aquatic Ecology, (3) Biodiversity – Birds and Terrestrial Ecology, (4) Soil Microbiology, (5) Agronomy, (6) Economics. The two experimental sites are near Lake Balaton (Figure 1). Szentgyörgyvár is for soil erosion studies with four large plots (120 m^2 each) on a 2 ha farm with a slope gradient of 9-10%, on a luvisol (sandy loess). Meteorological and runoff data will be transferred by a mobile phone and put on the internet once every day. Soil loss is measured manually. Dióskál (107 ha) is for the farm scale demonstration and for ecological studies [4].

a) Erosion plots. Runoff and soil loss amount are determined after each event and samples are taken undergoing the following analyses. Runoff: pH, soluted N, P, K, total suspended sediment, TOC, total salt content, herbicide content; eroded soil: dry mass, particle size distribution, N, P, K and organic matter content. Crop quality, quantity and biomass are also investigated. Economic viability of the practices employed (e.g. production costs) will be calculated whenever applicable.

b) Ecological plots. For the terrestrial ecology survey 12 conventionally tilled and 12 CA plots were established. The experiment includes the survey of weeds, soil micro-organisms, birds and earthworms-insects-seeds as important food sources for birds.

c) The results point to less runoff and soil loss on the CA plots: average runoff under CA was only 33.2% of that on conventional plots and the percentage of soil loss was only 1.7%. The average soil loss per year was 2.44 t ha^{-1} versus 0.08 t ha^{-1}, based on measurements between 2004-2006 [4]. Gravimetric soil moisture measurements at Dióskál show that the upper 20 cm of the CA plots had higher soil moisture content values (8.8% on the average). TOC, nitrogen, phosphorus and potassium concentrations of sediments were higher on CA plots, presumably due to the higher humus and nutrient content on the CA plots [4].

d) Ecological survey. CA offers better conditions for the activity of earthworms. The number of earthworms on the CA plots was significantly higher than on the traditional plots. Altogether 37 bird species were registered during two winter seasons including 28 protected species (76% of total). One third of these species are significant from European perspective indicating that agricultural areas are also important from the aspect of nature conservation. CA fields proved to be more favourable for birds, first of all for small warblers like skylark (*Alauda arvensis*), goldfinch (*Carduelis carduelis*), yellowhammer (*Emberiza citrinella*), greenfinch (*Carduelis chloris*) and tree sparrow (*Passer montanus*), than traditional

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Agronomica, U.K.; Cwi Technical Ltd, U.K.; FWAG, U.K.; Harper Adams University College, U.K.; Geographical Research Institute of Hungarian Academy of Sciences, HU; National Trust, U.K.; Cranfield University – NSRI, U.K.; RSPB, U.K.; Syngenta, U.K./HU; The Allerton Trust, U.K.; The Ponds Conservation Trust, U.K.; University of Leuven, Belgium; Vaderstad, U.K./HU; WOCAT, The Netherlands; Yara (UK) Ltd, U.K.

plots did in both of the winter seasons investigated. Conservation agriculture provides a better food supply and improves winter survival reducing the negative effect of agriculture on bird fauna [4].
e) Crop yield and production costs on the Dióskál plots were practically the same under the different tillage systems [4].

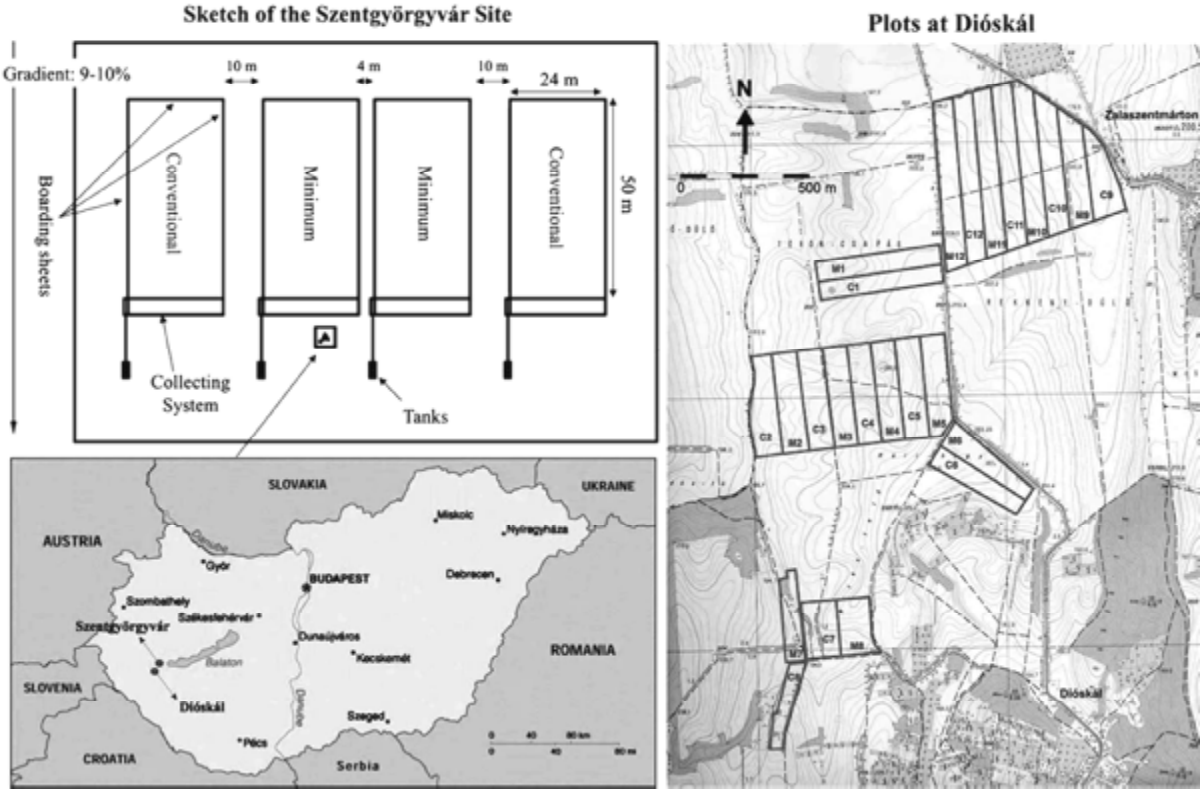

Figure 1 – Location and plan of the conservation agriculture experimental plots in Zala County, Hungary.

CONCLUSIONS

1. Because of the impact of agriculture on landscape development it is important to find sustainable solutions. Conservation agriculture is a sustainable way of farming with a landscape protecting effects on the landscape.
2. The results of the SOWAP project support the above statement. CA techniques have reduced soil loss and water runoff from fields compared to conventional farming. Under CA runoff was reduced by 66.8%, soil loss by 98.3%, TOC loss by 94.1%, nitrogen loss by 86.8%, phosphorus loss by 95.6% and potassium loss by 78.8% relative to quantities measured on the conventional plots. Soil moisture conditions were better in the upper 20 cm under conservation tillage.
3. Biodiversity conditions were also much more adequate on the conservation plots.
4. On one hand conservation agriculture is beneficial for the soil itself and the environment, on the other hand it promotes a healthy functioning of the landscape as a whole.

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Глава IV/13: ПРИНЦИПЫ СБЕРЕГАЮЩЕГО ЗЕМЛЕДЕЛИЯ В ЦЕНТРАЛЬНОЙ АЗИИ
Chapter IV/13: Principles of Conservation Agriculture in Central Asia

Мехлис К. Сулейменов*, Жексенбай А. Каскарбаев†
DOI 10.25680/4355.2018.75.51.278
*Эл. Почта: **Mekhlis@yahoo.com**
Научно-производственный центр зернового хозяйства имени А.И. Бараева, 021601, п. Научный, Шортандинский район, Акмолинская область, Казахстан

РЕЗЮМЕ. Принципы сберегающего земледелия меняются в зависимости от почвенно-климатических условий. В неорошаемом земледелии главным принципом является максимальное накопление снега, основного источника пополнения влаги в почве. Для этого делаются кулисы из высокой стерни. Второе, это создание оптимальной плотности почвы для максимальной водопроницаемости при таянии снега. Для этого в большинстве случаев необходима минимальная обработка почвы осенью. В орошаемом земледелии применяется нулевая технология после уборки озимой пшеницы, а при посеве озимой пшеницы после хлопчатника, что является обычной практикой, требуется обработка почвы. Третий принцип - это максимальное покрытие почвы растениями. Для этого в неорошаемом земледелии из севооборотов исключаются чистые пары. Они заменяются посевами зернобобовых культур или донника на сидерат. На орошаемых землях высеваются промежуточные культуры сразу после уборки озимой пшеницы. Адаптивно-ландшафтное земледелие позволяет применять более точно соответствующие приемы земледелия в соответствии с особенностями ландшафта.

Abstract. Principles of conservation agriculture change depending on soil climatic conditions. In rain-fed agriculture, main principle is maximum accumulation of snow as main source of soil moisture. Establishment of tall stubble barriers does it. Secondly, this is establishment of adequate soil density for maximum water permeability under snow thawing. For this in most cases minimum tillage in the fall is a need. In irrigated agriculture. No Till is used after harvest of winter wheat whereas for planting winter wheat after cotton, which is normal practice, tillage is necessary. Third principle is maximum soil coverage by plants. To do this in rain-fed agriculture elimination of summer fallow from crop rotations is necessary. Pulses or sweet clover as green manure replaces it. In irrigated agriculture, intermediate crops are planted right after harvest of winter wheat. Landscape-adapted farming allows do more precisely farming practices in accordance with peculiarities of landscape.

КЛЮЧЕВЫЕ СЛОВА: стерня, обработка почвы, севооборот, ландшафт, чистый пар
Keywords: stubble, tillage, crop rotation, landscape, summer fallow

ВВЕДЕНИЕ

Элементы сберегающего земледелия начали применяться в Центральной Азии в середине 1950-х годов. Это был регион северного Казахстана, где в период 1954-1956 гг. были распаханы огромные массивы целинных земель. Что касается вопроса обработки почвы, то вначале он решался в пользу безотвальной по методу Т.С. Мальцева [1]. Но после того как А.И. Бараев ознакомился с земледелием в провинциях прерий Канады, он пришел к выводу, что для обширных степей Казахстана более подходят приемы канадского земледелия, основными элементами которого были зернопаровой севооборот и плоскорезная обработка почвы [2]. Плоскорезная