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Edited by Madarász, B., Tóth A.

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Effect of land use change from forest to agricultural lands on some soil biological and chemical properties (Case study: Sari, Iran)

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The present study was aimed to investigate the effect of land use change from forest into agricultural lands (citrus garden, dry-farming of canola and paddy lands) on some soil biological and chemical properties. Samples from each land use were prepared in two soil depth of 0-20 and 20-50 cm from Semeskandeh region in Sari which located in north of Iran. Results indicated that land use change from forest to agricultural fields markedly decreased the amount of soil microbial respiration. Amount of microbial biomass of carbon and microbial biomass of nitrogen decreased 73 and 51 percent, respectively in dry lands farming as compared to the forest lands. The most amount of net nitrification rate was related to the forest land use. There was no significant difference between other land uses. Land use change from forest to agricultural lands decreased the amounts of total nitrogen, available potassium and phosphorus, but it had no significant effect on cation exchange capacity. This research clearly showed that land use negatively changed caused changes the most soil properties. The most adverse effects was seen where the forest lands changed to dry lands farming of canola.

Predictive model for expected salt accumulation due to afforestation on grasslands and croplands

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In Hungary, afforestation was one of the most significant land use changes during the last hundred years. 700.000 ha of former, non-profitable grasslands and croplands were forested on the Great Plain. For the coming 30 years, the same trend of afforestation is planned with the support of the European Union (Andrasevits et al., 2005; National Forest Strategy, 2009). Although it has been demonstrated that subsurface salt accumulation can be induced by forests in areas, where negative water balance, shallow and saline groundwater appear simultaneously (Bazykina 2000, Noretto et al., 2007, 2008), many of the forested areas (60% of total) have these circumstances. If salt accumulation rate becomes high at the root zone, water uptake of trees can be osmotically inhibited, thus productivity of the plantation decreases and economic damage may occur as a result of yield loss. During decision-making in forestry, the above parameters are not taken into account seriously as an input; therefore future risk is incorporated.

Investigating the Great Hungarian Plain, a database was created, including abiotic (soil and groundwater physical and chemical) data and biotic data, measured in field and/or laboratory, derived from the measured data and collected from literature. Based on this database, a predictive statistical model for salt accumulation was evolved for each investigated tree species (*Quercus robur*, *Robinia pseudoacacia* and *Populus* spp.) most characteristic in the afforestation of the Great Plain. Due to different features of the trees (water demand, salt tolerance, growth rate, etc.) different regression models were calculated. With the help of these models, salt accumulation risk can be quantified and - for a given plot - tree type of plantation, carrying the lowest risk to be established can be chosen. Thus, by sustaining the appropriate state of the soil/groundwater media and avoiding long-term decrease in plantation yield, sustainability of the forests can be supported.

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Amount of contaminants: heavy metals and polychlorinated biphenyls in different origin composts

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The most popular treatment way of biodegradable waste is composting. During composting process biodegradable waste are recycling by biological, biochemical and physical processes. Composting process result is a new product which has micro and macro elements, organic matter and other nutrients for plants and soil. On the other hand, depending on the origin, the compost produced may contain not only nutrients but also pollutants, such as heavy metals and persistent organic pollutants (POP). POP is a large group of organic compounds such as PAHs, PCBs, PCDDs/PCDFs and other. It is very important to determine them in soil improving substances, because POP show environmental toxic, cancerogenic, mutagenic effects and not decompose for long time. For this reason, constantly fertilizing fields with compost could be dangerous to contaminate soil.

The aim of this research work is to investigate different origin composts contamination with heavy metals and organic compounds polychlorinated biphenyls (PCB's). Depending on the materials used the compost obtained contains larger or lower levels of contaminants. In this study were investigated four different origin composts: green waste, sewage sludge, mixed municipal waste and mixed municipal waste after mechanical biological process. For determination and quantification of heavy metals ICP-OES method, according to the ISO 22036: 2008 certificate were used. The research results show that comparison of different origins compost contamination with heavy metals, the maximum level set zinc and at least composts contaminated with mercury. In assessing the amount of heavy metals the most contaminated compost is mixed municipal waste after mechanical biological separation, where total amount of heavy metals is $1,747 \pm 11.4$ mg / kg. It can be assumed that mechanically separated plastics do not reduce the pollution of mixed municipal waste compost. According to the total amount of seven heavy metals (Cd, Cr, Cu, Ni, Pb, Zn, Hg) the minimum amount was determined in green waste compost, 609 ± 26.3 mg / kg. PCBs in composts were identified by means GC-ECD analysis and external standard method. Total amount of PCB were verified from 3.21 ± 0.14 µg/kg in green waste compost to 505.09 ± 45.10 µg/kg in the mixed municipal waste compost.

Evaluating the impact of soil structure change on the pore size distribution of variously textured soils

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Agricultural practices (ploughing–harrowing, irrigation, wheel traffic, land levelling, chemicals application or other additives etc.) can affect physical, chemical and biological soil properties. Soil structure can be significantly altered due to either mechanical (e.g., animal tramping, tractor traffic, tillage) or hydraulic stress (effect of natural rain on bare soils or irrigation effects). Soil structure degradation alters total porosity and pore size distribution, which may cause significant modification of drainable water content, aeration, permeability, infiltration and surface flow, with direct effect on erodibility.

The effects of soil structure change on pore size distribution (PSD) were studied using a new methodology based on analysis of soil water retention curves (SWRC) of 2178 samples selected from the Hungarian Detailed Soil Hydrophysical Database, called MARTHA. Samples from those soil profiles were selected, which have information on land use, structure grades and aggregate shapes. Soils of the selected dataset originated from arable lands and forest stands and cover 12 WRB Reference Soil Groups including Leptosols, Vertisols, Gleysols, Stagnosols, Chernozems, Phaeozems, Calcisols, Luvisols, Cambisols, Arenosols, Fluvisols and Regosols. Soils' texture varied from sand to clay.

PSD can be derived from soil water retention curve (SWRC). For this purpose the specific water retention capacity function and the modal suction (corresponding to the most frequent pore size) for each soil were calculated from the first derivative of the van Genuchten SWRC function.

The objective of this study is to compare the SWRC and PSD of structured, non- and weakly-structured soils by texture classes and quantify the extent of the SWRC and the PSD changes.

The advantageous effects of soil structure on hydrophysical properties can be observed for extreme textured soils. In case of sandy soils soil structure partially compensates the unfavourable low water retention capacity, since the proportion of small pores increases. However, soil structure can improve permeability and aeration of the fine-textured soils, because the proportion of large pores increases significantly.

From the analyses of the SWRC and PSD characteristics, it can be concluded that the combination of soil texture and soil structure control the PSD and thereby the soil hydraulic properties. Our evaluation method can support studies on forecasting changes of soil hydraulic properties due to anthropogenic influences (e.g., agricultural practices or soil pollution) or climatic impacts (e.g., excess water or drought).

Determination The Soil Erosion of Lake Watersheds According To Russle Method Using Remote Sensing and Geographic Information Systems

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In this study, soil losses was calculated according to RUSLE Method using by Geographic Information System (GIS) and Remote Sensing Techniques and mapping for the Karacaören and Beyşehir Lake Basin in Turkey. In research were used the basin area maps, a variety of research results, the reports, meteorological data, statistical information, Landsat - 5 TM satellite image and the data as a result of field studies. The necessary parameters for the method RUSLE was prepared as a raster data into thematic layers using ArcGIS software and it was interacted due to method. As a result, erosion was seen as a dangerous situation from 21% of Karacaören Basin. According to erosion map, potential of annual soil loss from Karacaören Lake Basin was determined for total of 11429374 tons/year, for average of 47.51 tons/ha. Erosion was also seen as a dangerous situation from 85% of Beyşehir Lake Basin. According to erosion map, potential of annual soil loss from Karacaören Lake Basin was determined for total of 360,490,81 tons/year, for average of 83.97 tons/ha.

Soil quality assessment in conservation agriculture systems

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Soil is a key resource that provides the basis of food production and sustains and delivers several ecosystems services including regulating and supporting services such as water and climate regulation, soil formation and the cycling of nutrients carbon and water. During the last decades, population growth, dietary changes and the subsequent pressure on food production, have caused severe damages on soil quality as a consequence of intensive, high input-based agriculture. While agriculture is supposed to maintain and steward its most important resource base, it compromises soil quality and fertility through its impact on erosion, soil organic matter and biodiversity decline, compaction, etc., and thus the necessary yield increases for the next decades. New or improved cropping systems and agricultural practices are needed to ensure a sustainable use of this resource and to fully take the advantages of its associated ecosystem services. Also, new and better soil quality indicators are crucial for fast and in-field soil diagnosis to help farmers decide on the best management practices to adopt under specific pedo-climatic conditions. Conservation Agriculture and its fundamental principles: minimum (or no) soil disturbance, permanent organic soil cover and crop rotation /intercropping certainly figure among the possibilities capable to guarantee sustainable soil management.

The iSQAPER project – Interactive Soil Quality Assessment in Europe and China for Agricultural Productivity and Environmental Resilience – is tackling this problem with the development of a Soil Quality application (SQAPP) that links soil and agricultural management practices to soil quality indicators and will provide an easy-to-use tool for farmers and land managers to judge their soil status. The University of Évora is the leader of WP6 - Evaluating and demonstrating measures to improve Soil Quality. In this work package, several promising soil and agricultural management practices will be tested at selected sites and evaluated using the set of soil quality indicators defined for the SQAPP tool. The project as a whole and WP6 in specific can contribute to proof and demonstrate under different pedo-climatic conditions the impact of Conservation Agriculture practices on soil quality and function as was named the call under which this project was submitted.

The effect of farm size on the economics of adoption of modern soil cultivation system in Siberian Kulunda Steppe

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In the fifties and sixties of the 20th century the Soviet Union started to cultivate the natural grasslands of the Kulunda steppe which forms a large part of the Altai region in Russia. Mostly black chernozem soil and brown earth are used for arable crops. Cultivation practices which were aimed at achieving high productivity levels but which were not always well-adapted to the marginal ecosystem of the Kulunda steppe caused severe soil degradation and a depression of soil fertility and yield levels within a few years after first-time cultivation. Today, more than 50 % of agricultural land in the Kulunda steppe is affected by degradation (FRUEHAUF 2013). The methods we use provide empirical evidence regarding this basic question: Is the present lack of sustainable land use practices in the south west Russian Kulunda Steppe caused by their missing profitability on farm level compared with the conventional practices that are in place?

To answer this question, we examine the farm-level economics of three different crop cultivation technologies used in the area. The size of farms is often associated with use of no-tillage. Larger farm size may allow gaining greater value from investment into new seeding machinery that can be used across a larger crop area (Fuglie and Kascak 2001, D'Emden et al. 2006). To examine the effect of farm size on farm economics, we model three type of model farms with different size (500 ha, 5000 ha and 15 000 ha). The calculations are based on experts' estimates regarding the requirements and impacts of adopting reduced tillage systems on farming profitability in the marginal ecosystem of the Kulunda steppe. The defined model farms use three technologies utilized in the considered area: i) old Soviet (OS – intensive tillage), ii) modified Soviet (MS - reduced tillage) and iii) modern Canadian technologies (MC – no till).

The results show that under optimal weather condition and management system, reduced tillage system has potential to contribute to the welfare of farmers in Altai region. If we look at only the difference between sales and variable cost we can see that MC tillage system has more benefits for each type of farm than the other technologies. Moreover, labor costs are also relatively low under MC technology in comparison with other tillage systems. Although amortization cost is very low for middle and big size farms under MC tillage system, in small size farm the results show that amortization cost are higher with zero tillage technology than other tillage systems. Finally, gross margin without labour and machinery costs results demonstrate that for 500 ha farm MS tillage system is most profitable, but for 5000 ha and 15000 ha farms MC tillage systems show the highest gross margin. However, it is worth to mention that these results are farm specific and can be different depending on soil quality, climatic condition, management system and other farm's specific characteristics.

Influence of tillage systems on short-term soil CO₂ emissions

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It is assumed that climate change is result of human activities which have increased the amount of greenhouse gases in the atmosphere since the industrial revolution. Agricultural ecosystems can play a significant role in greenhouse gas emissions, specifically, carbon dioxide. Tillage management can increase atmospheric CO₂ concentrations and contribute to global warming but it is uncertain to which extent tillage enhances the transfer of soil CO₂ to the atmosphere. We assessed the influence of four different tillage systems on short-term soil CO₂ emissions from Stagnosol in a temperate continental climate of the central lowland Croatia in October 2013. Soil CO₂ concentrations were measured before, 0h and 3h after the tillage operation with *in situ* static chamber method. The four tillage systems were ploughing to 25 cm (P₂₅), very deep ploughing to 50 cm (P₅₀), subsoiling to 50 cm (PS₅₀[→]) and no-tillage (NT). The study showed that tillage had impact on soil CO₂ emissions and accelerated the transfer of soil CO₂ to the atmosphere but also soil CO₂ emissions declined sharply within hours after tillage operations.

New challenges in soil tillage – Endeavours and results in Hungary

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Throughout the last 120 years, the tillage attitude in Hungary can be characterized as a fight against extreme climatic and economic situations. However, this struggle has been beneficial in arousing new tillage trends and improving tillage methods for unfavourable conditions. The ‘Hungarian reasonable tillage’ strategy, promoted by Cserhádi at the end of the 1800s was aimed at reducing tillage without increasing the risk of crop production. The Campbell-boom and the anti-plough movement by Bippart did have some favourable impacts and effects for in addition to the benefits of applying ploughless tillage from time to time it also draw attention to reasonable tillage. The Mechwart’ steam plough and the power tiller by Kőszegi have really offered a better system to cut time and energy requirements.

In the mid-1950s the adaptable shallow tillage methods worked out by Manninger gave chance for innovation. The elaboration of periodical deep tillage systems by Sipos enabled to mitigate the risks of applying reduced tillage. The steady increase of fuel prices and the advent of a dryer period stimulated the spreading of soil preserving techniques between 1978 and 1988. The proportion of the area where ploughing was carried out has fairly reduced. In the next ten years, however, attributable to the economic circumstances, the standards of tillage has deteriorated. Worsening economic conditions may force to cut production costs, while the deteriorating of soils state may force to apply preserving procedures, adapting to the prevailing circumstances.

Results that elaborated in the last decades should be given solutions for both soils quality improvement and mitigation of the climate threats. The results are implemented: (1) Methods to be adaptable to reduce moisture and carbon loss and the climate risk are applied widely. (2) Adequate (35-45 %) cover of disturbed soils is used in normal, and a higher cover ratio (45-55 %) is adopted in dry and rainy summers protecting soils against heat and rain stress. (3) Stubble residues are mixed into the soil after the passage of the critical months. (4) Smaller soil surface are created in the summer months reducing water loss. (5) Subsoiling that is soil state remedying is used in wider ranging. (6) Ratio of the ploughed, loosened, tine tilled and disk tilled soils in Hungary is 40:25:22:13 %.

Traditions under changes: (1) Applying regular soil state assessments – recognition of soil defects – is gained ground. (2) Milder autumn and winter call for extending the use of water conservation to minimize the surface for evaporation. Soil in clods in the surface is unsuitable for wintering. Current troubles and tasks for the future: (1) Leave the autumnal ploughing off in wet conditions (classic authors recommended). (2) Field residues should not be removed for generating energy. Energy plants should be grown and use for industrial utilization. (3) The use of tools forming tillage pan should be avoided in wet soils.

Are biofertilizers really sustainable in agriculture?

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Sustainable agricultural systems are currently using beneficial microbial products, including several types and species of living bacteria and fungi. The role of those microorganisms is to improve the crop growth and development and or the better soil formation. Effect of those microorganisms are performed directly and indirectly in the soil-plant-environmental systems, however there are several uncertainty in their general use. We hypothesised that the success of those introduced microorganisms could be highly dependent on the existing soil/plant/environmental condition, and therefore it could be a strong necessity to monitor those characteristics preliminary of their use. First we should know why we are applying those microbes from outside sources, after the question arises when to apply and how? Is there any of them in the entirely soil as indigenous abundant or not? If there are only few “soldiers”, is it possible to get positively with physical-chemical soil conditioning to their original abundance or not? In case of those microbes are totally missing how we can manage of their growth efficiently in a soil-environmental condition to which they are non-adapted? Can we follow of their fate in the environment et all and if yes, which methods are appropriate in a “black box” of soil?

The microbial soil-inoculation has started in the years of ‘980; the rhizosphere effect of greater microbial abundance in plant rhizosphere was described by Hiltner in 1904. The “second and third generation” of microbial inoculation is currently applied nowadays. Should we know, which types of microorganisms are necessary for certain crop-soil systems and how to improve of their foreseen efficiency? Are there common and distinct characteristics and functioning of bacteria and fungi? Are the application really sustainable or which other methods, techniques can be used to avoiding the outside introduction of wanted microbial activity?

BIOFECTOR (7th EU Framework Programme, grant agreement 312117) works on “an improved understanding and utilization of biological processes supporting soil fertility”, essentially on the soil microbiome and bioactive natural compounds interacting with the root system and/or mutual or symbiotic microbes, termed bio-effectors.

BIOCHAR products are applied and EM efficient microorganisms in another EU-funded project (Piac-13-1-2013-0274) so as to learn their potentials of improving soil-quality and animal welfare among the highly intensive agricultural practices.

Lecture are summarising “pros and contra”s of using microbial inoculums, among them the monovalent and polyvalent solutions of introduction those products to homolog or heterologous environmental conditions. Case studies are going to be shown how those inoculums are/were efficient among an international background of various soil-environmental conditions and how is it potentially possible to improve of their efficiency and or even to avoid of their application by considering the non-living environmental potentials in “sustainable” and environmental-friendly agricultural practices.

The application of the organic animal production regulations at the small-scale farm conditions with special reference to Turkey

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In this study, the organic animal production conditions at small-scale farming level are discussed and EU standards were evaluated in relation to the issue of harmonizing organic standards, It also emphasized the problems encountered in application of organic animal production regulations at farm level with special reference to Turkey. Some recommendations proposes and the measures needed to be considered to implement EU organic livestock production concept.

In conclusion that there is a need for producers to have a good knowledge of organica farming concepts and increase their awareness about advantages of organic products and strategies that ensure the goals of good animal production practices and food safety even at small scale farming conditions. Organic animal production can be achieved in accordance with EU standards by adaptation of measures to local conditions.

A study on investigation of efficient use of natural grasslands for organic animal production with special reference to Eastern Turkey

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This study aimed to investigate the efficient use of natural grasslands available and suitable for organic animal production. It was estimated that about 28% of Turkey is covered by pastures and grasslands. The total coverage of grasslands was estimated at 21 million ha. In general, the animal production practices are carried out under extensive conditions and based on grasslands in Eastern part of Turkey, where approximately 40% of the whole grassland area of the country is present. The region has a great potential in terms of both the number of cattle and sheep and the large area of natural grasslands available compared to other regions of the country.

Therefore, in this study it was aimed to investigate not only the status of natural grasslands but also their efficient management in the region and discuss its potentiality for improving organic animal production. It was concluded that the efficient and the most suitable grazing management systems should be applied and local farmers should be trained about organic animal production practices.

Soil carbon sequestration and biological activity in Conservation Agriculture systems in North Italy

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A Life project called HelpSoil has been started to compare Conservation Agriculture systems with conventional “arable” agriculture. To this purpose 20 experimental sites have been selected all over the Po plain in North Italy, where agronomic and environmental indicators are monitored. Each site is arranged with two test plots, respectively cultivated under conservation and conventional practices. Different soil types and mean annual precipitation characterize the sites; crop rotations include winter (wheat and barley) and summer cereals (maize and sorghum), soybean and seeding of cover crops in the conservation managed test plots. Conservation practices mainly consist of no-till soil management. The main part of farms where study sites occur are irrigated; some of them are dairy farms and soils are fertilized with manure applications. A first soil sampling was carried out in the 2014 after the harvest of summer crop, providing three replications per plot. Results of this trial showed that SOC (Soil Organic Carbon) stock is considerably higher in Conservation Agriculture farming systems. Moreover clay soils (Vertisols and Vertic Cambisols) have been found to seem more responsive to SOC accumulation compared to other soil types. Earthworms abundance, QBS-ar index based on presence/absence of microarthropods and IBF index (Soil Biological Fertility Index) based on microbial activity were also detected to study the soil biological activity and biodiversity. All these indicators pointed out a positive and often considerable effect of Conservation Agriculture methods and a strong correlation with SOC content and stabilization of soil structure. Results achieved to date confirm that Conservation Agriculture is actually able to provide a huge contribution to control global warming and to enhance beneficial soil natural biological processes. However a second soil survey is planned by the project in the autumn 2016 to verify these data and trends over the time.

EU LIFE+ HelpSoil Project: Helping enhanced soil functions and adaptation to climate change by sustainable agricultural techniques

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The goals of modern agriculture are food production and income for farmers, jointly with providing ecosystem services, also related to climate change mitigation.

In the Italian river Po plain, the soil organic carbon stock is around 34-60 t/ha. Increase the soil carbon content can enhance soils to face the environmental stresses, to act as a pollutants filter, to reduce erosion and compaction susceptibility and to boost soil biodiversity.

HelpSoil project is led by Regione Lombardia and partners come from all other regions of the whole Po river plain (46.000 km²). It deals with the application of the EU CAP and Rural Development implementation.

HelpSoil promotes innovations in agricultural management practices, based on the principles of conservation agriculture, in order to:

- improve soil functions, organic carbon sequestration, soil fertility and biodiversity, protection against erosion;
- increase irrigation and fertilisers efficiency and limit the use of pesticides;
- develop soil ecosystem indicators and new techniques to assess the environmental benefits of the practices;
- make agricultural systems more resilient against climate change.

The activities carried out will provide technical support and expertise for the wider implementation of European strategies for soil conservation “Soil Thematic Strategy” and the proposed Directive. The activities can be considered a valid contribution to prevent the risks identified: soil erosion, organic matter conservation, compaction and loss of biodiversity.

The demonstration approach of the project will increase the awareness of the environmental issues related to agriculture and will spread the knowledge among farmers which are usually very suspicious about possible innovations. It promotes cultivation techniques by using a fewer amount of chemicals and mechanical works, in contrast with the usual intensive agricultural systems. This will enable to achieve a significant saving in the expenses incurred by farmers and therefore it can be considered an economic support to the agricultural sector.

Evaluation of the pedological data of agri-environmental monitoring programs

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The agricultural production plays a crucial role in providing food for human population. However, along with intensification, environmental issues arise. This is why agri-environmental programs intend to convince farmers to change their practices in order to reach a more environmentally friendly production while the yields remain at economically viable level. In the present research we provide the results of the evaluation of the environmental monitoring of the agri-environmental programs of Hungary. Integrated arable plant production (aa), ecological arable plant production (ac) and integrated orchard/vineyard (ca) programs are compared from pedological point of view. 866 parcels from the program and 174 control parcels were evaluated. Samples were collected from 0–30, 30–60 and 60–90 cm depth, in the presented cases.

Results proved the $\text{NO}_3\text{NO}_2\text{-N}$ -content to be significantly bigger in case of 'aa' than in the other two programs and the control as well. In the depths of 30–60 and 60–90 cm the situation was as follow: $\text{aa} > \text{ac}$, $\text{aa} > \text{ca}$, $\text{control} > \text{ac}$, $\text{control} > \text{ca}$, so 'aa' has the biggest content and control areas have the second biggest. In case of phosphorous (P), the biggest amount was found in orchards and vineyards while the ecological program had the lowest amounts. This can be explained by the high P-need of the plants in the orchards and vineyards. The analyses of the humus content (%) showed the following: in the 0–30 cm layer $\text{ca} < \text{any other program}$ and the control; in the 30–60 cm and the 60–90 cm layers $\text{aa} > \text{ac}$, $\text{aa} > \text{ca}$, $\text{control} > \text{ca}$. In case of the thickness of humus rich layer analyses showed the following relations: $\text{aa} > \text{ac}$, $\text{aa} > \text{ca}$ and $\text{control} > \text{ca}$. As ecological program has the most of the constraints concerning the bad soil protecting plants (e.g. maize, sunflower etc.) and requires a higher coverage of legumes, its bigger humus content was assumed. The pH values provided significant differences between programs in case of the depth of 0–30 ($\text{ac} < \text{aa}$, $\text{ac} < \text{ca}$, $\text{ac} < \text{control}$) and 60–90 cm ($\text{ac} < \text{aa}$, $\text{ca} < \text{aa}$, $\text{ac} < \text{control}$, $\text{ca} < \text{control}$) layers. The only reason that can prove the findings is the bigger amount of humus content in case of the ecological program as the pH of humus is acid, the more the humus, the lower the pH. The soil compaction was measured with penetrometer at every 10 cm up to 60 cm and values expressed in PSI (Pounds per Square Inch). Significant differences were as follows: in 0–10 cm depth $\text{aa} > \text{ca}$; in 10–20 cm depth $\text{aa} > \text{control}$; in 20–30 cm no differences; in 30–40 cm depth $\text{aa} > \text{ca}$; in 40–50 and 50–60 cm depths ca is smaller than all others. In case of soil biological activity we found that we have expected: mesofauna biomass was bigger in ac than in ca and aa; the number of individuals were higher in ac than anywhere else.

Overall we can conclude that the chosen indicators can prove the effects of the agri-environmental measures. More measurements are needed, more soil information to be collected in the program and in the control areas as well.

The effects of different harvest times on forage yield and quality of some vetch (*Vicia* spp.) species

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This research was conducted to determine the effects of four harvesting stages (beginning of flowering, 50% flowering, full flowering and beginning of seed filling stages) on forage yield and quality of some vetch (*Vicia* spp) species. The common vetch (*Vicia sativa* L.), hungarian vetch (*Vicia pannonica* Crantz.) and hairy vetch (*Vicia villosa* L.) were used in this trial. Dry matter (DM) yield, crude protein (CP), acid detergent fibre (ADF), neutral detergent fibre (NDF), total digestible nutrient (TDN) and relative feed value (RFV) were determined. According to results, the highest DM yield was obtained from hairy vetch. Harvesting at the late stages caused a reduction in forage quality. The CP, TDN and RFV decreased with advancing stages while DM yield, ADF and NDF contents increased in all vetch species.

The South of the Southern Hemisphere is also affected by global warming

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The role of microorganisms in soil function and biogeochemical cycles has been widely recognised along with their sensitivity to changes in the ecosystems. Predictions from the IPCC in 2007 pointed out that the global increase of temperature will continue to rise if the rate of greenhouse emissions is not decreased, modifying temperature and precipitation regimes, and CO₂ concentration. In turn, primary productivity will be affected through the carbon inputs into the soil, and the consequent modification on the rates of carbon and nitrogen decomposition. This research explores the effect of the global increase of temperature on the soil biological activity of carbon and nitrogen in the cold environment of Western Patagonia (Chile) and Maritime Antarctica, as they are considered fragile exposed ecosystems to the climate change and have not received enough attention at the Southern Hemisphere of the planet.

Contrasting ecosystems in soil organic matter content were studied, a) grassland system in a steppe ecosystem, b) forest ecosystem, c) soils from Antarctica (Arctowsky Station). The ecosystems were characterized in weather and soil properties, as well as in the exposure to the temporal variation of the temperature. The regional changes in temperature were monitored using MODIS satellite images. The effect of the temperature increase on the soil activity was measured by incubating soils at partial increments of temperature: 0, 5, 10 and 20°C for microbial activity (C-CO₂ evolution for 1, 7, 14, 21, and 42 days combined with 0, 30, 60, and 100% of the water holding capacity), as well as the dissolved organic carbon and nitrogen.

The soil materials in the study area consisted mainly of volcanic ashes and glacial detritus, the temperature and moisture regimens were Mesic and Frigid, and Udic and Xeric, respectively. The increase of temperature in this zone under the RCP 8.5 scenario is 2.5°C, whilst the calculated increase under the RCP 4.5 scenario was 1°C. A less consistent trend was found for rainfall predictions under both scenarios. The change on the climatic conditions in the future may increase the microbial activity and the release of organic carbon as CO₂ from the soil to the atmosphere. Rates of soil respiration at the specific sites of Western Patagonia and Antarctica are under calculation.

How farmers learn to practice conservation agriculture: a grid to describe the objects and processes of learning

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Conservation agriculture (CA) is based on 3 principles, namely reduced soil disturbance, permanent soil cover, and more complex and legume-rich rotations. It is being increasingly adopted by farmers, and multiple studies have shown positive impacts such as the reduction of soil erosion or the preservation of biodiversity. However, beyond these basic principles, CA encompasses a wide range of practices from reduced tillage to direct seeding, from simple cover crops to complex blends. This diversity results partly from a close adaptation to the ecological context of the farm: because CA relies on a variety of ecological processes –e.g. nutrient cycling or competition-- it is more deeply rooted in a specific ecological context than conventional agriculture. The complexity of these processes makes it difficult to elaborate general recipes to be applied by farmers with only minor adaptations to the context of their farms. As a result, farmers need to learn to make their own choices adapted to their own agroecosystem. We thus believe that helping farmers to move toward CA calls for supporting them in learning to develop their own practices. Farmers' learning remains poorly investigated at the individual level, with in particular very little work focusing on learning in CA. We hypothesize that learning to practice CA may be quite different from learning other kinds of farming, regarding both the objects (what you learn about) and the processes (how you learn about it). Because farmers need to manage ecological processes, they may focus on some components of their agroecosystem, such as deep soil structure, which would not necessarily be considered of first importance if the system was farmed in a different way; as a result, a farmer may have to learn about different objects if he evolves toward CA. Along the same lines, the processes involved in learning to practice CA may differ from those involved in conventional agriculture: for instance, the current lack of detailed reference documents may induce farmers to experiment more. Against this background, we here aimed at describing how farmers experienced in CA learn, by qualifying both the learning processes and the objects these learning processes focus on. To do so, we conducted fifteen semi-structured interviews with farmers experienced in CA, and then analyzed the data using the NVivo software to describe the processes and objects involved in learning. Our results consist in two hierarchical grids respectively classifying the learning processes (e.g. getting a new idea from a peer, generalizing a personal observation, explaining an observed phenomenon through an analogy with another phenomenon that is already understood etc.) and the learning objects (e.g. soil structure, soil mineral content, population dynamics of weeds etc.) involved in CA. These analytical grids may in the future be used for a quantitative analysis of the relations between learning processes and learning objects in CA.

Hungarian on-farm research program for varroa control in organic beekeeping

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Varroaosis as the current bane of the beekeepers is causing worldwide the biggest economic damage in the apicultural sector. Consistent control of varroaosis should be provided without harmful side effects such as the occurrence of toxic residues in the hive products. In the technology of organic beekeeping only natural materials are allowed to be used, such as essential oils and organic acids. Our paper presents the practical results of testing these substances under real-life organic conditions in 2014 in Hungary.

At the beginning of the beekeeping season each of the participating market operations selected 12 hives from their operation and made 2 groups of (2*6) colonies per apiary. The timing of treatment periods and the method of bee management depended on the honey flow seasons and the type of beekeepers' equipment. For counting the natural drop of phoretic mites from the bees the sticky board under a screen method was used. Because of the treatment timing setup the monitoring periods carried out right before a treatment were in some cases the backup measurements of the previous treatment as well. The backup monitoring was following a week after the treatments to avoid counting mites that have fallen directly due to the treatments. The infestation levels of the colonies were compared to their former varroa infestation stages.

The infestation level of the treated colonies stayed under the threshold level throughout the year. In the comparative trials of dribbling mixtures in June and November the combination of OA and CA showed to be more efficient than the combination of OA and FA. In the comparative trials of sublimation methods in August and October LA induced slightly higher changes in the infestation stages. In practice sublimation technique was carried out with less physical effort and disturbance compared to the dribbling treatments. The direct mite drops caused by the sublimation treatment are surprisingly high. In the comparative trials of FA evaporating devices the gel packs were easier to install and they were more effective than the barred cages with evaporator papers. Despite the good mite-fall results, the colonies that were treated with FA in September had unexpected queen losses and the winterbees had an earlier generational change in early spring of 2015.

The method of counting natural mite-fall proved to be a good practice for monitoring varroa infestation stage of colonies without disturbing the bees. The calculations of infestation stage changes were suitable for gathering comparable data from different apiaries and allowed good analysis of the datasets. However, the rate of infestation stages were significantly high in the spring period surprisingly all combination of treatment methods resulted low infestation stage until the end of the beekeeping season.

Strategic tillage in conservation agricultural systems of north-eastern Australia: why, where, when and how?

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The adoption of continuous no-till (NT), a key component of conservation agriculture (CA), has progressed steadily in north-eastern Australia. However, there are concerns regarding long-term sustainability of such systems due to build-up of herbicide-resistant weed populations, increased incidence of soil- and stubble-borne diseases, and stratification of nutrients and organic carbon near the soil surface. There is an increased interest in the use of an occasional strategic tillage (ST) to combat both biotic and abiotic constraints in such systems. We established 15 on-farm field experiments on sites with long-term history of continuous NT during 2012-15 and carried out Agricultural Production SIMulations (APSIM) using long-term climate data to explore key factors that need to be considered in decisions to implement ST in an otherwise NT systems. If tillage is necessary, the most important question is to find out the best timing, frequency and implement for such tillage operation. Timing of ST has the major implications for the success or failure of such operation. The use of ST resulted in reduced plant available water in short term. This effect could result in unreliable sowing opportunities. Rainfall between ST and sowing is necessary to replenish soil water lost. ST timings can have potential detrimental effect on yield during dry years which is related to interaction between rainfall amount, distribution and the soil type. Better understanding of these interactions can improve the decision making. Analysis of climate data showed 90-95% probability of receiving good rainfall for 3-5 months pre-sowing period reduces risks to cropping success. Use of ST operation in soils that exhibit texture contrast properties (Sodosols) and weakly structured A-horizons (Dermosols) are likely to suffer negative soil health impacts and should be treated with caution. Use of tillage implements that invert the soil is rare. Most growers use non-inversion tillage based on tine and disc, and differences between these implements and frequencies were non-significant. The tillage operation should be multi-purpose. The tillage event should occur after legume crops because legume crops generally have a small quantity of stubble, and this assists in stubble handling. Results suggest that occasional ST could be utilized as a viable management option to manage constraints of NT systems, improved farm profitability and reduced reliance on herbicides without impacting on long-term soil health benefits.

Rural restructuring and conflict of land use in the context of globalization: theoretical issues concerning rural policies in developing countries (Brazil)

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Rural restructuring indicates that agricultural and non-agricultural production systems are interconnected in different degrees, including rural and urban interaction and the articulation of rural dynamics with urban and global dynamics. National and regional interests also play an important part, particularly in rural spaces with higher levels of rural and urban interaction, such as occurs with large industrial projects and transport infrastructure that converges on urban agglomerations and connects different regions (Woods, 2005). Rural spatial transformations caused by large-scale development projects imply spatial modifications that, in turn, cause changes and new dynamics in every aspect of local life, generating profound transformations for the rural population and the environment.

The study of Bicalho and Machado (2013) on agricultural change in the context of spatial transformations associated with the construction of a new petrochemical complex is an example of the processes that take place in rural space of the metropolitan region of Rio de Janeiro (Brazil). This study identified contradictions but also highlighted persistence and resilience of rural space in which many farmers adapted to the new situation.

Sánchez (2012) emphasizes the need to create practices that introduce the most inherent aspects of territorial dynamics and that acknowledge the development of endogenous processes, whose actions are crucial for strengthening and consolidating territorial management with the participation of the actors in their different economic, political and cultural expressions, notably, in spaces of rural and urban interaction. For this author, there is an increased need for understanding governance in spaces where conflict can exist between different agents and institutions involved in concrete territorial processes. Some examples are: dispute for land and natural resources, real estate speculation for new non-agricultural activities, gentrification, outsourcing of rural space, spatial mobility of rural population or even strengthening the rural land market with new farm activities. Therefore, the focus on the territorial dimension is crucial for managing and enforcing public policies in multifunctional rural space.

Weed suppression effect of compost mulch in no-tillage organic vegetable production

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With growing agricultural demands from both conventional and organic systems comes the need for sustainable practices to ensure long-term productivity. In Hungary small scale vegetable growers face challenges in producing their crops due to the lack of effective weed control practices and viable methods of sustainable soil fertility management based on local or regional soil amendment resources. There is a demand for cultural practices that reduce hand labor requirements and black plastic mulches whereas long-term productivity would be held or increased. To identify effective alternative weed control and soil fertility management options for the management of intensive organic vegetable systems, our research focuses on the evaluation of compost and paper mulches, in conjunction with reduced-tillage practices. Since most organic tomatoes at present are grown on small acreage in Hungary, and are direct-marketed, the application of organic mulches can be assumed financially feasible. In 2015 determinate tomato (cv. Roma) is grown in five different soil tillage and treatments and using yard waste compost (C) mulch and combination of YWC and paper mulch (PM) plus bare ground control under intensive (IT) and reduced tillage (RT) variants to evaluate their effectiveness on weed suppression. We measured the weed coverage after 25 days of transplanting on each treatments and found that there are significant difference between the treatments. Average weed cover in the five treatments was as follows in ascending order: IT-Cmix>IT>RT-C>R-C+PM>IT-C, values were 77,78%, 67,22%, 42, 78%, 18,33% and 13,56%, respectively. Our results after the first year of our trial shows that the combination of organic mulching materials together with reduced tillage may be a viable option for organic vegetable growers. However, further research is necessary to meticulously justify this statement.

Microbial C biomass and number of bacteria as indicators of bioremediation of soil treated with sulfonylurea herbicides

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The aim of this research was to estimate the influence of sulfonylurea herbicides on microbial C biomass and bacteria abundance in soil as well as to assess the potential of microbes to degrade herbicides. Recommended, tenfold and one hundredfold doses of nicosulfuron and foramsulfuron, respectively were incorporated in soil and incubated in conditions of constant moisture and temperature. Microbial C biomass and number of bacteria were estimated 3, 7, 14, and 28 days after herbicide application. According to microbial C biomass values, the highest possible degradation potential was recorded seven days after application of nicosulfuron when 7,08 mg kg⁻¹ of herbicide could have been degraded. The degradation potential of foramsulfuron was a bit slower and was recorded 28 days after herbicide application. However, higher amount of herbicide could be degraded (71,0 mg kg⁻¹). This research showed that certain groups of bacteria had the ability to degrade one hundredfold doses of both investigated herbicides. Bacterial biomass increased in soil after herbicides application since they use herbicides as energy and C source. On the basis of values of C biomass (representing the total amount of microorganisms in soil) and number of bacteria (as a part of total amount of microbial population) it was determined that microorganisms possess the potential to degrade nicosulfuron and foramsulfuron, and they could be applied in bioremediation of soil treated with these herbicides.

On-farm experiment for developing species-rich seed mixtures for hungarian vineyards

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Mechanical soil cultivation and herbicide treatment were widely used technologies in vineyards in the second half of the 20th century. These treatments can cause soil degradation and may result in erosion damages especially on steep vineyard slopes; therefore, the use of alternative technologies, such as cover crops, has a special importance. Beside that species-rich cover crop mixtures can help to prevent erosion and provide easier cultivation circumstances; they also have positive effects on soil structure, fertility and ecosystem functions. We developed and tested three species-rich cover crop mixtures in Hungarian vineyards. The commercial Biocont-Ecovin mixture, a mixture of Legumes, and a mixture of Grass and Herbs were compared with control plots in vineyards of the Tokaj wine region. Each mixture was sown in three inter-rows. In the control blocks unsown inter-rows and mechanically cultivated inter-rows were located subsequently next to each other. After sowing (March 2012) we studied vegetation composition (June 2012, 2013 and 2014), pruning weight and diameter of the second bearing spur of the stocks and also yield quality and quantity. Most of the sown species established successfully. In the third year (2014) we found that the Grass and Herbs mixture-covered inter-rows were the least weedy in all sites. The most examined indices of grapevines were not significantly affected by the applied cover crops. However, the tendencies in the results show that in arid climatic conditions, intercropping in every second inter-row is more feasible, if erosion control is not the foremost risk. The interest of the vine-growers shows the practical importance of the topic, thus we involved vineyards from seven wine regions of Hungary in our further experiments.

Mobile crop monitoring by intelligent flying cameras for breeding stations

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The advantage of remote sensing in precision agriculture applications is the capability to characterize extended spatiotemporal field variability more effectively than by any other way. The technical accuracy of the spatially distributed spectral data depends on sensor and platform. However, when sensing distance is scaled down, the spatial and spectral resolution can be significantly increased. This demand motivates unmanned air-borne remote sensing.

We created a simple multispectral remote sensing setup using two identical low-cost CMOS cameras (Mobius ActionCam), attached in close proximity to a gimbaled drone platform (Mikrokopter, 3DR quadcopters with DYS and Tarot gimbals). One remained measuring the wide-band RGB spectrum. On the other one the Bayer-filter was replaced by a near-infrared filter which allowed the CMOS sensors to detect near infrared light. We created a custom software solution based on OpenCV for the rectification and pixel-level matching of RGB and NIR images, and to perform automated statistical image analysis.

The setup was applied on winter wheat in the long term N-fertilization field experiment of the Agricultural Research Center of HAS, Martonvásár (Koltay, 1980) in 2014. Spectral measurements were performed at anthesis, covering the whole trial area. 15 varieties were investigated on 8 N-treatment levels in 4 replicates in a randomized block design. Most of the common wide-band vegetation indices (NDVI, RVI, DVI etc.) were compared and evaluated for the plots based on detailed statistics. For validation of remote sensing data SPAD measurements were conducted on two varieties (MvKarizma, MvKolo) and on three N-levels (0, 80, 160 kg/ha). Kjeldahl-N determinations in leaf and seed samples were performed in order to include conventional analyses in the comparison.

Results showed strong correlation between remote sensing, proximal sensing (SPAD), and laboratory analysis data, also with respect to seed Kjeldahl-N results. Significant differences were detected between the varieties regarding their N-use efficiency with both traditional and remote sensing data. With the remote sensing setup we could, however, perform non-invasive measurements quicker, covering the whole experimental area, with a much higher spatial resolution (~1cm) compared to conventional approach. Our application may thus be of special benefit for breeding purposes, for the quick detection of nutrition-efficient individuals within a diverse population.

Influence of soil tillage and organic matter management on spring barley yield

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In the trials situated in dry region of the Czech Republic the influence of agronomic practices within spring barley growing system was examined. Results from two experiments for different soil tillage, straw management (first experiment) and growing intercrop (second experiment) will be presented. These measures, when properly used, can significantly improve system performance from the point of view of water husbandry and erosion resistance. Important task of agriculture is to maintain and protect resources of its productivity and to react and effectively adapt to changing conditions of environment (climate). Mentioned measures are concerned to be promising for these purposes.

In the first experiment two soil tillage systems (ploughing to 0.24 m and loosening to 0.15 m) and four variants of straw treatment (without nitrogen application and with 30 kg N applied on straw in form of three different fertilizers) were examined. Lower intensity of soil tillage showed statistically higher yield of spring barley in all years included in evaluation. But effect on barley grain quality (N content) varies among years. Nitrogen applied on straw doesn't seem to have effect on barley grain yield. Effect on quality differs among years and interaction between soil tillage and straw treatment was identified.

In the second experiment were examined three species of intercrops. White mustard (*Sinapis alba*) as very common intercrop and producing good amounts of biomass, Semi-perennial rye (*Secale cereale* v. *multicaule*) and Canary grass (*Phalaris canariensis*) both producing much less biomass. Yield of spring barley is affected by particular intercrops in combination with particular year. Effect is not clearly dependent on the total amount of biomass produced by intercrop across the intercrop species. Individual intercrop species characteristics matters too. There was significant decrease of yield observed after *Secale cereal v. multicaule* even though it produces quite low amount of biomass. Quality of grain (N content) compared to control was lower after *Sinapis alba* and higher after *Secale cereale v. multicaule* and *Phalaris canariensis* but no of these results was statistically significant.

The next step in both experiments will be to examine influence of soil tillage, straw treatment and single intercrop species on soil properties and moisture parameters. Than it is necessary to consider if prospective improvement in soil condition is worth the effects on main crop production parameters.

For all variants also economic calculations were done.

Determination of performances of Carniolan (*Apis mellifera carnica*), Caucasian (*Apis mellifera caucasica*), and Native (*Apis mellifera L.*) Honey Bees and Their Crossbreeds

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This study was conducted to compare brood rearing, frame with bees, flight activity, aggressive tendency and honey yield of purebred and crossbreed Carniolan, Caucasian and native honey bees under ecological conditions in Van, Turkey. Purebreds and crossbreeds of three different genotypes were obtained via artificial insemination in June and July 2010 as follows: NativeXCaucasian ($N_{\text{♀}} \times C_{\text{♂}}$), NativeXCarniolan ($N_{\text{♀}} \times CR_{\text{♂}}$), NativeXNative ($N_{\text{♀}} \times N_{\text{♂}}$), CaucasianXCaucasian ($C_{\text{♀}} \times C_{\text{♂}}$), CaucasianXCarniolan ($C_{\text{♀}} \times CR_{\text{♂}}$), CaucasianXNative ($C_{\text{♀}} \times N_{\text{♂}}$), CarniolanXCarniolan ($CR_{\text{♀}} \times CR_{\text{♂}}$), CarniolanXCaucasian ($CR_{\text{♀}} \times C_{\text{♂}}$) and CarniolanXNative ($CR_{\text{♀}} \times N_{\text{♂}}$). The study was completed with the honey harvest in August 2011, and significant differences were found between the groups based on brood rearing, frames with bees and aggressive tendency at a $P < 0.01$ level of significance, and flight activity and honey yield at a $P < 0.05$ level of significance. Study results demonstrated that Carniolan and Caucasian bees that demonstrate superior yield in natural deployment areas did not match their regular performances under regional conditions, while with selections and crossbreeds of native bees, successful outcomes could be obtained.

Adaptation of Agricultural Irrigation to Climate Change

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The climate of planet is changing. Huge demonstrations of temperature and precipitation alterations have been documented over the last years. Studies of variability about these parameters have been made; the Intergovernmental Panel on Climate Change (IPCC) concluded that between 1906 and 2005 the mean air temperature in planet had increased 0.74 °C. Other prediction study reports an increasing of 1 °C in the mean temperature and mean precipitation variations between 44.2 and 84.2 mm year⁻¹, all in the period 2011-2030. Studies in China and Vietnam shown changes in their climate conditions. On the other hand, climate change effects have been documented under different approaches. England predicted the population for 2030; also the Environment Agency predicted change in demand water in the rank of -28% to 49% for the year 2050, in England and Gales; other analysis involve the expected impact of climate change on water demands of crops. Likewise, some predictions have used a statistical method to obtain an assembly with general circulation models using weighted algorithm reliability of assembly.

The focus of this work is to know the climate impact over an agriculture zone with a dam water source, located in Zacatecas, Mexico. Before the construction of the dam, irrigation of agricultural area were with wells, guava was the only type of cultivate. With the implementation of the dam the irrigation is with drip, sprinkler and micro-sprinkler. The irrigation capacity of the dam is 165 hectares and is integrated by 21 members. Corn, guava, lime, lemon, tomato, pumpkin, tomato leaf and cucumber are the Crop types currently. For the predictions were used 15 from the 23 “Models Global Climate” employed in the fourth IPCC Evaluation Report. The predictions of three scenarios (A2, A1B and B1) were obtained with the support of the LARS-WG5 (Long Ashton Research Station-Weather Generator) software. There were three climate stations selected neared to the dam, obtaining the precipitation, and the minimum and maximum temperature data, for the period of 1978 to 2014. The predictions of these parameters were for every station and the mean was calculated based on three time periods (2015-2030, 2046-2065 and 2080-2099). A mean increase of 0.6, 1.7 and 3 °C was predicted for the minimum and maximum temperature and a decreased in the precipitation of 84, 4 and 48 mm, respectively was obtained. This inestable prediction for precipitation was observed in accord with the climate station.

Water infiltration and moisture in soils under conservation and conventional tillage in Zambia

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In controlled trials, conservation agriculture has been shown to increase water infiltration in soils compared to conventional farming. The extent to which “adopters of conservation agriculture” in three districts in Zambia actually benefit from increased rainfall efficiency was investigated by observing time for visible soil surface saturation, puddling and initial runoff of artificial rainfall; saturated water infiltration rates using ring infiltrometers; and soil moisture at six soil depths from start to end of two rain seasons using Theta Probe. All measurements were done in pairs of comparable fields under conservation and conventional tillage. Conservation fields showed consistently shorter time for surface saturation, puddling and runoff by an average 48 %. Infiltration rates in rip lines and basins of conservation fields were similar to rates in plowed fields. Infiltration rates between rip lines and basins were 37 % lower than those of plowed fields at the start of tests and 31 % after 60 minutes. Soil moisture in rip lines and basins of conservation fields was higher by an average factor of 1.08 down to 40 cm soil depth, whereas it was lower by an average factor of 0.89 between plant rows compared to fields under conventional tillage. Based on 34,000 measurements, soils in conservation fields contained a weighted average of 18.2 vol-% water compared to 19.9 vol-% in conventional fields. All differences with $P < 0.05$. The study does not support the general notion that conservation tillage is more “climate smart” than conventional tillage in terms of soil water. The inconsistency between results from earlier studies under controlled conditions and the current results, is presumably due to lack of soil cover and development of surface crusts in the fields of farmers classified as “adopters of conservation agriculture”.

Land use in Germany – How can it contribute to climate change?

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In Germany land surface is used intensively. Land fulfils many societal requirements f. e. production of food, energy and wood, or provides area for settlement, transportation infrastructure and recreation. Land resources are limited; therefore the existing competition between the various societal demands in Germany and many other regions of world will increase due to global change, such as climate change and globalization of economic systems. To integrate into this complex realm of land use conflicts aspects like the preservation of an intact environment, climate protection and sustainable resource management is the focus of our joint research project CC-LandStraD (BMBF, Funding number: 01LL0909A-F). The acronym stands for “Interdependencies between Land use and Climate Change – Strategies for a sustainable land use management in Germany”. The talk presents model results on the impact of global change on land use development and future land use change in Germany until 2030, including all relevant sectors (agriculture, forestry and settlement and transportation).

According to the complexity of determinants we apply a network of biophysical and socio-economic models: In this talk we present two of the core models: The LAND USE SCANNER is a GIS based simulation model in which qualitatively formulated scenarios are quantitatively underlain and simulated in spatially explicit. RAUMIS is a regionalized agricultural and environmental information system which simulates the impact of agricultural and environmental policies on agricultural land use, production, income and the resulting effects on the environment. Adjustments are modelled in a comparative static setting. Here, RAUMIS is used to specify the agricultural land use on county level. Major model inputs are global price projections (provided by University of Bonn) and information on the available agricultural area (provided by LAND USE SCANNER). The multi-level approach integrates global development (e. g. population growth, increase of meat demands), national trends (e. g. demographic change, energy system transformation / energy policy) and regional specifics (e. g. peat bogs or agricultural site quality) in a consistent framework. A multi-level assessment allows bundling of effects, including the dimensions of sustainability related to economy, ecology and society. The results are derived on a regional scale, to account for spatial heterogeneity and to develop regional land management strategies. We compare the impact of several scenarios which reflect societal demands on land use and land management, e.g. production of food, feedstuff or biomass, demand for settlement and transport areas, contribution to environmental protection and climate change. Related to the scope to run a cross-sectoral investigation of land use in Germany, agriculture, forestry and settlement/transport are considered. Another scope is direct greenhouse gas emissions due to land use and land use change and the substitution potential of biogenic raw materials.

Carbon distribution in water-stable aggregates from decomposing ¹³C-labeled shoots and intact roots under no-till field conditions

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Plant residues under no-till (NT) conditions are subjected to contrasted decomposition and stabilization conditions which may contribute to soil organic matter (SOM) pools with different turnover times. The objectives of the study were (1) to identify the fate of root vs shoot C in different aggregate size fractions and (2) to evaluate the relative contribution of roots vs shoot residues C to different size soil aggregates.

The field experiment was performed in the experimental area of Federal University of Santa Maria (UFSM), located in Brazil (29°41' S, 53°48' W; approximately 90 m elevation). The soil is classified as Typic Paleudalf with 10 % clay, 27% silt and 63 % sand in the top 0–30 cm soil layer. Wheat, pea and vetch plants were pulse labeled with ¹³CO₂ in the field and "paired treatments" were made by combining ¹³C labeled shoots with unlabeled roots and unlabeled shoots with ¹³C labeled roots (root + soil) to track shoot vs root residues C in whole soil and different aggregate size classes. Three randomly selected soil cylinders from labeled and unlabeled microplots were destructively sampled on days 0, 60, 180 and 365, by excavating the cylinders to 35 cm depth. Soil aggregates (>2000- μ m; 250-2000- μ m; 53-250- μ m and <53- μ m) were separated by wet sieving and C derived (C_{new}) from roots and shoots were determined.

Results showed that a greater proportion of the shoot and root derived C_{new} of three crops was associated with large macroaggregates (>2000 μ m) in 0-5 cm soil layer while small macroaggregates (250–200 μ m) held major proportion of root and shoot derived C_{new} in 5–15 and 15–30 cm soil layers. The C_{new} in small macroaggregates and microaggregates (53–250 μ m) increased with time in all soil layers. The shoot derived C_{new} retained in soil was in order of vetch > pea > wheat while it was in order of vetch > wheat > pea for root residues. After 360 days, 30% of the root derived C was still present in soil compared to 5 % (average of three crops) of the shoot derived C. The mean relative contribution of root vs shoot derived C_{new} was 2.1 ranging from 1.5 (pea) to 2.52 (wheat).

Our results indicated that quality of residues impact C stabilization only when residues are decomposing in similar environmental conditions whereas, location of the residues prevail on quality under contrasted decomposition conditions and impact C stabilization in soil.

Using a social-ecological framework to assess land use and cover change in reference to agriculture sustainability at the regional level

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Change in land use and land cover change (LUCC) is proven to take an important part in global environmental change. Its control is therefore an important topical issue for the sustainable development of agriculture from the local to the global scale. Many approaches have been developed in that view. The address of LUCC using a social-ecological framework and ecosystem services perspective appears of special value for assessing LUCC challenges attached to agriculture at the regional scale. Interlinkages between changes in the agricultural land-use system and the landscape mosaic of ecosystems constitute indeed the core processes that directly impact biodiversity and the functions and services of ecosystems in their many ecological, economic and social dimensions. However relationships between landscape management and function are complex. Their impact on ecosystem services, while incompletely understood, appear to largely depend on the composition and the spatial configuration of the ecosystem mosaic. But land use at the landscape level is often organized according to land management units different from ecosystem units. It results from mostly individual and uncoordinated short- and long-term decisions of many landholders. Relationships between land use and landscape appears therefore embedded in a complex and nested network of interactions and back loops from the parcel to the whole landscape at various temporal scales, which makes them difficult to understand. Spatially explicit assessment and multilevel empirical modelling of the land-use/landscape system at a given region can support progress in assessing changes under progress and topical issues for local agriculture sustainability. We briefly present here the socioecological framework method we used for an integrated assessment of change in land use and landscape ecosystem services and their consequences for agriculture sustainability in a valley of the Pyrenees National Park (France). The results gained emphasize the role of the long-term strategies of family-farmers and the local governance system rooted in agro-pastoral tradition on the persistence up to now of many regulation, production and cultural ecosystem services of major interest for agricultural and rural development. They also point out how changes in agricultural policy and market between 1960 and 2010 progressively weakened the economic viability and adaptive capacity of local agriculture. Sustainability of local agriculture would urgently require to consider the respective finalities, rules and actions of local agricultural population and rural stakeholders and public authorities, from the local to the European scale, as regards land and landscape management, and the possibility to combine and harmonize them into a consistent multilevel governance system of the local agricultural system viewed as a social-ecological system.

Effects of Hybridization of the Native and Commercial *Bombus terrestris* on Colony Development Traits

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Commercially produced colonies of *Bombus terrestris* are used as pollinator especially in greenhouse and number of colonies used as pollination agent has been increasing year by year. However, possible ecological impacts of this highly invasive species have intensively been discussed by ecologist. Negative ecological effects are considered not only for regions where *B. terrestris* is non-indigenous but also for regions where it is indigenous. One of the negative ecological effects of commercialized *B. terrestris* is hybridization and genetic pollution. Hybridization may be occur in different ways such as interspecific, intersubspecific and interpopulation. We investigated the effects of interpopulation hybridization of the native and commercial *B. terrestris* on colony development characteristics under laboratory conditions. Young queens and males produced in both native and commercial colonies were mated to constitute genotype groups of native X native ($N♀XN♂$), native X commercial ($N♀XC♂$), commercial X commercial ($C♀XC♂$), and commercial X native ($C♀XN♂$). Results show that hybridization affected the colony production rate of native population, but not other colony characters. Colonies founded by commercial queens produced more gynes than colonies founded by native queens.

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Willingness to Pay Additional Water Rate and Irrigation Knowledge of Farmers in Dinar Karakuyu Irrigation Areas in Turkey

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Water which has become commoditize product is an important product today. Turkey is not a water rich country. In this study, agricultural enterprises in the field of Irrigation Project Dinar Karakuyu implemented in 1992 by DSI, was analysed which factors affected to willingness to pay additional irrigation water rate by logit model and irrigation knowledge of farmers was determined by Likert scale. Dinar Karakuyu irrigation network is begun to lose the function in the region. It was planned 100% irrigation rate but decreased about 9% today. In this context, DSI (General Directorate of State Hydraulic Works) plans to rehabilitation work in the same area.

The main material of this study was crop farming agricultural enterprises data that to be obtained through a survey covered by the Irrigation Rehabilitation Project in the province of Afyonkarahisar Karakuyu Dinar. Data was based on collected from 67 questionnaires, which were answered by farmers in Karakuyu Dinar region.

The results indicated that 74.6% of farmers were willingness to pay additional water charge. The data were statistically analysed with the use of the logit model. The model results show that agricultural income, farmers' educational level, computer ownership, attendance of agricultural training activities, family size and agricultural experience were positive affect of farmers' willingness to pay additional water fee.

Economic analysis of dairy farms: a case of Burdur Province in Turkey

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The aims of this study, was determined economic structure of dairy farms in the Burdur province and to determine the relationship between the special characteristics of dairy farm enterprises with their economic indicators.

Primary data was employed in this study and the data was obtained by face to face interview with the help of well-designed questionnaire. The data was gathered from 105 farm enterprises using Neyman stratified sampling methods. The data was belong to the 2012 production season. Dairy farms were classified into four groups according to the number of cows.

The result of annual economic activities such as gross margin, absolute profit and relative profit were calculated and found positive for four groups. Average active capital of the farms was 462945.29 TL. The greatest portion of active capital farms was the land capital (46.54%). The greatest portion of the production cost was feed (64.41%).

Catch crops and their effect on yield and quality of spring barley

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Catch crops have various beneficial effects. The aim of the experiment was to evaluate the production capability of catch crops and their impact on yield and quality of spring barley. The small-plot field experiment was set up on one of the driest and warmest areas in the Czech Republic (Žabčice, South Moravia). There were examined three species of catch crops and their effect on yield and quality of spring barley in the experiment. Catch crops sown in August were left in the field until March and in March the following crop, spring barley, was sown. Nitrogen fertilization at 60 kg ha⁻¹ N was carried out in the spring. *Sinapis alba* produced sufficient quantities of biomass, *Secale cereale* v. *multicaule* and *Phalaris canariensis* produced less dry matter. Yield of spring barley is affected by particular intercrops in combination with particular year. Except drier beginning of the year *Sinapis alba* had a positive effect on the yield of spring barley. *Secale cereale* v. *multicaule* regularly reduced the yield of spring barley. Yield of spring barley was similar or lower after *Phalaris canariensis* when compared to the control variant. Quality of grain (N content) compared to control was lower after *Sinapis alba* and higher after *Secale cereale* v. *multicaule* and *Phalaris canariensis* but no of these results was statistically significant. The results of the monitoring for the years 2013 to 2015 are presented. In one of the warmest and driest areas in the Czech Republic *Sinapis alba* seems to be the appropriate catch crop. However, due to high proportion of *Brassica napus* var. *napus* in the crop structure in the Czech Republic, we cannot recommend *Sinapis alba*. Improper catch crop is *Secale cereale* v. *multicaule* and *Phalaris canariensis* because cannot meet the goals of planting of catch crops by reason of their low yield. It is necessary to try other species of catch crops.

The BonaRes Centre – A virtual institute for soil research in the context of a sustainable bio-economy

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Fertile soils are central resources for the production of biomass and provision of food and energy. A growing world population and latest climate targets lead to an increasing demand for both, food and bio-energy, which require preserving and improving the long-term productivity of soils as a bio-economic resource. At the same time, other soil functions and ecosystem services need to be maintained. To render soil management sustainable, we need to establish a scientific knowledge base about complex soil system processes that allows for the development of models and assessment tools to anticipate the impact of a multitude of management measures on soil functions. This, finally, will allow for the provision of site-specific options for sustainable soil management.

To face this challenge, the German Federal Ministry of Education and Research launched the funding program “Soil as a Natural Resource for the Bio-Economy – BonaRes”. In a joint effort, ten collaborative projects and the coordinating BonaRes Centre are engaged to close existing knowledge gaps for a profound and systemic understanding of soil functions and their sensitivity to soil management. This presentation provides an overview of the concept of the BonaRes Centre which is responsible for i) setting up a comprehensive data base for soil-related information, ii) the development of models and assessment tools aiming to estimate the impact of different management measures on soil functions, and iii) establishing a web-based portal providing decision support tools for a sustainable soil management. A specific focus of the presentation will be laid on the so-called “knowledge-portal” providing the infrastructure for a community effort towards a comprehensive meta-analysis on soil functions as a basis for future model developments.

The impact on soil quality of different farm types in Canada, 1991-2011

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Canada has developed a suite of agri-environmental indicators that are used to assess and report on the sustainability of agricultural production practices. The indicators include models that focus on the impact of land management practices on soil erosion, water contamination, greenhouse gas emissions, soil organic carbon and wildlife habitat. One of these indicators – Soil Cover Days (SCD) – relates to the impact of agricultural land management on soil quality as indicated by soil cover. Soil Cover Days is an estimate of the number of days in a year in which soil is protected from the elements and is a function of the type of crop, biomass yield, tillage practices, residue management practices and weather (snow) conditions. Higher SCD values indicate a lower risk of soil erosion, better maintenance of soil organic carbon, improved wildlife habitat and lower greenhouse gas emissions. The indicator has been calculated and reported on a spatial basis over the entire country every five years since 1981.

Currently, the agri-environmental indicators program is being re-oriented toward the assessment of the environmental sustainability of production sectors (beef, hogs, dairy, grains, oilseeds, etc.) and commodities (milk, eggs, beef, pork, etc.) rather than areal units such as counties, soil-landscape polygons and watersheds. As an initial effort in this direction, we have developed a temporal ‘farm types’ database on an ecostratification spatial framework and have applied the Soil Cover Days model to each farm type in each ecozone in order to assess the levels and changes in the impact of different farm types on soil quality over the period from 1991 to 2011. Initial outputs indicate that Specialty Crop, Dairy, Beef and Specialty Livestock provide the highest level of soil cover, Poultry farms provide moderate levels, and Hog, Field Crop and Fruit and Vegetable farms have the lowest levels. Temporal analysis indicates a general improvement in soil cover across most farm types from 1991 to 2011, with the exception of Dairy and Poultry farms, which show a stable situation over that time period. This presentation will outline the method of assessment and provide a more detailed comparison of Soil Cover Days between farm types within regions and within farm types across regions. The comparisons will also review changes in SCD by farm type over the 20 years from 1991 to 2011.

A Survey for Determination of Weeds Damage on Wheat (*Triticum* spp.) in Diyarbakır/Turkey

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The aim of this study was to determine the actual extent of weeds damage in wheat fields and to suggest the most efficient control methods for wheat producers in the Diyarbakır region. A total of 140 growers of wheat production districts in Diyarbakır province (Bismil, Silvan, Sur, Çınar, Ergani ve Çermik) were personally interviewed in 2014. The survey included 47 questions aimed to determine the extent of weeds damage. Results of the survey showed that, i) the vast majority of farmers makes wheat cultivation in dry areas, ii) they give importance to the cleanliness of farming tools and they use certified seed, iii) the vast majority of their makes rotation, iv) almost half of producers recognizes weeds in wheat, v) farmers believes the necessity of weed control, vi) the farmers indicate that increased of weeds despite herbicide use. The present findings indicate that information of farmers about the health of the plants have adequate. Furthermore, these findings provide important information for identifying of weeds and control of weeds.

Manure band placement and reduced tillage as means to improve the sustainability of the cotton-based systems in Burkina Faso: effect on soil properties and cotton yields

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The sustainability of cropping systems based on cotton is more and more threatened by land degradation exacerbated by inappropriate cultural practices. Therefore agronomic trials were carried out, over three rainy seasons (2010-2012), in a research station located in the South-Sudanian region of Burkina Faso, for assessing the effects of reduced tillage techniques combined to increasing doses of organic manure (1, 2 or 4 t ha⁻¹ every 2 years) on the properties of soil (soil structural stability, soil mechanical resistance, organic carbon content) and the cotton yields.

A bi-factorial experimental design (split-plot) was used to test conventional tillage (T4) and three reduced tillage techniques: soil scarification opening along the lines of ridges (T1), soil scarification opening along the lines of ridges followed by a second scarification between the first rays (T2) or plowing with a hoe (T3). It should be noted that farmers are increasingly adopting these reduced tillage techniques as a means to facilitate cotton establishment in response to the shortening of the length of the rainy season. Organic manure is applied only in the opened lines for the reduced tillage treatments, as opposed to broadcast application commonly associated with conventional plowing (T4).

The results of all the tests of soil structural stability (FW: Fast Wetting, SW: Slow Wetting, MD: Mechanical Disaggregation) showed that the values of the Mean Weight Diameter (MWD) with reduced tillage (T1 α T2) were significantly higher than those obtained with intensive tillage (T3 α T4). MWD values also tend to increase with increasing rates of manure application. We especially observed for the highest dose of manure (4 t ha⁻¹) a decreasing trend of MWD values from reduced tillage (T1) to intensive plowing (T4). The intensive tillage associated with plowing (T3, T4) resulted in a reduction of the soil penetration resistance, especially in the topsoil (0-10 cm). Moreover, manure band placement (T2, T4) resulted in an increasing trend of the soil organic carbon content compared to usual practice (T4).

Finally, treatments T2 or T3, allowed an increase in cotton yields up to 14% compared to the single scarification (T1) or conventional plowing (T4). This increase was even higher (37%) with increasing doses of organic manure. These experimental results suggest that reduced tillage could be viable alternative to conventional tillage for reducing the soil sensitivity to erosion, and so contribute to sustainable land use.

A review on the carbon footprint of sheep production

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A carbon footprint is defined as the total amount of greenhouse gases (GHGs) emitted directly and indirectly over the full life cycle of a process or product. The main GHGs are composed of carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFC's), perfluorocarbons (PFC's) and sulphur hexafluoride (SF₆). Carbon footprint estimates are expressed in unit of carbon dioxide equivalent (CO₂eq). Carbon dioxide equivalents allow for a comparison of different GHGs relative to CO₂. Although GHGs do occur naturally, GHGs accumulating in the atmosphere leads to climate change which is one of the most important issues of our time.

Agriculture is one of the most significant contributors to global GHG emissions. Agricultural GHG emissions come from the cultivation of crops and livestock for food. Sheep production is a significant source of GHG emissions. The main GHG caused by sheep is methane emission arising from enteric fermentation, as well as emission of nitrous oxide from urine and faeces. Greenhouse gas production is related to the animal type and size, management practices, and feed quality. The carbon footprint of sheep production can be reduced by improving genetics, feeding practices and digestibility of diets, pasture quality, and manure management. The purpose of this review is assessed the carbon footprint of sheep production.

Mobilizing Greater Crop and Land Potentials Sustainably

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The supply side of the food security engine is the way we farm. The current engine of conventional tillage farming is faltering and needs to be replaced. This presentation will address supply side issues of agriculture to meet future agricultural demands for food and industry using the alternate no-till Conservation Agriculture (CA) paradigm (involving no-till farming with mulch soil cover and diversified cropping) that is able to raise productivity sustainably and efficiently, reduce inputs, regenerate degraded land, minimise soil erosion, and harness the flow of ecosystem services. CA is an ecosystems approach to farming capable of enhancing not only the economic and environmental performance of crop production and land management, but also promotes a mindset change for producing ‘more from less’, the key attitude towards sustainable production intensification. CA is now spreading globally in all continents at an annual rate of 10 Mha and covers some 157 Mha of cropland.

Today global agriculture produces enough food to feed three times the current population of 7.21 billion. In 1976, when the world population was 4.15 billion, world food production far exceeded the amount necessary to feed that population. However, our urban and industrialised lifestyle leads to wastage of food of some 30%-40%, as well as waste of enormous amount of energy and protein while transforming crop-based food into animal-derived food; we have a higher proportion of people than ever before who are obese; we continue to degrade our ecosystems including much of our agricultural land of which some 400 Mha is reported to be abandoned due to severe soil and land degradation; and yields of staple cereals appear to have stagnated. These are signs of unsustainability at the structural level in the society, and it is at the structural level, for both supply side and demand side, that we need transformed mind sets about production, consumption and distribution.

CA not only provides the possibility of increased crop yields for the low input smallholder farmer, it also provides a pro-poor rural and agricultural development model to support agricultural intensification in an affordable manner. For the high output farmer, it offers greater efficiency (productivity) and profit, resilience and stewardship. For farming anywhere, it addresses the root causes of agricultural land degradation, sub-optimal ecological crop and land potentials or yield ceilings, and poor crop phenotypic expressions or yield gaps.

As national economies expand and diversify, more people become integrated into the economy and are able to access food. However, for those whose livelihoods continue to depend on agriculture to feed themselves and the rest of the world population, the challenge is for agriculture to produce the needed food and raw material for industry with minimum harm to the environment and the society, and to produce it with maximum efficiency and resilience against abiotic and biotic stresses, including those arising from climate change. There is growing empirical and scientific evidence worldwide that the future global supplies of food and agricultural raw materials can be assured sustainably at much lower environmental and economic cost by shifting away from conventional tillage-based food and agriculture systems to no-till CA-based food and agriculture systems. To achieve this goal will require effective national and global policy and institutional support (including research and education).

Estimation of total CH₄ emission from rice paddies in Japan based on the DNDC-Rice model

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Methane (CH₄) is a greenhouse gas, and paddy fields are one of its main anthropogenic emission sources. To mitigate this emission applying effective management measures, CH₄ emission from paddy fields must be quantified at a national scale. In Japan, country-specific emission factors (=EFs) used to be applied since 2003 to estimate national CH₄ emission from paddy fields. However, this method cannot account for the effects of weather conditions and temporal variability of nitrogen fertilizer and organic matter application rates; thus, the estimated emission is highly uncertain. To improve the accuracy of the national-scale estimates, we revised the country-specific EFs based on simulations by a modified version of the DeNitrification-DeComposition (DNDC) model, namely DNDC-Rice. DNDC can simulate carbon and nitrogen cycles including emissions of greenhouse gases (CO₂, CH₄, N₂O, and NO) and NH₃, and DNDC-Rice was developed to improve the simulation of CH₄ emission from rice paddies. First, we simulated CH₄ emission from 1990 to 2010 using 986 datasets that included soil properties, meteorological data, and field management data. From the simulated site-specific emissions, then, we calculated annual mean emission for each of Japan's seven administrative regions, two water management regimes (continuous flooding and conventional mid-season drainage), and three soil drainage rates (slow, moderate, and fast). The mean emission was found to be positively correlated with organic carbon input to the field. Therefore, we developed linear regressions for the relationships between CH₄ emission and carbon input for each combination of the regions, water managements, and drainage rates. Using above regressions and relevant activity data (paddy area attributed to each type of drainage level, and water management, and organic carbon application rate), we estimated total CH₄ emissions from paddy fields in Japan. The total CH₄ emissions from 1990 to 2010 were 323 to 455 ktC yr⁻¹, which were 1.2 to 2.1 times higher than those calculated using the previous EFs (206 to 285 kt C yr⁻¹). The difference could be attributed to underestimation by the previous EFs, as well as overestimation by our method. Previous EFs themselves may be negatively biased, because they were derived from CH₄ emission data observed at fast-draining fields. Also, the area of continuously flooded paddies was underestimated in previous estimates of total CH₄ emissions. On the other hand, our method may have overestimated CH₄ emissions, due to overestimation of organic matter decomposition rate and plant growth in simulations by DNDC-Rice.

Effects of different nitrogen doses on the turf performance of tall fescue (*Festuca arundinacea* L.) cultivars

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This study was conducted to determine the effects of different nitrogen doses on turf performance of some tall fescues cultivars on Agricultural Research and Applied Center of Suleyman Demirel University in Turkey, during 2014-15 years. This research was conducted in randomized block design with three replication. Tall fescue (*Festuca arundinacea* L.) cultivars Starlet, Debussy and Rebel were used in this research. Four nitrogen levels (0, 2, 4 and 6 g m⁻² mount⁻¹) were applied in this research. The speed of emergence (day), ground cover speed (day), ground cover rate (1-9 point), cold tolerance (1-9 point), leaf color (1-9 point), regeneration power (1-5 point), tiller number, general appearance (1-9 point), dry matter yield (kg ha⁻¹) and nitrogen content (%) were determined in this research. According to results, Debussy cultivar showed the best performance in terms of leaf color, regeneration power, dry matter yield and nitrogen content. The effects of nitrogen fertilizer applications on turf performance were significant. Increasing N fertilization rates resulted in an increase in cold tolerance, leaf color, regeneration power, tiller number, general appearance, dry matter yield and nitrogen content.

Biochar doses and bioeffector bacterium affected to pot-and field grown organic tomato

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Biochar application is a well-accepted method in sustainable agricultural practices, even though there are large discrepancy about its positive and or the negative effects in the literature. The biochar might improve the physical-chemical soil properties, and the water-retention of soils, the clay-and organic-matter content, the pH-levels, the N- and P-availability, the doses of other meso- and micro-nutrients and also the soil-oxygen levels and air content, due to its high porosity. The other thing, that microorganisms needs an efficient surface protection by large absorptive capacity of biochar products, and improved water/nutrient supply. The main questions are therefore; how the soil microorganisms can react to the biochar application among the various soil-environmental conditions? Is there any limits of the soil-application? Can the beneficial bioeffector bacteria are able to reduce the negative effect of a certain biochar product?

Our aim was to study the environmental impacts of biochar doses in microcosm experiments in pots and also among organic agricultural production. There were 5 different biochar doses (between 0,5-10%) mixed into the soil with 4 replicates in pot experiment. Among field conditions the 4 and 10 t/ha biochar were applied at Soroksár experimental field of Szent István University, Hungary. In both experiments the tomato (*Solanum lycopersicon* Mill.) Hungarian cultivar of 'Mobil' were used. The abundance of soil-microorganisms was assessed by the most probable number (MPN), colony-forming unit (CFU) and dehydrogenase enzyme activity methods.

We found that doses between 0.5–5% of biochar had positive effect for the soil microbial abundance and the soil-enzyme activity; however the 10% ratio has decreased it. The optimal doses at a certain soil-plant ecosystem might depend on many soil-environmental parameters, such as humus content, cation exchange capacity (CEC), pH and soil-water level. The biochar can adsorb the nutrient-elements from soils, and therefore might create an obstacle against the plant availability. The environmental circumstances, such as the rainfall and drought can create also a great influence on their adsorption capacity. Among therefore at a low soil-fertile capacity, such as the sandy-soil in Soroksar, the 10 t/ha biochar application was found to get a larger negative effect to the tomato's fruit production. Regarding the beneficial effect of biofertiliser bacteria, a *Pseudomonas putida* isolate was found to be an efficient bioeffector of reducing the negative effects of the larger biochar doses to soil microbial composition.

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Effects of single usage of mouldboard plough after long-term reduced tillage on soil physical properties

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Reduced tillage as one kind of conservation tillage is a common tool for combining ecological, economic and social requirements in agriculturally used landscapes. Increased saturated hydraulic conductivity, aggregate stability and biological activity are some properties that can be influenced positively by reduced tillage. Otherwise, long-term conservation tillage can cause problems like weed pressure, stratification of nutrients or soil compaction. Application of one-time inversion tillage, also called occasional tillage or strategic tillage, may be a possibility to overcome these disadvantages.

The aim of our study was to analyse how far the improved soil functions derived by long-term reduced tillage maintain after one-time inversion tillage by mouldboard plough. The investigations were conducted on a 5.5 ha wide field in the southern part of Lower Saxony, Germany. Since 1996, the study site is divided into three plots, one tilled by mouldboard plough, one by chisel and one by disk harrow. In October 2014, the entire field was tilled by mouldboard plough to a depth of 28 cm. During the following year, three field campaigns were performed to analyse the effects of this one-time inversion tillage on volumetric water content, bulk density, saturated hydraulic conductivity, infiltration rate and penetration resistance. The surveys were compared to measurements of soil physical properties conducted before the application of one-time inversion tillage.

The results clearly showed that the improved soil functions still remain after the mouldboard ploughing. At all three sampling dates saturated hydraulic conductivities and infiltration rates were significantly higher under the former reduced tilled plots compared to the conventional tilled plot. For penetration resistance the result was different. Before the application of mouldboard plough, the penetration resistance was significantly higher under reduced compared to conventional tilled plot. After inversion tillage of the entire field the penetration resistance was significantly reduced and showed the same values like the long-term conventional tilled plot. This indicates on the one hand that the high loosening effect of the mouldboard plough reduced the compaction of the topsoil. On the other hand the improved aggregation and structure of the long-term reduced tilled plots was not completely destroyed by one-time mouldboard ploughing.

The study revealed that one time inversion tillage after long-term reduced tillage do not necessarily diminish all benefits from conservation agriculture. Quite contrary, one-time inversion tillage gives the farmer the opportunity to overcome disadvantages like weed pressure. However, how often the one-time inversion tillage can be applied without affecting the improved soil functions and whether the results can be transferred to other soils must be part of further studies.

Using penetration resistance measurements to analyse the long-term effects of different soil management - A spatial approach

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Conventional and conservation tillage practices influence soil physical properties e.g. hydraulic conductivity, soil structure or soil fauna. In addition, field traffic like harvest activity has a major impact on soil functions due to soil compaction. Measurement of penetration resistance is a common tool to evaluate the effects of different primary tillage practices or traffic intensities.

In this study we used extensive penetration resistance measurements to detect and evaluate spatial patterns caused by different tillage practices and traffic intensities. Therefore a 5.5 ha wide field, divided into three plots by different tillage practices, serves as study site. Since 1996, one plot was conventionally tilled (mouldboard plough), while on the other two plots reduced tillage practices (chisel and disk harrow) were applied. During two field campaigns (June and October 2014) more than 500 measurements using a penetrometer were conducted. The resulting penetration resistance (in MPa) was then stepwise interpolated using kriging with external drift. To evaluate the penetration resistance, additional core samples were taken at 20 sampling sites.

The results showed significant spatial differences between the primary tillage practices in the topsoil. Compared to the conventional tilled plot, the penetration resistance was up to 2.3 MPa higher under reduced tillage. In the subsoil there was no further difference between the tillage practices. Another spatial pattern was observed between the inner field and the headlands. This area is characterised by high traffic intensity resulting in continuously higher penetration resistance values from surface to the depth of 50 cm.

The study indicates that the spatial prediction of penetration resistance is able to detect spatial patterns resulting from different tillage practices and traffic intensities. Combining the extensive measurements of penetration resistance with additional soil information like hydraulic properties may enable to a field-wide derivation of soil functions affected by soil management.

Flax in Direct Seeding new opportunities to the conservation agriculture

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New techniques for sowing flax have been tested in France (Haute Normandie) in the last few years.

In this region and in most regions where flax is cultivated, linen represents an important economic opportunity. It remains difficult for farmers wishing to move towards conservation agriculture to integrate flax in their crop rotation. This crop is renowned to be demanding concerning the soil preparation.

Thus, a group of farmers (Sol en Caux) in response to a call for projects CASDAR <<Mobilisation Agro-écologique>> gathered together to put in place innovative practices in conservation agriculture. One of the trials involved a comparison of 4 arrangements according to different types of plantings with reduced soil preparation. In 2014, under the soil and climatic conditions of Haute Normandie, one of the approaches stood out from the others. It was superior not only on the quality criteria of the fibres but also on the quantity (yield of fibre). The plant development was also observed at two important stages of growth: germination and pre-harvest. The results are very encouraging and provide new perspectives for the introduction of industrial crops in conservation agriculture.

Land use optimization in the Drava floodplain

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The lower Drava river along the border between Croatia and Hungary represents one of the last remaining continuous riverine landscapes in Central Europe with a range of natural landforms (large natural islands, gravel and sand banks, distributary channels, meanders, loess cliffs, oxbows etc.). In Hungary the lower Drava is part of the Danube-Drava National Park and extensive areas are included in the Natura 2000 system. The Old Drava Programme, under implementation, envisages a profound transformation of land use pattern, where the preservation of protected wetlands is of primary significance. For nature conservation the connectivity of oxbows and backwaters is central for the assessment of the ecological conditions of the morphological floodplain. Extensive agricultural land use types (grazing lands, floodplain orchards) have to be concentrated in the buffer zones of protected areas. The detailed survey of floodplain landforms (with special regard to higher-lying natural levees) allows the identification of areas suitable for large-scale farming. Our research also intends to assess the agroecological potential of the floodplain along the Hungarian Drava River from the viewpoints of water availability, soil conditions and vegetation. The efficiency of floodplain rehabilitation activities is assessed and, thus, decision making on regional development issues is supported.

Biofuels and rural development in Mexico

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Biofuels have attracted the interest of many countries all over the world mainly as a tool to promote energy security, rural development and environmental sustainability. In some cases, biofuels are considered an effective means of improving the trade balance. Many countries, in particular many developing countries, have expressed interest in obtaining the benefits of this industry. In pursuit of these benefits, they have initiated projects with different levels of intensity. Mexico, being no exception to this trend, has enacted several laws and regulations aimed at promoting biofuels. However, due to its role as a major oil producer as well as a major consumer and importer of corn, the main motivation for promotion of biofuels in Mexico should be the possibility to instigate the rural development. The key aspect that pushes the rural sector to the center of attention of the development of biofuels is its use of crops in the production of biofuels. Depending on the raw materials used in the production as well as the technology applied, biofuels are generally divided into biofuels of the first, second and the third generation.

As Mexico is a major producer of oil, the argument of energetic security is not of high relevance with respect to biofuel production. The argument of decrease of the consequences of the greenhouse effect does not seem to be relevant either since there are other options available for meeting this goal, such as modernization of oil refineries and improvement of the environmental policy in terms of handling industrial waste. Consequently, the only valid reason for which Mexico should promote the production of biofuels is promotion of its rural development. The Mexican government needs to understand that the promotion of biofuels can be an excellent tool to reactivate the rural sector and to support its development. Even though this undertaking is not free of risks and obstacles, it can be accomplished, on condition that it includes in its initiatives the implications of the mandates, regulations and subsidies that have a direct effect on the use of land, the environment and the lives of people.

The aim of this paper is to analyze the arguments in favour and against the promotion of biofuels in Mexico. The paper starts with introduction of the most recent initiatives in Mexico aimed at promotion of biofuels, followed by an analysis of the rural sector and the arguments for and against biofuels used as a trigger of rural development and the final part of the paper comes up with some relevant recommendations and conclusions in this field.

Conservation and conventional tillage: long-term effects on yields, a case study in Hungary

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The present study reports data on Conservation Tillage (CT) in the continental sub-humid climate zone in Central Europe (Hungary). The results of a 10 year (2003-2013) comparative study of mouldboard ploughing tillage (PT) and CT types are reported. Our extensive monitoring system has provided new and detailed information about technologies and yields both from the first, transitional period and from the following years of adapted technology. Our results suggest that tillage type had major influence on the yields than either the highly variable climate of the studied years, or the diverse slope conditions of the plots. During the first three years of technological changeover to CT (2003–2006) a decrease of yields of 8.7% was measured, respective to PT. However, during the next seven years (2007–2013) the CT yields were 12.7% higher. Our study revealed key factors leading to an initial reduction of crops during the technological change, and may accordingly serve as a guideline for the shortening or avoidance of decline in the transitional period.

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The ecosystem services supplied by soil in relation to land use

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The concept of ecosystem services has become an important tool for modelling interactions between ecosystems and their external environment in terms of global bioclimatic changes. The provision of ecosystem services depends on biophysical conditions and changes over space and time due to human induced land cover and land use. Traditionally, agroecosystems have been considered primarily as sources of provisioning services, but more recently their contributions to other types of ecosystem services have been recognized. According to several authors agroecosystems can provide a range of other regulating and cultural services to human communities, in addition to provisioning services and services in support of provisioning. Six agricultural study areas, each of them with two different land use categories (arable land and permanent grasslands) located in various natural conditions of Slovakia, were evaluated. For the analysis of the agroecosystem services study sites were selected on the basis of the following criteria: 1/polluted area (inorganic contamination) , 2/non polluted area (without the inorganic contamination), 3/ area threatened by erosion, 4/ abandoned land, 5/ low productive land, 6/ productive land. The relationship among provisioning services, regulating services (filtration of the inorganic pollutants, carbon sequestration, potential of erosion- RUSLE model), cultural services (according SolVES model), soil abiotic parameters (pH in KCl, soil organic carbon - Cox, total nitrogen - Nt, nutrients - P, K, Mg), biodiversity (Shannon-Wiener index), macro-organisms (earthworms and earthworm fresh body biomass, earthworms were collected by hand sorting (35x35x20 cm of soil), were evaluated. The greatest differences can be seen in the relation to sites land use and diversity of soil type, from the abiotic factors is that the soil pH value, organic carbon content, P- nutrient content and oxic conditions in the soils. When compared to provisioning services and cultural services is their apparent contradictory character. Ecosystems and biodiversity play an important role for many kinds of tourism which in turn provides considerable economic benefits and is a vital source of income for local providers. Ecosystems regulate the global climate by storing and sequestering greenhouse gases. The greatest impact on carbon sequestration has soil pH value in addition to the carbon content and nitrogen content in the soil.

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Short-term fertility-building crop influences on wheat performance in arable farming

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Nitrogen (N) from inorganic fertiliser is the main cost of conventional cereal production. Use of short-term fertility-building crops (FBCs) is sometimes proposed to minimise the impact of N fertiliser costs and also provide potential environmental benefits. To evaluate this approach, a field trial at the Royal Agricultural University, Cirencester, UK in 2007-2008 provided the N contributions of eleven different FBCs established by two methods of straight sowing or undersowing in spring barley to be evaluated on subsequent winter and spring wheat test crops. No N fertilisers were used on the trial and no herbicides were used on any of the FBCs during the fertility-accumulation phase. Normal agronomic treatments (apart of absence of N fertilisers) were applied to the test crops.

FBCs produced substantial enhancements of soil N levels. Yield of the winter wheat test crop was significantly increased by the straight-sown FBCs of red and white clovers (*Trifolium pratense* and *repens*); white lupin (*Lupinus albus*) and a legume mixture. In the case of spring wheat, however, the undersown FBCs of red and white clovers; the legume mixture; vetch (*Vicia villosa*) and black medic (*Medicago lupulina*) all gave significant yield increases whilst maintaining the yield of the spring barley. In these cases the FBC treatments adopted beforehand were particularly beneficial to farm practice. Such FBCs can potentially provide, therefore, both the N required by wheat crops with more environmental benefits than by applications of mineral N fertilisers alone.

Farmer's perspective on adaptation and up-scaling of conservation agriculture based management practices in Indo-Gangetic plains of India

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Conservation agriculture (CA) is gaining momentum in the Indian Indo-Gangetic plains (IGP) to conserve resources and counteract the negative effects of soil nutrient mining while improving environmental quality. Understanding the farmer's perspective has traditionally been seen as critical to influencing the adoption and up-scaling of CA-based climate-resilient practices. The objective of this study was to investigate the biophysical, socioeconomic, and technical constraints in the adoption of CA by farmers in the Trans- and Lower-IGP. A structured questionnaire of 50 respondents and interviews with five key informants were conducted at two sites in the IGP: Karnal, Haryana in the Trans-Gangetic plains and Samastipur, Bihar in Lower-Gangetic plains. We show that CA constituted about 76.8 and 32.5% of total cultivated land area in Karnal and Samastipur, respectively, among adopters during 2015. Major techniques used by farmers in Karnal were zero tillage, crop residue retention, and crop rotation, whereas their counterparts in Samastipur mainly adopted large crop rotation, minimum tillage, and permanent bed planting. In Karnal, survey was done in six villages; among these villages Taraori with more than 75% CA adopters had the highest adoption rate. Whereas, in Samastipur district, seven villages were selected for survey, among them Bhishapur Digambara with more than 45% CA adopters had the highest adoption rate. Adoption intensity depended on the age, education, resource richness, and interest of the farmers toward the adoption of new technologies. In Karnal, young (20-35 years, 40%) and resource-rich farmers influenced the adoption of CA technologies more than poor and older farmers (36-50 years, 50%). In both the study sites, majority of the farmers were unaware about soil health and quality of their field but surprisingly they recognize that adoption of CA technologies positively impacted soil and they found more microbial activity (earthworm) as compared to conventional agriculture. This preliminary survey revealed that participatory methods and stakeholders involvement is very important including local governments and agricultural change agents at village levels to fasten the CA adoption process. Marginal and small (less than 5 acres of land) farmers in Karnal and Samastipur were 24 and 82%, respectively. CA technologies should be targeted as per the socio-economic status and biophysical constraints and encouraged by the government and other stakeholders.

Exploring carbon sequestration potential of organic farming: a case study of Indian subcontinent

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The CO₂ emissions continue to rise at the high end of a range of emission scenarios and hence expanding the gap between current trends and efforts to limit climate change below 2 °C. One of the most important developments of last century and beginning of new millennium has been raising CO₂ in atmosphere and the impending threat of climate change. The rise continues and looking at the emission scenario the evolution of carbon sink in the ocean and land has become increasingly important not only to limit CO₂ but its sequestration also. In 2015, CO₂ rise in atmosphere was recorded as high as 400 ppm has become an alarming global concern owing to uncertainty if it has reached its threshold or would it increase unabashedly. In this context soil holds the greatest global carbon mitigation potential as it constitutes the largest carbon pool (1550 Gt SOC, 950 Gt, SIC), 4.5 and 3.3 magnitude of biotic pool (560 Gt) and atmospheric pool (760 Gt) respectively.

Today organic farming emerges as high potential carbon sequester as well as alternative food production system. Indian subcontinent occupies 2nd and 13th position in terms of number and area of certified organic farms (44,926) respectively representing only 0.3 % of total agricultural land which has marked dissimilarities. With a large land area and diversity of agro climatic and ecological regions makes it a more vulnerable and threatens livelihood security of large rural masses of the Country. It is a giant rain fed ecosystem and contributes to economic growth because majority of its population and the work force depend on natural resources viz water resources, agriculture, forests animal husbandry, fisheries etc. for employment.

Investigations have been carried out on the soil contents and its relation with sequestration for modern, classical and organic farming to underline the potentials along with other environmental issues. Studies reveal adaptational difficulty of Indian organic farming rooted in non-availability of sufficient organic supplements, bio fertilizers and local market for organic produce and poor access to guidelines, certification and input costs. An attempt is made to pinpoint various mitigation methods particularly organic farming and its potential of Carbon sequestration in a sub continental perspective of India. It suggests that an integrated effort is needed from government and nongovernmental agencies to encourage farmers to adopt organic farming (OF) as a measure to climate change, health and sustainability issues.

Conservation agriculture for mainstreaming sustainability in Mediterranean basin

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Nations around the world are in the process of negotiating a new climate regime to address the issues of climate change and forge new international agreements entailing profound cuts in greenhouse gas (GHG) emissions. Mediterranean region is experiencing climate change that in no way can be considered normal, and the challenge that this brings to agriculture is twofold. Reducing greenhouse gas emissions that generate the changes to climate is the first challenge to be tackled. The second challenge relates to the impacts of climate change on production, and the capacity of agriculture to adapt where it is most vulnerable. Over the past decades, there have been concerted efforts to promote climate smart agriculture strategy through diffusion and adaptation of conservation agriculture (CA). CA is a set of soil management practices that minimize the disruption of the soil's structure, composition and natural biodiversity. No-tillage agriculture (NT) is among technology and knowledge intensive CA systems mostly widespread in divers ecologies and households. Despite high diversity in the types of crops grown, all forms of NT share 3 core principles: (i) maintenance of permanent or semi-permanent soil cover and direct seeding with minimum soil disturbance, (ii) diversified crop rotations or sequences and (iii) integrated weed management. It also uses or promotes where possible or needed various management practices such as utilization of cover crops, integrated pest and disease management, use of well adapted, high yielding varieties and good quality seeds, efficient water management and controlled traffic over agricultural soils. The origins, inventions and evolution of NT principles are embedded in North and South American farming societies who, out of necessity, had to respond to the severe erosion problems and productivity declines on their agricultural soils due to “intensive” tillage-based production agriculture. For Mediterranean dry environments, many researchers believe that agriculture has the potential of becoming a much larger sink for CO₂, if CA principles are followed. In fact, climate change will become an additional driver for developing no-tillage practice across the Mediterranean basin. This paper addresses the CA benefits related to climate issues in order to smooth policy shifts to CA in dry Mediterranean areas. This work is also attempting to shed some light on the challenges surrounding the NT adoption and discussing some keys success indicators. No-tillage agriculture is gaining momentum in the region due to improvement in crop productivity, yield stability and farm profitability, amelioration in soil quality attributes (mainly soil fertility, organic matter and aggregation), upgrading of environmental quality indicators (mainly reduction in carbon emissions and soil erosion and sedimentation).

Conservation agriculture research in Meknes-Fes region (Morocco): A Review and Perspectives

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The introduction of sustainable agricultural technologies to dryland farming enterprises is not an easy task. Research on Conservation Agriculture (CA) in rainfed production systems of Meknes-Fes region (Morocco) can be traced back in 1980's wherein efforts were made to develop the no-tillage technology and systems at agricultural research institutions of Meknes. Efforts are being made to engage and accelerate the adoption of this technology by farmers in the region. Under dryer conditions, CA yields tend to be higher than conventional yields. In cases where yield reductions were observed the most common reasons were soil compaction, crop residue or weed management problems. Over years, yields under CA appear to increase due to the build-up of soil quality, and even under very difficult conditions, eventually any initial yield reductions disappear after few years. The improved soil quality or productivity implies improving the overall capacity of the soil to grow crops and to buffer them against stresses caused by farming operations and environmental hazards. Hence, the observed gains in crop production and environmental protection are encouraging signs and a compelling argument that conservation agriculture should be practices in larger areas of Meknes-Fes region. What is required is better understanding of CA performance and requirements across geographic regions and environmental conditions to enable the diffusion of the technology. In Meknes-Fes region and considering the results reported in this review paper, CA must no longer be side-lined as an alternative development technology representing the best option for a sustainable future. In order to develop CA and to path its adoption in the region, CA must be closely linked with micro-climatology, crop physiology, weed science, plant genetics and other agricultural disciplines to insure the development of tactical management practices (cultivars, weed, pest, disease, water management strategies and practices, fertiliser regimes etc.) suitable for CA-based crop management technologies.

The transition from conventional to conservation agriculture assumes that the farmer will, or needs to, convert the whole farm to CA at the same moment. This is not necessary, and in fact farmers in Meknes-fes region have learned to manage the new system properly under their circumstances and conditions before converting gradually the farm to CA. Solid bridges should be built between policy-makers, scientists and land users to develop consensus on sustaining agricultural systems with conservation agriculture and leading to large-scale improving impacts on soil resources. These ecologically intensive systems should be scaled-up to address problems of climate change, food insecurity and depletion of natural resources simultaneously. Moreover, the recent Moroccan Green Plan can create favorable environment for ensuring CA adoption by farmers in near future.

Environmental management of tea production using joint of life cycle assessment and data envelopment analysis approaches

(Not presented on the Conference)

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In this study, two methods including data envelopment analysis (DEA) and life cycle assessment (LCA) were applied in order to determine energy efficiency and aid in the reduction of environmental burdens for tea production in Guilan province, Iran. The initial data were collected from 30 tea producers using a face-to-face questionnaire. Two models including constant return to scale (CCR) and variable return to scale (BCC) were used for calculating efficiency scores. Simultaneously, ten impact categories (AD, AC, EP, GW, OLD, FE, ME, HT, TE, and PO) were assessed to identify the main problem areas in the tea farms. The results indicated that the average technical efficiency, pure technical efficiency and scale efficiency were 0.881, 0.979 and 0.897, respectively. Moreover, the total energy saving was computed to be in the range of 7193 MJ ha⁻¹. The highest share of total energy saving potential belonged to nitrogen with 65.93% observed. Based on the results, nitrogen, diesel fuel and machinery were the main hotspots in the majority of impact categories in both of present and DEA farms. Furthermore, in this study, the potential for impact category reduction was investigated and the results illustrated that between 17% - 20% of emissions can be reduced by converting present to DEA farms. In conclusion, the joint DEA + LCA method can improve the energy efficiency and environmental impacts in tea production, significantly.

Strategies of organic agriculture in Russia: opportunities and barriers

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The agriculture in the Russian Federation faces today challenges a growing domestic food demand. At the same time, agriculture has to contribute to the reduction of the burden on the environment in terms of greenhouse gas emissions in the context of the decisions taken at the conference in Paris-2015. The lack of mineral fertilizers use in farming for many years seems to be a significant advantage for the development of the organic agriculture. In Russia, as well the demand on the organic products is growing rapidly today. In this report the authors demonstrate, that the strategy of organic farming development must consider natural climatic and economic diversity of the regions of Russia. Contemporary conceptions of sustainable development demonstrate a holistic view at the economic, ecological and social challenges to society and a balanced way of elaborating development goals and strategies at the national as well as at the international levels. The absence of a contemporary legal regulation in Russia constitutes serious barriers to its dissemination. Russia's national standard of organic agriculture (GOST R 56508-2015) approved just by 2015, June 30, needs international acceptance, especially from the European Union. Our study, based on the analysis of statistical data, assesses the level of the sustainable development of the agricultural regions of Russia in terms of economic, social and ecological parameters. The results reveal regions with low, medium and high levels of sustainable agriculture. For each group of regions, the carried out SWOT analysis highlights the strengths and weaknesses of organic agriculture, as well as the opportunities and threats to its development. On this basis, the authors suggest some recommendations for strategy development of organic agriculture in Russia.

Does minimum tillage improve livelihood outcomes of smallholder farmers? A micro-econometric perspective from Zambia

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Low adoption of minimum tillage (MT) by smallholder farmers in sub-Saharan Africa has led some to question its suitability for the region. Why adoption is low remains an open question. This study applies a simultaneous equation model with endogenous switching to assess impacts of adopting MT on household incomes using data from 780 plots in Zambia. Data are drawn from a survey of households randomly selected from Mumbwa and Nyimba districts where MT has been promoted for nearly 20 years and Mpika district, which is outside the promotional areas. I use an endogenous switching regression framework to account for heterogeneity in the decision to adopt MT or not, and to consistently predict actual and counterfactual outcomes for both adopters and non-adopters. Empirical results suggest that adopting MT did not significantly increase household and crop incomes in the short term for adopters in the sample. However, non-adopters would have earned higher farm and crop incomes had they adopted. Since it is unknown for how long farmers in the sample used MT, these results should be interpreted as short term impacts. In the context of the study areas, these results may partially explain perceived low uptake of MT. Overall, these results call for targeting and adapting MT and MT promotion to local contexts. Future research could evaluate the impact of the full package of conservation agriculture or climate smart agriculture, or combinations that explicitly include minimum tillage or individual components of minimum tillage.

No-till winter wheat (*Triticum aestivum* L.) cultivation in the irrigated conditions Central Asia and the Caucasus

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Conservation Agriculture (CA), which minimizes or avoids mechanical soil disturbance (i.e. no-tillage), keeps the soil covered with mulch, and promotes a diversified cropping system is proving to be good for farmers and the environment, and leads to reduced use of agrochemical and water while producing higher output. CA systems have a great potential for increasing agricultural production in CAC region at the same time to maintain soil health and fertility.

The main objective of the experiment reported here was to study effect of different tillage methods on productivity of winter wheat in the irrigated conditions of CAC. There were three different tillage treatments; conventional till (CT), minimum till with disking (MTD) and no-till (NT).

Winter wheat productivity was higher in the treatment with no-till method compared to other treatments across all the countries. This is in line with Nurbekov et al. (2012) where it is reported that no-till winter wheat crop had a higher yield compared to conventional and minimum till crop yields. This can be explained by the fact that soil evaporative losses of water from no-till plots are lower than from conventional till plots, and with reduced soil evaporation the accumulation of salts in root zone decreases. This facilitates in the proliferation of roots and which in turn leads to greater crop growth and yields. In the long-run, no-till practice with retention of crop residues helps in lowering the salinity levels due to combined effects of reduced evaporation and recycling of organic matter. The absolute highest yield of 6.71 t ha⁻¹ was recorded in the no-till treatment in 2013 in Uzbekistan while in conventional tillage the maximum yield was 6.54 t ha⁻¹ in 2012 in Uzbekistan. The lowest grain yield (4.7 t ha⁻¹) recorded under conventional till in Kazakhstan.

Conclusions: No-till method tested in the Central Asia and the Caucasus proved to be suitable for local conditions and can provide similar or higher crop yields. No-till winter wheat results in an increase in crop production and higher grain yield as compared to conventional and minimum till.

Effect of tillage methods on productivity of double cropped mungbean in the irrigated conditions of Tajikistan

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Wheat, barley and maize continued to be the major crops grown by private and public sectors in Tajikistan. In the irrigated areas of Tajikistan, farmers usually finish harvesting winter wheat and barley during the period mid-June through mid-July, and they undertake next planting of these winter cereals during the first fortnight of October. Thus, the land remained idle for more than three months after the wheat harvest, and efficient of the land could be made through double cropping for example with legume crops. Climatic conditions of the Tajikistan allow growing two crops per year. Multiple cropping (growing two or more crops in one year or a single growing season) offers a good opportunity to increase annual crop production. Multiple cropping is one of the most important modern agricultural developments for production intensification. In double-cropping, timing of planting of the second crop becomes limited along with pressures of harvesting of the mature crop on time. The main objective of this experiment is to study effect of different tillage method on productivity of double cropped mungbean in the irrigated conditions of Tajikistan. Mungbean grain yield increased with tillage methods. The greatest grain yield response was recorded with no-till mungbean 1898 and 2365 kg/ha in 2014 and 2015 year respectively. Conventional tillage had lowest 1595 and 1365 kg/ha in 2014 and 2015 year. The differences in the mungbean grain yields between conventional till and no-till is not clear yet, but we hypothesize that soil moisture content could have been a cause yield increase. The maximum (2002 USD), medium 1183 USD and minimum 926 USD net revenue was obtained with no-till, minimum tillage with disking and conventional tillage methods respectively. It can be concluded that no-till treatment is the best on the basis of cost benefit analysis of the present study.

Mungbean is one of the best second crop that can be grown after winter wheat harvest not only in Tajikistan but also in entire southern part of the Central Asia. The second year results kept the same trend that was in the first year of the research on no-till mungbean cultivation after the wheat harvest. The research results shows that no-till mungbean had higher productivity than conventional and minimum tillage mungbean in the irrigated conditions of Tajikistan.

Application of molybdenum and cobalt in common bean (*Phaseolus vulgaris* L.), with two fertilization systems under no-tillage

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Molybdenum and cobalt play an important role in N metabolism of grain legumes; however, the effects of their application to alkaline soils has been scarcely studied. A field experiment was set up to evaluate the application of Mo and Co on yield and nitrogen uptake of common bean cv Canario Centenario under two nitrogen fertilization systems: inorganic fertilization and inoculation with *Rhizobium etli*. In each system, molybdenum (Mo) and molybdenum plus cobalt (MoCo) were applied by seed impregnation at doses of 1.36 g.kg⁻¹ of seed for Mo and 0.26 g.kg⁻¹ of seed for Co; a control for each fertilization system and an absolute control were included. Plant height, leaf area, grain yield and its components, total dry matter production, the number and weight of nodules per plant, and nitrogen uptake by grains and foliage, were evaluated. A completely randomized block design with 7 treatments and 5 replications was used. Molybdenum application increased leaf area, grain yield, plant nodulation and nitrogen content in grains and shoots under both fertilization systems, highlighting the increase in total nitrogen content of the plant by 35.4 and 26 %, respectively. Inorganic fertilization showed yields higher than inoculation with *Rhizobium*. Cobalt application increased only number of nodules, weight of nodules and nitrogen content under inoculation with *Rhizobium etli*. Molybdenum application to beans cultivated in alkaline soils is recommended but cobalt application is suitable only when beans are inoculated with rhizobia.

Conservation agriculture impact for saving agricultural labourers and increasing of the soil biological activity in bean and corn in the highlands of Peru

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Peasants of peruvian highlands has developed traditional agricultural practices, as soil tillage with animal traction or hand power, earthing crops up and stubble burning, leading soil depletion with high production cost and migration of youths to urbane zones. This context worries Caritas Huancavelica, which bet on the conservation agriculture, with aims to reduce crops production cost, save time and adapt agricultural practices against the climate change. The project implementation started in june 2008, with 51 peasants in San Juan, through demonstrative plots and field school for peasants. In the plots, where there were cornstalks, they sowed beans and the ones, where there were only weed, they sowed corn. These plots were not plowed, farmers did not burn vegetable residue in these plots, and neither they did not earth crop up, only these plots received a suitable nutritional and sanitary management. So, by not plowing, peasants saved the work of 2 agricultural labourers and animal traction, working 10 days per hectare. And, they saved the work of 4 agricultural labourers, working 7 days per hectare without earth crops up. Also, the conservation practices decreased the soil erosion impact. The watering frequency in the traditional agriculture was every 7 days, while in the conservation agriculture was every 11 days, saving 2052 m³ of water per crop cycle, doing efficient the using of water and keeping longer humid soil, due to shallow stubble, which decreased the water evaporation. Moreover, when the environment temperature at midday was 30°C, these factors, stubble, temperature and humidity attenuated drastically the soil temperature to 21°C, versus 41°C in the soils with traditional management. In consequence, these factors were keys for exponential growing of the earthworm population from 0 to 670000 units/hectare. Also, the crops yields doubled the local yield. Finally, the demonstrative plots allowed to saved money and time, 266 dollars/hectare and 13 days workless, respectively. Furthermore, there was an increase of the biological activity and efficient use of irrigation water.

Short-term green manure legume cover crops and maize rotation system effects on selected soil properties in a Rhodic Ferralsol

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The integration of green manure legumes as cover crops into sole maize-based cropping systems has the potential to improve soil physical and chemical properties, and hence soil fertility and crop yield. Effects of a two-year green manure legumes cover crops (GMLCC) and maize rotation system on selected soil physical and chemical properties were determined in a Rhodic Ferralsol. The rotation system consisted of three GMLCC, viz. mucuna (*Mucuna pruriens*), lablab (*Lablab purpureus*) and sunhemp (*Crotalaria juncea*), and a fallow plot, followed by maize for two seasons (2007/8 and 2008/9 seasons). At the end of the two seasons, selected soil physical and chemical properties were determined. The water stable aggregates was least (62%) in fallow and highest (76 %) in sunhemp plots in the 0-10 cm depth. In the 10-20 cm depth, the water stable aggregates was least (64%) in fallow and highest (70%) in lablab plots. Cumulative infiltration was 21.7% in lablab, 31.6% in mucuna and 25.3% in sunhemp plots more relative to the fallow plots. The cumulative infiltration in mucuna plots was significantly ($p < 0.05$) more than the fallow control. There were no significant differences ($p < 0.05$) in soil pH and available P among the GMLCC treatments. Total N and organic C contents in sunhemp plots were significantly high ($p < 0.05$) relative to the fallow treatment. These results demonstrate the potential for green manure legumes to improve soil properties, with sunhemp as the green manure legume with greater potential to improve soil properties.

Improving the resilience of sandy soils to pressures

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Sandy soils are important in terms of global food production and therefore food security. Their global distribution is not restricted by climate or geographical location. In many areas, sandy soils represent a significant proportion of land being cultivated. However, sandy soils can be problematic due to their inherent physical, chemical and biological properties. The interaction between these properties can result in soils that are low in water and nutrient holding capacity, are prone to leaching (which can result in both water and economic losses, as well as contamination of groundwater), have high decomposition of organic matter and reduced microbial biomass. In the face of climate change and current legislation on water use restrictions in agriculture, farmers cultivating sandy soils are likely to be particularly affected.

To improve the resilience of sandy soils to these pressures, a PhD project was initiated. A pilot laboratory column leaching experiment was conducted at the University of Warwick, United Kingdom, to examine the potential of combined applications of clay and organic matter on water and nutrient retention using a pure sand and a sandy loam (65% sand). Two clay soil amendments (Clay 1 and Clay 2) of varying properties were applied at a rate of 2.5% and 5% (w/w). The organic matter amendment (OM) was applied at 10, 20, and 30% (v/v) of the pure sand or sandy loam. Acrylic tubes (50 cm high and 12 cm wide) were used for the column experiment. Water and nutrient retention was simulated by introducing two litres of a nutrient solution (ammonium nitrate at 150 kg/N/ha in RO water) into the dry sand / soil, then allowed to drain under gravity for 24 hours.

Significant differences were found among the treatments for both water and nutrient retention. Water retention increased with the rate of each amendment applied, except for the sandy loam amended with 2.5% Clay 1. The increase was approximately linear except (possibly) above 2.5% clay in the 30% OM treatment and 2.5% Clay 1 for the sandy loam. Weight for weight, Clay 1 was less effective in increasing water retention than Clay 2. Sole application of OM was less effective than either of the clay treatments on a percentage amendment basis. OM-clay combinations were more effective than either OM or clay alone at the same rate in improving water retention with the exception of soil amended with 10% OM and 2.5% Clay 1. This work shows that water retention of up to 300 thousand litres / ha is possible in an amended soil. For nutrient retention, in both sand and soil, the amendments reduced nitrate and ammonium nitrogen losses compared to the un-amended treatment. The results demonstrate that amending soils with both clay and organic matter has great potential to improve the water and nutrient retention of sandy soils.

Organic Fruit Production Potantial of Sivashl District (Uşak)

(Not presented on the Conference)

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Sivasli is a town which is located in the inner part of the Aegean Region of Western Anatolia in the province of Uşak, has a surface area of approximately 486 km². The south-east of Usak and Usak Denizli State Highway 35 kilometers, was founded in the foothills Bulkaz. County northwest of the town of Usak, Banaz north, east boxes, located in the south and the southwest Karahallı Civril counties. Today, in developed countries as well as in developing countries, especially Turkey awareness on issues such as the environment and human health has started to increase gradually. Therefore, the growing organic products in our country as well as in the world and is therefore a growing demand for agriculture. In this study it aimed to reveal the district of Sivasli organic fruit farming potential.

Conservation agriculture influences yield sustainability and carbon sequestration in the western Indo-Gangetic Plains: Sensor-based nitrogen and integrated weed management strategies

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Weed interference due to the avoidance of tillage and nitrogen immobilisation owing to the slow decomposition of surface crop residues are major trade-offs in conservation agriculture system particularly in the transition periods (1–3 years) from conventional system. The inclusion of weed and N management as a fourth principle in conservation agriculture is gaining momentum, hence the integration of weed management measures and complementary soil test and GreenSeeker (plant sensor) strategy can reduce weed pressure and enhance N availability. We investigated weed and nitrogen management effects on soil organic carbon and crop productivity in a conservation agriculture based maize–wheat system in the western Indo-Gangetic Plains. Three weed treatments: weedy check (control), brown manuring (*Sesbania* cover cropping killed at 25 days after sowing), and herbicide combinations in the mainplot; and four nitrogen levels: 100% basal (whole application), 50% basal + 25% broadcast at 25 days after sowing + rest N by GreenSeeker, 50% basal + rest N by GreenSeeker, and 80% basal + rest N by GreenSeeker in the subplot. Our ‘best optimised’ GreenSeeker–N rate (50% basal + 25% broadcast at 25 days after sowing + rest N by GreenSeeker) increased maize and wheat grain yields (mean of two years) by 20 and 14% higher, respectively, over the whole N (100% basal) application at sowing, while the soil organic carbon pools was 4% higher after two years of cropping. The integration of brown manuring in maize and the herbicide combinations in wheat resulted in 3% higher soil organic carbon stocks, over the herbicide combinations alone, while the mean grain yields of maize was 10% higher in the brown manuring and the herbicide combination, respectively, over the weedy check; and that of wheat grain yield increased by 10 and 20% in the pre- and post-emergent herbicide combinations, respectively, over the weedy check. Here we demonstrate that synchronous N fertilisation based on optimised N rate and GreenSeeker-guided N supplementation to match crops demand enhance and sustain yield with greater soil carbon input. The synergistic effects of brown manuring and herbicide combination suppress weeds resulting in higher crop and soil productivity.

Effects of Climate Changes on Productivity in Animal Production

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The world has been face to face with global warming and climate changes as a result of the massive use of technology and chemicals in agriculture and animal husbandry for the last century to fulfil the food needs which bring about industrialization and growth in population. Heat stress based on the global warming results with direct effects as decrease in feed consumption and live weight, low pregnancy ratio, a decrease in egg production and deterioration in egg quality in farm animals, and also indirect effects as decline in feed crops due to drought, water scarcity, and pathogens. Climate change will directly affect the animal husbandry across the world, and in the following years it will cause an increase in demand for animal products. In response to the increasing of demand for animal products, decreasing of water supplies lead to a limitation in usage of water in agriculture and subsequently causes a danger for food security. Food and water security will be a priority for humanity in the 21st Century. Avoiding the possible effects of climatic changes in future depends on knowing the interaction of the components, and creating a strategy for the sustainable agriculture and global food security.

Qualitative assessments of resistant main-crop potato varieties on Hungarian organic farms

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The breeding of potato varieties in Hungary is performed currently solely under conventional agricultural practices. Therefore organic growers have no data about the potential of new potato varieties under organic conditions, including the quantity of marketable tubers, i.e. tubers without major quality disorders. In order to provide such information in 2012 we initiated a participatory-research program for testing different resistant potato varieties under organic conditions on certified organic farms. 2012-2015 thirteen main-crop varieties were tested by volunteering organic producers. Participants planted their tubers every year during April. The minimum size of the test plots was 12 m² for each variety. No repetition of plots was conducted on the single farms; however, each production site was handled in the data analysis as a repetition. At harvest, samples of 50 tubers were taken from each test plot. We conducted a visual inspection of the tubers' surface and recorded infection by *Streptomyces*, *Rhizoctonia*, *Fusarium*, *Erwinia*; severe damage by animals and machines. We also recorded deformed and greened tubers. Results of the qualitative assessments show that *Streptomyces* infection is generally the most frequent qualitative problem in Hungarian organic potato production. The second largest quality disorder is the damage by animals (including *Agriotes* larvae); the third is the infection of *Rhizoctonia*. All together, among red-peel varieties *Démon*, among yellow-peel varieties *Hópehely* showed highest resistance to examined infections. The results indicate which elements of the production technology should be changed by the participant farmers to reach better quality produce: the infection of *Streptomyces* and *Rhizoctonia* could be reduced with the selection of tubers before planting, applying a broad crop-rotation, conducting proper irrigation, avoiding the use of immature manure, applying varieties that show resistance also under organic conditions. The on-farm program is still running, after the selection of best performing varieties the interest of farmers turned towards appropriate fertilization. The achievements and results of the program underline the importance of practice-oriented participatory research networks.

Biochemical indexes of soil quality in olive and peach orchards managed in a sustainable way

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In the recent years, soils has been recognized to play a double role in the entire agro-ecosystem: it is important for a good production as well as for a healthy environment. In conventional agriculture, adopted by the majority of the farmers, frequent soil tillage strongly reduces the complexity and diversity of soil microbiota. For this reason, the conventional, non-sustainable, agronomic practices should evolve in a more sustainable management addressed to ameliorate the ecological networks and nutrient cycling in which soil microorganisms are involved. In this scenario, the selection of biological and biochemical indicators closely correlated with the total carbon (C) and/or total nitrogen (N) soil contents is of key importance for the quantification of soil quality and its resilience to stresses.

The main objective of this study was to analyze soil quality parameters in an olive and peach orchard, both managed under sustainable agricultural practices. In the olive orchard, plants were drip irrigated by urban wastewater, soil was not tilled and covered by spontaneous plants, and pruning material was used ad mulch. The peach orchard was managed according to EU Reg. 834/07 "Organic agriculture", including the use of compost and drip irrigation. Three soil sampling for biochemical analyses were performed during one year. For each orchard, two sampling areas were identified: row (under the emitters) and inter-row (rain-fed). The degree of soil quality has been expressed by the ratio Nc/Nk, where Nk is Kjeldahl total soil nitrogen, while Nc is a linear function of microbial biomass carbon and nitrogen mineralization capacity combined with three enzyme activities (phosphomonoesterase, β -glucosidase and urease).

The ratio Nc/Nk exhibited all the attributes of a good soil fertility indicator, showing significant differences in the different areas of each orchard (row and inter-row). Seasonal, inter-site and intra-site variation of Nc/Nk is discussed, with a particular emphasis on nitrogen soil dynamics (fixation, mineralization, immobilization, organication, nitrification and denitrification). Soil physicochemical parameters and the expression levels of some bacterial genes involved in nitrogen soil metabolism (nitrogenase, nif H; ammonia monooxygenase, amoA; nitrite reductase, nirK and nirS; and nitrous oxide reductase, nosZ) were also determined. Results revealed that sustainable soil management practices increased both soil quality and plant nutritional status.

The increase of knowledge on biochemical processes of the soil microorganism involved in C and N dynamics, that influence their availability for plants, will lead to optimize management strategies for a modern and multifunctional concept of agriculture, based on product quality, environmental protection, resource saving and promotion of human health.

Determinaion of weeds spatial distribution in corn field using geostatistics

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A field experiment was conducted to investigate the spatial distribution of weeds in corn field at the Sari Agricultural Sciences and Natural Resources University in 2011. Field was divided into 42 grids (1.5×1.5 feet) then all samples were taken from grids intersection points before corn planting, after harvesting and ear emergence stage by square (50cm×50cm) and rectangle (25cm×100cm) quadrates. Kriging and semivariograms were used to estimate weed densities at unsampled locations of the field by Gs+ software (Version 7.0). All data were transferred to the Rock Work 99 software to draw maps of weed seed and seedling distribution. Relationships between emerged weed community and soil seed bank for each quadrate were determined by SPSS software (IBM Corporation, 1 New Orchard Road, Armonk, New York) and finally in each case, the weed data were fitted to the best equation. The results showed that the highest amount of weed population belongs to prostrate pigweed (*Amaranthus blitoides* S. Watson) followed by nutsedge (*Cyperus* spp.) and redroot pigweed (*Amaranthus retroflexus* L.). There was a strong and moderate spatial correlation as spherical and exponential variograms model at all stages of sampling. Regression coefficient (R²) between weed seed bank and prostrate pigweed population in rectangle and square quadrates were 0.75 and 0.69, respectively. These coefficients for nutsedge and redroot pigweed seed and seedling in rectangle quadrate were 0.95 and 0.74, respectively, whereas regression coefficients in square quadrate were 0.36 and 0.63. The results of the present study showed that quadrate shape is very important to study weed seed bank and its relationship with seedling populations in corn field and also rectangle quadrate is superior as compared to the square quadrate. Generally, the seed banks were patches with different sizes and densities. Since, seed bank patchy pattern at the beginning of season was in accordance with seed bank at the end of season, knowing the seed bank density is important to forecast weed seedling density during crop growing season.

The Effects of Organic Growing on Yield and Some Pomological Characteristics in Organic Apricot Cultivation

(Not presented on the Conference)

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This study was conducted to determine the yield and some pomological characteristics of organic apricot growing. Organically grown Alyanak and Hasanbey apricot cultivars were used in this study. This research was carried out in Isparta/Turkey. Organic apricot production was 4102.34 tons in 2014 in Turkey. However, organic apricot production was 94798.00 tons in 2013. Therefore, there was a great reduction in organic apricot production. The reason for this reduction is that organic apricot growing is more difficult compared to other species. Thus, the fights against to especially fungal and bacterial diseases are very troublesome in organic apricot cultivation. The certified organic pesticides which may be used for these aims are very limited. As a result of these, the other problems faced by producers of organic apricot, products are not purchased by traders due to the relatively low quality organic apricots because of ineffective fight against the disease compared to the quality conventional product. Even if the products are purchased by traders, the same prices are paid while organic apricot prices should be higher than conventional products. For these reasons, organic apricot growers were return to conventional production quickly in Turkey. Organic apricot producers should be encouraged to solve this problem by giving some incentives and marketing loss to the producers should be prevented.

Organic apricots production in Isparta where this study conducted has fallen slightly from 1645.84 ton in 2014 to 1586.74 ton in 2013 despite the rapid decline in Turkey in general. In this research, pomological characteristics as fruit size, fruit height, fruit weight, dry matter, pH, soluble solid content, titrable acidity and yield values were determined. Total phenolic and antioxidant activity were also determined. Hasanbey cultivar had higher yield value (69.80 kg / tree) than Alyanak (60.78 kg/tree) cultivar. At the same time the total phenolic content of Hasanbey (305.94 mg GAE/100g) variety was determined to be higher than Alyanak (172.84 mg GAE/100g). Antioxidant activity of Alyanak and Hasanbey were determined as 32.37 mg/ml IC50 and 17.09 mg/ml IC50 respectively. There was not any big problem in terms of the fight against diseases in this study. It is believed that this can be associated with mountain climate characteristics of the study region. Therefore, the evaluation of the regions with the mountain climate for the development of organic apricot cultivation would be more appropriate. However, the fight against disease in organic apricot cultivation in the mountain climate conditions should be investigated with scientific researches. In terms of the observed characteristics, Hasanbey cultivar was come into prominence compared to Alyanak apricot variety in Isparta ecological conditions.

Ten years of experiences in disseminating sod seeding in rural areas of southern Italy

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In 2005, in the frame of a project funded by the Italian Ministry of Work, a rural animation activity was initiated in a marginal rural area of Southern Italy (Benevento Province, Campania Region) characterized by the presence of small, family run farms. The activity aimed at proposing the practice of sod seeding as a way to reduce cultivation costs and soil erosion in hilly areas.

Farmers, although aware of the existence of sod seeding, pointed out the lack of support from extension services and farmers' organizations in disseminating information, and in supporting demonstrative experiments.

Frontal lectures proved to be of little utility, but helped to raise attention about the topic, showing the large experimental work already performed by different Institutions, and the abundance of experimental results. Subsequently, some demonstrative fields were set up, and "farmer to farmer" learning started, being based largely on non-verbal mutual understanding. Contacts were also fostered between local farmers and farmers from other parts of the world, already using sod seeding, through some study tours. Empowerment was further stimulated by the creation of an association of farmers (AIPAS), aiming to disseminate information and to promote sod seeding, being run directly by farmers.

In the frame of the EU VII Framework project "Carboschool+", experimental fields were set up in the local technical school for agriculture, in which farmers supported teachers in the preparation of the plots and in the discussion of results. Given the topic of the EU project, the relevance of sod seeding in increasing soil carbon content and reducing erosion was stressed.

The talk will report the activities carried out, taking in account the developments in local agriculture that took place in the last ten years, such as the growth of sod seeding practices, the empowerment of farmers, the growth of AIPAS.

Energy and economic evaluation of spring wheat production under contrasting tillage systems and nitrogen fertilisation management

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In response to increasing global demand for food, energy-use in agriculture has been intensified to maximise yields; minimise labour intensive practices or both. Moving towards a sustainable agriculture production requires, however, a more efficient energy-use which could provide financial savings, reduction of fossil resources use and less air pollution. Field experiments were established from 2013 to 2014 at the Royal Agricultural University's Harnhill' Manor Farm, Cirencester, UK, to investigate energy input and outputs per hectare, and make cost and economic consideration of the adoption of contrasting tillage systems, including conventional plough-based tillage (CT), high intensity non-inversion tillage (HINiT) and low intensity non-inversion tillage (LINiT), at various nitrogen (N) fertilisation rates (0, 70, 140 and 210 kg N ha⁻¹) on spring wheat production. Results showed that energy and economic performances of the different agricultural management practices used were dependent on weather conditions affecting grain yield and protein content. Regardless of high input energy and production costs, CT can potentially be efficient in the energy-use and economically viable. However, LINiT increased productivity and economic returns when higher yields were produced. HINiT resulted in poorer grain yield compared to CT and higher production and energy consumption than LINiT resulting in less energy efficiency and lower economic return. N fertilisation was not always energy-efficient and economically viable, even when higher final yields were produced, mainly due to high energy-use and costs of production. When considering low energy consumption and production costs, this study concludes that LINiT is the most reliable alternative to Conventional plough-based Tillage, while N fertilisation can be justified when yield and, grain quality and value are searched.

Sustainability assessment of land use change for biofuel production using agent based modeling

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Sustainable development will only be possible if society is able to successfully transition to energy sources that avoid causing irreparable ecological harm, such as climate change. Second-generation biofuels from woody biomass offer an important energy alternative to traditional fossil fuels that can greatly reduce our carbon footprint. Second-generation biofuels can also avoid the unintended consequences of first-generation biofuels, such as cellulosic ethanol, that have been known to cause increased food insecurity due to heightened competition for edible crops (maize/corn) necessary for the fuel production process. However, despite their great potential, the true sustainability of second-generation biofuels is not fully understood. The proposed paper presents a framework for assessing second-generation biofuel sustainability using landowner surveys, land-cover Geographic Information Systems (GIS) data, and Agent-Based Modeling (ABM). The ABM simulation approach makes it possible to test non-linear hypotheses intended to explain system-level phenomena that emerge from the feedback among two or more complex sub-systems. In this paper, the emergent phenomenon of interest is the sustainability of land-use change patterns that result from actors converting land to biofuel feedstock production sites. The sub-system feedbacks driving this change (toward or away from sustainability) stem from the interactions of socially adaptive land-use decision-makers participating in a market for biofuel feedstocks. One critical social driver of sustainability in this context includes neighbors adopting similar land-use practices that cause land-change clustering effects at the landscape scale. This type of clustering can be an important indicator of unsustainable landscape effects in the form of wide-scale habitat disconnectivity. Another important social driver is the adaptation of land-use decision-makers responding to price changes in the market for biofuel feedstocks. These changes often have a temporal clustering effect that encourages actors to over/undersupply feedstocks due to delays in the pricing signal, which is typically tied to the regrowth and regeneration cycles of differing available feedstock species. The proposed paper demonstrates how to explore such complex dynamics in an experimental fashion that permits researchers to isolate the effects of a single or series of controlled parameter modifications as a means to assessing sustainability. The paper outlines the necessary data requirements, simulation design features, and experimentation procedures necessary to conduct such an investigation. Finally, the paper explains how the ABM simulation environment can be used for general-purpose assessment needs beyond those specifically investigated in the current research.

Salt-affected and acid soil amelioration with desulfurization gypsum and waste concrete in China

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In arid and semiarid regions of China, the decrease in agricultural production due to excessive salts is a very serious problem. In addition, acid soil distributes mainly at south part of China. On the other hand, environmental and health problems due to sulfur dioxide (SO₂) emissions have become a serious problem in China. Moreover, the accelerating urbanization has generated a huge amount of construction and demolition wastes. The need for the recycling and reuse of both desulfurization waste and waste concrete is very urgent and necessary. Therefore, we have investigated the effectiveness as degraded soil amendments of both flue gas desulfurization gypsum and waste concrete.

In this paper, sodic soil (SS 1) in Yinchuan (pH=10.4, EC=2.4dSm⁻¹, ESP=56.4%), acid soil (AS 1) in Nanjing (pH=6.0, EC=1.6dSm⁻¹) and acid soil (AS 2) in Guangzhou (pH=4.1, EC=0.2dSm⁻¹) were used in soil amelioration test. As soil amendments, waste cement fine powders (CFP) ($\leq 200\mu\text{m}$ (particle diameter)), waste concrete particles (WCP) ($\leq 4.75\text{mm}$ ($\leq 0.6\text{mm}$, 0.6-1.0mm, 1.0-2.0mm, 2.0-4.75mm)), and wet (W-FGDG) and semi-dry FGD gypsum (SD-FGDG) were examined. In SS 1 amelioration test, the CFP and various WCPs based on both 0.5wt% application rate of W-FGDG and 1.0wt% application rate of SD-FGDG were added to soil. The application rates were 0, 0.05, 0.10, 0.20wt% in AS 1 test and 0, 0.5, 1.0, 2.0wt% in AS 2 test, respectively. Soil properties (pH, EC, exchangeable Na, soluble ions (Na, Ca, Mg, K)) before and after mixing with soil amendments were measured. The pH, EC, and solution cations were measured using 1:5 water extracts. The CEC was determined using 1 N NaOAc at pH 8.2. In acid soil test only, Al toxicity and the balance of salts (CaO, K₂O, MgO) in soil was evaluated.

As a result, changes in pH, EC, Ca, Na, Mg, K concentration of all soil amendment solutions indicated that their parameters take the larger numerical value in the smaller size of particle diameter. The order of Ca concentration that is effective for sodic soil amelioration was SD-FGDG>W-FGDG>WCP>CFP. In SS1 amelioration experiment, all sodic soils decreased drastically in EC and ESP, and soil pH decreased gradually after three and six weeks. Consequently, the smaller WCP could ameliorate at a smaller amount of application rate. In AS 1 and AS 2 amelioration test, the pH and EC increased slightly with the increase of application rate and reached to the appropriate value range of both pH and EC. In case of pH in AS 2, the appropriate application rate of SD-FGDG, WCP(< 0.6mm) and WCP(2.0-4.75mm) were 0.5wt%, from 1.0wt% to 1.5wt% and $\geq 2.0\text{wt}\%$, respectively. Moreover, EC and the balance of salts in soil amelioration tests indicated the increase of the application rate and/or chemical fertilizer. Lastly, the exchangeable Al concentration decreased drastically with the increase in pH due to soil amendments. Thus we can propose a new salt-affected and acid soil amelioration method using FGDG and WCP in China.

Climate change adaptation – a qualitative survey among farmers in North-East Germany

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Climate change in the Northern-Eastern parts of Germany is expected to cause an increase in average annual temperatures, shifts in seasonality of precipitation (decreased in summer, increased in winter), accompanied by shifts in potential evaporation. Up to now, climate change is not yet directly effecting farmers' behaviour, but climate change is the topic of the general debate and topic of ongoing research projects.

In a case study with two networks of farmers (organic, conventional) the potential adaptation strategies were gathered through farmer interviews and discussed during a actors workshop. Some adaptation strategies are well known among farmers and their effects are accepted. However, the need for change is still not perceived by most farmers.

The following strategies were further discussed and evaluated during the workshop with the criteria "relevance" and "feasibility": reduced tillage, inter cropping, crop diversification (soy beans, winter peas, white lupins), irrigation, more flexible timing of drilling, mixed cropping.

As an outcome of the evaluation, reduced tillage, intercropping and crop diversification were identified as the main adaptation strategies, while irrigation, timing of drilling and mixed cropping were considered less relevant or feasible.

Although reduced tillage has been adopted by many farmers, they still believe that only ploughing can help to cure some extreme problems. Farmers are experimenting with different forms of reduced and no till measures (strip-tillage, mulch seeding after knife roller). At the moment, even convinced no-till-farmers are returning back to optional ploughing, as a measure to control weeds or soil structure problems (high vulnerability to soil compaction due to soil texture). Inter cropping is considered a well appreciated measure for both conventional and organic farmers for its advantages (soil cover, catch crop, erosion control). However, both groups know of the difficulties of establishing an intercrop due to water deficits in the growing seasons (competition to cash crops). Crop diversification is suitable for conventional and organic farmers, if new cultivars could deliver stable yields and achieve promising market prices. None of the farmers practices Conservation Agriculture per se, but several elements of CA are included.

Regional crops are not very suitable for irrigation, but irrigation is strongly discussed and some farmers do invest in it, but the mainstream is still hesitant to invest in this system. Farmers are aware of the positive effects of a more flexible timing of drilling, but see themselves restricted by workload and management. Mixed cropping systems are still seen as being risky and difficult to implement.

The qualitative survey among farmers helped to shortlist specific strategies and to highlight drivers and barriers to adaptation. Further research can focus on the removal of obstacles on the level of both agronomy and attitudes.

Territories and terroir, for a diversity of agriculture in Algeria

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Today, we are experiencing deeply the need to rooting in places that speak to us of life, of genuine, local conditions and traditions. The taste of the terroir is part of a normal evolution of all societies today, where the myth of technical progress loses its luster. Tradition is not exceeded, it instead provides pins needed to build the future.

In this context, this work is to highlight two complementary subjects: the first is to explain and describe the concept of terroir in its territorial context; while the second consists of the presentation of some regional products of Algeria, their gastronomic specificity, local roots and their cultural and historical dimension as well as the knowledge and know how for their production.

Organic farming in Algeria: state and perspectives of development project

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The Standard Algerian agriculture suffers from a sustainably competitive and low integration with external markets. Traditional policies and successive agricultural development plans produced only meager results in terms of potential and needs of the country. Faced with such a finding, organic farming can be an interesting alternative to develop local resources, especially as the global marketplace continues to grow, to face the food crisis. Sustainability, profitability of agriculture and proximity to growth markets (Europe) are also factors favorable to the development of this agricultural model in Algeria.

This work tries to answer the question of the current state of the agricultural sector, its potential and prospects for his development in Algeria.

Soil Conditioning Index in conventional and conservation maize cropping

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The Soil Conditioning Index (SCI) is a tool for soil organic matter (SOM) prediction based on crops, climate, tillage, erosion and SOM decomposition. It consisted of the 3 components: (1) the amount of organic material returned to the soil, (2) the effects of tillage and field operations on SOM decomposition, and (3) effects of erosion coupled with the management system. The assumption is that negative rating would indicate SOM depletion, a zero would mean steady state and a positive number would mean an increase in SOM. To evaluate SCI data was acquired from the long-term experiment at the Rimski Šančevi experimental station of the Institute of Field and Vegetable crops. Our investigation was performed on a Haplic Chernozem (CHha) on loess parent material, loamy textured, calcareous, with neutral pH reaction. The data on climatic characteristics indicate semiarid conditions with a precipitation sum of 628 mm and average year temperature of 11.6 °C. The management systems that we analyzed were as followed: maize monoculture, 2-year rotation and 3-year rotation in conventional (moldboard) tillage versus projected conservation tillage change (chisel and direct sowing). Fertilization for phosphorus and potassium was based on soil analyses whereas N was added at rate of 120 kg ha⁻¹ and crop residue were incorporated each year. Evaluation of the conventional maize-based cropping systems resulted with negative SCI. The maize monoculture showed lowest SCI -0.42, the 3-year rotation had -0.30 and the 2-year rotation -0.24. In the projection based on chisel tillage negative scores were also observed that suggested less SOM decrease compared with the moldboard plowing. In the maize monoculture SCI was -0.11, at the 2-year crop rotation -0.04 and at the 3-year rotation -0.06. Assessment of direct sowing management demonstrated negative SCI values in the maize monoculture -0.04 and at the 2-year rotation -0.02. Conversely the 3-year maize rotation showed positive SCI values that indicated less soil disturbance and steady or improved SOM conditions. This study showed that only with conservation tillage in a multiyear rotation with legumes and addition of external C (ie. manure) can positively impact SOM. Obtained result could contribute to the understanding of SOM change in Chernozem related to the cropping management and could help in improvement of management practices toward SOM preservation.

A tool on agricultural runoff and best management practice to support farm managers prevent soil degradation in field crops

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The world is reported to be in an agricultural crisis. The projected population increase by 2050 demands at least a 60% increase in food production (Ray et al. 2012) and resources to produce food are becoming limited, including in Europe (FAO 2015). One of the major challenges is to keep our soils healthy and fertile and prevent further degradation of cropland. Worldwide 40% of total farmland is degraded to some extent (UNCCD 2015). To address this challenge, it is important that farm managers understand the cause of degradation in soil health and take the corrective measures not only to comply with EU legislation (e.g. the Sustainable Use Directive and the Water Framework Directive) but also to improve their own farm businesses.

The Agricultural Runoff & Best Management Practice Tool developed by Syngenta is an interactive tool for farmers and advisors¹. The tool can be used at field and catchment levels to assess runoff potential and based on this, draft farm or catchment specific mitigation plans. The tool has four field diagnosis steps to complete before the mitigation plan can be drafted. Each diagnosis step will give you a score. The first step is an assessment of key landscape factors, i.e. the average slope and soil permeability characteristics. The second step is a further refinement of the diagnosis based on the distance of the field or farm from surface water and visible signs of runoff and erosion. The third step is a review of soil, crop and water management related factors that could either increase, or decrease the runoff potential, e.g. slope length, slope patterns, soil cover, rooting and cropping system, irrigation patterns, etc. The final step of the diagnosis is to add all scores obtained from the previous steps and determine the runoff potential class, which then directs to recommended Best Management Practices (BMPs) framework that requires refinement according to the local situation. Farm advisers could help with drafting the mitigation plan. For the diagnosis at catchment level, there are two additional steps, namely to review the patterns and hotspots for runoff potential at catchment level and to agree the mitigation plan with relevant stakeholders in the catchment for its implementation.

The Runoff Tool needs testing in different regions and crops to create a number of use scenarios with regional as well as crop specific advice on BMPs. Last year the tool has been tested in Sicilian vineyards and this year also in arable crops in Hungary. This paper presents the results of the field study performed in Hungary reviewing both the practical use of the tool and the recommended BMPs. The Hungarian fieldwork added another dimension to the overall study, namely the use maps and high resolution pictures, to diagnose runoff potentials and erosion from cropped lands. The Runoff Tool is compared with other existing tools that support farm level decision-making meant to improve soil health and fertility and prevent erosion.

¹The European Crop Protection Association and its partners (which includes Syngenta) in the TOPPS-prowadis project have harmonized the general approach to Best Management Practice of agricultural runoff. The Agricultural Runoff and Best Management Practice Tool is aligned with this general approach.

Microorganisms of agronomic importance in soils managed with sustainable practices

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In conventional fruit growing, adopted by the majority of the farmers, frequent soil tillage strongly reduces the complexity and diversity of soil microbiota. For this reason, the conventional, non-sustainable, agronomic practices should evolve in a more sustainable management (e.g., grass cover, pruning residues recycling, organic matter inputs, etc.) addressed to ameliorate the ecological networks in which soil microorganisms are involved. A better understanding of soil microbial communities can lead to identify agricultural management practices that stimulate and select specific soil microorganisms having beneficial purposes in agriculture, such those involved in the biogeochemical cycles or with antagonistic effects against plant pathogens. The trials (approximately 20 years) were carried out in different experimental orchards (olive, peach, apricot, kiwifruit and grapevine) located in Basilicata Region (Southern Italy) and managed according to two different soil management systems: the sustainable treatment (ST) and the conventional, non-sustainable, treatment (CT). Soil microbiological quality in the two systems was continuously monitored by microscopic, cultural-dependent and molecular microbiological methods. In the sustainable orchards, soil microbiota always showed a higher complexity and metabolic diversity. The medium-term adoption of ‘innovative’, sustainable, agricultural practices caused positive effects on soil microbiota and its biodiversity, that in turn can significantly influence soil fertility and plant growth by increasing nutrients availability/turnover and contrast plant pathogens. The role of some of the identified microorganisms of agricultural relevance in the soil microbial network is discussed. The results of our studies encourage the use of sustainable agricultural practices able to enhance soil microbiological fertility. The practical goal is to convince farmers to adopt a sustainable farming system as a whole, not just as individual elements, in order to promote good-quality fruit production without negative effects on the environment.

Management Practices Under Heat Stress Conditions in Farm Animals

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Increasing of world population and nutrition requirements by quality nutrients engenders an increment of the amount and quality of the animal origin food which have an important role among the food resources. At this point, improving of housing conditions and regulating of environmental conditions have critical importance in order to maximize profitability in animal production. One of the most important environmental factors which decrease the productivity in animal husbandry is the heat stress. The body temperature, respiration ratio, and other vital indicators are affected under heat stress conditions. The changes of these features affect the feed intake and water consumption, so it result with weakening of immune system, recession in growth and development, failure in fecundation, metabolic disorders, and it finally decreases animal performance. It must not be ignored that the desired productivity in animal production should be achieved under optimum environmental conditions, and it must not be forgotten that issues about the flock management have critical importance under heat stress conditions.

Research on regenerative agriculture at the Geographical Institute, Hungarian Academy of Sciences

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Arable land is not only the area of production, but also the habitat of many wild plant and animal species. In Hungary, 48.5 % of the land is under agricultural crop production and it is important to consider these areas also as habitats. On arable land intensive soil management can lead to severe soil erosion and loss of biodiversity. Conservation tillage is a sustainable farming practice; its main advantages are the protection against water and wind erosion, preservation of soil structure, retention of soil moisture, increase of soil organic matter and protection of soil life.

In 2003 an experimental site was established in western Hungary in order to investigate the effects of regenerative agriculture. For soil erosion monitoring 4 plots were installed at Szentgyörgyvár next to each others (2 conventionally tilled, 2 conservation tilled), each 50 × 24 m in size. Ploughing cultivation was applied on the conventionally tilled plots. On the conservation tilled plots a non-inversion shallow tillage was applied, where the residue cover was about 30% and the number of passes by combined machines was reduced. Since then runoff and soil loss has been measured continuously after each erosive precipitation event. By this time the various cultivation systems have have such significant impacts on the soil what can be measured. To quantify these differences a wide palette of methodology is being applied.

Solving the scale problem and to gain complex hydrological soil data a self developed, field scale (6 m²) rainfall simulator is applied as a replication of the plot measurements. Special emphasis is taken to carbon farming that means a monitoring of total organic carbon content of the soils, aggregates, soil losses and sediments. Moreover microbiological activity changes are estimated on the basis of respired carbon dioxide volume of the soils. Soil redistribution and net erosion is monitored using rare earth elements as tracers. However the analyses of the results as a whole are in progress preliminary results suggest that only thirteen years of cultivation shift can dramatically determine the processes in soils and result a much sustainable land use practice.

Assessment of the usefulness of substrate with sewage sludge and halloysite in tall wheatgrass cultivation on lands under remediation

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The study was conducted in order to assess the usefulness of halloysite $[Al_2Si_2O_5(OH)_4 \cdot (H_2O)]$ – a natural clay absorbent in stabilisation processes of heavy metals accumulated in sewage sludge intended for land remediation. The study was conducted in the form of pot experiments with the use of a test plant – tall wheatgrass (*Agropyron elongatum* L.). The study involved eight-week pot cultivation under controlled conditions. The study involved four variants with a different percentage of halloysite addition, i.e. 10%, 30%, 50% and 25%, respectively (with a 25% addition of light soil). A significant part of the substrate comprised of sewage sludge contaminated with heavy metals, which excluded the possibility of its direct use for remediation purposes. In order to compare the obtained results, two control cultivations were established, i.e. one comprising of sewage sludge and one comprising of sewage sludge with a light soil addition in a ratio of 1:1. The total content of heavy metals in the cultivation substrates and obtained biomass was determined by the method of atomic absorption spectroscopy (AAS) with the use of atomic absorption spectrometer after mineralisation in aqua regia. Moreover, the pH of soil substrates and such test plant's growth parameters were examined as the rate of seed germination and growth of biomass.

The study results indicated that the addition of halloysite modifies the level of sorption of heavy metals by contributing to the reduction or intensification of sorption of selected elements by the test plant. In order to use sewage sludge in land remediation, the variant with 30% addition of halloysite is recommended as it significantly reduced the level of sorption of heavy metals, especially copper and zinc. The test plant's seeds within this variant were also characterised by the most successful germination and biomass growth. Halloysite did not affect the pH soil substrates in any of the variants (the pH was either slightly acidic or neutral), but provided the test plant with optimal growth parameters as well as contributed to the success of seed germination and rate of growth of plants and biomass. The initial results of the study indicated that the addition of halloysite to substrates contaminated with heavy metals differentiates the level of their sorption according to its amount. They also create realistic and flexible possibilities of using such types of substrates for remediation purposes.

Continuous effects of winter flooding on soil fauna, as revealed by the community structure of soil nematodes in a rice paddy in Japan

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Winter flooding is an agricultural practice in which rice fields are flooded during the winter season after harvesting, and is practiced in several rice-cultivating area across the world. In Japan, it has been traditionally practiced to supply organic debris for plant nutrition with drainage water. Winter flooding also physically inhibits the establishment of weed germlings with a well-developed muddy layer (called the *toro-toro* layer in Japan), and allows the farmers to reduce herbicide applications. Winter flooding in rice paddies has been evaluated in recent studies on the basis of its significant role in the conservation of birds and other above-ground wildlife by providing alternative wetlands. However, there have been few studies on its role in the conservation of biodiversity in the soil. This study examined the effects of winter flooding on soil fauna as represented by nematodes. Soil samples were collected from experimental paddy fields at the Field Science Center, Tohoku University, northern Japan, over a period of one and a half years. The treatments applied to the experimental rice paddies were winter flooding with organic farming, no winter flooding with organic farming, and no winter flooding with conventional farming. NH_4^+ concentrations in soil were highest in winter-flooded fields, and lowest in conventional fields, although the difference gradually disappeared in the cropping season. Eh was lower in winter-flooded fields than in the others. In general, winter flooding altered the paddy soil environment to be more fertile and reductive. The nematode population density in the top 0–5-cm layer of the soil in the winter-flooded fields was higher than that in the conventional fields. By contrast, the 5–10-cm layer had a generally lower nematode population density than the top layer. Polymerase chain reaction–denaturing gradient gel electrophoresis analysis of the nematode 18S rRNA gene defined 34 operational taxonomic units with the three most dominant taxa, *Tobrilus* sp.1, *Tobrilus* sp.2, and *Hirschmanniella* sp. The nematode diversity of the winter-flooded fields was significantly lower in the 5–10-cm soil layer. The lower diversity was correlated with the dominance of *Tobrilus* sp.1 in the winter-flooded fields. This study is the first to demonstrate the alteration of the soil environment and nematode fauna by winter flooding, and suggests that nematodes could be a useful bio-indicator to assess the ecological risks to soil fauna in wetlands exposed to environmental stresses. Winter flooding in rice fields has generally been regarded as “environmentally friendly”. However, this study demonstrates that winter flooding could have detrimental effects on soil fauna and biodiversity. Further studies in various soil types and climate conditions are necessary. The functional relationships between nematodes and physical environments also need to be clarified to guide the ecological management of paddy fields as alternative wetlands.

Studies on control of smoothseed alfalfa dodder (*Cuscuta approximata* Bab.) in alfalfa (*Medicago sativa* L.)

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The aim of this study was to determine the most appropriate control methods with smoothseed alfalfa dodder (*Cuscuta approximata* Bab.) which caused problem in alfalfa (*Medicago sativa* L.) in Van, Turkey. For this purpose, the effect of imazethapyr and imazamox herbicides, their application times, and three cutting heights of alfalfa on controlling dodder were investigated. The study was planned in the split plot design with four replications, and trial was conducted in field conditions between 2010-2013 years. As a result, it was determined that preemergence application of imazethaphyr and pre- and post-emergence applications of imazamox suppress the dodder in the first year after applications, however this effect decreased in the following years. In 2013, a substantial decrease in the hay yield and raw protein ratio of alfalfa was defined. In addition, it was found that control of dodder was not significantly affected by different cutting heights.

Soil biogenity and productivity of strawberry as affected by different fertiliser type

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The paper presents the results of the research into the impact made by fertiliser type on the counts of different systematic and physiological groups of soil microorganisms, generative potential and production traits of the 'Clery' strawberry cultivar in the second and third years of fruiting (2012–2013). Two types of fertilisers were applied – chemical NPK fertilisers and microbiological fertilisers (B1 – biofertiliser 1, combination of bacteria of the genera *Azotobacter*, *Azospirillum*, *Bacillus* and *Pseudomonas* and B2 – biofertiliser 2, an inoculum obtained from the liquid culture of diazotrophic bacteria *Klebsiella planticola* TSHA-91).

Significantly higher numbers of azotobacter, ammonifiers and oligonitrophils were observed under biofertilisers treatment compared to the chemical fertiliser treatment and control in both years. During the period of investigation, significantly higher counts of fungi were obtained under chemical fertiliser and biofertiliser 1 treatment, while the chemical fertiliser application had a positive effect on number of actinomycetes only. A significantly higher total number of microorganisms during 2012 was observed in the chemical and biofertiliser 2 treatments compared to the biofertiliser 1 and control. On the other hand, the total counts of microorganisms in 2013 was significantly higher in the treatment with biofertiliser 1, compared to other fertiliser treatments under consideration, including the control. Higher generative potential and better production traits of cultivar 'Clery' were obtained in the second year of fruiting (2013). During 2012, the generative potential and fruit yield increased after chemical fertilisation, whereas in 2013 these parameters were positively affected not only by chemical fertiliser, but also by biofertiliser 1. Given the biological properties of the soil examined and the yield parameters, in order to improve the existing technology of strawberry production, a partial or full substitution of chemical with microbiological fertilisers can be recommended.

Complementary examinations to a field scale study on soil redistribution due to erosion using rare earth oxides as tracers

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Laboratory and field studies of soil erosion on arable lands have several decades of tradition, our knowledge on the right place of origin of eroded sediment is still limited resulting in gaps in controlling soil loss and its associated nutrient and pollutant transport, as well as in developing appropriate watershed management tools. Quest for spatially distributed erosion data has directed scientific interest to the development of tracing methods. Due to their advantageous characteristics, rare earth elements (REEs) have already been successfully used as multi-sediment tracers, but up to now under field conditions without gaining information on soil redistribution along the studied slope profile.

The primary goal of my research will be to investigate and track sediment redistribution along the slope in field scale, in a multi-year period. Data received from this experiment will help in a good understanding of the tracer redistribution along the tagged slope profile, which could be the key for reducing the uncertainty associated with the conversion of tracer concentrations into erosion rates.

At the beginning of the experiment a very important consideration was the selectivity in REE binding to soil aggregates of different sizes. For this reason REE analysis had to be carried out also on separated samples for different aggregate sizes. The laboratory experiment was carried out after the suggestions by Zhang et al. The present paper shows the results of this preliminary laboratory experiment of the starting field study.

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Determination of farmers' perception of the land consolidation projects carried out in Isparta-Turkey

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This study aims to examine to what extent the expectations of farms from the project were met, whether they were satisfied with the new parcel plans, and to what extent farmers' requests were fulfilled during the implementation of the project in those villages where land consolidation projects were implemented in Isparta, Turkey.

The information obtained with the questionnaire method from the 205 farms determined according to the method of stratified sampling in the Kuleönü, Gümüşgün, Güneykent, Çiçekpınar, and Bozanönü Villages, where consolidation projects were implemented in Isparta, constitutes the main material of the research. The farms concerned were examined in three groups depending on their land sizes. According to the research findings, the educational status of 62.96% of the farmers is at the primary school level. The vast majority of them are over the age of 50. 28.78% of the farms have 5 and more parcels.

According to the research results, of the farmers, 68.78% stated that they had been provided with adequate information before the project; 37.06% stated that land gradation was generally carried out accurately; 65.85% stated that they did not suffer from land consolidation; 90.69% stated that they were now able to use their small parcels, which they had not been able to use before consolidation; 92.90% stated that their land losses decreased; and 72.66% stated that they saved on labor after the project. However, especially the problems of failure to abide by the work plan at the indicated dates occurred in the implementation of the projects.

The role of companies in reducing water risks in food, beverage and agricultural supply chains

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Global fresh water supplies have become increasingly exposed to risk as a result of both growing demand, and pressures on supply, including those linked to climate change. Meanwhile, agriculture remains the heaviest user of fresh water supplies, responsible for approximately 70% of the world's fresh water consumption. Traditionally, businesses have focused on their direct water consumption, although many have failed to recognise the importance of understanding and managing risks throughout their supply chains. Companies who fail to manage supply chain water risks may see impacts on their performance such as increased input prices, disruptions in supply or reputation damage.

These risks are particularly relevant to companies in the food, beverage, apparel, retail and agricultural products sectors, who are the focus of this research and related collaborative engagement. Despite the risks, little is known about their extent and materiality. This stems from the complexity in agricultural supply chains, the localised and disperse nature of water risks and the limited availability of data, which prevent simple analysis of company exposure.

From a production standpoint, water is material to the bottom line of most individual farmers and companies. Fresh water ecosystem services represent unrealized assets for many companies. Business engagement beyond the fence line should not simply be a matter of corporate social responsibility (CSR) or public relations. There is an essential business case for achieving sustainable flows and access to clean water.

Corporate water stewardship means that companies seeking to improve the efficiency and cleanliness of their internal operations and in their supply chain, while also facilitating the sustainable management of shared freshwater resources through collaboration with other businesses, governments, NGOs, communities, farmers and others. One of the most important the shared values of companies and farmers is water. This is the reason why engaging farmers is one part of solving water related challenges for companies.

Fulvic and humic acids determination in different composts

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Every year Lithuania accumulated millions tons broad range of waste. Due to improper waste management there is a threat of infection in humans and animals. Waste separation, sorting, and processing of certain materials recycling or waste disposal carried secluded from its source locations. Composting biodegradable waste are one of the best solutions to revitalize soil vitality due to organic materials depletion in soil. Microorganisms break down animal residues and plant in the soil to form a stable dark brown organic material called humus. The main humus materials are fulvic and humic acids. Humic acids bind to the mineral part of the soil, forming organic-mineral compounds under suitable conditions accumulating in the soil. Humus materials has a protective and sanitary functions: promotes decomposition of pesticides, various toxic substances are sorbed and prevents them from entering the crop, and also provides the nitrogen, carbon and other organic substances. The aim of this work is to research fulvic and humic acids in different Lithuanian composts. The humic and fulvic acids were characterized and compared using chemical methods and spectroscopic techniques ultraviolet visible (UV-vis). In this work researched five types of compost - green waste (tree leaves, grass, branches) and food waste (food products with expired validity fruits, meat products, vegetables), sewage sludge (sewage sludge mixed with branches and straw), manure (livestock manure, peat), biogas production waste (digestate - obtained under anaerobic conditions by processing corn into bioethanol). The ratio of fulvic to humic acid is also significant; both together with carbohydrates are linearly related to the soil organic carbon. Cattle manure has the biggest amount of fulvic (1,57%) and humic (11,65%) acids. The lowest contents of fulvic (0,10%) and humic (0,26%) acids, but the biggest amount of organic matter (91,35%) is characterized biogas production waste.

Soil erosion and conservation agricultural systems research in South African smallholder farms

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There has been a flurry of scientific and developmental projects on conservation agriculture (CA) targeting smallholder farms in sub Saharan Africa. However, much of the research over-emphasize crop yield and economic benefits and less on the gains in soil productivity. Soil erosion immensely decreases soil productivity. In South Africa alone, 12.6 tons of fertile top-soil is lost annually from each cultivated ha against the world average, which is a third of this figure. The current review shows that soil erosion is often not the target objective. Soil erosion projects in South Africa continue to follow a dichotomous approach; mapping and zoning of degraded areas, and to a lesser extent studying the underlying mechanisms and processes. The review concludes that soil erosion research should be a preferred objective in future CA projects.

Early Hungarian Evaluation and Development of Direct Drilling (Conservation Agriculture) Systems for Wheat and Maize in 1982-1985

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The Hungarian Plant Protection and Agrochemistry Centre of the Ministry of Agriculture and Food conducted a programme from 1982 to 1985 for field scale evaluation of direct drilling/planting wheat and maize into uncultivated soils (DD) in Northern Hungary.

Earlier studies in the late 1960's by the 'Ministry of Agriculture and the UK company, Imperial Chemical Industries (ICI), concluded that, while DD was promising for pastures, there was widespread skepticism of its suitability for cereal crops. In 1982, a further three-year collaborative evaluation was begun on the farm "Alkotmány" at Bajna/Epöl, north east of Tatabánya in County Komárom. Under traditional, intensive cultivation systems the soils and topography of the area make it prone to erosion and soil degradation. Soils are chernozems and brown forest soils common in Central and South East Europe.

A project review after 3 years concluded that, in the case of DD winter wheat both yield and profitability were increased. Additional benefits were improved overwintering of seedlings and lower labour and fuel costs. The increased use and cost of pesticides, principally fungicides, was a disadvantage.

For maize the change to DD meant no deep ploughing in autumn or tillage in the spring. Maize stalks were left of the soil surface to mitigate the effects of water erosion and soil damage. The suspicion of soil compaction as a result of DD was shown to be unfounded. Erosion was controlled and soils remained in good condition due to increased populations of earthworms and general soil biological activity.

There were increased yields and net income, major savings in fuel, but there were difficulties with perennial weeds that required the use of herbicides. For control for mixed grass and broad-leaved weeds, paraquat mixtures were used pre-planting but where there were only broadleaved weeds, cheaper selective hormone products were effective. Weed control and residue management required further investigation, especially for maize.

The evaluation concluded that wheat and maize grown without cultivation (DD) were comparable to conventionally grown crops and offered a series of important economic and environmental benefits. The system was extended to a further 26 farms in 1986 but the continued adoption of DD was hampered by difficulties in importing specialist equipment.

The Effect of Organic Fertilizers on Maize Grown for Grain in Lithuania

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Organic fertilizers are a well-recognized source of essential plant nutrients; however, their effect on soil fertility and crop yield varies widely. Traditionally, maize is grown for silage in Lithuania, but a new focus on grain needs research efforts in order to reevaluate the use of organic fertilizers for this crop. The aim of the study was to investigate the effect of different organic fertilizers on yield formation of maize grown for grain. A field experiment was carried out in 2015 at the Lithuanian Research Centre for Agriculture and Forestry in Akademija, Central Lithuania. The soil is characterised as sandy loam, neutral in pH, relatively low in humus, medium in available potassium and phosphorus. An early maize variety AGIRAXX (FAO 190) was sown in May, at the 75 cm row spacing. The experimental design included 10 treatments arranged in four randomised blocks. Pelleted poultry and cattle manure, municipality green waste compost was applied at a rate equivalent to 170 kg ha⁻¹ of N or 80 kg ha⁻¹ with addition of 90 kg ha⁻¹ of N as ammonium nitrate (AN). In 2015, maize growing season lasted for 158 days. The weather conditions were rather specific - with low temperatures at the beginning and high temperatures at the end of the growing period, and with a low amount of precipitation in comparison to the standard climate normal. "Watermark" soil moisture meters indicated water deficit starting since week 8 until week 16 after planting. The calculations with a model "Cropwat" also confirmed the water shortage, which can be one of the reasons behind lower fertilizer efficiency. Periodical measurements of chlorophyll index and maize biomass yield showed significant differences among the treatments starting from stem elongation stage. At harvest, grain yield in the plots without fertilizers was relatively high – 7.11 t ha⁻¹; however, the efficiency of applied fertilizers was low. The effect of poultry manure on grain yield (+0.69 t ha⁻¹) was higher than that of cattle manure, but lower than that of commercial NPK fertilizers. Nevertheless the highest grain yield (8.83 t ha⁻¹) was obtained in the plots applied with pelleted poultry manure in combination with AN. The effect of municipality green waste compost was very low, but increased substantially when combined with AN. Thus, combining organic and mineral fertilizers can be a relevant measure to enhance the effect of organic fertilizers. Analyses of soil samples taken after maize harvesting showed relatively high amounts of nitrates (above 70 kg ha⁻¹ in a layer of 0-60 cm) in the treatments that had received 170 kg ha⁻¹ of N as AN or AN in combination with pelleted poultry manure. These findings suggest that the maximal level of nitrogen provided for in the "nitrate directive" can exceed maize requirements, especially in a droughty year, if applied in a readily available form, which can increase the risk of nitrate leaching from the soil and thus can contribute to the eutrophication of surface waters.



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