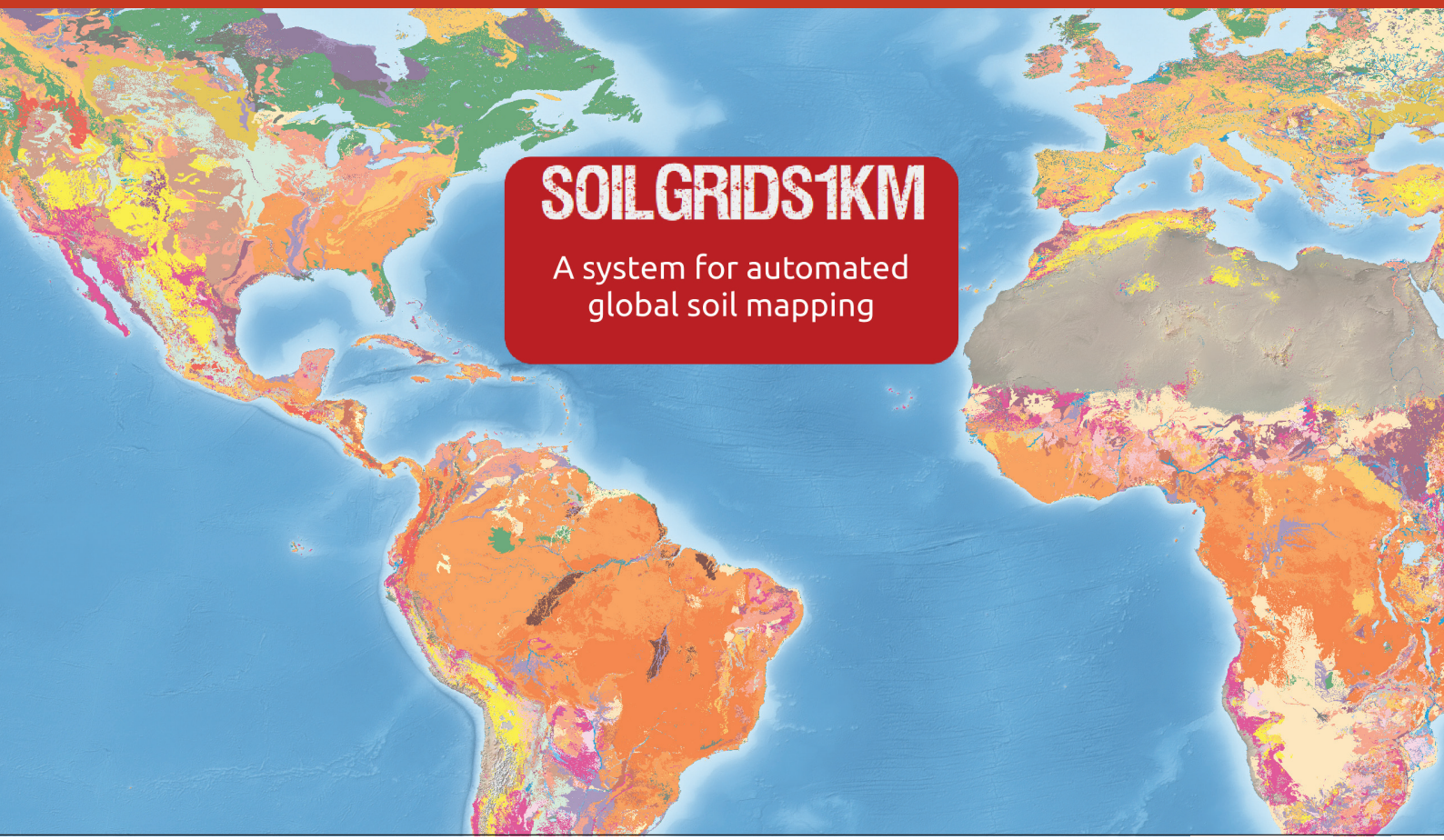
Highlights 2012-2013

ISRIC World Soil Information



International Developments

A key development in the international arena has been the launching of the Global Soil Partnership (GSP) in 2011 and its formal establishment in 2013. The GSP is mandated by the Committee on Agriculture of the FAO and aims to support and facilitate joint efforts towards sustainable management of soil. Endorsed by the Netherlands Government, ISRIC - World Soil Information (ISRIC) has partnered in this global initiative and has committed to make a considerable contribution to the aims of the GSP – in particular with regard to activity pillars that aim to enhance the quantity and quality of soil data and information and to harmonise methods, measurements and indicators for sustainable soil management.

The contribution of ISRIC to the GSP is one of the most important challenges for the institute in the near future, given the great implications this can have for the soil sciences in general, as well as for the societal impact of the soil sciences in particular. The world is changing, and so is the societal agenda for the soil sciences. We face the pressing need to produce food of good quality for an increasing global population. But apart from achieving global and local food security, the central role of soil quality has become apparent in many other global issues. The soil is a major component in the global cycling of materials, energy and nutrients. It is also a major source of and sink for radiatively active greenhouse gases (CO_2, N_2O and CH_4). This emphasizes the importance of soil and water management to adaptation and mitigation of climate change. Along with the increasing human population, soils in urban environments become increasingly important to the establishment of green, clean and safe environments. The soil also harbours a tremendous biological diversity, which is the driving force behind numerous ecosystem services in terms of making nutrients available to plants and creating suitable habitats for species-rich natural ecosystems. All these developments ask for new ways to create soil information systems. A special challenge for ISRIC is to develop adequate, up-to-date techniques to deliver such novel soil information systems. The rapid developments in digital soil mapping and advanced geo-statistics have a fundamental effect on the way soil information systems are to be developed.

Mr Wouter Verhey, Policy Coordinator, Ministry of Economic Affairs of The Netherlands in discussion with ISRIC representatives prior to the presentation of the initial SoilGrids1km product (FAO/GSP, Rome, 5 Dec. 2013; Photo: H.E. Gerda Verburg)

A key example of the new ways to develop soil information systems is the Global Soil Information Facilities (GSIF). It is a combination of expertise, hardware and software that provides a cooperative way to collect, organise, harmonise and analyse soil information, and make this information 'fit for use'. GSIF enables cooperation with soil information gathering agencies and institutes, including activities like crowd sourcing, while property rights are ensured. A recent product of the GSIF is the *SoilGrid1km*, as detailed below; a prototype of this system was presented by ISRIC at the celebration of the World Soil Day (5 December 2013) at the FAO headquarters in Rome.

In 2014, ISRIC will contribute to the implementation of the activities as laid out in the GSP Pillar plans as approved by the General Assembly of the GSP. Furthermore, ISRIC will continue and strengthen its international activities by providing its contribution to international processes, projects, and activities, such as the *GlobalSoilMap*, the *Africa Soil Information Service* (AfSIS), EU FP7 Research Projects and similar.

International Scientific Advisory Council

The International Scientific Advisory Council (ISAC) is an advisory body of internationally recognised soil experts representing the research community, UN organisations, private enterprises, policymakers and representatives from Civil Society Organisations. The role of the ISAC is to help set out the overall strategy for ISRIC, and to provide advice about, and actively support actions to implement the strategy.

The first meeting of the new ISAC was held at the FAO headquarters in Rome (13 March 2012). The objective

of this meeting was to reflect on the developments at ISRIC over the 2010-2012 period and propose strategies for the coming two to three years in terms of: 1) type of data/information to be provided to which user groups, 2) database development and webservices, 3) staff development and, 4) funding and international cooperation and positioning. The main recommendation coming out of these discussions was the need for ISRIC to ensure its international position and mission in terms of providing soil information systems, rather than developing into a market-oriented research institution. Further, ISAC recommended that ISRIC's major asset should be a strong international position as frontier scientific institute in the field of soil information systems. It also recommended that ISRIC take up a central and leading role in the Global Soil Partnership, as this is at the heart of ISRIC's mission.

International Cooperation Strengthened

Global Soil Partnership
ISRIC is a pro-active partner in GSP. It has provided training during regional workshops held in Jordan and Colombia, organised under the auspices of FAO/GSP, to support the compilation of harmonised regional soil databases, drawing on available legacy data. It is developing a soil and terrain (SOTER) database for Western Africa, as a contribution to an anticipated update of the Harmonised World Soil Database (HWSD). Most importantly, the first approximation of *SoilGrids1km* was presented to the GSP in Rome, as a proposed contribution of The Netherlands, for possible endorsement by the Intergovernmental Technical Panel on Soils (ITPS) in 2014.

GlobalSoilMap
ISRIC is also a member of the *GlobalSoilMap* project consortium, which aims to produce a 90 m resolution soil property map for the world by 2018. In that capacity, it was responsible for developing the uncertainty quantification specifications for *GlobalSoilMap*-derived products, was a co-organiser of the First *GlobalSoilMap* Conference (Orleans, October 2013), and managed the project website.

ICSU World Data Centre for Soils
The World Data Centre for Soils (WDC-Soils) at ISRIC focusses on soil-related collections and information services. It supports the mission and objectives of the World Data System of the International Council for Science (ICSU-WDS) by 'ensuring the long-term stewardship and provision of quality-assessed data and data services to the international science community and other stakeholders'. Through ICSU-WDS, ISRIC is registered as a Participating Organization in the intergovernmental Group on Earth Observations (GEO) since 2013.

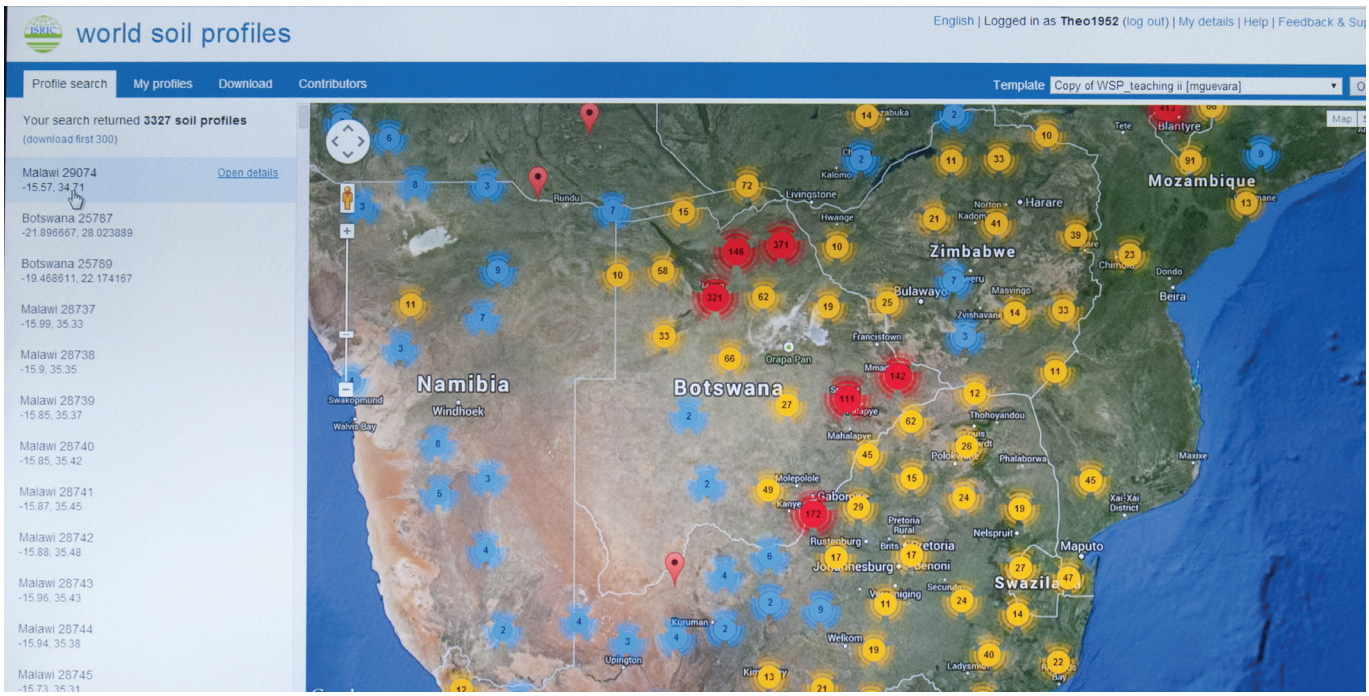
UNCCD Accreditation
In 2013, ISRIC renewed its accreditation with the Conference of the Parties of the United Nations Convention to Combat Desertification (UNCCD); it is registered as a Civil Society Organization (CSO) under the sub-category Research Institution.

Soil Data and Soil Mapping

SoilGrids1km
SoilGrids is an automated system for global soil property and class mapping that draws on a global compilation of shared soil profile and covariate data. The system is a key component of the overarching Global Soil Information Facilities and the result of international collaboration. The first products generated using *SoilGrids* are at a resolution of 1 km; they are the first in a series of global soil property and class maps that will be produced by ISRIC and its partners in the years to come.

Institutional Database Structure
Primary soil data, needed to underpin the various GSIF applications, are handled through the World Soil Information Service (*WoSIS*), ISRIC's institutional database structure. All data managed, maintained or hosted by ISRIC will be integrated into the system. The holdings in *WoSIS* can be accessed and queried by multiple services. The interface, through which various data holdings will be made available to users, is under development; access to each data holding will be in accordance with the licence specified by the various data providers, as described in the ISRIC Data Policy.

World Soil Profiles
World Soil Profiles (WSP) is the user-friendly access facility to *WoSIS*. It permits users to access information and run spatial searches for 'shared' profiles held in the central database. The multilingual WSP service presently supports ten languages; users may register and introduce their own data using predefined templates



Example of a spatial search for soil profiles using World Soil Profiles (http://worldsoilprofiles.org/)

or create project specific templates. Once the data is screened at ISRIC, the newly submitted data is added to *WoSIS*. From there, the data will be ready for visualisation and further data processing (subject to the licence category specified by each data provider).

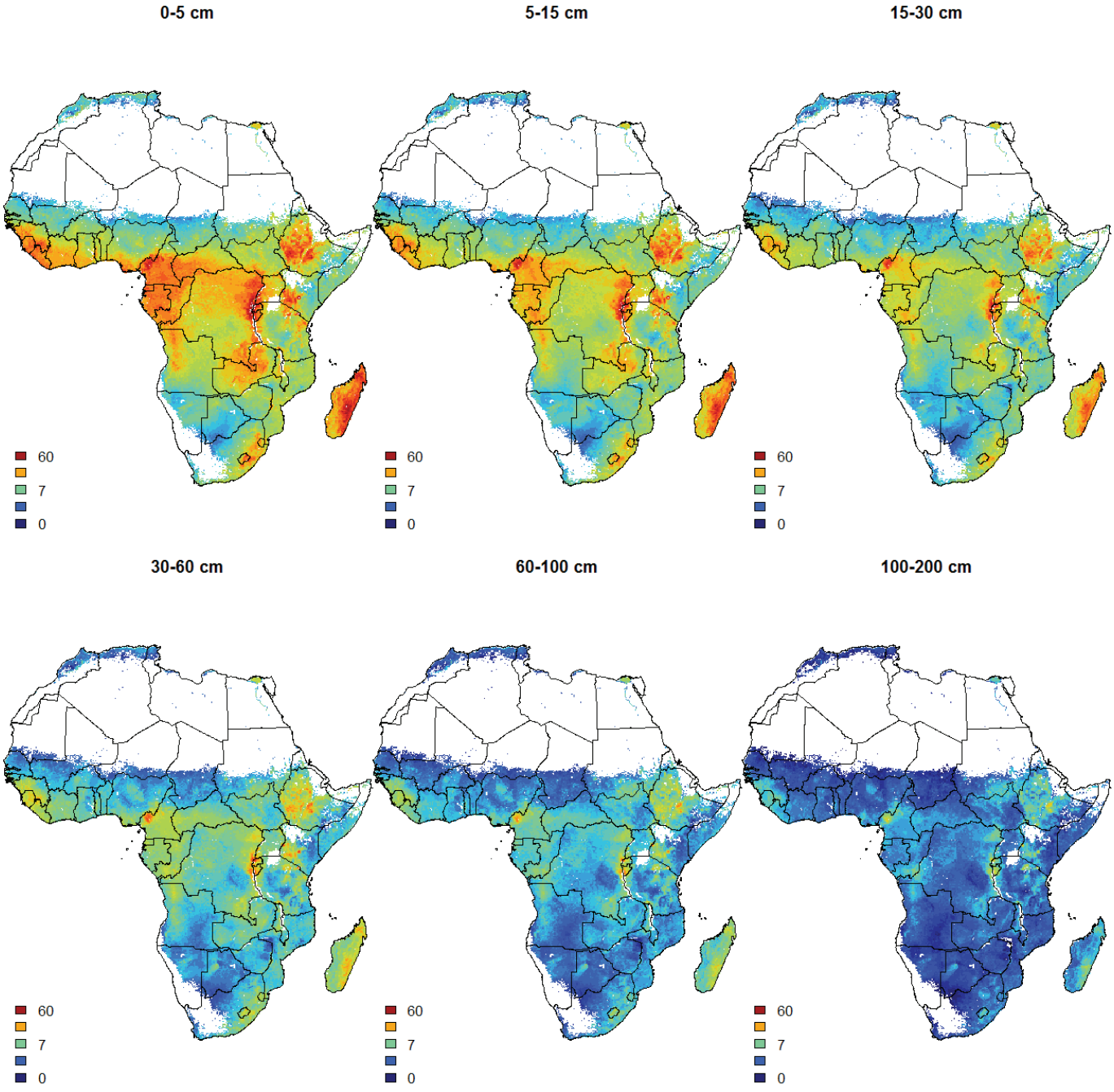
Africa Soil Information Service

ISRIC has been instrumental in successfully bringing the first phase of the Africa Soil Information Service (AfSIS) project to completion – the Africa Soil Profiles (AfSP) database and continent-wide 3D soil property maps at 1 km resolution derived from it are now available to the international community for use. ISRIC has also contributed to the follow up phase, the aim of which is to transform the original science project into a 'product and service provider'. On-going activities include the extension of the AfSP database and soil property mapping at higher spatial resolution for focus countries in Africa. Active involvement of prospective 'users of soil information', such as national governments and the private sector, is being sought to be able to provide improved soil information to support agricultural production.

The AfSP database draws on decades of soil survey campaigns in Africa, converting a myriad of legacy soil data into queryable formats that are linked to the digital platforms developed for AfSIS. At present, the soil database holds over 16,000 unique profile records inventoried from over 450 different sources, both digital and analogue. All data have been submitted to routine quality checks and digitized using a common standard. The AfSP is made available as a standalone database and it may be accessed through WoSIS.
Digital soil mapping algorithms embedded in *GSIF*, that access the AfSP point data and GIS-layers of environmental variables held in the *worldgrids.org* repository, were used to generate soil property maps for the 'non-desert' parts of the continent at 1 km resolution. The 3D-maps present estimates for selected properties, such as organic carbon and soil pH, at six depth intervals and also quantify the associated uncertainty. This is in accord with the requirements and specifications of the *GlobalSoiMap* project.

Soil and Terrain Databases

The EU-FP7 funded e-SOTER – where SOTER stands for World Soils and Terrain database – was a European contribution to a global soil observing system, as part of the Global Earth Observing System of System (GEOSS). The project delivered a regional pilot platform with methodologies, concepts and applications. Together, these should facilitate: 1) an enhanced SOTER database methodology at scale 1:1 million for Europe and the world; 2) the generation of finer-scale maps of specific soil and terrain attributes, and digital data based on existing soil survey data and remote sensing; 3) the development of a framework for cost-effective programs of field survey and monitoring. The e-SOTER project (2008-2012) was co-ordinated by ISRIC – World Soil Information and involved collaboration with 14 partner institutes in Europe, China and Morocco.



Soil organic carbon content (%) at six depth intervals produced using the GSIF methodology developed for the AfSIS project

Soil Carbon Mapping in Tanzania

In support of the UN-REDD programme in Tanzania and the National Forest Resources Management and Assessment (NAFORMA), ISRIC staff contributed to the development of a topsoil carbon map at 250 m resolution for the country. In addition to the actual mapping exercise, seven Tanzanian scientists were trained in digital soil mapping during training sessions in Wageningen and Dar es Salaam. The project (2013) was carried out in close collaboration with five Tanzanian organisations and the AfSIS project; technical support was provided by the FAO.

Application of Soil Information in Global Development Issues

GEF Carbon Benefits Project

Conserving and improving organic matter held in the soil is critical for the provisioning and functioning of a range of ecosystem services. ISRIC was a partner in the Carbon Benefits Project (CBP), implemented by UNEP, which developed standardised tools for the GEF (Global Environmental Facility) and other sustainable land management projects to measure, model, monitor and forecast carbon stock changes and greenhouse gas emissions. The online tools were released by UNEP in 2013 upon the incorporation of the recommendations of an international review meeting organised by GEF and UNEP. The standardised C-benefits protocol will permit the consistent comparison of different sustainable land management projects by GEF and other donors.

Review workshop for the GEF of the tools developed by the CBP consortium (Voi, Kenya, 13-16 September 2012)

SCOPE Benefits of Soil Carbon

The Rapid Assessment Project on Benefits of Soil Carbon (SCOPE-BSC) is a major international effort to transfer complex science evidence into new policy approaches and into new land management practices. Some forty international experts were contacted to prepare background chapters summarising the state of knowledge within their disciplines. Subsequently, an international workshop, hosted by the European Commission - Joint Research Centre (Ispra, March 2013), assembled these experts to write four cross-cutting chapters that build on the state of the knowledge from the background chapters, point out knowledge gaps, identify research needs, and propose new solutions. Upon peer-review and final editing, these chapters are to be published as a SCOPE Science Monograph in 2014.

Green Water Credits

The Green Water Credits (GWC) project aims to develop a funding mechanism between downstream beneficiaries from upstream interventions based on soil and water conservation measures. Pilot projects were started with Dutch funding in two countries. In China, ISRIC and its partners have implemented a GWC feasibility study as well as training on the GWC concept. The team has also developed a toolkit for 'Green Water Management and Credits' that was demonstrated in the Danjiangkou Reservoir catchment of the Changjiang (Yangtze River) Basin and discussed with various stakeholders. In the second country, Algeria, preparatory missions were carried out to establish contacts with the partner institutions. The demonstration project is part of a larger initiative, led by the Netherlands Africa Business Council (NABC), aimed at enhancing Dutch-Algerian collaboration in the field of water.

Mitigation and Remediation of Land Degradation

The EU-FP6 funded project on *Desertification Mitigation and Remediation of Land Degradation* (DESIRE), coordinated by Alterra of Wageningen UR, was completed in 2012. In 2013, the EC considered DESIRE to be a 'flagship project'; ISRIC was responsible for the Work Package on 'Study site contexts and goals: local desertification extent and impact'.

The aim of the subsequent project on *Preventing and Remediating Degradation of Soils in Europe through Land Care* (RECARE) is to fill knowledge gaps in the understanding of the complexity and functioning of soil systems and their interaction with human activities. The EU-FP7 project (2013-2018) is led by Wageningen University and involves collaboration with 27 institutions and organisations in Europe. ISRIC is coordinating the Work Package on 'identification and selection of appropriate mitigation and prevention measures'.

Global Assessments of Land and Ecosystem Degradation

Within the project on *Biodiversity, Ecosystem Services and Development* of the Netherlands Environmental Assessment Agency (PBL), ISRIC and Plant Research International (PRI-WUR) have developed a quantitative methodology to assess the global loss of productivity due to soil degradation. The aim of the project was to

quantitatively understand interrelations between ecosystem degradation and economic development, particularly with regard to food and water security, through the IMAGE-GLOBIO model. Preliminary results were presented and discussed during the 2nd UNCCD Scientific Conference in Fortaleza (2013); fine-tuning and validation of the methodology by the consortium are ongoing.

In conjunction with the above, a review commissioned by the UN Convention on Biological Diversity (CBD) has been conducted in collaboration with the World Resources Institute (WRI), the UNCCD, and PBL. One of the aims of the 'Aichi Biodiversity Targets' is to restore 15% of degraded ecosystems by 2020. ISRIC has been helping to define the basis for this vital international target, and the progress made towards achieving it.

Characterization of major soils of the CASCAPE project area, Ethiopia

Soil Information and Agricultural Production in Ethiopia

The CASCAPE project, a joint effort of Ethiopia and The Netherlands, aims to improve agricultural productivity in Ethiopia by capacity building for scaling up of evidence-based best practices. The project is executed by Alterra of Wageningen UR in close collaboration with the Agricultural Growth Programme of the Ethiopian Government. ISRIC was sub-contracted to assist in the soil characterisation study, which is to provide the basis for developing site-specific and functional soil information that would guide soil fertility management decisions by smallholder farmers.

Soil Atlas of Africa

The Soil Atlas of Africa, published in 2013, is the result of a collaborative initiative of the European Union, the African Union, and the FAO. ISRIC staff provided expertise and valuable materials drawn from the World Soil Library and Map Collection. They also contributed to the development of the Harmonised World Soil Database, the data of which underpin the maps in the atlas.

Reference Collections

Towards a New World Soil Museum

ISRIC has been working on the realisation of an exciting project, the construction of an eye-catching building for the World Soil Museum. The outside walls have been coated with clay loam to give the building a natural soil appearance. About 80 monoliths of the world soil reference collection are on display inside; these provide the nucleus for the museum's educational programme. Visitors can experience the diverse functions of soils in supporting life and ecosystems, and also get an impression of the enormous diversity of soil types around the world; from the deep, black monolith from the Russian steppe to the puddled rice soil from the Philippines. Six 'multi-media', thematic stations provide visitors with additional information on food production, soil and water, land degradation and conservation, soils and landscape, soils and biodiversity, and soils and climate change. Further, using the state-of-the-art visualisation functionality built into GSIF, visitors can explore a selection of soil property and class maps on a central screen. The new exposition has been open to visitors since January 2014; the official opening of the new World Soil Museum will take place on 7 April 2014.

Soil Exploration and Sampling Project

Drawing on the experience of a wide range of partner institutes, ISRIC has been sampling soil profiles and collecting monoliths in the framework of the *Soil Exploration and Sampling for Science and Education* (SOLEX) project (2010-2014). SOLEX is part of a global sampling scheme aimed at enhancing the scientific and educational scope of ISRIC's World Soil Reference Collection. New sites are selected on the basis of criteria such as geographic representation, soil taxonomic class, main soil processes, soil management, and scientific interest. Desert soils were sampled along a transect in Jordan; in Morocco, profiles were sampled in key soil-geographic regions. In Borneo (Indonesia), sampling

A subset of ISRIC's reference collection of soil monoliths displayed using the visualization functionality of GSIF; the actual monoliths are on display in the World Soil Museum

was along a gradient of land use and forest cover. Alternatively, in the Netherlands, special attention was paid to profiles with a specific management history such as a 'flower bulb soil' and a 'deep-ploughed soil' from the former 'peat colonies'. Targeted sampling and monolith preparation will continue in 2014. The SOLEX project is co-funded by the Netherlands Ministry of Economic Affairs, Wageningen University, and ISRIC.

Soil Reference Library

Since its foundation in 1966, ISRIC has been maintaining a repository for 'endangered' documents on soil resources. The collection now includes some 8,500 soil-related maps, of which 78% have been digitized, and some 15,700 reports, of which some 28% are available online in full-text format. With respect to the acquisition of new materials, special attention has been paid to the collection and digitization of soil maps and reports for Africa in conjunction with the AfSIS project; the accrued information is available for online consultation. There is a growing demand, from all parts of the world, for materials held in ISRIC's online library. In 2013, the database has been queried some 49,000 times up from 36,000 in 2011.

Sampling of profiles for the ISRIC World Soil Reference collection

Training and Education Programme

The Training and Education Programme provides the international community with a wide array of courses and lectures on soils of the world and their classification, soil mapping and soil information systems, as well as on the use and importance of soil information for sustainable land management. Since 2013, ISRIC has been organising a Spring School for beginning soil scientists as well as experienced ones. The five-day event consists of two modular courses: 'World Soils and their Assessment' (WSA) and 'Hands-on Global Soil Information Facilities' (GSIF). Upon successful completion of the Spring School, participants were given a certificate of attendance.

Participants and lecturers of the first 'ISRIC Spring School' (April 2013)

ISRIC experts have also provided soil science lectures for hydrologists and environmental engineers at the Institute for Water Education (UNESCO-IHE) and contributed to a BSc course on land and water management of Wageningen UR. Other tailor-made courses that were provided by ISRIC include 'Uncertainty specifications for GlobalSoilMap' (at USDA-NRCS, Lincoln), 'Digital Soil Mapping' (at EU-JRC, Ispra), and two training missions on 'soil classification, data harmonization and soil information systems' for the GSP. Details can be found at *http://www.isric.org/services/training-and-education*.

Participants of the training course on Soil Data Harmonization in Cali, Columbia

Visiting Scientists and Internships

The guest researcher programme aims to strengthen international collaboration and stimulate the exchange of knowledge and information. During the period under review, ISRIC had guest researchers from Argentina, Brazil, Croatia, and India. Main subjects addressed included geo-statistical soil mapping and uncertainty analysis, web-based soil applications, and the development of regional SOTER databases.

MSc students were given the opportunity to gain experience within an academic working environment by contributing to an ongoing project under the supervision of an ISRIC staff member. In conjunction with this, contacts were established with the International student association AIESEC and two other Student Associations of Wageningen UR.

Staff

Dr Prem Bindraban, Director ISRIC – World Soil Information up to 15 June 2013, left to take up the position of Executive Director of the Virtual Fertilizer Research Center, Washington DC. Prem played a crucial role in refocusing ISRIC's activities and strengthening the institute's position in the international soil community. Pending the appointment of a new Director, in 2014, the Board of ISRIC has made Dr Hein van Holsteijn, acting Director, responsible for daily management of the institute; Professor Dr Peter de Ruiter, Chair Managing Board, now has the responsibility for international relations and scientific guidance.

Six valued colleagues have retired or taken up new positions. Most of the resulting vacancies have been filled; at the end of 2013, ISRIC had a staff complement of 21 (15 fte), including scientific staff as well as support staff for collection and website management. Support on financial, legal, human resource affairs, and library maintenance has been provided by the Environmental Sciences Group (ESG) of Wageningen UR under a cooperative agreement with the institute.

ISRIC Staff in 2013 (http://www.isric.org/staff)

Website

The website plays a key role in the information dissemination strategy of ISRIC – World Soil Information, which hosts the WDC-Soils. Over 50,000 online guests visited the website in 2013. The importance of the website is apparent from the over 133,000 'downloads', corresponding with 591 different online documents or datasets, in that year. Many of our datasets can also be accessed through the Global Change Master Directory (NASA-GCMD) and the GEOSS portal.

Staff Publications

Peer-reviewed and other publications authored or co-authored by staff address the broad range of issues that fall under the ambit of our institute, which is to serve the international community with information about the world's soil resources to help addressing major global issues; full references may be found on our website (*http://www.isric.org/biblio/*).

In recognition of their scientific work, several ISRIC researchers are associate editors (*European Journal of Soil Science; Spatial Statistics*) respectively Editorial Board members of one or several Scientific Journals (*Agriculture, Ecosystems & Environment; Environmental and Ecological Statistics; Geoderma; Geoinformation; Geographical Analysis; International Journal of Applied Earth Observation*).

Accounts and results for 2013

Balance sheet

Assets

fixed assets	€	331,664
current assets	€	479,372
liquid assets	€	569,179
Total assets	**€**	**1,380,215**

Liabilities

capital	€	546,859
provisions	€	155,016
current liabilities	€	678,340
Total liabilities	**€**	**1,380,215**

Profit & loss account

Turnover

base funding	€	1,279,987
research projects	€	789,562
Total income	**€**	**2,069,549**

Expenses

Personnel costs	€	1,351,790
General costs	€	491,822
Material expenses on research	€	195,849
Total expenditure	**€**	**2,039,461**
Net result	**€**	**30,088**

ISRIC

World Soil Information

ISRIC – World Soil Information is an independent foundation with a global mandate for collecting, storing, processing and disseminating soil information in support of global research and development.

ISRIC obtained its mandate at the UNESCO General Conference in 1964, and has been supported by the Netherlands Government since 1966. ISRIC is the ICSU-designated *World Data Centre for Soils* since 1989.

ISRIC coordinates a number of global soil programs through grants from major institutions and donors. It has a strategic association with Wageningen UR (University & Research centre) and collaborative agreements with a range of institutions including FAO and JRC.

Additional information may be obtained through *www.isric.org*.

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