NEWSLETTER 1/2016

EUROPEAN SOCIETY for SOIL CONSERVATION

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CO_2 in the atmosphere is a resource out of place. Restoration of carbon sinks stored in soil and biota is an essential tool in mitigating climate change, and in meeting biodiversity targets and other goals of sustainable development. Álftavatn, Southern Highlands, Iceland. Photo taken by Andrés Arnalds, Hella, Iceland.

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CONTENTS

This issue of the ESSC Newsletter presents the 26th 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 Saulius Marcinkonis from Vilnius, Lithuania.

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. Work on Volume 1 includes the first 25 Guest Editorials of the ESSC Newsletter.

Zinc around us

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What is the human daily requirement for zinc (Zn) and what Zn resources are available in the environment? Most of us pay little attention to that, because daily we take multi-vitamins and/or mineral supplements and live in much nicer and cleaner environments compared with Sumgayit (Azerbaijan), Norilsk (Russia) or La Oroya (Peru) (some of the top 10 most polluted sites in the World). Some might become interested after watching the famous film 'My Zinc Bed' (2008), starring the Hollywood actress Uma Thurman (Figure 1). Reviewers described it as an uncompromising "study" of alcohol addiction and obsession. Actually, it is not about Zn studies or how important are the effects of Zn deficiency on human health. The truth is that the lack of Zn can have marked affects on emotional and addictive behaviour, such as alcoholism and obsessions. Alcohol both decreases Zn absorption and increases Zn loss in urine. Zn deficiency has also been linked with antisocial behaviour, such as delinquency and criminality. So let's have a look around and explore the world of Zn.

Soils and plants

According to European geochemical mapping (FOREGS survey) in European soils, Zn concentrations vary by over three-orders of magnitude, from <3 to >3000 mg kg^{-1} (Salminen *et al.,* 2005). In general, more coarse textured soils have less Zn compared to loam/clay soils, and more Zn is present in soils rich in organic matter, but not in pure organic soils. Zn concentrations are often high in animal manures, therefore we can assume that manured soils are supplied with Zn. Most grains require <250 g per hectare of Zn supply. The grains contain ≤20 mg kg^{-1}, most vegetables and fruit are low in Zn (usually <5 mg kg^{-1}). But some seeds are really Zn-rich and are listed among the TOP 10 zinc foods (such as oil pumpkin seeds having ≤100 mg kg^{-1} or flax seeds at ~60 mg kg^{-1}) (Figure 2). Zn also accumulates in some herbs and spices. For instance, St. John's wort was richest in zinc (86.0±0.4 mg Zn·kg^{-1}) among 30 herb

and spice samples commonly used in households (Zn concentrations varied from 14.4 to 86.0 mg Zn·kg^{-1} (Bielicka-Giełdoń and Ryłko, 2013)).

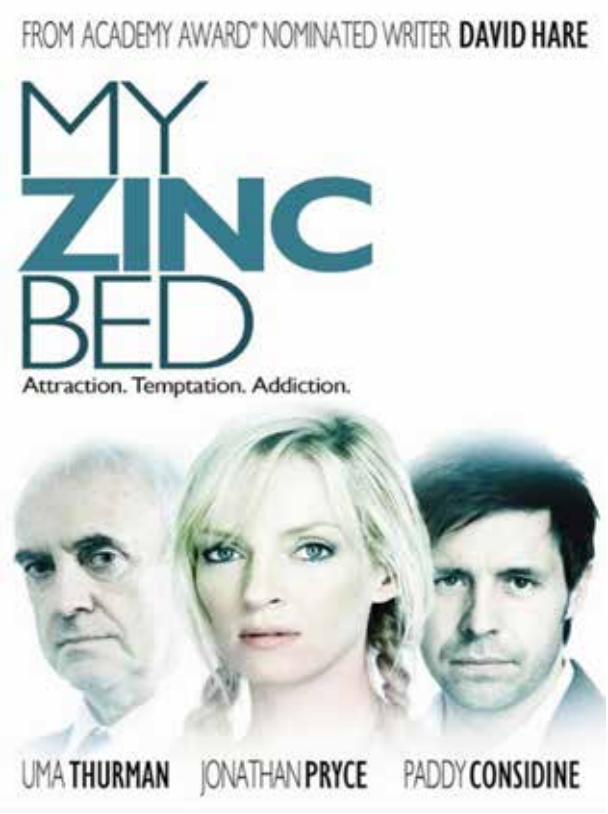

Figure 1: *Advert for the film 'My Zinc Bed.'*

Another complex issue is that the bioavailability of Zn from vegetarian diets is lower than from non-vegetarian diets, even when vegetarians consume Zn-rich food. That is because vegetarians typically eat high levels of legumes and whole grains, which contain phytates that bind Zn and inhibit Zn absorption (Zinc. Factsheet).

We know…

Zinc and environment questions attract the interest of researchers across the world. In the last decade, there have been several EU driven initiatives aimed at bringing together experts in 'zincology' to address actual issues, such as the ongoing 'Zinc-Net:'

http://www.zinc-net.com

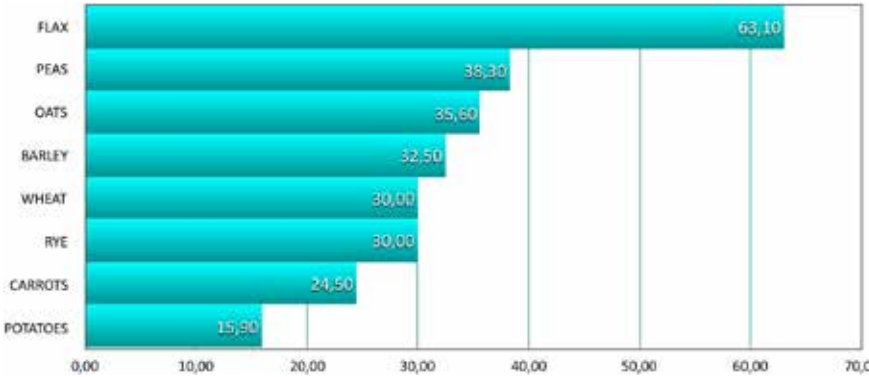

Figure 2: Zinc accumulation (mg kg^{-1}) in some crops (source: Tamulis, 1986).

Our knowledge of the role of Zn in the environment has grown exponentially, in parallel with technological advances that have enabled increasingly sensitive detection of Zn and visualizing and explaining distribution patterns (Figure 3), transport effects and the bioavailability of Zn in plants, water, sediment and soil. Researchers still have to answer the question: do Zn supplements act differently in enriched foods and biofortified crops? The agronomic fortification approaches, including plant breeding, soil and foliar fertilization, are supported by biotechnologies with transgenic approaches, including increased uptake and transport to edible parts of plants. The challenge is to both ensure that Zn is efficiently delivered and in sustainable ways. Fortunately, on a global scale, the influence of natural Zn cycling processes on environmental Zn levels is much more important than the influence from human activity. However, at a local scale, anthropogenic emissions can in some places outweigh natural processes.

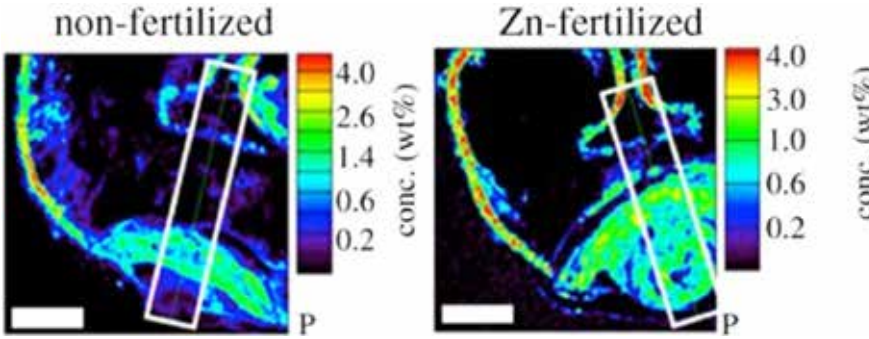

Figure 3: Zn distribution within grains of wheat.

From the journal 'Interface':
http://rsif.royalsocietypublishing.org/content/10/84/20130296

Surprisingly, Zn can be obtained through your skin. Almost 20 years ago studies indicated that topical application of Zn may be useful in cases of dietary zinc deficiency or in treating diseases which produce Zn deficiency. The results of trials using sunscreens enriched with stable Zn isotopes demonstrated that small amounts of Zn (<0.01% of applied dose) are absorbed through the skin and can be detected in blood and urine (Gulson *et al.,* 2012). Therefore, taking a spa with a mud mask might compensate for lost Zn, so why not to touch a soil with all of your body?

Agriculture as a future zinc market

Superphosphate is a fertilizer which contains high concentrations of Zn (≤600 mg $Zn.kg^{-1}$), but its use is declining due to its replacement by higher purity compounds. Currently, some market watchers have been touting what they believe is an up-and-coming end market for the metal: agriculture. Most significantly, mining magnate Robert Friedland has pointed to the potential of the metal in the agriculture sector, commenting that zinc *"is now recognised, along with potash, as one of the most intense organic fertilizers"*. Agricultural policies in both China and India now recognise the importance of Zn as a fertilizer.

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Introduction

Landscapes in Iceland are characterized by unusual variability. This is in part due to its unique geology, being one of the youngest countries on Earth, but also due to the consequences of 1100 years of land use. The visitor will soon discover that the lack of trees and the extensive barren areas are some of the most striking features. The nakedness of the land may seem a natural condition in a volcanic country with a chilling name. But, the reality is different. Most of the deserts and areas with little soil were once covered with lush vegetation. Despite over a century of combating the destructive forces and restoring lost resources, an enormous task is still ahead in healing the land and new conservation concerns are emerging.

A millennium of land degradation

Since settlement of Iceland in *circa* 870 AD, more than half of the original vegetation and soils, and ~95 % of the birch woodlands may have been lost. Serious soil erosion characterizes 40 % of Iceland today (Arnalds *et al.,* 2001). The current extent and composition of vegetation in Iceland bears little resemblance to what it was historically. The degraded state of the ecosystems and continued destruction of soil and vegetation are among the greatest environmental problems in Iceland.

Arnalds (1987) summarized some of the various sources that can be used to reconstruct the vegetation of the past and trace some of the major changes in cover and composition through the centuries. Such information about changes in land health is important as one of the tools for setting goals for restoration of damaged land in Iceland. It is also a sharp remainder on the potential consequences of long-term unsustainable land use in a sensitive environment.

A century of healing the land: Reflections on the journey

The severity of land degradation prompted the establishment of one of the world´s oldest Soil Conservation Services (SCSI). There have been numerous success stories in over 100 years of national effort on halting soil erosion and restoring land quality. However, in retrospect, the early work was very 'top-down' in approach and various cultural barriers reduced local acceptance of the need to change land use practises and inhibited the rate of progress (Arnalds and Runolfsson, 2009; Crofts, 2011). More recently, the Soil Conservation Service has increasingly provided guidance and leadership to all who can improve the care of the land. Over 30% of sheep producers in Iceland, along with many other farmers and charitable organizations, are now actively participating in soil conservation work under the themes **Farmers Heal the Land** and, for larger projects, the **Land Improvement Fund.**

Grazing, mainly by sheep and horses, is the main determinant of land health in Iceland (Plate 1). In areas of sensitive soils and vegetation, overgrazing can have dramatic effects,

causing large-scale erosion and slowing down recovery of damaged areas. Strategies for more sustainable land use are being developed, following the path marked by other nations, based on sustainable ethics of land stewardship.

Plate 1: *Sheep production in Iceland is heavily subsidized, but the Government is still paying at* ***both*** *ends; for both the production* ***and*** *the damage to the land. Degraded communal rangeland in the Central Highlands. Photo by Brian Slater.*

Soil conservation in Iceland: the need for a holistic approach

Policies for conservation and restoration of the land resources of Iceland have been gradually evolving from single-issue localized conservation to more holistic approaches meeting a broader spectrum of environmental and societal needs. Five main elements embrace the current approaches.

1. Linking agricultural support to sustainability

First is the linking between agricultural support and land stewardship. Icelandic agriculture is characterized by high levels of governmental support, direct and indirect import barriers, and a growing realization of the need to maintain prosperous agriculture for food security. Debates over the role of governmental support in causing land degradation are growing and can have major impacts on public goodwill towards agriculture. Only a third of the support to sheep farmers is linked to goals of land stewardship, with the consequence that the government has been paying at both ends: for food production and for repair of land damage. A revision of the support regime is essential; not only for the environment but also for the farmers to maintain their social license for continued agricultural support (Arnalds, 2011).

2. Fostering community engagement in caring for the land

Second, there is a need to foster community engagement in caring for the land, as restoration of degraded land and the quest for sustainability are unattainable without a commit-

ment to good management by the agricultural community. Further steps in land user and other stakeholder involvement need to be taken. For fostering community engagement, Iceland is increasingly seeking inspiration and models from globally evolving movements like **Landcare** and **Land Stewardship** (Plate 2). Both are important tools in improving the livelihoods of rural communities, increasing land literacy, aiding in more holistic planning at the landscape level, and reaching goals of biodiversity conservation and restoration (Arnalds, 2014).

3. The needs and impacts of growing tourism: overcooking the golden goose!

Thirdly, there is the growing awareness of the impacts of tourism, which has become the most important industry in Iceland. But the skills and funds for preventing damage to the sensitive nature are lagging far behind, so that tourism is fast becoming one of the biggest environmental issues. The stark beauty of Iceland is partly related to low growing plant species and open landscapes (Plate 3). For tourism, this means that in addition to trampling damage and the building of infrastructure with insufficient regard for site sensitivity, new issues are emerging, such as the need to protect scenic landscapes and preventing loss of view by tall growing non-native trees. Uncontrolled development of vehicle tracks, outside the planning system, is also resulting in massive soil and landscape damage, along with putting Iceland´s extensive wilderness areas under threat (Arnalds, 2016).

4. Role of conservation and land restoration in combating climate change

Fourth is the vitally important role of conservation and land restoration in combating climate change and in attaining other foundations for sustainable development. Soil con-

Plate 2: *Community awareness and participatory approaches are high on the SCSI agenda. The next generation of Icelanders are learning planting techniques and contributing to revegetation. Hólasandur (north-east Iceland) was once a fertile woodland. Photo by Jón Ragnar Björnsson.*

servation and restoration activities preserve and convert carbon dioxide, one of the main atmospheric greenhouse gases, to soil organic matter (SOM), which in turn is the foundation of land fertility and food production (Arnalds, 2008; Halldorsson *et al.,* 2015). As a result of the massive land degradation, vast amounts of carbon have been lost from Icelandic ecosystems; several hundred times more than the current release of greenhouse gases to the atmosphere. The Government is increasingly using the conversion of CO_2 to SOM as one of the tools in meeting national emissions targets, restoring biological diversity, combating soil erosion, revegetation of eroded land and reforestation. Linking carbon sequestration with such goals has been a boost for incentives to ecological restoration.

Plate 3: *With escalating tourism the sensitive nature of the landscape of Iceland urgently needs increased protection. An example in Skogarfoss, on the Skógá River, in southern Iceland. Photo by Andrés Arnalds.*

5. Policy and law

Fifth is the need for a comprehensive law and institutional change to promote sustainable use of soil and other natural resources in a holistic manner. The Organisation for Economic Co-operation and Development (OECD) Environmental Performance Reviews for Iceland (2014) indicated several weaknesses that need to be rectified. These include multiple institutions being responsible for implementing environmental law and land use policies and the lack of co-ordination and co-operation among agencies and between ministries. As a consequence, nature conservation is very weak on ~80 % of Iceland (Plate 4). The importance of soil conservation and land restoration is also not sufficiently recognized as one of the most important tools for broad-based nature conservation. Work is currently under way exploring the feasibility of merging soil and nature conservation into one institute, and possibly also including forestry with native tree species, particularly birch (*Betula pubescens*). The outcome is still uncertain, but his would open up new options for radically increasing the sustainability of both land management and ecosystem restoration in Iceland.

Plate 4: *Rofbard (remnant from wind erosion) in Iceland, a silent witness of lost resources, demonstrating the release of possibly the equivalent of 1.6 billion tonnes of CO_2 to the atmosphere from Icelandic ecosystems. The land between the soil remnants has been reseeded, demonstrating the important role of carbon sequestration by land restoration in combating climate change. Krýsuvík, south-west Iceland. Photo by Andrés Arnalds.*

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Soil Protection with Permaculture Gardening

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Abstract

Permaculture is a complex approach that connects environmental, social and economic aspects. Due to its innovative approaches and natural appearance, it is interesting for people of all ages, including the young, and there is a growing need to deploy permaculture in practise. Permaculture means new opportunities for soil protection and saving natural resources and ensuring greater self-sufficiency. We illustrate the points with reference to the Dole site in Slovenia.

Key words: permaculture, self-sufficient supply, gardening, soil protection.

Introduction

The basic guideline of permaculture is to observe what happens in nature and try to transfer the findings obtained by observation to the human environment. Natural ecosystems are sustainable, and if we understand how they work, sustainability can be transferred into our lives. In nature, the minimum energy consumption gives the highest production:

http://www.permaculture.org/

The focus is not on individual elements, but rather on the relationships built between them and how they are integrated in the landscape. The basic permaculture ethics are care for the Earth, care for people and care for sharing of surpluses and permacultural design principles (Nayak and Prasanna, 2007). Permaculture seeks appropriate political strategies, a healthy global environment and to progressively restore environmental systems (Hemenway, 2009).

Permaculture is an ecological design system for sustainability in all aspects of human endeavour. It teaches us how to design natural homes and abundant food production systems, regenerate degraded landscapes and ecosystems, develop ethical economies and communities, and much more. As an ecological design system, permaculture focuses on interconnections between things more than individual parts (Permaculture Institute, 2013; Graham, 2010). Permaculture is much more than a land-use planning system. It includes the combination of stocking and food production, water supply, energy, waste-water treatment with ecoremediation and co-occupation with animals (Whitefield, 2012). Permaculture is increasingly popular around the world and, whether they achieve it fully or not, many gardeners aspire to its basic principles. Permaculture is all about design; it is a way of creating everything, from abundant and self-sustaining homes and gardens to truly meaningful community projects (Permaculture Free Press, 2013). It is increasingly recognized that industrial production and processing of food and globalized approaches are not the only ways to provide healthy food and water, as well as the required quality standards for all people. Therefore, necessary local initiatives were established to promote sustainable modes of food production and life, to create new jobs and many services and activities. Food security is the basis of human survival (Raman, 2006; Green, 2012) and it is therefore a key challenge for any economy to ensure sustainable provision of adequate quantity and quality of food for the population. We need to take into account the natural capacity for food production (Pierce, 1990) and the main natural resources are fertile soil and ample good quality water. Natural soil fertility decreases land degradation processes, such as erosion, flooding, drought and disease (Jakešova and Vaishar, 2012). The strategy of providing food safety for each country includes sustainable self-sufficiency by the use of locally grown and processed products. In turn, that creates jobs, innovative occupations, motivates people's interest in sustainable technologies and decreases energy consumption (less mobility due to greater use of local resources) and potentially increases agricultural value and employability.

According to FAO we could require current food production to be increased by 50 % by 2050. However, insufficient additional arable land is available. Thus, it is necessary to deal with the land extremely carefully and efficient production approaches must be used. This includes permaculture (permanent culture, food production with special care for soil and water) and ecoremediation (taking into account natural processes). By the mid-21st Century there may be ~10 billion people in the world. Based on current food consumption patterns, we do not have sufficient fertile land and, consequently, food (Stutz and Warf, 2005). Vegetarian food habits require between 700 – 800 m^2 of cultivated land per person, while meat-and-dairy

food habits require ~4000 m^2. In Slovenia, we have 858 m^2 of cultivated land *per capita,* the lowest within the EU (the EU mean is 2080 m^2) (Plut, 2012). All this forces us to think about obtaining land where we could grow food, regardless of land ownership (even those who have no agricultural land and live in cities). Passive attitudes to self-sufficiency can mean even greater deterioration of the situation, for which we are all responsible. Therefore, to increase self-sufficiency we have great responsibility to promote and develop education that can bring these issues into closer scrutiny. These issues apply to everyone (from kindergarten to life-long learning) and we need to incorporate 'land literacy' into everyday learning (Dunphy and Spellman, 2009). Self-sufficiency is an extremely broad issue and is not only the domain of the agricultural profession.

The permaculture garden of Dole is located in the village of Dole in the Municipality Poljčane in Slovenia and covers 1.2 ha (Figure 1, Plate 1). The permaculture garden was established in 2010 and its main purpose is education in self-sufficiency, for everyone from pre-school education to life-long learning. The focus of the permaculture garden is identifying the possibilities of using natural resources for self-sufficiency in energy, which is closely related to mathematics, geography, geomorphology, climatic geography, hydro-geography, vegetation geography and soil geography.

Figure 1: *Location of permaculture garden near Poljčane, Slovenia.*

Plate 1: *Students working on the permaculture garden at Dole, Slovenia.*

Differences in soil properties before and after permaculture gardening

Increased soil moisture content is a consequence of both rainfall, which fell within the days prior to sampling, as well as the ability of soils to trap moisture (Mahmood *et al.,* 2004). Soils that have organic matter have a greater ability to retain moisture. Moreover, soil organic matter (SOM) interacts with the mechanical processes that occur in soil and with soil air content and associated gas exchanges. This affects the activity of micro-organisms, root respiration and soil chemical properties. Incorporation of SOM into the soils at the Dole site has changed soil consistency from hard into crumbly and without physical cultivation. Continual incorporation of SOM has also increased the number and diversity of soil fauna. SOM also plays an important role in the formation of humus, which, in turn, has favourable effects on other soil properties. SOM also decreases evaporation from the soil surface and protects plants and soils from the erosive forces of water and wind. Loss of SOM decreases water infiltration rates, resulting in both more run-off and susceptibility to drought. SOM is an essential component of healthy soils and protects soil from degradation processes. Beneficial effects of permaculture are evident in that the increased SOM improves soil structure and root penetration. SOM also absorbs and retains water, increases water infiltration rates and decreases soil susceptibility to compaction, erosion and landslides.

The results of soil property measurements

Table 1 contains data of the properties of the upper Ap horizon of the soil (0 – 15 cm depth) in 2011 at the Dole permaculture garden. The soil for Profile 1 was taken from the upper part of the permacultural garden and the soil of Profile 2 was taken from the lower part of the permacultural garden. It is evident that the samples from the Dole garden had similar

properties. The samples from the upper part of the permacultural garden had ~2% less soil moisture content and a smaller diameter of stones. The soil from the bottom of the garden had a more argillaceous (clay-rich) texture and lower pH.

Table 1: Soil characteristics without permaculture use in the Dravinja valley (2011)

Soil profile	Profile 1	Profile 2
Colour	Grey-brown	Grey-brown
Moisture content (% by weight)	17	19
Consistency	Stiff	Stiff
Field water capacity	110 mm/100 cm^3	112 mm/100 cm^3
Amount of stones (% by weight)	2	2
Size of stones (mm)	1 – 4	3 –4
Structure	Blocky	Blocky
Texture	Silty loam	Silt clay loam
Calcium carbonate (%)	1	1
pH	6.10	5.90
Soil organic matter (% by weight)	2.0	2.2

The measured properties of two profiles from the field indicate that the soils were poor with low SOM content. The grey soil colour is indicative of reduction processes associated with water retention. The soils were difficult to cultivate, because of their blocky structure and hard consistency.

Table 2 shows the data after two-years of using permacultural approaches, namely, mulches, mulched raised beds and the addition of dolomite sand to increase the soil carbonate content. After taking soil samples, we found significant differences. Soils covered with mulch were friable (with evidence of mole hills). There were no lumps and the soil was uniformly moist. The soils were visibly darker in the upper of Ap horizon, FWC was higher, the proportion of stones decreased, the structure was lumpy, the texture was loam with less clay and higher $CaCO_3$, pH 7, and the SOM content was 4.2 %.

Table 2: Soil characteristics with permaculture use in the Dravinja valley (2013)

Soil profile	Profile 1	Profile 2
Colour	Dark brown	Dark brown
Moisture content (% by weight)	26	27
Consistency	Crumbly	Crumbly
Field water capacity	141 mm/100 cm^3	147 mm/100 cm^3
Amount of stones (% by weight)	2	2
Size of stones (mm)	<1 – 4	0 – 4

Soil profile	Profile 1	Profile 2
Structure	Subangular	Subangular
Texture	Loam	Loam
Calcium carbonate content (%)	2.5	2.7
pH	7.0	7.0
Soil organic matter content (% by weight)	4.0	4.2

Comparison of soil samples from 2011 and 2013 shows marked effects of permaculture in just two years (Table 3). The darker colour of the upper horizon is the result of increased SOM content. This is extremely important in terms of affects on soil processes, including increased water retention and providing a source of energy for soil micro-organisms. The transition of soil colours was from grey to brown and dark brown indicates water no longer stagnates in the Ap horizon. Studies on the temporal dynamics of soil systems on the Dole site are continuing.

The importance of mulches for soils

Mulch significantly affects soil moisture retention. Analysis showed that moisture was particularly retained in mulched raised beds. Pseudogley soils contain higher proportions of clay in Bg horizons, which dries-out in the dry season, thus allowing penetration of warm and dry air to depth and adding to the drying of soil (Plates 2 and 3).

Table 3: Differences in the properties of the soils in the the Dravinja valley

Soil profile	Profile 1	Profile 2
Colour	Dark(er) brown	Dark(er) brown
Moisture content (% by weight)	+9	+8
Consistency	From hard to crumbly	From hard to crumbly
Field water capacity	+30 mm/100 cm^3	+ 25 mm/100 cm^3
Amount of stones (% by weight)	+1.0	+0.7
Size of the stones (mm)	1	1
Structure	From blocky to subangular	From blocky to subangular
Texture	From silty loam to loam	From silty clay loam to loam
Calcium carbonate (%)	+1.5	+1.7
pH	+0.9	+1.1
Soil organic matter (% by weight)	+2.0	+2.0

Conclusions

The improvement of the physical properties of the soil with the use of permaculture demonstrates the benefits of this soil treatment. Permacultural approaches increase soil or-

ganic matter content and help adapt agro-environmental systems to climate change. The most important affect of the mulch on the soil is increasing and stabilizing soil moisture content in the top-soil. Therefore, permaculture systems significantly increase soil moisture retention, especially under extreme climate conditions. Research has shown that permaculture is a comprehensive approach that contributes to adapting to climate changes. In the future, permaculture could make important contributions to local communities, through increased motivation and educational opportunities, leading to the creation of new 'green jobs,' particularly in rural areas. These influences can be combined with the teaching of geography, to encourage a comprehensive approach through the integration of young people and co-operation with local communities.

Permaculture has broad agro-environmental implications. Permacultural approaches have spread across Europe and are increasing local self-sufficiency. Permaculture offers an attractive approach to food production and an integrated design for all aspects of life.

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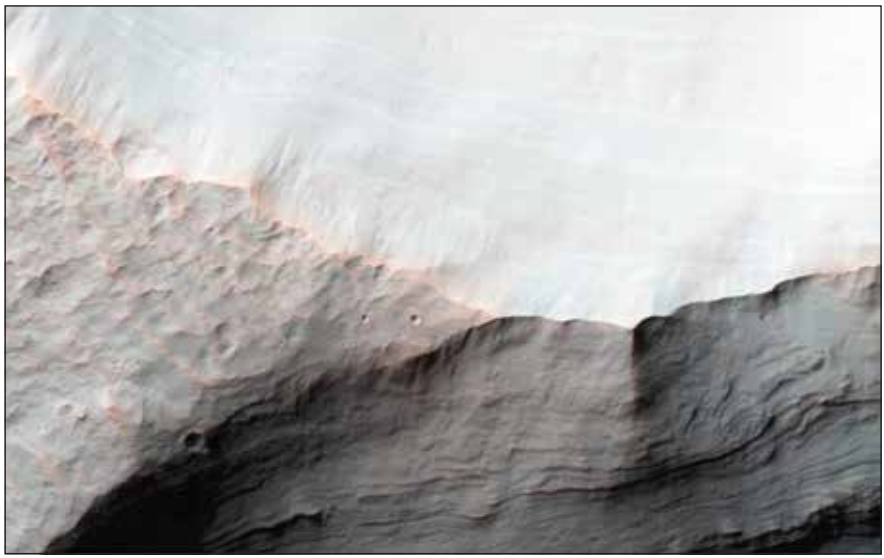
Plate 2: *Mulched raised beds at the Dole site.*

Plate 3: *Permaculture gardening based on mulching soil at the Dole site.*



Alluvial fans are gently-sloping wedges of sediments deposited by flowing water. Some of the best-preserved alluvial fans on Mars are in Saheki Crater. This observation, captured on 23 January 2016 by the High Resolution Imaging Science Experiment (HiRISE) camera on NASA's Mars Reconnaissance Orbiter, covers two impact craters that expose the stratigraphy of the fans. This image will be used to measure the depth of the fan and describe its depositional history, as well as closer views of some of these layers.

Source: **http://www.nasa.gov/image-feature/alluvial-fans-in-saheki-crater-mars**

The **'First International Conference on Afro-Mediterranean Soils: Constraints and Potentialities'** (and the last international conference closing the International Year of Soil) was a revealing and stimulating experience. The Conference was held in Marrakech during 18 – 19 December 2015 and included most important issues related to soil and soil use with a pan-African perspective. This provided an excellent update of the most important problems related to soil constraints in Africa. The Conference was also a very enriching overview of promising approaches towards soil and land management. Soil information and modelling, soil carbon sequestration, soil fertility and crop management, soil restoration and soil health, agro–ecosystem services and climate change were some of the topics addressed during the Conference. The presentations and the discussions showed a dynamic soil science community dedicated to providing scientific and applied knowledge for current challenges and opportunities. The Conference also showed the commitment and willingness to contribute to ameliorating social and economic difficulties, many of them related to problems of climate change. In this context, the organization of UNFCCC COP22 in Marrakech in 2016 merits thoughtful analysis and planning.

The Conference was opened by Professor Mohamed Badraoui (Director of INRA Morocco), Mr. Amine Mounir Alaoui (Executive Vice-President of Fondation OCP) and Mr. Michael George Hage (the Representative of FAO in Morocco). Mr. Yosr Tazzi acted as moderator during the entire Conference.

The Conference was organized into seven Scientific Sessions with keynote presentations, and Workshops with both oral and poster presentations. Session One focused on **'Carbon management and sequestration and Climate-Smart Agriculture.'** The Keynote speakers were: Rattan Lal (Ohío State University, USA) with a video presentation on 'Soil carbon sequestration and management to mitigate climate change.'

Rainer Baritz (FAO, Rome) with 'Carbon soil information under climate change.'

Rachid Mrabet (INRA, Morocco) with 'Conservation agriculture (CA) as a climate-smart approach for coercing sustainability in the Mediterranean basin.'

Joseph G. Mureithi (KALRO-ACT, Kenya) with 'Enhancing access to conservation agriculture knowledge and information and partnerships: Experiences of the African Conservation Tillage Network (ACT).'

Session Two was dedicated to **'Soil erosion and conservation measures.'** It included a keynote presentation by José Luis Rubio (ESBN, ESSC, WASWAC and CIDE-CSIC, Valencia, Spain) on 'Challenges and opportunities for soil conservation under climate change scenarios.'

Session Three was on **'Soil information and modelling,'** with two keynote presentations. These were: Rachid Moussadek (INRA, Morocco) on 'Soil Information Systems in Africa and NENA: an opportunity for improving soil management and climate change adaptation.'

Erik Braudeau (Texas A&M University, USA) with 'A new paradigm in soil science allowing for modelling 'green water' dynamics in soil.'

Session Four was on **'Soil in Africa: Quality and land degradation monitoring,'** with three keynote presentations: Mamadou Traore (African Soil Science Society, University Polytechnique de Bobo Dioulasso, Burkina Fasso) with 'Soil resources in Africa.'

Baghdad Bouamer (IAV Hassam II, Morocco) with 'Soil decontamination.'

Imad eldine Babiker (Agricultural Research Corporation, Khartoum, Sudan) with 'Climate-smart Vertisols and water management in rainfed dryland farming.'

Session Five was on **'Soil Fertility management and crop fertilization,'** with two keynote presentations. These were: Bouabid Rachid (Soil Fertility Map Project Consortium, ENA-Meknes, Morocco) with 'Fertimap: a web-based soil information system for the management of soil fertility and crop productivity in Morocco.'

Tasse Hezekiel (Ethiopian Agricultural Transformation Agency, Ethiopia) with the 'Ethiopia Soil Fertility Project.'

Session Six reviewed **'Linking research to extension for eco-efficient soil management.'** Mougli Lhoussaine (IAV Hassan II, Morocco) gave a keynote presentation on 'The role of extension for better soil management.'

Session Seven was dedicated to Conclusions, recommendations and the Closing Declaration. In the final part of this Report, the Recommendations that emerged from the Conference are presented. The following overview of the Conference was elaborated by Rainer Baritz (FAO Rome), which highlights the salient relevant outputs.

Underlining the Conference

Some 165 participants from 18 countries met in Marrakesh to discuss the very critical condition of soils, especially in Africa. The final communique highlights the crucial role soils play for the social and economic security of 40 – 80 % of the African people who are mainly dependent on small-scale agriculture. While the growth rate of the world population averaged 34 % over the 20 years 1990 – 2010 world-wide, it reached up to 120% over the same period in some African areas. At the same time, crop yields decreased by an average of -8 %, reaching alarming extremes of up to -40% in some areas. Between 1990 – 2010, over 50 % of the land area was degraded, due to water and wind erosion. In addition, nutrient losses, salinization and soil organic matter (SOM) losses on agricultural land are also important causes of land degradation. Even if these conditions were not considered, most African soils would be difficult to manage, due to natural conditions of low nutrient amounts and storage capacities. Most of Sub-Saharan Africa has naturally acid soils. SOM, the most important mediator to supply nutrients to crop roots, often has naturally low concentrations.

The Conference revealed alarming facts about the condition of soils in Africa, high pressures from land use and hazards, such as erosion and soil organic matter loss.

Only 8 % of Africa is suitable for agriculture, probably with a potential to increase if degraded lands were restored. However, there are insufficient reliable data on soil degradation, soil fertility and its potential improvement through sustainable soil management. Knowledge is also lacking about the carbon sequestration potential of African soils. Sufficient SOM

levels are crucial for soil functions, and eventually help improving the resilience of farmers to climate change. Conference participants exchanged various technical reasons for this dramatic situation, but also solutions. For example, various inventories and scientific studies are being conducted to explore current crop yield gaps, which refer to the mismatch between potential and actual crop yields. Farmers lack reliable advice and new knowledge considering the diversity of soil and local management conditions. Absence of planning instruments, knowledge exchange and insufficient technical equipment are some of the main reasons. Reliable data and advice from laboratories (usually taken for granted in many developed countries) are lacking in many African countries, even if the sampling and analysis is sponsored or co-financed by government programmes.

Reliable and up-to-date information about soils and its sustainable management is unavailable.

Soil institutions in research, government and higher education suffer from decreased personnel and lack of funding. However, very promising large-scale soil programmes are conducted with specific purposes related to the closing of the crop yield gap through conservation agriculture and decision support for efficient fertilization. In Morocco, the Fertimap Project covers 6.8 M ha of cropland, with some 26,000 soil samples taken. The results will be made available through a web-based soil information portal offering decision support to farmers. Similarly, in Ethiopia, EthioSIS covers almost the entire Country with some 53,000 sampling points. Some 6,000 extension specialists ensure that the information collected is disseminated to and supporting farmers. The experiences collected through these soil programmes demonstrate the magnitude of effort necessary to successfully guide and support farmers.

Soils can only be sustainably managed and restored if sufficient data reveal insights into the soil condition and its reactive potential for improving the nutritional status.

South-south co-operation is an important means to utilize existing resources and to transfer knowledge and capacity to areas where it is still lacking. The regional soil partnerships for North Africa, the Near East and Sub-Saharan Africa, which are regional bodies of the 'Global Soil Partnership,' can be good means to intensify co-operation within Africa, but also with the global community of soil experts from government institutions, research and education. The African Soil Science Society has developed regional networks in order to better address and advise on challenges regarding sustainable soil management and soil restoration. One of the urgent needs for information is about the current state of soils. It is not well known where soil degradation and its restoration offers new opportunities for agriculture and to what degree soils vulnerable to hazards such as erosion and nutrient loss must be protected. Landscape and agricultural management planning need to consider the sustainable use of soils. However, reliable and high-resolution soil data are mostly lacking.

The Report about the Status of the World Soil Resources, launched at the 2015 World Soil Day at FAO Headquarters in Rome, has especially considered regional issues. The lack of basic information about soils and the threats endangering them, especially in Africa, is alarming.

Morocco will be hosting the 22nd Conference of the Parties (COP) of the UN Framework Convention on Climate Change (UNFCCC) at Marrakech from 8 – 18 November 2016.

Recently, the international community has begun to discuss agriculture and cli-

mate change, especially in the context of adaptation and mitigation. The importance of small-holder farmers for regional food security, and the risk from climate change, are aspects addressed in the discussion. At this point, no clear strategy has been formulated to address agricultural issues, including soils, during UNFCCC negotiations. During COP21 in Paris, soils and sustainable soil management received attention through the '4per1000' initiative, which was included in the Lima-Paris Action Agenda. The next COP will be in Marrakesh. For the alarming situation of Africa's most endangered natural resources (water and soils) this will be a challenge and opportunity to halt the continued degradation of these resources, to improve information about their condition, and to manage them sustainably.

Finally, the Recommendations that emerged from the Conference are presented. The draft was developed by an ad hoc group under the leadership of Rachid Mrabet (President of the Scientific Committee of the Conference), who presented the text to Conference participants at the final Plenary Session for discussion and approval.

Recommendations

1. In response to the Declaration by the UN for 2015 as the 'International Year of Soil' (2015-IYS), OCP Foundation, INRA and FAO were pleased to have organized this international conference on Afro-Mediterranean soils and by the high quality contributions from national and international institutions and associations. The Conference considers the challenges of soil degradation in participating countries and implications for food security and future generations.
2. The Conference was an important forum for exchanges of experience and a platform for knowledge sharing. The presence of high-level experts in various sciences and domains of soils from 18 countries has given the Conference a powerful impetus in developing new ideas and opportunities for further durable development in Africa and the Mediterranean basin.
3. The participation of many young researchers and students (with appropriate gender balance) guarantees future interest in research into the sustainability of soils.
4. The Conference itemized the crucial roles of soils in social, environmental, economic and food security challenges for the future well-being of African societies.
5. The Conference highlighted and underlined the urgent need to deepen south-south co-operation and enrich the exchange and sharing of technologies, resources, experiences and knowledge.
6. The debate and profound discussion in Conference workshops helped participants to acknowledge the important attributes of soils, crops, pastures and forestry and their interaction with global warming. Several management systems were addressed and science-based options were discussed, in order to regenerate soil fertility and revitalize the environment.
7. The importance of soils in policy and decision-making was reviewed. The Conference emphasizes the need for strong information systems, reinforcement of capacity building of all stakeholders (e.g. universities, research institutions, private laboratories and extension services) and to foster soil protection legislation and policies.
8. The Conference recognizes the importance and implications of COP-22 to be or-

ganized by the Government of Morocco in November 2016 and recommends the creation of a task force or an advisory group to prepare a road map to COP-22 for issues related to the priorities and challenges affecting African soils and climate change.

9. The Conference proposes via the Global Soil Partner (GSP) initiative to implement a World Soil Charter. The Charter should address soil degradation, competition for resources, effects on soil productivity, the environment and economy.

10. The scientists and academics assembled at the Conference identified that soil research status in Africa should be further improved through increasing the volume of research and the incorporation of new innovative tools and integrative solutions for soil restoration and improvement. This should include the upgrade of scientific and research platforms, while using state-of-the-art innovations, equipment and methods (e.g. isotopic techniques for soil erosion and water productivity studies, precision techniques, monitoring tools, and soil information and mapping technologies).

11. Sparse soil information in Africa requires an extensive soil survey and digital mapping for better management of land. This would contribute to satisfying the increasingly diverse expectations of Afro-Mediterranean societies from their soil resources.

12. Fostering soil carbon sequestration and management in agricultural, pastoral and forested lands is vital for combatting and mitigating climate change and providing needed agro-ecological goods and services. Professor Rattan Lal stated that *"with a great success, as exemplified by the '4 pour mille' proposal at COP-21, it is important that the International Union of Soil Science (IUSS) and national societies celebrate 'Decade of the Soil' from 2015 to 2024".*

13. Integrated nutrient management, conservation agriculture and soil and water conservation need additional consideration, testing and adoption by farmers and stakeholders. Improved approaches to mass dissemination and adoption are crucial.

14. Research centres should enforce their synergies in order to improve soil research and scientific infrastructures. In this regard, the three Organizing Institutions commit to progress the Conference Recommendations and organize more conferences and support projects on soils. These recommendations will be shared with all participants and their institutions.

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4th European Biochar Winter School: 'Biochar applications: current developments and future perspectives,' Palermo (Italy) 9 – 12 February 2016

The **4th European Biochar Winter School entitled: 'Biochar applications: current developments and future perspectives,'** took place at the University of Palermo in the Aula Magna of the Department of Agricultural and Forestry Sciences from 9 – 12 February 2016. The School was funded by the European Biochar Research Network and COST Action TD1107 'Biochar as an option for sustainable resource management' and organized by Professor Pellegrino Conte, Dr Vito Armando Laudicina and Professor Eristanna Palazzolo from the University of Palermo, Italy. About 40 people, including 12 teachers, attended the School (Plate 1).

Plate 1: *Participants in the '4th European Biochar Winter School Biochar applications: current developments and future perspectives' in Palermo (Italy), February 2016.*

Biochar, or charcoal, is a porous material obtained by pyrolysis of biomass obtained from agricultural practises. Agricultural uses for biochar have been known since ancient times, as evidenced by recent discoveries made in the Amazon River basin of Brazil. To date, many studies have shown that the high absorbent capacity of biochar positively modifies soil properties, thereby enhancing fertility. Advantages in agricultural biochar applications lie also in its enormous physical and chemical stability, which prevents its rapid degradation,

thereby enabling carbon sequestration in soils and slowing the release of greenhouse gases (GHG) to the atmosphere.

The 4th European Biochar Winter School brought together global experts, which reported the the latest innovations in biochar use in agricultural and environmental contexts. The first lecture was from **Professor Carmelo Dazzi** (University of Palermo and President of the European Society for Soil Conservation), who introduced the meaning of the soil as a living body and non-renewable resource. Afterwards, **Professor Bruno Glaser** (Martin-Luther-Universität Halle-Wittenberg, Germany and responsible for the COST ACTION which funded the event) retraced the history of the biochar discovered in the Amazon basin and all its possible applications in modern agriculture. **Dr Alba Dieguez Alonzo** (Technische Universität Berlin, Germany) discussed the most modern analytical techniques for assessing the porosity of biochar. **Dr Hans-Peter Schmidt** (Ithaka Institute, Ayent, Switzerland) discussed innovative techniques to produce low cost biochar and the need for a European Certification to ensure consistent quality standards for all EU countries. **Professor Heike Knicker** (IRNAS-CSIC, Seville, Spain) described the use of nuclear magnetic resonance spectroscopy to characterize biochar and its applications in semi-arid soils of the Mediterranean region. **Dr Kurt Spokas** (Agricultural Research Service, USDA, USA) discussed the role of biochar in mitigating the effects of GHG, its influence on soil hydraulic conductivity and the physical processes involved in the stabilization of biochar in soils. **Professor Claudia Kammann** (Geisenheim University, Geisenheim, Germany) described the absorbent properties of biochar and its role as a fertilizer. **Dr Olivier Husson** (Africa Rice Center/CIRAD, Bénin) discussed the redox properties of biochar and their relationships with soil fertility. **Professor Saran Sohi** (Biochar Research Centre, Edinburgh, UK) discussed the economic advantages of using biochar on a global scale. The Winter School ended with the closing talk by **Professor Pellegrino Conte** (University of Palermo) who, summarizing the previous lectures, reviewed current knowledge on biochar and possible future developments concerning this 'hot' topic.

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Review of: M.A. Fullen, J. Famodimu, T. Karyotis, C. Noulas, A. Panagopoulos, J.L Rubio and D.R. Gabriels (Eds) (2015). Innovative Strategies and Policies for Soil Conservation, Advances in GeoEcology 44 (274 pages, 68 figures, 7 photos and 60 tables) (ISBN: 978-3-923381-62-3, US ISBN: 1-59326-266-3)

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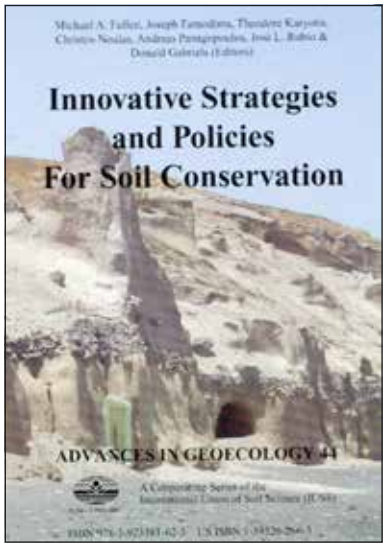

Soil conservation remains a long-lasting and critical concern world-wide, since soil accomplishes essential environmental, economic and social functions. This book consist of 25 papers, based on the '6th International Congress of the European Society for Soil Conservation' held in Thessaloniki (Greece), from 9-14 May 2011. The Mediterranean region, with Greece as the main contributor, delivers half of the papers and it is followed by other European countries from which the Czech Republic has five papers. In addition, South America receives specific coverage, associated with three papers from Brazil and Venezuela. Papers cover a broad range of topics and the main approaches are further summarized as follows:

- Retrospective critique of soil protection policies and strategies reveals the insufficient perception of policy-makers and the general population in several EU countries of the seriousness of the problem and the consequences of inaction. However, soil protection remains high on the EU agenda.
- Several methodologies are discussed. These include the use of spatial data in land planning and soil protection, for modelling sediment and phosphorus (P) transport in streams and reservoirs, for merging analogue and digital soil surveys, and for the development of a model component for more accurate estimates of water balance and erosion under mixed land-uses.
- Modelling water balances through collaboration at regional scales by using lysimeter data.
- Modelling the relationship between seasonal variations of climate and ground-water vulnerability under intensive agriculture.
- Using Electron Paramagnetic Resonance (EPR) techniques to assess changes in soil organic matter.
- Determine the reasonable agreement between different methods used for assessing

nitrogen (N) recovery efficiency in plants.

- Establishing the best time to plant the main crops by monitoring soil temperature and moisture using data-logging stations.
- Determine the effects of three types of poultry litter on soil physical properties under different tillage systems.
- Evaluate changes in soil physical soil properties due to compaction under sugarcane conservation tillage on a Latosol. Soil scarification after the second year of cultivation is recommended.
- Underlining that the soil characteristics related to mean weight diameter (MWD) and Absolute Sealing Index (ASI) are the main factors controlling degradation processes, such as surface sealing and crusting, on loamy soils in central Venezuela.
- Improving knowledge of the effects of pine afforestation on soil organic carbon (SOC) and N to evaluate the best management strategies (BMS).
- Emphasizing the success of reforestation with pine species depends on soil substrate and volume in severe disturbed semi-arid Mediterranean ecosystems, but greater sensitivity is typical for high elevation species.
- Assessing the effects of repeated fire on soil in Mediterranean shrub-lands.
- Reporting the efficacy of using zeolites (Na-chabazite) for remediation of oil contaminated soil and underlining the enormous potential of sand-zeolite mixtures for an environmentally-friendly and sustainable 'green' technology.
- Understanding the importance of expert management of fishponds in maintaining their proper quality standards and avoiding higher sediment and P concentrations.
- Emphasizing the decline of European soil biodiversity as a major threat by estimating its economic value and the adoption of monitoring programmes. Under this approach it is possible to increase public awareness, to facilitate decision-making and identify where to effectively apply policy tools.
- Bridging the gap between scientists, policy-makers and practitioners in applying best management practises to minimize soil salinization in arid and semi-arid environments of the Mediterranean basin.
- Emphasizing the decisive role of land consolidation processes (merging of small individual plots) for implementation of appropriate soil conservation practises.
- Implementation of the GAEC (Good Agricultural and Environmental Condition) standard to protect soil.
- Development of a Geoportal as a useful tool to enable access to soil data and thus increase awareness of soil degradation and protection. Based on this web portal, an interesting series of thematic maps could be drawn by stakeholders. These maps included land productivity, land quality, soil conservation and soil functions.
- Developing the concept of 'Education for Sustainability' through an integrated programme that facilitates understanding the interconnectivity of all three pillars of sustainability (environment, society and economy).

Overall, this book represents a very important piece of research, shedding more light on soil conservation and, through collective efforts, very important gains have been made in the successful management of soil systems.

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Review of the Natural Hazards Special Issue on 'Gully Erosion as a Natural and Human-Induced Hazard:' based on Symposium Papers presented at the '6th International Symposium on Gully Erosion in a Changing World,' held in Iaşi (Romania), 6 – 12 May 2013. Natural Hazards (2015) Special Issue 79

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Gully erosion is recognized around the globe as a major source of sediment to stream systems and catchments, and is a significant natural hazard that can be accelerated by climate change, extreme climate events, and human land-use activities that lead to land degradation. The Natural Hazards (Springer Journal) has recently published a comprehensive suite of 14 papers on **'Gully Erosion as a Natural and Human-Induced Hazard'** in their Special Issue Volume 79, Supplement 1, 2015. The Guest Editors Ion Ionita, Michael A. Fullen, and Wojciech Zgłobicki organized the Special Issue, and were also part of the Scientific Committee on the **'6th International Symposium on Gully Erosion in a Changing World'** held in Iaşi (Romania), 06 – 12 May 2013, on which the Special Issue is based.

This Special Issue contains the latest state-of-the-knowledge in gully erosion science in terms of erosion processes; gully development and rates; advances in measuring techniques; gully erosion modelling, and gully erosion control. The issue is a 'must read' for gully erosion scientists, students and field practitioners. The Special Issue on gully erosion continues the high quality of research presented at and published from previous Gully Erosion Symposia in Leuven (Belgium) in 2000, published in Poesen and Valentin (2003), Chengdu (China) in 2002, published in Valentin *et al.* (2005), Oxford (USA) in 2004, published in Römkens and Bennett (2005), Pamplona (Spain) in 2007, published in Casali *et al.* (2009), Lublin (Poland) in 2010, published in Janicki *et al.* (2011), and most recently, Iaşi (Romania) 2013, published in Ionita *et al.* (2015a).

The 6th Symposium on Gully Erosion was chaired by Professor Ion Ionita at the "Alexandru Ioan Cuza" University of Iaşi, along with the Co-Chair Professor Jean Poesen, (KU Leuven, Belgium). The Symposium was sponsored by the 'International Association of Geomorphologists' (IAG), the 'European Society for Soil Conservation' (ESSC), the 'Romanian Association of Geomorphology' (AGR) and the 'Romanian Academy.' Professor Ion Ionita and the Romanian Organizing Committee and Secretariat graciously hosted a collaborative conference in the historic city of Iaşi, which brought together over 50 scientists from all continents and 21 countries, with 34 oral presentations and 20 posters. As a participant in the Symposium, I can confirm that it was a truly wonderful experience in all aspects of scientific rigour, fascinating

field trips, fruitful collaboration and learning, delightful food and catering, and the beauty of the Romania landscape, its people and culture (Plate 1). A very special ceremony was also held by the Senate of Alexandru Ioan Cuza University of Iaşi recognising Dr Jean Poesen as an Honorary Professor for his outstanding contribution to the field of Physical Geography in Romania and around the globe (Plate 2).

Plate 1: *Gully erosion scientists who participated in the 6th International Symposium on Gully Erosion and the Natural Hazards Special Issue.*

The contents of the Natural Hazard Special Issue covered a variety of themes related to gully erosion, including: 1) the process-based development of rill and gully networks, 2) field measurement of gully erosion rates and process, 3) mapping and modelling of areas prone to gully erosion, 4) the potential for geo-tourism and education at gully sites, and 5) the stabilization and control of gully erosion. These themes and relevant articles are reviewed below.

The initiation of gully erosion progresses from overland water runoff, to concentrated rill formation, to deep gully erosion, and eventually the development of entire drainage networks, are all influenced by top-down controls (hydrologic and hydraulics) and bottom-up controls (base level and vegetation roughness). In the keynote paper for the 6th International Symposium on Gully Erosion, Bennett *et al.* (2015) presented detailed experimental flume data on the development of rill networks triggered by base-level lowering and simulated rainfall. Their numerical analysis showed a high correlation of the surface drainage network prior to erosion and rill development location after erosion and head-cut migration. They emphasized the importance of antecedent topography and the ability to predict future erosion locations from high quality topographic datasets. In another flume environment, Momm *et al.* (2015) measured the evolution of gully width using detailed photogrammetry, which is also an applicable measurement method for field gullies. Their data showed the importance of block failure and bank erosion to the evolution of gully width after head-cut expansion. In a much larger 'field flume' experiment on bank gullies in China, Su *et al.* (2015)

measured soil erosion rates above, at and below head-cuts according to water runoff and hydraulic drivers on both bare ground and cultivated soil. They found differences in erosion on slopes above gullies from disturbance, but no erosion differences at or downstream of head-cuts. They concluded that decreased soil disturbance and increased vegetation cover were the keys to erosion prevention and control.

Plate 2: *Dr Jean Poesen at his award of an Honorary Professorship by the Senate of Alexandru Ioan Cuza University of Iași, with wife Catti and Professor Dan Bălteanu (Bucharest).*

Field-based studies of gully erosion rates and process remain at the core of applied geomorphic research. Ionita *et al.* (2015b) provided a classic study of gully erosion in agricultural hills in eastern Romania, based on decades of detailed research of hazard-prone areas. They measured the massive erosion and extension (15 – 30 m/yr) of deep gullies (≤20 m) into agricultural valleys and slopes during the last five decades. This gully erosion was triggered by deforestation and land conversion in the 19th Century in soils and valleys naturally prone to gully hazards, and has been continued by ongoing changes in land management practises. Severe land degradation has resulted, with high sediment concentrations (100 – 300 g/L) resulting in reservoir infilling downstream. In tropical examples of gully erosion hazards accelerated by massive land use change, Moeyersons *et al.* (2015) investigated the 'mega-gullies' of Kinshasa (DR Congo), where population has increased twenty-fold over 50 years to nine million people and gullies affect urban dwellings and livelihoods. Their analysis of rainfall-runoff coefficients and thresholds demonstrate that water runoff and erosion are controlled by urban soil compaction, vegetation cover, slope, and road water runoff, with the latter roads being a primary cause of accelerated gully erosion. These findings are critical to identifying erosion prone areas and developing improved urban development planning and gully stabilization strategies. New technologies, such as Terrestrial Laser Scanning (TLS), are now available to measure topography and erosion change within gullies in high resolution, as demonstrated in the field study of Kociuba *et al.* (2015) in Poland. Their research shows that precise measurements of erosion rates from TLS can be compared to driving variables, such as summer rainfall and winter snowmelt, as well as the evolution and incision of gully head-cuts.

Mapping the current landscape distribution of gully erosion and modelling the sus-

ceptibility of areas to gully erosion are essential for improved planning and management to avoid increasing gully erosion from land-use impacts and reduce sediment yields from gully erosion 'hotspots.' Jurchescu and Grecu (2015) provided a detailed review of a statistical modelling method to predict gully location and density at two different catchment mapping scales. Their predictions were based on independent landscape variables and calibrated from detailed gully mapping, despite major gully masking issues with forest cover. They found that both mapping scales were useful and sufficiently accurate for management planning, by starting with the coarse scale and then increasing the scale of investigation into priority areas. Gómez-Gutiérrez *et al.* (2015) statistically analysed the ability of topographic data and metrics at both high and low resolution (2 – 50 m pixels) to predict areas of gully erosion susceptibility. They found that the size and form of gully erosion (hillslope versus valley bottom gullies) influenced the ability for predication at different scales, with finer scales needed for the prediction of small linear hillslope gullies. In developing countries with more limited datasets, Maerker *et al.* (2015) demonstrated how the combination of global digital elevation datasets, Google Earth satellite images, and GPS ground-truthing can be used to artificially increase the resolution of DEMs. Simple, low-cost but accurate methods for gully assessment are very useful in common situations. Similarly, Zakerinejad and Maerker (2015) combined standard remote sensing, elevation, rainfall, soil and vegetation datasets with more detailed Google Earth satellite imagery to model and map the distribution of both rill and gully erosion. They found that a combined approach for predicting surface and rill erosion from an erosion and deposition model, and gully erosion from a stream power index threshold, together resulted in reasonable predictions of field observations. For highly gullied badlands in Italy, Vergari (2015) used standard topographic and lithology metrics along with catchment sediment yields of denudation rates to statistically assess the main causes of erosion. A Susceptibility Index to water erosion and its intensity was developed, which can be used by agricultural land managers to avoid disturbing or abandoning areas prone to badland erosion.

Topographic thresholds of slope and catchment area are commonly used to explain and predict the locations of gully heads in the field. Rossi *et al.* (2015) demonstrated the bias in these standard thresholds and added an additional curve-number metric to take rainfall and hydrology into account. However, they concluded that future threshold analyses must utilize additional variables, such the distance to the catchment outlet from different land uses and vegetation conditions, as a weighted CN approach.

Across the planet, gully erosion comes in many fascinating forms and sizes, from the deepest gully canyons, to completely denuded badlands, to intricately fluted sidewalls of bank gullies, to slot canyon gullies incised into loess and revegetated with mature trees. The geotourism potential of gully sites was explored in Poland by Zgłobicki *et al.* (2015). Their surveys found that key gully sites and landforms can be used as both geo-tourism and educational sites (Geoparks), and that through education the public can be better informed about the hazards and threats of gully erosion.

Throughout the six International Symposia on Gully Erosion, the topic and focus on gully stabilization and rehabilitation has typically been a small component of research papers (Poesen, 2011). This could be that much of the active gully management is left to field practitioners, individual farmers and government agencies; or that many gully scientists focus on erosion processes and prevention education rather than applied field implementation; or that limited funding to actively address chronic gully erosion problems creates a science and rehabilitation void in the 'too hard basket.' However, there is a long history of gully prevention and stabilization programmes in many countries, with detailed research documented in

both the scientific and 'grey' literature (for example see reviews in Shellberg and Brooks, 2013; Guerra *et al.*, 2015). To effectively reduce the downstream impacts of elevated sediment yields from gully erosion, more applied research into the most cost-effective gully prevention, stabilization and rehabilitation techniques must be conducted to build on this past knowledge.

As a terrific example published from this Natural Hazards issue (see erratum), Guerra *et al.* (2015) provided a scientific case study of community participation in an urban gully stabilization project in Brazil. The associated research demonstrated the effectiveness of locally constructed and applied biological (palm-leaf) geotextiles, stakes, contour terraces, fertilizer and grass seeds to stabilize gully slopes. The successful project rehabilitated a degraded area and provided income and improved livelihoods to people in the local neighbourhood. The site serves as an educational example of the need for sustainable economic development, where gullies are caused by rapid population growth and urban development.

From these outputs of the Natural Hazard Special Issue and the '6th International Symposium on Gully Erosion,' it is hoped that soil and land management can be improved using this process and practical knowledge across the globe, so as to reduce gully erosion threats from human activities and impacts to downstream environments under the ever increasing challenges of population increase and climate change.

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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, 52 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.

ESSC Newsletter and ISSN Number (2413-9297)

The ESSC Newsletter has been registered with its own International Standard Serial Number (ISSN 2413-9297). The ISSN was first printed on the cover of ESSC Newsletter 2015/1 and is now printed on all subsequent Newsletters. In accordance with the international agreement on ISSNs, a copy of each issue of the publication must be lodged in the national library of the relevant editorial office. Therefore, a copy of the 32 issues of the Newsletter (2005/1 to 2016/1) is now lodged in the British Library at Wetherby (near York, in north-east England). All future issues of the ESSC Newsletter will also be lodged at the British Library. Arrangements are in progress to collate the entire collection of ESSC Newsletters for permanent archiving in the British Library.

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Recent Publications by ESSC Members

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 775. 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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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:
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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: **kajove@gmail.com**

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:

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ESSC
EUROPEAN SOCIETY for SOIL CONSERVATION
8th ESSC CONGRESS
12-16 June 2017
Lleida (Spain)
To be held under the framework of the "1st WORLD CONFERENCE ON SOIL AND WATER CONSERVATION UNDER GLOBAL CHANGE" (CONSOWA)
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INVITATION

As President of CONSOWA 2017, I cordially invite you to participate in the '1st World Conference on Soil and Water Conservation under Global Change' to be held from 12-16 June 2017 in Lleida (Spain). For the first time, all the main World scientific organizations promoting wise and sustainable use, management and conservation of the main natural resources of soil and water have decided to stage a joint Conference.

The venue of the Conference is Lleida, which is a pleasant middle-sized city in Catalonia, on the River Segre and surrounded by the most extensive irrigated fruit plantations in Spain. It has also the oldest University in northern Spain, founded in 1297. The programme of field tours will investigate interesting issues relating to soil and water conservation, especially the management of dry-lands and intensive irrigated agriculture.

Professor Dr Ildefonso Pla Sentís

President of ISCO, Vice-President of WASWAC, Member of the Executive Council of ESSC, President of the Soil and Water Conservation Section of SECS.

Pre-Conference field trip: Saturday 10 June 2017 (Soil Use and Landscape in Periurban areas of Barcelona).

Conference: Monday 12 June-Friday 16 June 2017.

Field tours (five options): Wednesday 14 June.

Post conference field trip: Saturday 17 June-Monday 19 June 2017 (Traditional Rainfed Agricultural Systems and Desertification Processes in Semi-arid Volcanic Islands; Canary Islands of Lanzarote and Fuerteventura).

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Deadlines
Submission of Short Abstracts: 30/11/2016; Letter of acceptance: 15/01/2017.
Submission of extended abstracts: 31/03/2017.
Early registration fee €400: 31/12/2016; (fee for officially confirmed students: €200).
Late registration fee (after 31/03/2017) €550 (fee for officially confirmed students: €275).
Payment of the fee for the Pre-Conference field trip: 15/02/2017.
Payment of the fee for the Pre-Conference field trip: 15/03/2017.


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Ulldecona
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Conference field trip 2
Conference field trip 3
Conference field trip 4
Conference field trip 5


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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.
(iv) A reference list of your 'new' international refereed scientific journal papers, which have been published recently (since and including the year 2000).
(v) 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 three 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: Autumn harvest festival, Qingkou village, Yuanyang. Photo taken by Mike Fullen (Wolverhampton, UK) on 12 November 2010.

IV. On the Arrival of the Three Months of Autumn

❧

Verse 204

Cicada and Dayue, do fly to the branches of the chestnut tree under which the Hani rest.
Over there the voice is ringing and the resting place is cozy.

Do not rest upon the lowest branch, where the dew is too wet;
Do not rest upon the highest branch, where the wind is too strong;

Rest upon the middle branch,
From where the voice is ringing,
And the singing is more pleasant,
What is more, fresh leaves are abundant there.

Haven eaten tender leaves on the tree,
Having drunk dew on the ground,
They tweet with natural necks.
The natural loudspeakers are hidden under their wings,
As big as thumbs,
But their voice rings over nine hills and nine valleys.

❧

Verse 212

New paddy is harvested, in the family field at dawn.
The goddess of new paddy comes to initiate the ceremony,
And three branches are inserted on the verge of the field
With feet standing firmly in the field.
When cutting the first paddy,
We pay best wishes for a bumper harvest;
When cutting the middle paddy,
We pay best wishes for health and the longevity of mankind;
When cutting the last paddy,
We pay best wishes for the prosperity of domestic animals.

❧

Verse 230

The girl goes out to chop firewood in the early autumn morning,
Without the awareness of Mam and Dad.
The teak in the village cannot be chopped.
For it is the right place for Bingu bird and cuckoo to rest there;
The Longan in the village cannot be chopped,
For cicada and Dayue sing there;
The teak and Longan are those trees
Marking the turn of the year and month.

Do not chop the high and strong chestnut tree,
It is quality material in building houses for the offspring,
Either to be girder or to be post.
Bear in mind not to chop the chestnut tree.

Climb over the mountain,
We try to find a zhaba tree to chop.
There are ten trunks in a tree,
There are ten branches in a trunk.

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

"I bequeath myself to the dirt, to grow from the grass I love; if you want me again, look for me under your boot-soles" (Walt Whitman, 1819-1892).

"We are able to breathe, drink, and eat in comfort because millions of organisms and hundreds of processes are operating to maintain a livable environment, but we tend to take nature's services for granted because we don't pay money for most of them"
(Eugene Odum, 1913-2002).

"Probably more harm has been done to the science by the almost universal attempts to look upon the soil merely as a producer of crops rather than as a natural body worth in and for itself of all the study that can be devoted to it, than most men realize"
(C.F. Marbut, 1920).

"A soil is not a pile of dirt. It is a transformer, a body that organizes raw materials into tissue. These are the tissues that become the mother to all organic life"
(William Bryant Logan, Dirt: The Ecstatic Skin of the Earth).

"Desire added to concentration will wrench any secret from nature"
(Charles F. Haanel, 1916).

"It is more profitable to produce tools than goods, and thus by producing researchers, one was putting one's talents out at compound interest"
(Professor William W. Watts FRS (1860-1947), commenting on why he preferred advising researchers rather than focusing on his own research).

"Time is not absolute. The underlying reality of all things is eternal, and what we call time is really quantified eternity" (Deepak Chopra, 1993).

"Pass then through this little space of time conformably to nature, and end thy journey in content, just as an olive falls off when it is ripe, blessing nature who produced it, and thanking the tree on which it grew"
(Emperor Marcus Aurelius (121-180 AD), Book Four, Verse 48).

"Say "out" to every negative thought that comes into your mind. No person, place, or thing has any power over you, for you are the only thinker in your mind. You create your own reality and everyone in it" (Louise L. Hay, 2004).

"This existence of ours is as transient as autumn clouds.
To watch the birth and death of beings is like
looking at the movements of a dance.
A lifetime is like a flash of lightning in the sky,
Rushing by like a torrent down a steep mountain"
(Gautama Buddha, quoted in Deepak Chopra, 1996).

International
Decade of Soils
2015 - 2024

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

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