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1/2014

ESSC EUROPEAN SOCIETY for SOIL CONSERVATION

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Water-logging due to subsoil compaction on medium-textured soil in Diksmuide, Flanders, Belgium. Picture taken in February 2014 when precipitation was much above average (photo by Wim Cornelis, Ghent, Belgium).

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CONTENTS

This issue of the ESSC Newsletter presents the 22nd of our 'Guest Editorials.' This is an opportunity for leading authorities in the soil science community to offer their perspectives on issues relating to soil conservation. This contribution is from Wim Cornelis (Ghent, Belgium and ESSC Treasurer).

Catena Verlag has kindly agreed to publish a book based on Guest Editorials. This will be entitled 'Global Perspectives on Soil Conservation.' This will form part of the Catena 'Advances in GeoEcology' series. In principle, it is agreed that there will be future volumes, associated with the four year cycle of Congresses of the ESSC. Work on Volume 1 is progressing well.

Subsoil Compaction: The Invisible Enemy

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Soil compaction is acknowledged by the European Commission as one of the major *threats* to soils in the EU, or to paraphrase Michael Hamell in his Guest Editorial in ESSC Newsletter 2011/2 on EU soil protection, alleviating soil compaction should be one of the main challenges in respect of soil protection. Using the term challenge instead of threat *"tends to inspire greater commitment to action."* What actions do we need to take? At the seminar on 'Soil compaction – effects on soil functions and strategies for prevention' held in Helsinki in 2012, Johan Bouma (2012) referred to the proportionality principle, which indicates that actions to be taken must proportional to the severity of the problem. Otherwise, regulatory overkill should be avoided. Or to cite Donald Gabriels in his Guest Editorial in ESSC Newsletter 2009/1 on priorities on research on soil degradation, do we need "*more research? more models? more theory? more data? more indicators? more measurements? more scientific publications? more success stories? more applications? more funding? who pays?",* or do we have all cards on the table to start immediate action?

It is a fact that, despite all the research on soil compaction and awareness raising initiatives for several decades, and two concerted actions on subsoil compaction in Europe (FAIR and INCO-Copernicus; van den Akker *et al.,* 2003), European soils (but in general, soils worldwide) are facing serious threats of ever increasing soil compaction. Already in the 1990s, it was estimated that soil compaction was responsible for soil degradation on 33 million ha in Europe (Van Ouwerkerk and Soane, 1994). Fraters (1996) estimated that 32 % of Europe's subsoils are highly vulnerable to subsoil compaction and another 18 % are moderately vulnerable. Jones *et al.* (2003) presented a map of inherent susceptibility of subsoils in Europe to compaction, showing vast areas of moderate to very high susceptibility. Similarly, Montanarella and Houšková presented a map at the ESSC 2008 Congress in Palermo showing the natural

susceptibility of European soils to compaction (**http://eusoils.jrc.ec.europa.eu**). However, these estimates were very rough and leave much room for improvement. Jan van den Akker (2004) mapped subsoil carrying capacity using his SOCOMO model in The Netherlands, while Rainer Horn and co-workers calculated pre-compression stress as a measure of soil susceptibility to compaction and mapped it for Europe in general and Germany in particular (Horn *et al.,* 2005). Recently, Troldborg *et al.* (2013) presented a generic risk framework for the development of Bayesian Belief Networks to map the risk to soil compaction in Scotland. Using the Terranimo® model (Lassen *et al.,* 2012) developed within the ERA-NET funded PredICTor Project, Wheel Load Carrying Capacity maps may be produced for a range of combinations of matric potentials, soil depths (depths with no deformation allowed) and tyre type/inflation pressures (Fig. 1).

To illustrate the huge amount of completed research (and thus money invested) so far on soil compaction, Fig. 2 shows the evolution of papers including the term *'*soil compaction'* in its **title** (not even **topic**) published in Web of Science (WoS) journals per year. (The steady rise in papers does not necessarily reflect more research being performed, but is to some extent associated with the publication pressure most of us face nowadays). In total, 991 papers have been published since 1955 (with the first one in 1960). They received 11,838 citations and produced an h index of 46 (which means that 46 of these papers have been cited at least 46 times). For comparison, statistics for *'soil erosion'* (not *'water erosion'* or *'wind erosion,'* neither *'erosion by…'*) were 2,599 papers, 30,677 citations and an h index of 66. Some 44% of the soil compaction papers had one of the authors from the USA, Canada, Brazil or Australia (these countries were also within the top six listed). Some 37 % of the papers had at least one author from Europe. This does not necessarily mean that these papers reported research conducted in Europe, but they had at least one European researcher involved.

Subsoil compaction: a hidden form of soil degradation

Soil compaction refers to *"the process by which the soil grains are rearranged to decrease void space and bring them into closer contact with one another, thereby increasing the bulk density"* (SSSA, 1997). Unlike soil erosion and salinization, which shows strong evidence on the soil surface, soil compaction is a hidden form of soil degradation without clear visible exposure and evident marks on the surface. This may lead to specific problems that are often blamed on other causes (Hamza and Anderson, 2005).

Soil compaction can manifest itself in the form of a dense crust resulting from aggregate breakdown caused by raindrop impact, a dense topsoil due to high ground pressure or axle load from heavy machinery or livestock trampling, a dense tillage pan from repeated tillage operations at the same depth year after year, and a dense subsoil.

Deep and persistent subsoil compaction is merely caused by high wheel load traffic under unfavourable conditions. I recall Wolfgang Burghardt saying in his presentation at the 2008 ISCO Conference in Budapest, that in Germany the weight limit for vehicles on highways is 45 tonnes (a 'road conservation' measure!). For soil, where loads are often higher than this value, no legislation exists. Of course, soils have a highly variable response to soil compaction, depending on several factors, including soil texture and soil organic matter, soil structure, soil-water status, and axle load, tyre type and inflation pressures. Subsoil compaction reaches depths at which the compacted layer can no longer be restored by conventional ploughing techniques or natural loosening processes, including freezing and thawing, drying and wetting, and biological activity. The inter-Nordic POSEIDON Project ('Persistent effects of sub-

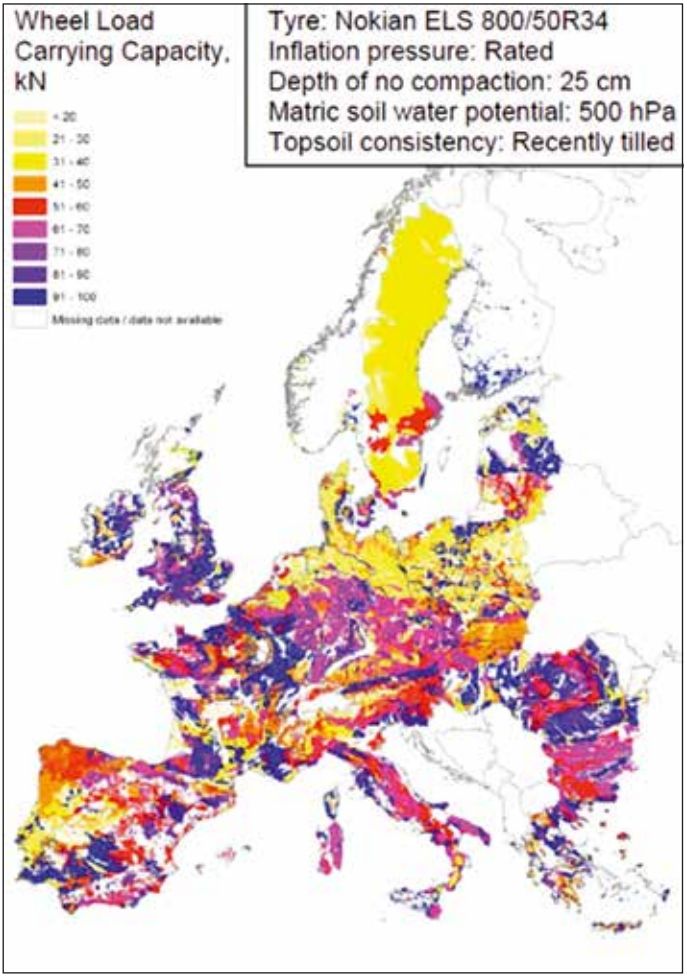

Figure 1. *Map of wheel load carrying capacity for Europe using the models and prediction equations also active in Terranimo® and developed within the PredICTor Project.*

soil compaction on soil ecological services and functions') concluded that commonly used agricultural machinery can compact the soil to almost 1 m depth (Berisso *et al.,* 2012). With the ever increasing wheel loads in modern agriculture, the persistent character of subsoil compaction thus forms a serious threat to European soils (Plate 1). It should be noted, however, that high axle loads should not necessarily lead to soil compaction, if due consideration is given to inflation pressure and type of tyres and/or moisture conditions during planned agricultural operations. The use of dual wheels instead of single wheels or rubber tracks might also help alleviate soil compaction (Arvidsson *et al.,* 2011).

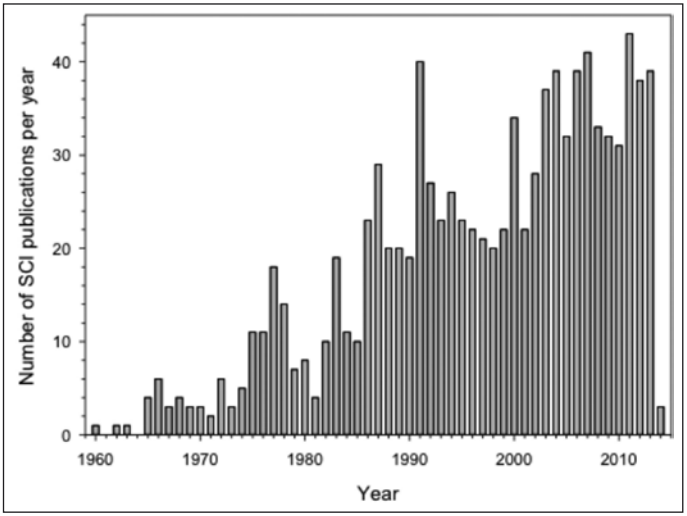

Figure 2. *Number of papers including the term '*soil compaction' in its title (not even topic) published in WoS journals (SCI-Expanded) per year (on 7 April 2014).*

Plate 1. *Ever increasing axle loads in agriculture, contributing to the persistent character of subsoil compaction. However, if due consideration is given to inflation pressure and type of tyres, moisture conditions during planned agricultural operations and/or when shifting to dual wheels or rubber tracks, soil compaction might be minimized. Photographs taken at the Agribex Fair in Brussels, Belgium (January 2014, Wim Cornelis©).*

Subsoil compaction – so what?

Many studies in Europe and elsewhere have demonstrated that subsoil compaction affects several soil functions defined in the EU 'Thematic Strategy on Soil Protection.' It directly affects biomass production; storing, filtering and transforming nutrients, substances and water; and biodiversity. More specifically, it restricts movement of water and gas, and increases mechanical impedance. This results in limited infiltration, ponding and water-logging and increased runoff, which in turn both increases the risk of soil erosion, flooding and loss of nutrients and agrochemicals affecting surface water quality (increased sediment load,

water pollution and eutrophication), and encourages drought. Subsoil compaction also leads to increased emission of greenhouse gases, particularly methane and nitrous oxide, and of ammonia, because of prevailing anaerobic conditions, restricted gas diffusivity and reduced hydraulic conductivity. On the other hand, however, the release of CO_2 through soil respiration might remain equal or even be lower in compacted soils because of decreased microbial and root respiration (Gasso *et al.,* 2013). Soil compaction generally decreases harvests, not only because of lower water and nutrient availability, but also because of decreased aeration of the root-zone, lower resistance to pests, pathogens and weeds, decreased workability and accessibility of fields by machinery for planting and harvesting, impeded root penetration and limited capillary rise. Overall, soil compaction results in serious agricultural and environmental impacts. With an increase in number and intensity of heavy rainfall and number and extent of dry spells projected by future climate scenarios, the problem may be even aggravated in the future.

More research or immediate action?

Several studies have investigated the effects of soil compaction on soil properties, soil processes and soil functioning, how to evaluate and monitor soil compaction, and how to minimize its effects in modern agriculture. For excellent reviews published over the last 11 years consult: Alakkuku *et al.* (2003); Chamen *et al.* (2003); Spoor *et al.* (2003); Lipiec and Hatano (2003); Lipiec *et al.* (2003); van den Akker *et al.* (2003); Hamza and Anderson (2005); Drewry *et al.* (2008); Batey (2009); Beylich *et al.* (2010); Alaoui *et al.* (2011); Tracy *et al.* (2011); Gasso *et al.* (2013); and Keller *et al.* (2013). Commonly recommended strategies include avoidance, alleviation, controlled traffic and acceptance. Because of the persistent character of subsoil compaction, there is an urgent need to avoid it.

To present avoidance strategies that are acceptable by local farmers and contractors, more research will be needed. The occurrence, extent and effects of soil compaction are site specific, which means that there is no universal strategy that will work everywhere. Recently (from February 2014), the 'Environment, Nature and Energy Department of the Flemish Government' within Belgium financed a research project to quantify the consequences of soil compaction on water movement in soil, since detailed numerical data are simply lacking in the Flemish Region of Belgium. Such site-specific data, together with data on environmental and economic impacts, are needed by policy-makers and advisors in order to effectively communicate about the problem in a convincing yet realistic manner, and thus raise awareness.

Because of the urgency of the problem, however, stakeholders (farmers, contractors, farm machinery industry) should be kept informed about potential problems. In the context of the Interreg Project PROSENSOLS ('Protect our Soils') between the Flemish and Wallonian regions in Belgium and Northern France, soil kits and leaflets have been developed and workshops and demonstrations have been organised to illustrate impacts of soil compaction. The 'Environment, Nature and Energy Department of the Flemish Government' recently developed a demonstration tool which they present at agricultural fairs, allowing the public to experience effects of soil compaction (Plate 2). As a result of these efforts, increasing numbers of farmers and contractors are becoming aware of soil compaction problems, although they still lack specific tailor-made advice on how to avoid compaction on their own fields with little investment.

Plate 2. What's learnt in the 'craddle' lasts until the tomb (left). Right: Mrs. Joke Schauvliege (Flemish Minister for Environment, Nature and Culture) demonstrating to a critically watching Mr. Piet Vanthemsche (President of the Boerenbond; professional organisation for farmers and growers) how little resistance plant roots experience when growing through non-compacted soil (right). The Demo tool was developed by the Environment, Nature and Energy Department of the Flemish Government, allowing the public to ***"feel the difference in soil compaction" ("Voel het verschil in bodemverdichting").*** *Pictures taken from the stand of this Department at the Agriflanders Fair in Sint-Denijs-Westrem, Belgium (January 2013, ALBON©, Agriflanders©).*

Avoidance of subsoil compaction requires well-founded advice to farmers and contractors on maximum allowable wheel loads for their soils, including advice on type of tyres and inflation pressures, taking into account the predicted moisture conditions during their planned agricultural operations. To address this and predict the sustainability of any planned traffic event on their cropland, the user-friendly online (web-based) decision support tool Terranimo® was developed within the above mentioned PredICTor Project ('Preparing for the EU Soil Framework Directive by optimal use of Information and Communication Technology across Europe') (**www.soilcompaction.eu**). Terranimo® incorporates a database of several hundreds of tyres commonly used for agricultural operations and a database of the most common soil types of Denmark, Switzerland and Finland. Within the RAI-SOILCOMP Project ('Raising awareness on the impact of subsoil compaction') which started in October 2013 and was funded through the SNOWMAN network, this dataset will be updated with new data from Belgium, The Netherlands and Sweden. In order to assess the risk for subsoil compaction for a given combination of axle load, soil type and water status, the user can estimate soil strength (as determined by soil type and water status) from pedotransfer functions and compare it with the imposed strain (as determined by axle load). Such predictions can also help farmers in judging whether changing from single wheels to dual wheels or rubber tracks would be worth the investment (at least in terms of mitigating soil compaction).

Nevertheless, more research is also needed here to refine this and/or other models and improve predictions. This relates particularly to the methodology for evaluating soil strength (typically in terms of pre-compression stress) relevant to an agricultural context, where soils experience rapid exertion of loads when trafficked by agricultural machinery, in contrast to geotechnical applications focusing on long-term loadings under buildings on deeper soil horizons. More research is also needed to improve modelling of stress propagation in the soil profile under different tyre types and rubber tracks for a wide variety of soil types.

With the Terranimo® tool developed so far (and which is currently available in English, Danish, Swedish, Finnish, Norwegian, French and German and a Dutch version will follow

soon), users can already obtain good indications about how to avoid compaction or serious compaction (if stress is 50 % larger than strain) resulting from planned operations, and take immediate action. Moreover, on soils that are susceptible to compaction, introduction of controlled traffic farming based on GPS can limit field-wide subsoil compaction to zones below permanently defined traffic lanes. This contributes to alleviating soil compaction impacts and results in greater economic benefits (Kingwell and Fuchsbichler, 2011).

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Conservation Practises for Climate Change Mitigation and Adaptation Will Be Needed for Food Security in the 21st Century

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It has been documented across the peer-reviewed scientific literature that the challenges that we face during the 21st century, such as climate change, depletion of water resources needed for agricultural production, and higher demand for food and fibre, are due to a larger global population, which will place great pressure on agroecosystems across the world. That could threaten the potential to maintain and/or increase food security during this Century. Climate change and extreme events (e.g. floods and severe droughts) are impacting fragile agroecosystems. One of the impacts of climate change and these extreme events is a higher potential for soil erosion, so it is essential to develop and implement policies that increase air, soil and water conservation throughout the world to increase the potential to increase productivity and maintain and/or achieve food security (Delgado *et al.,* 2011; Figure 1). World agroecosystems will be faced with greater production demands as an additional 2.5 billion people are added to the human population by 2050.

In 2011, the Soil and Water Conservation Society (SWCS) invited a group of scientists to review the scientific literature on conservation practises and climate change (Delgado *et al.,* 2011). The team published a feature article in a 2011 issue of the 'Journal of Soil and Water Conservation' that reviewed the scientific literature and identified some key principles for mitigation of and adaptation to climate change (Delgado *et al.,* 2011). The SWCS used the Delgado *et al.* (2011) Feature Paper as a scientific reference to develop its 'Position Statement on Climate Change and Soil and Water Conservation,' and a press release announcing the creation of the position statement. In the position statement, the SWCS stated that "soil and water conservation practices can play a major role in the mitigation of agriculture's contribution to greenhouse gas emissions and adaptation to changes in seasonal precipitation and temperature patterns." The SWCS also stated that stake-holders in government and the non-profit and private sectors should apply soil and water conservation principles, such as increasing soil carbon levels when selecting and promoting conservation practises for climate change mitigation and adaptation. The Delgado *et al.* (2011) paper, the SWCS press release, the SWCS position statement and additional materials are available to download at:

www.swcs.org/policy

Following are the principles that are listed in the Delgado *et al.* (2011) feature article and that were used to develop the SWCS position statement:

Principles for Communication

1) **Develop communication that connects science to land managers** for better communication with farmers and farmers' groups.

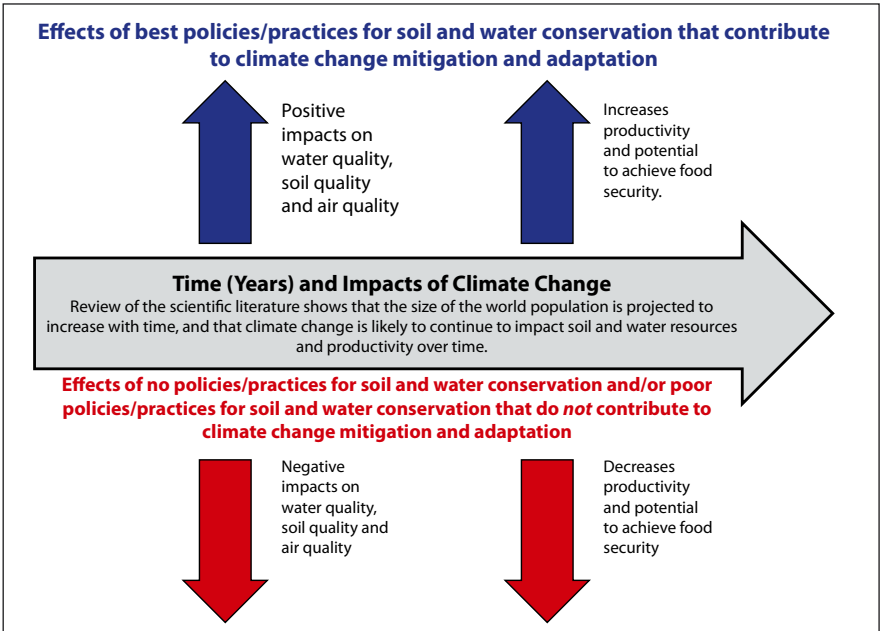

Figure 1. There is a close relationship between climate change, limited global water and soil resources, population growth and food secunty As climate change impacts the world's soil and water resources, it threatens to negatively impact food production (i. e., decrease food production and/or food production potential). As the climate changes, conservation practices have the potential to help us achieve maximum sustainable levels of food production, which will be essential to efforts to feed the world's growing population. Good policies/practices for soil and water conservation will contribute to positive impacts on soil and water quality, soil productivity, and efforts towards achieving and/or maintaining food security. These good policies/practices will contribute to climate change mitigation and adaptation. Poor policies/practices for soil and water conservation (or a lack of policies/practices) will contribute to negative impacts on soil and water quality, soil productivity, and efforts toward achieving and/or maintaining food security (From Delqado *et al.* 2011 – *Journal of Soil and Water Conservation*).

Figure 1: *Effects of best policies/practices for soil and water conservation that contribute to climate change mitigation and adaptation.*

2) **Develop communication that connects science to the public** to increase awareness of the benefits of soil and water conservation programmes.
3) **Teach the value of soil carbon** to increase public awareness of its importance.
4) **Embrace technology** and encourage technology transfer, to increase conservation effectiveness.
5) **Improve historical context** by developing long-term data records.
6) **Ongoing training is essential** for maintaining an educated workforce that can work towards the development of more efficient management practises.
7) **Enhance exchange** with fora for exchanging information between farmers, scientific societies, scientists, conservation practitioners and others.

Principles for Conservation Practises

1) **Surface residue protects** and conservation agriculture increases sustainability.
2) **Soil function improves with soil carbon** sequestration.
3) **Cover the surface** and avoid harvesting of plant residues if soil func¬tion would be compromised.

4) **Value perennial crops.**
5) **Embrace technology** to increase conservation effectiveness.
6) **Off-field remediation practises are helpful.**
7) **Improve landscape diversity with agroforestry.**
8) **Synergism achieved through multiple conservation practises.**
9) **Build on within-field tried and true practises.**
10) **Effectiveness enhanced with landscape-targeting precision conservation.**
11) **Promote energy efficiency** through green programmes that can save energy.
12) **Value water more** and increase water-use efficiency.
13) **Greater diversity needed,** such as diverse cropping systems and new varieties that are tolerant to stressors, such as drought.
14) **Minimize gas losses,** since reducing greenhouse gas emissions at the farm level will benefit the environment.
15) **'Tighter' nutrient cycles** are needed to increase nutrient use efficiency, save energy and reduce nutrient losses to the environment.

Principles for Research

1) **Research pays dividends long term**

In Summer 2013, one of the key-note presentations at the 'International Soil Conservation Organization' (ISCO) meeting held in Medellin, Colombia, was entitled 'Conservation practices are essential land management strategies for climate change mitigation and adaptation.' This presentation covered recent publications related to the science of climate change and soil and water conservation and the SWCS position statement on the same topic. Following this keynote presentation, ISCO's Board of Directors is now considering adopting a similar position statement to the one adopted by the SWCS. The position statement is available at:

www.swcs.org/policy

The SWCS position statement suggests that it is important to implement conservation practises (e.g. conservation practises that protect soil productivity) in order to maintain and/or achieve food security that will continue to be threatened by the world challenges that we are confronting during the 21st Century. Healthy and productive soils will only become more important as the world population continues to grow. Climate change and extreme events present real challenges and necessitate the application of the principles listed above in order to develop sustainable systems and help ensure that there will be sufficient resources for long-term food security (Delgado *et al.,* 2011, 2013; Walthall *et al.,* 2012; SWCS position statement). Position statements like the one developed by the SWCS (**www.swcs.org/policy**), and publications produced by government agencies, such as the USDA (Walthall *et al.,* 2012) are key to increasing public awareness of the great challenges we will face in the 21st century and the importance of adaptation in responding to these challenges. A key message from these publications is that conservation practises are needed for climate change adaptation and protection of soil resources. If we do not protect our soils with conservation practices that help us adapt to climate change, the survival of the human species will be at risk (Delgado *et al.,* 2013). Position statements about the importance of using conservation practises for climate change mitigation and adaptation go a long way in increasing awareness of this relationship, both by members of professional societies and the general public.

The above information is already published and available (see provided web links and references) and may be a useful starting point of discussion for the European Society for Soil Conservation if they wish to consider developing their own position statement on conserva-

tion practises and climate change mitigation and adaptation or perhaps joining the SWCS in their position statement.

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Editor's Note

In this article, Jorge invites the ESSC "…*to consider developing their own position statement on conservation practises and climate change mitigation and adaptation or perhaps joining the SWCS in their position statement.*" It would be a constructive debate if ESSC members considered adopting or adapting the SWCS position statement, whether verbatim or in a modified form.

Personally, I think the 'Principles for Communication' could be used as a valuable teaching aid. In summary, adopting the principles that:

2) Develop communication that connects science to land managers.
3) Develop communication that connects science to the public.
4) Teach the value of soil carbon.
5) Embrace technology.
6) Improve historical context.
7) Ongoing training is essential.
8) Enhance exchange.

Jorge identified the stress that global population growth places on resources. In classroom discussions of this issue, I find the 'World Population clock' very useful. I sometimes open the clock at the beginning of a lesson and note the estimated global population. Some time later, especially at the end of the lesson, I revisit the site and note the estimated population and calculate the net increase over that time period. I invite students to guess how much the world population has increased over the hour of so. They are generally staggered by the net increase, usually ~11,000 people per hour. There are several population clocks available on the web. The one I use most is:

http://www.worldometers.info/world-population/

The World Agricultural Heritage Foundation

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The 'World Agricultural Heritage Foundation' (WAHF) was established on 1 January 2013 in Rome. The founders were Parviz Koohakfan (former Director of the Department of Water and Land Development of FAO); Stefano Grego (Professor of Soil Science at the University of Tuscany; Viterbo, Italy); Vincenzo Naso (Professor of Engineering at University La Sapienza, Rome); Miguel Altieri (Professor of Ecology at the University of Berkley, USA); Mohammed Rouighi (former Ambassador of Algeria to FAO) and Notori Saeed (Special Adviser of General Director of FAO).

The mission of the Foundation is to promote, encourage, assist, support, enhance and develop research and higher education within the disciplines of the Programme of FAO 'GIAHS: 'Globally Important Agricultural Heritage Systems.' These are remarkable land use systems and landscapes which are rich in globally significant biological diversity evolving from the co-adaptation of a community with its environment and its needs and aspirations for sustainable development. Specifically, the Foundation will promote and support basic and applied research, project development and verification, innovation and the creation of international master and doctorate degree programmes progressing sustainable development and the principles of the science of sustainability. Furthermore, the Foundation intends undertaking activities to promote centres of excellence, both domestically and internationally, and facilitate relations involving co-operation and synergy between businesses, institutes and international organisations. The Foundation will particularly focus on relationships between Universities and Research Centres and associated technology transfer.

For the purpose of attaining its aims and purpose, the Foundation may, amongst other things:

a) Enter into legal instruments or agreements, also for financing projects and approved transactions, including, but not limited to, the taking out of loans and mortgages, the purchase of property as owner or with superficies rights, the entering into agreements, including those that are on public record, with government or private bodies that are deemed fitting and constructive for attaining the aims and purpose of the Foundation.
b) Administer and manage its assets, in respect of which it may be owner, lease or user under a gratuitous use arrangement or which it may hold or own under any other title.
c) Be a partner in associations, foundations, state-owned or private organisations and institutes, whose activities aim, directly or indirectly, at pursuing similar, complementary and compatible aims and purpose to those of the Foundation. Whenever the Foundation deems it constructive for pursuing institutional aims and purpose, it may participate in the formation of these entities.

d) Form companies or hold equity interests in corporations that operate in activities, as their main and exclusive operations, directed towards pursuing the aims and purposes of the Foundation's statutes.
e) Promote and organise seminars, vocational and continued education courses, events, conventions and meetings, publish relevant papers and documents and support projects suitable for furthering across-the-board contact between the Foundation, operators and domestic and international bodies, their respective operators and the general public.
f) Create and/or manage functional space and structures for courses or research.
g) Enter into agreements for engaging third parties to conduct activities included under the institutional aims and purpose and those deemed necessary for their attainment.
h) Establish prizes and scholarships and associated finance institutes and research projects.
i) Conduct marketing, distribution and sell published, multimedia and audio-visual materials where these promote institutional aims.
j) Receive property as donations or as inherited assets in compliance with current legislation.

As an initial activity the Foundation is organising an international Master's course on Sustainability and Agricultural Heritage.

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The Dravinja Valley learning region (Slovenia): intergenerational experiential education for sustainable development

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Summary

In 2009 – 2010, the State of Slovenia launched two projects supported by the European Social Fund (ESF) of the European Union for innovative education and for creating appropriate conditions for experiential education for sustainable development. Within these two projects, the Dravinja Valley learning region was established, connecting two learning polygons[1] , 15 learning trails, seven learning observation points, three cycling educational trails and the Development Centre in Nature. By establishing the Dravinja Valley learning region, we cre-

[1]The learning polygon is a part of an area, equipped with teaching and research resources and facilities, aimed at real learning for schools, faculties and for life-long learning.

ated an outdoor classroom in nature for the purpose of current development research into climate change, green technology, bio-economy, self-sufficient supply, traditional practises of environmental management and innovation. In this paper we evaluate the Dravinja Valley learning region in terms of sustainable ecosystem dimensions: the dimension of integrity, prosperity and self-sufficient supply, involving the local population. We were interested in the learning region´s contribution to achieving the educational goals for sustainable development. For that reason and based on the sustainability factor, we developed criteria, evaluated the learning region according to the level of sustainability and classified it in a model of sustainability.

Keywords: education, ecoremediation, self-sufficient supply, dimensions of sustainability, sustainable development, learning region.

Introduction

Over the last decade of education for sustainable development (2004 – 2014), there has been strong emphasis on gaining direct experience in solving the current problems threatening the Earth for decades. Because of the growing number of natural disasters, problems with water, food and soil are constantly increasing, a fact which should be taken into consideration in relevant educational approaches (Haubrich, 2006). In line with this reasoning, in 2009 we developed a project which proposed an innovative approach to education, where we developed the methodology of an outdoor classroom in nature. We have provided a theoretical basis for interdisciplinary experiential learning with emphasis on sustainable development. Educational institutions in Slovenia, as well as in other Balkan countries, have supported such an approach to classrooms in nature and the initiative was taken by the Ministry of Education of Slovenia to prepare a tender for the establishment of conditions for experiential education for sustainable development.

In 2009 – 2010 an attractive learning environment for all ages was created (Senegačnik *et al.,* 2009). In the Dravinja Valley (eastern Slovenia), in the protected area of Natura 2000, and where nature is still well-preserved, real natural classrooms were established. These 'learning polygons' are equipped for research, meaning that learning trails and bike paths are marked with notice-boards and informative teaching aids. In its role as a project-based learning centre, the 'Development Centre of Nature' is the starting-point for development in the Dravinja Valley (Figure 1). In addition to the established conditions for experiential education, we issued e-learning materials, exercises, manuals, tutorials, instructions for field-work, films and manuals for teachers. The most frequent users of the learning region are educational institutions, from kindergartens, schools and university faculties, to associations, companies, non-governmental organizations and municipalities. We believe that people have to see, feel and experience the phenomena and processes in nature before they really understand these elements (Vrhovšek *et al.,* 2009). In this paper we show the dimensions of experiential education experienced by users of the learning region. We expected that experiential education would form the foundation for sustainable thinking and acting, a hypothesis which was confirmed during the research.

Figure 1: *The town of Poljčane is in the centre of the Dravinja Valley.*

Research objectives and methodology

The Dravinja Valley, together with the central part of Poljčane Municipality, forms an outstanding training ground for teaching and learning about nature, its laws and treasures. With the concept of the outdoor classroom in nature, intertwining 10 thematic learning paths and the learning ecoremediation polygon, the area with its natural and cultural heritage has become an excellent starting point for the implementation of various natural science days, projects, interdisciplinary field-trips and research activities. These have individual starting-points that facilitate learning about the characteristics of the Valley and its wealth of natural and cultural heritage. For this purpose, teaching materials and worksheets have been prepared which support teachers and professors, helping them to implement these activities. Such learning materials were created for the Project by professors and practitioners teaching courses in nature preservation and environmental protection techniques and by those teaching such subjects as the environment, science and technology, and biology at elementary educational level.

We have prepared materials for innovative research, learning and teaching. At the same time all learning programmes and educational materials were generated to help teachers to implement mandatory practises and practical lessons in the scope of the educational programme 'Environmental Preservation Technician'(it is a school subject with practical work) as well as to achieve the learning objectives in the context of environmental education for

sustainable development (Plate 1). Learning programmes prioritize learning content offered by the combination of the 10 established thematic learning pathways in the Dravinja Valley. These are the monastery learning path, the Ličnica ecosystem learning path, the learning path through the Dravinja Valley, the learning path along the valley of crayfish, the bee-keeping educational pathway, the Boč forest learning path, the learning path for tree resources, the learning path through the abandoned quarries of Boč and the Ecoremediation Learning Centre in Modraže and permaculture polygon in Dole.

In the context of professional backgrounds for the preparation of educational curricula and modules for classroom practise, field-work and excursions, four curricula were prepared. These are:

1. Curricula in accordance with the knowledge catalogues for compulsory and elective modules of the Environment Preservation Technician educational programme.
2. Curricula for research, field-work and learning at the established ecoremediation polygon in the field of nature preservation, environmental protection and environmental education, with cross-curricular links to mandatory general education courses, such as biology, geography and chemistry, as well as elective courses in subjects including bee-keeping and environmental chemistry.
3. Preparation and implementation of educational curricula for natural science days and field-work within primary education, focusing on environmental subjects (triad 1[2] of the nine-years of primary education), natural science and technology (triad 2); biology and geography (triad 3) and in particular on the elective course environmental education at all stages of primary education. The scientific platforms for the preparation of curricula for practical lessons for biotechnical schools, research, field-work and excursions to provide overviews of the content and learning objectives. These will be achieved through implementation of individual learning programmes within the 'classroom in nature.'

In accordance with the strategy for lifelong learning in Slovenia and the strategy for education for sustainable development and the development of catalogues of knowledge and curricula, the purpose of these learning programmes is to upgrade and supplement knowledge gained through theory with direct experience in nature. The key purpose of preparing these programmes is to emphasize experiential learning and, through a combination of learning paths in the Dravinja Valley and the ecoremediation learning polygon, prepare curricula and modules that will help teachers to implement natural science days, project days, field-work, required obligatory practise and practical lessons for those biotechnical schools that implement the educational programme 'Nature and Environment Preservation Technician.' In creating the background for preparation of the learning programmes and materials, three practical training sessions for teachers were also carried out.

The following programmes were prepared:

The curriculum for the implementation of the obligatory practise and practical lessons in the educational programme, with a view to achieve the learning objectives and upgrading the learning content within the following modules: sustainable development, protection of natural values, ecosystems, implementation of activities in the region, ecoremediation, and environmental tour guiding.

[2]Triad is the organisation framework in Slovenian basic schools (basic school takes nine-years. Triad 1 is Years 1, 2 and 3; triad 2 is Years 4, 5 and 6 and triad 3 is years 7, 8 and 9).

Plate 1: *Soil research polygon for permaculture in Dole in the Dravinja Valley.*

The curriculum for realization of practical lessons, research and learning at the ecoremediation learning polygon in order to promote the learning objectives in the educational programme 'Nature and Environment Preservation Technician' and to achieve the objectives of an elective course 'Environment and sustainable development' for general education and high schools.

The curriculum for the implementation of natural science days and field-work to meet the objectives of environmental education in the first triad of primary education.

The curriculum for the implementation of natural science days, field-work to achieve the goals of environmental education and education for sustainable development in primary schools.

We have also gathered outstanding examples of teaching materials and problem-based tasks, which have been prepared by teacher practitioners (according to the methodological and professional guidelines of Kamenšček (2009)). These materials are designed to assist teachers when deciding to undertake natural science days or field-work within the classroom in nature, while problem-based tasks are formed in such a way that they can also be used in other learning situations or they can be transferred into the local school environment. Problem-based tasks have been prepared in the context of individual modules. These are at two levels: basic, primary education, and the obligatory and elective professional modules of the educational programme 'Nature and Environment Preservation Technician.' For primary education, problem-based tasks were prepared for studies on ecosystems, biodiversity, habitats, learning about the environment, pond biodiversity, water (running and standing) and caring

about the environment.

During the preparation of problem-based tasks for the educational programme 'Nature and Environment Preservation Technician,' the following tasks were created, representing examples of good practise in the preparation of problem-based tasks and content selected learning units. Obligatory and elective professional modules are listed in parentheses:
The ecological farm and sustainable development (module: Sustainable development).
The forest learning path (module: Environmental tour guiding).
Chemical analysis of water (module: Ecological analysis and monitoring).
Composting (module: Organic waste processing and maintenance of biological and vegetal purifying plants).
Wood biomass (module: Production of wood biomass).
Designing space for ecoremediation plants (module: Ecosystems, implementation of activities in space and ecoremediation).
Natura 2000 (module: Sustainable development).
Forest decline (module: Ecosystems, implementation of activities in space and ecoremediation).
Plants effective at environmental phytoremediation (module: Ecosystems, implementation of activities in space and ecoremediation).
Herbs in the organic farm (module: Sustainable development).
Identifying soils and soil analysis (module: Ecological analysis and monitoring).

The Dravinja Valley learning region was analysed according to the four dimensions of sustainability (Vovk Korže, 2011):
The ecosystem dimension.
The dimension of integrity.
The dimension of prosperity.
The dimension of self-sufficient supply and active public involvement.

Ecosystem dimension

Generally, in discussions on sustainability issues, equal emphasis is placed on the development of environmental, economic and social systems. However, more attention must be paid to the environment and nature in order to achieve prosperity. Ecosystems with their ecosystem services are essential for our survival (Jax, 2008). Neglect of ecosystems has negative impacts on our well-being, on the quality and availability of basic resources and thus on our health. Therefore, in stressing the importance of the connection of all subsystems in the region or in local communities, the ecosystem dimension, which provides connections with other systems, should be highlighted as a priority. This dimension is, therefore, consistent with the ecosystem approach, which has emerged in recent decades and may be identified as the most important dimension of the Regional Agenda 21 (RA21) sustainability plan. The preservation of biodiversity and ecosystems, the ecosphere, is therefore an ecopolitical question that requires knowledge, responsibility and an integrated systems approach that respects planet Earth as the fundamental basis for our development and survival (Türk, 2008).

Dimension of integrity

An important reason for the failure of sustainable development is the segmentation of development into economic, social, ecological, human and local themes and the conse-

quent separate support for each of these themes within their individual respective compartments (Radej, 2009). This approach has divided complex issues of progress into smaller problem sections, thus blurring their inter-relations. This is even more controversial, since these relationships are often conflicting. The result is that we live in an era of partial developments, as governments try to add new adjectives by 'magic glue' to the dogma of development and thus blur the view of the negative consequences of the developmental concept. Even if the adjective 'social' is added to the concept of development, economic growth will be supported. The concept of sustainable development, whereby governments are trying to prove the feasibility of an economically efficient, ecologically sustainable, socially equitable development of the democratic foundations, is geopolitically and culturally compatible with diversification. The concept does not support integrated approaches, but divides development into separate components, which has proved unsuccessful. Thus, it is necessary to combine components, in particular the capital of a certain region (e.g. environmental, human and economic capital), and to develop these together, not individually. A prime example of an insufficiently holistic approach is the 'Natura 2000 Project,' under which many protected areas are stagnating because no connection was made between natural capital and social, human and economic capital.

Dimension of prosperity

Economic growth focused on the production of material goods should not have such a fatal influence on the processes in society and nature as it had in the past. Serge Latouche (2012) proposed that a de-growth society should be created. In order to achieve prosperity, we must first answer the question of what it means when the economy dominates everything else in life, in theory and practise, especially in our minds (Latouche, 2012). The concept of de-growth primarily introduces a re-definition of the boundaries of economic rationality (Radej, 2009). The beginning of the de-growth concept dates from the early 1970s, when economic growth was becoming increasingly self-sufficient. The concept of de-growth was first used by the mathematician and economist Nicholas Georgescu-Roeg (1971). He drew on the laws of thermodynamics, which means *inter alia,* that the consequences of our actions are often irreversible, so we have to think long-term. In economics, this means according to Dennis Meadows (2012), a system theorist and co-author of the book 'Border Growth,' that leaders should not be rewarded for short-term successes and that in politics the time between elections should be extended (Meadows, 2012). Georgescu-Roeg defended the 'minimum bioeconomic program' aimed at preservation of energy and material stocks, leaving these intact for future basic human needs (Radej, 2009).

By considering the dimensions of prosperity in the sustainable design of RA21, we could avoid threats in advance, warning that if we will not change our behaviour, future generations will live in hostile conditions. Research suggests that the population living on Earth in 2050 will probably experience more heat-waves, droughts, floods and storms. Many of today´s plants and animals will die out because of the construction of new infrastructures and the use of phytopharmaceutical resources in agriculture. Quality of life and economic growth will decrease because of the loss of biodiversity, which provides a balanced ecosystem (Krotscheck, 2007).

Dimension of self-sufficient supply and active public involvement

The activation of neglected potential, relations between and motivation of people and

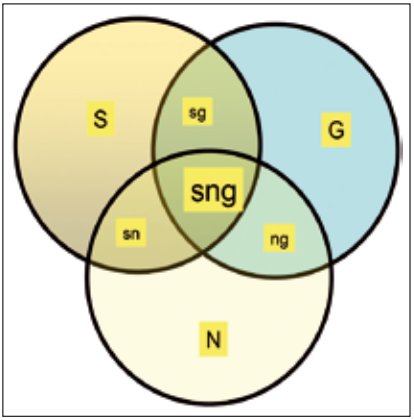

Figure 2: *Cross-sectional Venn diagram.*

regulated legislation are all of key importance for initiating self-sufficient supply. Following the ideas of John Venna, who in 1880 invented a diagram for a graphic representation of relations among groups, this diagram can be used for self-sufficient supply.

Regions have systems of social (S), natural (N) and economic (G) capital (or subsystems, which are dead in themselves, as long as they are not connected to each other). It is important that they be connected to each other with the content that they have in common (Figure 2). From the cross-sectional perspective, this means that the contents of S, N and G vary from region to region, and it is not feasible to use the same approach to their relationship/connection, if their backgrounds are unknown. The connection of N, G and S is the basis for the integrated treatment and progress, in particular prosperity, of the region's self-sufficient supply. Integrated effects appear only cross-sectionally (Radej, 2009). This is why every aspect of partial development from the perspective of overall prosperity can only be valued by its secondary impact on other partial developments, which have distinct primary objectives. Self-sufficient supply, based on respect for the ecosystem, can be used, by cross-sections of subsystems, to develop many new cross-sections, which create a solid network and links between man and nature. The dimension of self-sufficient supply also means the activation of many interests, which through shared vision lead in the same direction. This differs radically from 'beacon' approaches, which are externally visible, but basically unenlightened. This is a metaphor for major projects that do not bring long-term prosperity to the region but the contrary. In the book 'Politik der Inwertsetzung' (2007), among 12 decisions to be made by each region on the way to sustainability, self-sufficient supply is listed as the basis for comprehensive regional development (Krotscheck *et al.,* 2007).

Based on the dimensions of sustainability, criteria for the analysis of the Dravinja Valley learning region were designed with the aim of determining the achievement of sustainability. For each dimension, based on the theoretical principles, descriptive criteria were developed for use in the evaluation of learning materials and guidelines for the learning region. We also studied the achievement of sustainability within the learning region from multiple perspectives, including the further development needs of the learning region.

The Dravinja Valley learning region can be classified according to the criteria of sustainability as a model of strong sustainability. Most striking is the way of living in harmony with nature and planning and implementing all activities accordingly. Different types of projects are being prepared in order to achieve a shared vision, which is consistent with the finding that processes must be related and based on local-regional sources and specifics.

This evaluation of the Dravinja Valley learning region enables classification according to a model of sustainability (Plut, 2008). Among the four models of sustainability (very strong, strong, weak and very weak sustainability models), the Dravinja Valley learning region ranks in the top model. We believe this is a very strong and ideal sustainability model.

Plate 2: *Young people learn to protect soil (photo by A. Vovk Korže, 2013).*

The review of the established conditions for experiential education for sustainable development and prepared teaching materials for education in nature shows that the characteristics of the landscape ecosystem are taken into account, that the local population participates in the programmes and that the learning region receives broad support from local government. Furthermore, people are well informed and show great interest in promoting the learning region. Interested landowners make a particularly notable contribution by acting as investors. This is why the region has become 'the classroom in nature' for all types of schools, providing compulsory practise and practical training for both local people and visitors, who aim to transfer knowledge gained from the learning region back home (Plate 2).

Conclusions

Establishment of the Dravinja Valley learning region is the result of European policy, which within the educational programme for sustainable development supports experiential and problem-based approaches. With the possibility of using EU funds (European Social Fund), Slovenia has gained a well equipped and designed educational area, which has the status of a classroom in nature. Technical equipment and related educational arrangements are adjusted to educational curricula, practical training and real learning, and the implementation of cross-curricular activities in nature. The aspect of problem situations and actualization was also taken into account, meaning that the learning region provides guidelines enabling an understanding of everyday problems (natural systems for erosion prevention, natural purifying plants for water treatment, permacultural arrangements for food produc-

tion, ecoremediation arrangements such as buffer strips, constructed wetlands and diverse ecosystems (wet, dry, forest, grassland)).

The evaluation of arrangements according to the sustainability criteria shows that we are achieving a high level of sustainability (taking into account the model of sustainability), since the established arrangements respect nature, tradition, history and the local population. The prepared educational programmes, worksheets, e-learning and other learning materials are designed for applied research. Users visit the region to learn about useful approaches that can be immediately applied in practise. Learning materials are an important enrichment mainly in terms of utility, since users can connect theory with practise. Achieving sustainability dimensions in the learning region is an example of good practise for climate change adaptation, reduced attenuation of biodiversity and increased individual responsibility for natural resources and energy. Modern e-learning approaches also strive for education in nature.

The use of knowledge appears nowadays in the labour market as the maximum value of each individual (Pintrich *et al.,* 2002), which is extremely difficult to achieve in the educational process. Although modern trends in education increasingly stress the importance of innovative forms and methods of work in the classroom, teachers, particularly those in Eastern and Central Europe, still opt for the classic lectures presented in the front of the classroom, which is based solely on the accumulation and recollection of facts (Haubrich, 2006). The problem of knowledge acquired solely on the basis of explanation is that pupils or students cannot verify it themselves and therefore soon forget the content. Many experts are, therefore, placing increasing emphasis on experiential learning in the educational process, providing a problem-based process of knowledge acquisition as well as sustainable knowledge.

Pupils and students have the opportunity to check out the theory in practise; learn to think critically about a particular phenomenon or process and additionally to imagine processes, based on their own understanding. Based on experience they can form their own view of a phenomenon and their own position, which will affect their attitude and behaviour towards that phenomenon or process in the future. Taking into account these facts, we have decided to provide the conditions for in-depth, innovative education, based on useful knowledge that will also ensure the promotion of sustainable development. As a prerequisite for achieving quality in the learning process, we have set ourselves the original goal of ensuring adequate on-site infrastructure, offering a variety of tools, gadgets and equipment for field-work. The establishment of the polygon was also the first step in our plan to ensure appropriate conditions for the implementation of experiential learning. At the same time it is a fundamental pillar, ensuring sustainability and societal awareness.

According to the feedback from users of the learning region, the concept is excellent, and this is why we will continue to create the conditions for future experiential education in other parts of Slovenia and in the international arena. With the support of local authorities, the regional and local population and EU policy, the creation of learning regions can be one of the exits from the crisis situation. Combining knowledge, transferring of experience between generations, reviving old practises and their relationship to innovation and, above all, their own active involvement, are the ways to self-change. This is the foundation of a new way of thinking and acting.

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Univerza v Mariboru

The Newsletter and supporting Ph.D. research

Editor's note:

At the ESSC Council meeting in Lleida (Spain) in September 2006, the interactions between the ESSC and younger soil scientists were discussed (see Newsletter 2006/3, p. 5-8). It was decided that the ESSC should be more proactive in its support of younger scientists. As part of that initiative, we welcome articles from both Ph.D. researchers and supervisors. We would like to hear from recent Ph.D. graduates; what advice and experience do you have which you would like to share with your colleagues in earlier stages of their research? We would also like to hear from current Ph.D. researchers; what are the factors which both encourage and limit progress? What are the particular challenges facing part-time Ph.D. researchers? We also invite contributions from experienced Ph.D. supervisors. What experience would you like to share with less experienced colleagues? If you are a less experienced Ph.D. supervisor, what supervisory issues do you find challenging? In short, please tell us "what I know now, which I wish I knew then!"

Editor's note:

The citation details of Ph.D. theses by ESSC members since and including 2004 have been added as an additional page to the ESSC web site. To date, 51 Ph.D. theses are quoted. On the ESSC web site, please look under 'Publications.' Please forward the citation details of any additional Ph.D. thesis completed since the year 2000 by an ESSC member to any of the Editorial team. We will then add the thesis citation details to the web site.

Included are the citation details of papers and books produced by ESSC members. These provide a growing resource for exchange of valuable information to both research and teaching. The cumulative citation list is being added to and updated on the ESSC web site. Students of ESSC members (both undergraduate and postgraduate) are increasingly accessing this facility in their literature searches. Currently, the number of quoted publications cited on the web page is 721. Please e-mail the citation details of papers in international refereed journals since and including the year 2000 to any member of the Editorial team.

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Professor Dr Dan H. Yaalon (1924-2014), R.I.P.

Dan H. Yaalon passed away in the morning of 29 January 2014. I lost a dear friend, loyal colleague and a sound professional authority.

As a person and managing editor of the journal CATENA for 20 years (1973 – 1993), and still active for the CATENA SUPPLEMENTS and its follow-up series, 'Advances in GeoEcology' (now published by CATENA VERLAG Gmbh), I feel indebted to express my gratitude and deep respect for Dan H. Yaalon's continuous friendship, loyal support and inspiring co-operation over the last 40 years.

Dan H. Yaalon was born in 1924, between the two World Wars, in an assimilated Jewish family in the former Czechoslovakia. The course of his life: studies in Denmark and Sweden, graduating from the Hebrew University of Jerusalem, UNESCO Fellow in Tashkent (former USSR), and guest professorships in Australia, Belgium, the UK and the USA, is vivid testimony of not only the tragic history of Europe and the Jewish people during World War II, but also of a rich and fulfilled life of a person dedicated to Soil Science.

Experiencing major historical changes in his own life, Dan became interested in the 'laws of history' and it took only a small step for him to make the transfer to introduce such historical thinking into his own field of science, the intensive study of the 'History of Soil Science.'

I first met Dan and his wife Rita in 1984 at their home in Jerusalem. But already long before, I knew him as an outstanding scientist, and was privileged to become acquainted with him via correspondence through our editorial work for CATENA. He had a courageous and fighting spirit, who did not hesitate to speak the truth about the quality of an article, and I learned to appreciate his sharp mind, and his fair and honest reviews. His work was marked by high ethical standards.

Dan belonged to the group of founding editors of the interdisciplinary journal CATENA in 1973. He never hesitated to point out flaws and shortcomings that inevitably accompany the foundation of a new international journal embarking on the new idea of interdisciplinary research: 'GeoEcology.' My late husband, Heinrich Rohdenburg, who served as the Chief Editor of CATENA until his untimely death in 1987, once told me that "*this is a real friend, a true supporter of the new idea and the new Journal.*"

When I took over as Chief Editor of CATENA after Heinrich, a Joint Chief Editors forum was established. I approached Dan at the 1995 INQUA meeting in Berlin and asked him if he would serve as one of the Chief Editors. He replied *"Are you sure? You must know that I am very critical. I am not an easy going person."* I answered *"But that is why we need you."* He smiled and agreed.

In 1981 we started with Dan as Editor of the first monograph in the series

'CATENA SUPPLEMENTS': 'Aridic Soils and Geomorphic Processes.' In 1985 he co-edited 'Volcanic Soils – Weathering of Landscape Relationships of Soils on Tephra and Basalt' with E. Fernandez Caldas.

It was a special pleasure, an experiment, to work together on the project of the 1997 'History of Soil Science – Perspectives' by Dan H. Yaalon and Simon M. Berkowicz, Advances in GeoEcology (the follow-up of the CATENA SUPPLEMENTS).

For his outstanding work in the History of Soil Science he was honoured by the University of Ghent with the George Sarton Medal. For his achievement in research in Soil Science, he received the Doukouchaev Medal in 2010. At the time he unable to travel anymore, but his grand-daughter Idit was his respectful ambassador at the festive ceremony.

We now live in a transformed world of the 'electronic revolution.' Information and knowledge can be transmitted within fractions of a second around the globe. Dan, with his broad 'Bildungshorizont' (horizon of educational knowledge and wisdom) enjoyed these new means to dive into the history of Soil Science. With skill and insight, he traced and compiled the achievements of the pioneers of Soil Science for coming generations.

Dan H. Yaalon and Margot Rohdenburg in his house in Mevasseret, Jerusalem, in December 2010. Dan H. Yaalon is showing his Dokuchaev Award, which he had received in Summer 2010. Photo by Simon Berkowicz.

On many meetings and some excursions, I had the chance to discuss with him the well-being of the CATENA Journal. When after 20 years, in 1993, I passed the journal to Elsevier, Dan said *"you could not do better to secure its future."*

After my 'Aliya' (immigration) to Israel in 1995, I had the chance to meet him and his wife Rita frequently in Jerusalem, and we spoke regularly by telephone, especially to exchange greetings on religious holidays. During the last years his voice on the phone became weaker and thinner, but his spirit remained vivid, positive and encouraging. He never complained about physical hardship or his emotional sorrow after the death of his dear wife Rita in 2010.

It was a big reward for him to be able to stay in his home until the end, where his loving children and grandchildren supported him beautifully.

I last talked to Dan by phone in December 2013. I was unable to visit him in person, but we agreed to meet on my next visit to Jerusalem during Passover 2014. Dan's his last words to me were *"very good, all the best, Lehitraot"*(see you).

While we were talking, I imagined him sitting in his room, working peacefully, serene, in harmony with himself, looking out of his window over the Judean valleys and mountains and, on the horizon, the silhouette of the first stone houses of Jerusalem. After nearly a century of life travel, he had arrived home.

Margot Rohdenburg, February 2014

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Requiescat in Pace

Martian sand dunes

The team operating NASA's Curiosity Mars rover will probably drive the rover westward over a dune and across a valley with fewer sharp rock hazards than alternative routes. A final decision on whether to pass through this valley will ride on evaluation of a short drive planned this week toward the top of the dune that lies across 'Dingo Gap.' The dune is about 1 m high at its centre, tapered off at both sides of the gap between two low scarps. A colour view assembled from images taken by Curiosity's Mast Camera (Mastcam) on the east side of the dune shows details of the valley that the rover may traverse in February. NASA's Mars Science Laboratory Project is using Curiosity to assess ancient potentially habitable environments and major changes in Martian environmental conditions.

NASA Image of the Day 04/02/14:
http://www.nasa.gov/content/go-west-young-rover/

Migratory birds and military aircraft often fly in a V-shaped formation. The 'V' formation greatly boosts the efficiency and range of flying birds, because all except the first fly in the

Martian sand dunes. Photo taken by the Curiosity Rover.

Barchan dunes on Mars

upward motion of air (called upwash) from the wingtip vortices of the bird ahead. In this image of a dune field on Mars in a large crater near Mawrth Vallis, some of the dunes appear to be in a V-shaped formation. For dune fields, the spacing of individual dunes is a function of sand supply, wind speed and topography. This image was acquired by the HiRISE camera aboard NASA's Mars Reconnaissance Orbiter on 30 December 2013.

NASA Image of the Day 19/02/14:
http://www.nasa.gov/content/martian-dunes-flying-in-formation/

Sediment Transport Video

A video demonstrating sediment transport by raindrop induced saltation and rolling can be seen by going to:
www.ozemail.com.au/~pkinnell

The six minute video illustrates three of the five sediment transport processes that may follow detachment by drops impacting on shallow water flow. Sediment transport by rain-impacted flow is important in transporting nutrients, pollutants and carbon from sheet and rill erosion areas, where raindrop impact provides the main source of energy used to cause detachment. Splash may move detached particles through the air, but five transport processes can occur in rain impacted flows:

1. Continuous suspension in the flow.
2. Raindrop induced saltation.
3. Raindrop induced rolling.
4. Flow driven saltation.
5. Flow driven saltation.

The video demonstrates raindrop induced saltation and rolling that can, in addition to continuous suspension, transport soil particles and aggregates over slopes of very low gradient. The slope in the demonstration is zero. The video shows two runs that were 5 minutes and 10 minutes long, respectively (sections of the video are speeded up). Flow depths were 4-5 mm deep and flow velocities were ~40 mm/s. The rain was made from hypodermic needles spaced 2.5 mm apart in a module mounted 3.0 m above the target. Simulated rain intensity was 100 mm/h and mean drop size was 2.6 mm. The file is 214 Mb (so allow sufficient time to download the video).

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Editor's note:

At the University of Wolverhampton (UK) it took 30 seconds to download the video.

Web Based Bulletin Board

The ESSC wishes to rapidly disseminate information to its members. Please forward information to the ESSC web site to be placed on our ESSC Bulletin Board. These could include searches for potential collaborators for research proposals, calls for research proposals, job opportunities, research studentship opportunities, impending conferences and other items of important information for rapid dissemination. Of course, we will also continue the regular circulation of information via our Newsletter. The ESSC web site is:

http://www.essc.sk

ESSC membership list and contact details

The full ESSC membership list is held on the ESSC web site. Under 'members' you can obtain a full listing. Also under 'members' you can click on any member country and find a listing of members in the selected country.

We are trying to keep the membership list on the web site up-to-date. Please check your details and let us know if there are any necessary correction(s). If your details change, also please let us know. Some members have requested that we do not add their e-mail addresses to the web site, to avoid uninvited 'spam' e-mails. Of course, we respect this request. Therefore, while we retain a list of the e-mail addresses of ESSC members, this list will not be available on the web site.

Editorial matters in Bratislava are handled by Ing Karol Végh. In terms of membership lists, contact details and the ESSC web site, please send updated information to Karol at:

E-mail: **k.vegh@vupop.sk**

Please also use and refer to the **'Directory of European Organizations and Persons Working on Soil Protection'** as a reference source for European colleagues, both members and non-members of the ESSC. This publication contains the e-mail addresses of most ESSC members and will be subject to periodic updates. The reference citation is:

Rubio, J.L., Imeson, A.C., Bielek, P., Fullen, M.A., Pascual, J.A., Andreu, V., Recatala, L. and Ano, C. (2006). **Directory of European Organizations and Persons Working on Soil Protection.** Soil Science and Conservation Research Institute, Bratislava, 190 pp. (plus CD-Rom).

This publication is available as a pdf document on the 'Publications Archive' on the ESSC web site.

HydroEco´2015

HydroEco2015. 5th International Multidisciplinary Conference on HYDROLOGY and ECOLOGY: Advances in Monitoring, Predicting and Managing Hydroecological Processes Vienna (Austria), 13-16 April 2015.

Scope and Objectives

This is the fifth HydroEco Conference. The four previous meetings were held in Karlovy Vary (Czech Republic) in 2006, Vienna (Austria) in 2009 and 2011, and Rennes (France) in 2013. The aims of the Conferences are:

1. To present new findings and approaches on interactions between hydrology and ecology.
2. To promote interdisciplinary interactions on water related issues between hydrology, hydrogeology, biogeochemistry, microbial ecology and ecology.
3. To explore advances in monitoring, modelling and predicting dynamics of hydroecological processes.
4. To discuss management approaches and applications to tackle environmental issues, including engineering measures for ecosystem preservation and restoration of ecologically valuable environments.

To address the relevant issues, the Conference aims to bring together experts from several disciplines, including hydrologists (ground-water and surface-water), ecologists, biologists, subsurface microbiologists, environmental biogeochemists, eco-technologists, geomorphologists, hydraulic engineers, forest managers, nature reserve managers, regional and landscape planners, and experts from governmental institutions. The unifying theme is the interaction between ground-water and/or surface-water and ecological systems.

The Conference is organized by the Universität für Bodenkultur Wien (BOKU), University of Natural Resources and Life Sciences, Vienna, and is convened by BOKU, The International Association of Hydrological Sciences (IAHS) and Charles University, Prague (Czech Republic).

Abstract submission will be possible from mid April 2014, abstracts are due by 4 September 2014.

For further information, please contact the Organizing Committee:
Hans-Peter Nachtnebel: **hans_peter.nachtnebel@boku.ac.at**
Karel Kovar: **karel.kovar@pbl.nl**

More information is available on the Conference web site: **http://web.natur.cuni.cz/hydroeco2015/**

Photographs of Vienna courtesy of ©WienTourismus/MAXUM.

EUROPEAN SOCIETY for SOIL CONSERVATION

AGROecological assessment and Functional-environmental Optimization of Soils and TERrestrial ecosystems

Dear colleagues,

We are pleased to announce that 7th International Congress under the umbrella of the **EUROPEAN SOCIETY for SOIL CONSERVATION** will be held in Moscow (Russian Federation) from 18 – 22 May 2015.

The general subject of the Congress will be: 'Agroecological assessment and functional-environmental optimization of soils and terrestrial ecosystems.' The Congress will focus on fundamental and applied aspects of studying, analysis, assessment and modelling of soils and terrestrial ecosystems, experiencing anthropogenic influence and global changes.

The principal issues of the scientific discussions will include impact of soil erosion, degradation, sealing and pollution on the environment as well as adaptation of agricultural and urban ecosystems and land-use to dynamical environmental conditions at multiple scales. Special emphasis will be devoted to the development of sustainable and environmental-friendly anthropogenic soils and ecosystems, climate-smart agriculture and best management land-use practises.

The Congress is open to soil scientists and ecologists, educators and agronomists, stakeholders and policy-makers. It will consist of invited lectures and scientific sessions with oral and poster presentations and a field excursion and will attempt to advocate interest in the importance of the knowledge of soil forming and degradation processes for environmental protection. Selected papers will be published in international and Russian journals. Special attention will be given to five technical meetings, focused on applied issues following the main issues of the Congress.

The general subject of the Congress is split into the following main 10 sessions:

S1. Policies and strategies to support and maintain soil agroecological quality.
S2. Soil quality agroecological assessment and modelling.
S3. Monitoring of the anthropogenic impacts, soil protection and risk assessment.
S4. Climate-smart agriculture: scientific, practical and political aspects.
S5. Soil ecological functions and ecosystem services: from concepts to application.
S6. Agricultural soil management in organic farming.
S7. Biodiversity in managed soils and ecosystems.
S8. Spatial-temporal variability of soil features and processes: in maps and models.
S9. Environmental impact assessment and soil environmental quality certification.
S10. Bioremediation and reclamation of degraded or contaminated lands.

We welcome suggestions from prospective participants that may be of general interest as well as for Topical Meetings, Training Schools and Workshops inside the AGROFOSTER general subject.

Technical meetings

T1. Advanced techniques in agroecological and urban monitoring.

T2. GIS and geostatistics in soil agroecological analysis.

T3. Urban soil management and engineering.

T4. DSS in agricultural and urban planning.

For further information please visit the Congress web site:
www.essc-congress2015.ru

Summary of Forthcoming Conferences

Information on forthcoming conferences will be presented both in the ESSC Newsletter and on the ESSC web site. Below are the essential details of forthcoming conferences which have already been announced in the ESSC Newsletter.

50th Anniversary Congress of the International Association of Engineering Geology, 15-19 September 2014, Turin, Italy

Conference website:
http://www.iaeg2014.com/

Articles, reports, letters, views or comments on any aspect of soil erosion and conservation in Europe are always welcome.

We invite proposals for special thematic issues of the Newsletter. We also welcome any comments on the ESSC Newsletter and suggestions on how it can be improved and developed.

Do not forget to send in your details of the following information:

(i) Reviews of recent conferences.
(ii) Recent grant awards.
(iii) The citation details and abstracts of completed Ph.D. and M.Sc. theses.
(iv) Newly enrolled Ph.D. research students, title of their research topic and names of research supervisors.
(v) Recent staff institutional movements/promotions.
(vi) A reference list of your 'new' international refereed scientific journal papers, which have been published recently (since and including the year 2000).
(vii) At the ESSC Council at Průhonice (Czech Republic) in June 2009, it was agreed that the Newsletter will present a series of national reports on soil erosion and soil conservation activities in individual European countries. If you would like to volunteer a contribution, please contact any member of the Editorial team.

Send these details to either:
Professor Mike Fullen: **m.fullen@wlv.ac.uk**
or
Dr Colin Booth: **colin.booth@uwe.ac.uk**

and they will include this information in the next issue.

PLEASE NOTE:
We publish two Newsletter issues per year. The deadlines are:
1 March and 1 September.

The following four verses are a selection of translated ancient songs (ballads) of the Hani minority people of Yuanyang, Yunnan Province, south-west China. The Hani are world-famous as the builders and guardians of the rice terraces of Yuanyang (Plate 1). Until recently, the Hani had no written language. These ballads were collated by Hongzhen Zhang, based on meetings with the Mopi (elders of the Hani). The verses were abstracted from:

Hongzhen Zhang (2010). Interpretations of the Hani Seasonal Production Ballads. Yunnan Press Group Company and Yunnan Art Press Company, Kunming, 248 pp. (ISBN 978-7-5489-0034-4).

Plate 1: *The rice terraces of Yuanyang (photo taken by Mike Fullen (Wolverhampton, UK) on 20 October 2009).*

II. On the Arrival of the Three Months of Spring

Verse 134

Crops are planted in family fields,
Where they grow well,
The fields should be taken good care of,
And the weeds such as Moniucao and Yisacao should be got rid of.
Be careful in repairing the field bank,
Cut neither the mole cricket's neck,
Nor the body of earthworms.

When harrowing in the fields,
If the water buffalo is capable enough,
He will rake the fields thoroughly;
In raking, weeds named Arrowhead and Reyicao should be removed.

Verse 136

Young women are sowing the seeds carefully,
And the seeds are sown well-proportioned,
Then covered with soil evenly.
Cut the palm leaves in front of the house,
Or cut barbed bamboo poles behind the house,
To make pretty good broom.

The seeds have been sown,
And the different flowers are arranged around the field,
To make it look fine.
Various flowers can be found,
Such as peach bloom and safflower.

Verse 138

The time has come for the cultivation of buckwheat fields in the mountains.
It is slash-and-burn cultivation,
And when the seeds of buckwheat have been sown,
Flowers are arranged around the field.
The flowers are in bloom in the right season.

Verse 140

The men are brave enough in the effort of cultivating fields
For growing buckwheat;
The women sow the seeds carefully,
And the buckwheat grows trimly,
With the length of a hoe.

May the buckwheat thrive in the mountain fields,
May the paddy flourish,
With bumper harvest!

When the season changes,
Flowers blossom in the fields.

Thanks to Professor Li Yong Mei (Yunnan Agricultural University, P.R. China) and Dr Wang Weiguang (The University of Wolverhampton, UK) for their editorial help with the Hani ballads.

I am stepping ahead of myself
over the mantle of mosses,
passing a sprawl of bramble
where beetles seethe,
passing ivory stumps of pines,
their roots pre-Roman.
The bog, with its inner sea,
has memory. I touch the peat,
the past pulsing under my palm.

Some evenings, stumbling home in mist
their shapes emerge; others blow whistles
when dark falls on fog, the bog sucks.
Say bog, think of bodies – soil's store
in an acid hold preserving –
perhaps, too, the bones of mammoths.
Peat cutters fear they'll slice through flesh.

Time now to retreat, leaving the twilight
to twilight's creatures, leaving
the bog wrapped in itself.

From: Kingdom of Sphagnum, p. 9-22 In: Gladys Mary Coles (2001). The Echoing Green, Flambard Press, Hexham (UK), 71 pp. (ISBN: 1-873226-48-9)

For all things come from earth, and all things end by becoming earth.

(Xenophanes of Colophone, Greek philosopher circa 570-475 BC)

If this is to be a permanent nation we must save this most indispensable of all our God-given assets - the soil, from which comes our food and raiment. If we fail in this, remember that much sooner than we have expected this will be a nation of subsoil farmers.

(Hugh Hammond Bennett, 1933)

It is in thy power whenever thou shalt choose to retire into thyself. For nowhere either with more quiet or more freedom from trouble does a man retire than into his own soul. This then remains: remember to retire into this little territory of thy own.

(Marcus Aurelius, Book Four, Verse 3)

The inward voice that reasons beyond cleverness and know beyond knowledge.

(Wayne W. Dyer, 2001)


HOTEL
Dear colleagues, We are very concerned about the impact of farming on the environment!
RESTAURANT
HOTEL
CATERING SERVICE
WELCOME TO THE CONCERNED SCIENTISTS CONFERENCE

AIMS OF THE SOCIETY

The ESSC is an interdisciplinary, non-political association, which is dedicated to investigating and realizing soil conservation in Europe. The ESSC pursues its aims in the scientific, educational and applied sectors by:

Supporting investigations on soil degradation, soil erosion and soil conservation in Europe.

Informing the public about major questions of soil conservation in Europe.

Collaborating with institutions and persons involved in practical conservation work in Europe.

The ESSC aims at co-ordinating the efforts of all parties involved in the above cited subjects: research institutions; teachers and students of geosciences, agriculture and ecology; farmers; agricultural planning and advisory boards; industries and government institutions.

ZWECK DER VEREINIGUNG

Die ESSC ist einer interdisziplinäre, nicht politische Vereinigung. Ihr Ziel ist die Erforschung und Durchführung des Schutzes der Böden in Europa. Die ESSC verfolgt dieses Ziel auf wissenschaftlichem, erzieherischen und angewandtem Gebiet:

Durch Unterstützung der Forschung auf den Gebieten der Boden-Degradierung, der Bodenerosion und des Bodenschutzes in Europa.

Durch Information der Öffenlichkeit über wichtige Fragen des Bodenschutzes in Europa.

Durch Zusammenarbeit mit Institutionen und Personen, die an der Praxis des Bodenschutzes in Europa beteiligt sind.

Die ESSC will alle Personen und Institutionen zusammenführen, die sich für die genannten Ziele einsetzen: Forschungsinstitutionen, Lehrer und Studenten der Geowissenschaften, der Landwirtschaftswissenschaften und der Ökologie, Bauern, landwirtschaftliche Planungs- und Beratungsstellen, Industrieunternehmen und Einrichtungen der öffentlichen Hand.

BUTS DE L'ASSOCIATION

L'ESSC est une association interdisciplinaire et non politique. Le but de l'association est la recherche et les réalisations concernant la conservation du sol en Europe. L'ESSC poursuit cette finalité dans les domaines de la recherche scientifique, de l'éducation et de l'application:

En encourageant la recherche sur la dégradation, l'érosion et la conservation du sol en Europe.

En informant le public des problemes majeurs de la conservation du sol en Europe.

Par la collaboration avec des institutions et des personnes impliquées dans la pratique de la conservation du sol en Europe.

L'ESSC souhaite favoriser la collaboration de toutes les personnes et institutions poursuivant les buts définis ci-dessus, en particulier: institutions de recherche, professeurs et étudiants en géosciences, des agriculteurs, des institutions de planification et des conseil agricole, de l'industrie, et des institutions gouvernementales.

OBJECTIVOS DE LA SOCIEDAD

La ESSC es una asociación interdisciplinar, no-politica, dedicada a la investigación y a la realización de acciones orientadas a la conservación del suelo en Europa. La ESSC persigue sus objectivos en los sectores cientificos, educacionales y aplicados, en al ámbito europeo:

Promocionando la investigación sobre degradación, erosión y conservación de suelos.

Informanto al público sobre los principales aspectos de conservación de suelos.

Colaborando con instituciones y personas implicadas en la práctica de la conservación de suelos.

La ESSC aspira a coordinar los esfuerzos, en los temas arriba mencionados, de todas las partes implicadas: centros de investigación, profesores y estudiantes de geo-ciencias, agricultura, selvicultura y ecología, agricultores, servicios de extensión agraria, industrias e instituciones gubernamentales.

Visit the ESSC Website: http://www.essc.sk

MEMBERSHIP FEES

I wish to (please mark appropriate box):

- Join the ESSC
- Renew my membership of the ESSC
- Know whether I have outstanding membership contributions to pay

Membership rates:

Standard Rates:

- One year € 25.00
- Three years € 70.00

Institutional Membership € 15 per member per year.

Institutional membership involves the payment of a flat rate of € 15 (per member per year) for institutes/societies with at least 10 members. This fee is irrespective of the country.

Members of the specific institute or society would be full members of the ESSC and receive the ESSC Newsletter.

Students:

50 % reduction on above rates for three years
Your supervisor must provide written confirmation of student status

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Please send this form to: ESSC Treasurer, Professor Dr Wim Cornelis
Department of Soil Management, Ghent University,
Coupure links 653, B-9000 Ghent, BELGIUM
Wim.Cornelis@UGent.be