Bi-Annual Report 1997 - 1998

ISRIC

ISRIC was born out of an initiative of the International Society of Soil Science, and was adopted by Unesco as one of its activities in the field of earth sciences. It was formally founded on 1st January 1966 by the Government of The Netherlands, upon assignment by the General Conference of Unesco in 1964, and became a Foundation in 1994.

Most of the working funds are provided by the Dutch Ministry of Education and Sciences, and are administered by the Directorate-General for International Cooperation (DGIS) of the Ministry of Foreign Affairs.

The constituent members of the Board of ISRIC are the International Institute for Aerospace Survey and Earth Sciences (ITC), Wageningen Agricultural University (WAU), the Agricultural Research Department of the Netherlands (DLO), and the Ministry of Agriculture, Nature Management and Fisheries.

Advice on the programmes and activities of ISRIC is given by the Scientific Advisory Council.

The financial-administrative responsibility for the working funds and for the ISRIC's personnel rest with the Board of ITC.

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International Soil Reference and Information Centre

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Inquiries:
International Soil Reference and Information Centre (ISRIC)
P.O. Box 353
6700 AJ Wageningen, The Netherlands
Phone : +31 317 471711
Fax: +31 317 471700
E-mail : SOIL@ISRIC.NL

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1 ORGANIZATION

1.1 THE LONG-TERM STRATEGY OF ISRIC

ISRIC, the World Data Center for Soils of the International Council of Science (ICSU) collects, stores, processes, and disseminates information on soil and terrain resources with the objective to contribute to research and development on sustainable utilization of the land.

Soil, a crucial life supporting system, is a complex medium, which displays a great diversity in physical appearance, in chemical behaviour, and in the flora and fauna present. The role of the soil is of vital importance to mankind and the maintenance of a healthy environment. Soil is a natural resource, which is not renewable in a short time, and very expensive to reclaim or to improve once it is eroded by water or wind, physically degraded or chemically depleted. It is our common duty to safeguard it for future generations, while obtaining the best benefit from its use now (Stoops and Cheverry, 1992)[1].

Although world cereal production almost doubled between 1966 and 1990, the growth in aggregate cereal output started to decline after 1982, mainly as a result of a decline in quality and performance of irrigation systems, an inefficient use of fertilizers, a negative nutrient balance in most non-irrigated drylands in developing countries, increased losses from pests and diseases, and a fall in commodity prices, leading to reduced incentives to invest.

In a report, prepared by a panel of senior scientists for the World Bank, Borlaug (1995)[2] argued that, although advances in science during this century have increased world food supplies more rapidly than the population has grown, “we must acknowledge that in many of the most productive areas – especially irrigated areas located in warm climates – there are problems of declining soil and water quality that, if unchecked, can lead to permanent loss of prime agricultural land. Low profits (mainly in developing countries) have kept farmers from adequately investing in resource conservation, while excessive subsidies (mainly in industrial countries) have caused over-use of agricultural chemicals, with subsequent environmental damage".

[1] Stoops, G. and C. Cheverry, 1992. New Challenges for Soil Research in Developing Countries: a Holistic Approach. Proceedings Workshop of the European Community (STD 3), Rennes, 22 p.
[2] Borlaug, N.E., 1995. Food Production. In: Meeting the Challenges of Population, Environment and Resources: The Cost of Inaction. Environmental Sustainable Development Proceedings Series No. 14. World Bank, Washington, p. 16-18.

In much of Africa and in most non-irrigated dry lands in Asia and Latin America, the mining of soil nutrients is pushing average crop yields into decline. Farmers are trying to produce more food by extending their traditional low-input practices into forest land, or onto drier and more vulnerable pasture lands, or by shortening fallow periods. As a consequence, soil quality deteriorates e.g. by soil nutrient decline, loss of organic matter, and soil compaction. Fertile top soil is washed away by the erosive forces of water, or blown away by wind. This so-called first generation of environmental problems leads not only to a negative nutrient balance, but also causes habitat destruction and loss of bio-diversity.

In some of the more advanced developing countries high-input farming systems have caused a second generation of environmental problems. Excessive use of water in irrigated areas in the semi-arid and arid regions have lead to water-logging and secondary salinization. Excessive use of fertilizers and pesticides and inadequate nutrient and animal waste containment have resulted in acidification and pollution of soil and water resources, not only causing a health hazard for human and animal population, but also leading to loss of bio-diversity and contamination of rivers, lakes and coastal waters.

As a consequence of the increasing population and of the scarcity of unused land, which is physically and socio-economically suitable for cultivation, there will be increasing pressure on all sectors of society to utilize the existing cultivated areas as efficiently as possible, and on a sustainable basis. In his plea for feeding humanity, Pinstrup-Andersen (1995)[3] urged action to meet the food needs of a growing population , while preventing or containing environmental degradation. In this light ISRIC, as World Data Center for Soils, has reformulated its long-term strategy as follows: *Contributing to the Challenge of Providing Sufficient Food for the Growing World Population, while Preserving the Biophysical Potential of Natural Resources, and Minimizing Environmental Degradation.*

1.2 PROGRAMMES AND ACTIVITIES

ISRIC, established in 1966, is a centre for documentation, research and training about the soils of the world with emphasis on developing countries. It aims to promote interaction between producers and users of soil and terrain information. ISRIC facilitates access to and use of this information in studies on world food security and global change. Wherever and whenever possible ISRIC participates in alliances with international, regional and national agricultural research centres and natural resources information institutions. Its target beneficiaries are international agencies; donor agencies; natural resources organizations, mainly in Africa, Asia, Central and Eastern Europe, Latin America and the Middle East; the scientific community, educational institutions, and the general public.

[3] Pinstrup-Andersen, P. and R. Pandey-Larch, 1995. Food Security and the Environment. In: Ecodecision no. 18, Quebec, p. 18-22.

Historically, ISRIC’s mission has been the collection and dissemination of scientific knowledge about the soils of the world, aimed at their suitability and utilization for various agricultural and non-agricultural purposes. The establishment of a global collection of soil monoliths in Wageningen, the development and improvement of methods of soil analysis, and support through training for national and regional soil reference collections in the developing countries formed the core of ISRIC’s activities.

With the rapid emergence of information technology ISRIC shifted its emphasis to the development of methodologies for the systematic storage of data concerning soil and terrain resources in a computer-compatible format. The internationally recognized Soil and Terrain database programme (SOTER) – a joint FAO, IUSS, ISRIC, UNEP project – constitutes since the mid-eighties one of ISRIC's main lines of activity.

Primary data on soil and terrain resources, as well as on other environmental resources form the base-line for the assessment of land qualities and for monitoring changes. The demand for accurate, up-to-date and readily accessible data on natural resources is repeatedly expressed. (The first policy recommendation for the protection and improvement of agricultural lands, as formulated by IFPRI (Scherr and Yadav, 1996)[4] deals with the improvement of information systems for land management: "A high priority is to develop geo-referenced, computerized information systems, that can collect, store, and analyze data on natural and socio-economic resources and that can disseminate in "user-friendly" format, information about the range of options and techniques for different types of soils, climate and farming systems"). ISRIC’s research programme makes use of databases, such as SOTER and auxiliary databases on climate, land use/land cover, to provide information to better understand and quantify the impact of soil conditions and the changes of biomass production over time.

Since the late eighties ISRIC, together with its partners overseas, has devoted much effort to synthesize at global, regional and national scales the status of human-induced soil degradation. The Global Assessment of Human-Induced Soil Degradation (GLASOD), published in 1990, was followed-up by a more detailed assessment of the Status of Human-Induced Soil Degradation in South and South East Asia (ASSOD). Early 1997 ISRIC was commissioned by FAO to implement a study on Soil and Terrain Vulnerability Mapping in Central and Eastern Europe (SOVEUR). The last two studies use the SOTER methodology to delineate mapping units.

Of equal importance is knowledge on soil conservation approaches and technologies. ISRIC is a partner in the World Overview of Conservation Approaches and Technologies programme (WOCAT), which is coordinated by the Swiss-based Centre for Development and Environment (CDE). WOCAT also uses SOTER mapping units in its mapping programme.

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[4] Scherr, S.J. and S. Yadav, 1996. Land Degradation in the Developing World: Implication for Food, Agriculture and the Environment to 2020. Discussion paper 14, IFPRI, Washington, 36 p.

Ultimately the three methodologies (SOTER, GLASOD/ASSOD/SOVEUR, and WOCAT) should be integrated into a Land Resources Information System (LRIS). Late in 1998 the International Institute for Tropical Agriculture (IITA) and ISRIC formulated an initiative for the development of an Integrated Land Resources Information System for the Conservation and Rehabilitation of Land Resources of West Africa (WALRIS).

Terrestrial eco-systems play an important role in controlling/regulating global atmospheric conditions. Changes in world climate conditions take place as a result of increased atmospheric concentrations of so-called greenhouse gases, mainly as a result of increased fossil fuel emissions and changes in land use. The soils of the world, and their vegetative cover, are important sources and sinks of a number of greenhouse gases such as carbon dioxide, methane, nitrous oxide and nitric oxide. Human-induced changes in land cover, and their effects on the area of productive and degraded soils, form a significant element of global change.

On the other hand, changes in climate and atmospheric conditions will have an impact on the soils of the world and, as a consequence, on world food production. ISRIC, as an ICSU World Data Center for Soils seeks to strengthen links with the International Geosphere – Biosphere Programme (IGBP).

Data quality is a prime concern. Information, derived from databases is as good as the quality of the data they contain. Based on its experience with soil and water analytical laboratories in different countries ISRIC's laboratory staff developed the Guidelines for Quality Management in Soil and Plant Laboratories and a Soil Laboratory Information Management System for Soil and Plant Laboratories (SOILIMS). The detailed guidance and management systems are powerful tools for improving the quality of soil analytical data.

In order to strengthen and extend communication with its wide range of users ISRIC has developed its own Website. The present site (http://www.isric.nl) is in the first stage of development and is presented to illustrate the potential for ISRIC' s services. ISRIC aims to improve its capabilities to disseminate information and to offer a wider range of services using modern Information and Communication Technologies (ICT). During the past 10 years ISRIC has stored its bibliographic and most of its cartographic collection in computerized databases.

Soil classification serves as a powerful tool of communication between soil scientists. However even after a hundred years of modern soil science a generally accepted system of soil classification has not yet been universally adopted (Dudal, 1990)[5]. During the past 20 years a consortium of international soil scientists have devoted their time and experience to develop a World Reference Base for Soil Resources (WRB). This initiative of FAO, supported by UNEP and the International Society of Soil Science resulted in the publication of the WRB volumes, formally presented to the President of the ISSS at the 16th World Congress of Soil Science held in Montpellier, 1998. From the outset until its completion ISRIC was associated with the development of the WRB.

The need for geo-referenced soil and terrain information, at resolutions ranging from global to national and local, is repeatedly expressed. This information not only provides a service for global action programmes related to global change and global food security issues, but is of equal importance at national level. There is a great demand for information, derived from baseline soil and terrain data, to achieve a better understanding of soil conditions and to quantify the impact of soil degradation on bio-mass production. This information should be disseminated in different formats to a wide range of users of the land, both at farmer’s level and at policy, research, and decision making level. Details of ISRIC’s programme and its activities are further elaborated in Chapter 2.

1.3 INSTITUTIONAL DEVELOPMENTS

ISRIC is an independent foundation with a cooperative management agreement with the International Institute for Aerospace Survey and Earth Sciences (ITC), located in Enschede. This agreement was formalized in 1994. Since ITC belongs to the family of Institutes of International Education (IO) any institutional developments or reorientation of organizational structures will also have an impact on ISRIC’s programmes.

In 1998 an "Interdepartmental Policy Research Report for the IO institutes" was prepared by an evaluation committee at the request of the Ministry of Education and Science. A structure focussed on "client orientation", "flexibility", and "competition" was recommended. The proposed reorientation may imply that core subsidies ("input financing") will gradually be replaced by project subsidies ("output financing").

[5] Dudal, R., 1990. Progress in IRB preparation, in: Soil Classification; Reports of the International Conference on Soil Classification (12-16 Sept. 1988), Alma-Ata, USSR, Moscow, pp. 69-70.

In view of these recommendations ISRIC will have to rely upon external funding mechanisms for its programmes more than it has in the past. Programmes and associated activities, which were highly relevant in the past, have to be reviewed for their future relevance. It should however be stressed that not all functions, which remain relevant for ISRIC's long-term strategy, can be funded by external resources (e.g. ISRIC's function as "Soil Museum", and as "World Data Center for Soils"). Presently the programme of ISRIC's laboratory for soil and water analysis is under review. Most of the traditional work (analytical work on ISRIC's soil monolith collection) has been completed. New client-oriented activities have to be developed, for which ISRIC has a comparative advantage. An integration of the various soil analytical laboratories in Wageningen is also envisaged.

Although located in Wageningen, ISRIC is not directly involved with the reorientation that took place within the Wageningen Agricultural University (WAU) and the Agricultural Research Institutes (DLO) and that resulted in an integration of the WAU and DLO, now called Wageningen University and Research Centre (WUR). ISRIC has however indicated its interest to cooperate closely with the WUR in joint implementation of project activities.

1.4 STAFF DEVELOPMENTS

On October 1, 1997 one of ISRIC's senior staff took early retirement. Drs. J.H.V. (Hans) van Baren, deputy director of ISRIC , has been employed at ISRIC since 1972. Although he formally retired from ISRIC, he remains active as guest researcher at ISRIC and continues his function as Deputy Secretary General of IUSS. His position at ISRIC as deputy director was taken over by Ir. J.H. (Sjef) Kauffman.

To mark the retirement of Hans van Baren (JHVB) after 26 years of service with the International Soil Museum and the International Soil Reference and Information Centre, the following discussion was recorded when Hans reminisced over his working life during a lunch with Dr. E.M.Bridges (EMB) in June, 1999. It gives a good insight into his interests and professional career.

Interview with Hans van Baren

EMB *We first met twenty-five years ago at an ISSS meeting held in Ghana on the Soils of the Semi-arid and Sub-humid Savanna lands, but I would like to take you back to your early life before you became a well-known soil scientist. Please tell me a little about your boyhood.*

JHVB I was born in The Hague, but my formative years were spent in Utrecht, the town to which my family moved in 1940. It was in Utrecht that I attended school and ultimately went to University. In my secondary school years I was greatly influenced by a Dr C. van Rijsinge whose views of the importance of ecology were broadcast on radio, and who had set up a centre for the study of the interaction of different branches of science.

EMB *To what extent were you influenced by your parents in your choice of career?*

JHVB My grandfather was an agro-geologist and a contemporary of Dr van Rijsinge and my father was a graduate of the Agricultural University of Wageningen. My father's interests were in soil fertility, trace elements in soils and practical applications of soil science in agriculture. Although prospects for a young geologist at that time were not very good, I studied geology at the University of Utrecht. The course I followed included soil studies in Wageningen under the guidance of Professor Edelman. My fellow students at that time included Pieter Bleeker, Nico Meyer Drees and Wim Vreekens. As a student, I also became acquainted for the first time with Dik Creutzberg, who subsequently became a life-time colleague and friend at the International Soil Museum/ISRIC.

EMB *You were obviously a successful student, coming from a family with academic traditions, did you ever have aspirations of reading for a doctorate?*

JHVB Yes indeed. Professor Doeglas, the Head of the Department of Geology at Utrecht, had employed me on a part-time basis for 6 years to assist him with his sedimentological studies, and I did some mapping for him in France where he was investigating to relationships between sediments and soils. In my last two years at University it was proposed that I should work for a PhD on a similar investigation of soils and parent materials in the area known as the Weald in Southeast England. I was about to begin this work when Professor Allen of Reading University published upon exactly the same topic I was to investigate. I had no option but to abandon the project.

Hans van Baren thanking Dr. Masanori Okazaki for his gift (a bottle of sake) and for travelling from Japan to Wageningen on the occasion of Van Baren's retirement. On the right, Hans' partner Els

EMB *That was most unfortunate, but how did you move across into mainstream soil science?*
JHVB Well, I took the initiative to make contact with Unesco, which at that time had a system whereby young scientists were recruited to work in their projects around the world. With the support of my uncle, Professor F. van Baren, I went to Paris where I was interviewed by Dr Bramao and subsequently offered employment. The post was in Rome and the task was to assist Dr Dudal in preparatory work for the FAO-Unesco Soil map of the World. This was a busy, happy time for me as I had recently married, and with my wife and son, had set up home in Rome.

EMB *What happened next?*
JHVB After 3 years working in the FAO-Unesco Soil Resources Office, I was sent by FAO to East Pakistan, just before it became Bangladesh where my immediate colleagues were H. Brammer, G. Higgins and R. Brinkman. This posting lasted for 2 years after which I was sent to Kenya to assist with the development of soil surveys. With my Dutch colleagues, Van der Schans, Veenenbos, and somewhat later Sombroek, our work was to first make a soil reconnaissance of the whole country and subsequently to make detailed maps of areas of high agricultural potential.

EMB *When did you return to live in the Netherlands?*
JHVB With the experience gained in Rome, Bangladesh and Kenya, I wrote to ITC at Enschede asking what positions were available. In 1972, I was fortunate to be offered a post in the International Soil Museum, which had only then recently been set up by the International Society of Soil Science. The Museum was then housed in temporary quarters in the Department of Soil Science in the University of Utrecht where I joined Dik Creutzberg who had been appointed a few weeks earlier. Together with the assistance of W. Bomer senior we set about collecting and preparing soil monoliths of different soils according to the classification of the FAO-Unesco Soil Map of the World. These monoliths were the foundation of the ISRIC collection of today which numbers some 900 soil profiles.

EMB *So, when did you move to Wageningen?*
JHVB The removal of the International Soil Museum from Utrecht to Wageningen took place in 1978 after Professor Buringh persuaded the University to provide a site free of charge. In a happy co-incidence, an old wooden building conveniently burnt down, and this enabled the Soil Museum to be erected alongside the Department of Soil Science and Geology in Duivendaal. A sectional building, specially designed for ISM, was constructed containing a lecture room, an exhibition hall, offices for staff and laboratories for soil monolith preparation and soil analysis. The building was opened at a ceremony on 9th March, 1979, I eventually moved to Wageningen in 1981.

EMB *How did ISM develop following its relocation in Wageningen?*
JHVB It was always envisaged that the Soil Museum would be more than a collection of soil monoliths, and with the appointment of Wim Sombroek and other members of staff, the work of the Museum expanded. Reflecting this widening of the institute's work, the name was changed to the International Soil Reference and Information Centre in 1984.

EMB *What was your role in these developments?*

JHVB In earlier years I was much involved in the collection and classification of the soil monoliths. I was also concerned with developing the display of soil monoliths in the exhibition hall. This display was based upon the categories of the Legend of the FAO-Unesco Soil Map of the World, extending the fascinating work I began with Dr Dudal in Rome. With minor changes, this exhibition remained until the threat of flooding from the river Rhine in 1994 forced the removal of all the profiles in the exhibition hall to the upper floor of the building. This dramatic event, together with the incentive of a number of important visiting workshops, allowed us to completely recast the exhibition along soil-ecological zones between 1995 and 1996. As the staff numbers grew, I became increasingly involved in administrative duties and with overseeing the publications of ISRIC.

With Sombroek as General Secretary and myself as Assistant Secretary of the International Society of Soil Science, there was much work to be done for the International Society as well. A positive benefit for ISRIC in housing the offices of the ISSS has been the steady flow of books that came into the library after being reviewed in the ISSS Bulletin. We also have a unique collection of publications resulting from activities of the International Society. ISRIC is also the repository of many manuscripts of soil surveys carried out in different parts of the world.

EMB *With your retirement in 1997, will you be able to indulge your own cultural interests to a greater degree?*

JHVB As you know, I have been on the committee that has facilitated the bi-annual sculpture exhibitions in the Wageningen Botanical Gardens, but I also have interests in the Arts and music which I will be able to spend more time upon. Until the next meeting of the International Society of Soil Science, now the International Union of Soil Sciences, I remain as Deputy Secretary General, so although I have retired, I remain active!

EMB *Before we close this conversation, what are your thoughts for the future of ISRIC?*

JHVB ISRIC faces a very competitive market place for its expertise. Increasingly, this expertise must be used to attract funding for suitable projects. There remains a great need for co-ordinated research that brings together the physical, social, economic and practical pressures on soils as Dr Rijsinge impressed upon me early in my career. There is much that ISRIC can contribute to the sustainable use of soils, for food security and forest production, as well as providing a sound pedological background to problems of soil pollution. The data-handling facilities developed by ISRIC staff over the past few years have permitted easier manipulation of the mass of descriptive and analytical data arising from soil investigations, and this has led ISRIC staff into providing courses for field and laboratory staff in many parts of the world. It has also enabled ISRIC to make a significant contribution to global environmental studies. I hope these trends continue.

2 ACTIVITIES

2.1 SOIL AND TERRAIN INFORMATION SYSTEMS

2.1.1 ISRIC Soil Information System (ISIS)

BACKGROUND

Since its establishment in 1966, one of ISRIC's objectives has been to assemble a collection of soil monoliths, accompanied by associated analytical information to illustrate the units of the FAO-Unesco Soil Map of the World. Soil samples were analyzed by ISRIC's Soil, Plant and Water Analytical Laboratory. To facilitate the storage and management of these soil and environmental data, a computerized data management system (ISIS) has been operational since 1986. At the end of 1996, information of some 687 reference soil profiles were available in ISIS database. A typical data sheet, derived from the ISIS dataset is given in Table 1.

ACTIVITIES IN 1997-1998

Screening and verification of analytical data stored in ISIS revealed that a number of data were still missing or had to be re-analyzed. Before ISIS can be released to users on request, analytical work to bring ISIS up-to-standard continued in 1997/1998. ISRIC still has an additional 260 profiles archived.

Of these profiles some site information is incomplete, and locations not precisely determined, so these archived profiles will only be analyzed if the need arises. In view of ISRIC's project SOVEUR (see Section 2.2.2) 30 profiles from East European countries (Czech Republic, Hungary, Poland, Romania, Slovakia) were analyzed and stored in ISIS. In addition, ten new monoliths were acquired from West Africa (Benin, Burkina Faso, Niger, and Togo, see Section 2.4.1) and soil samples analyzed and stored in ISIS.

FUTURE ACTIVITIES

Screening and verification of analytical data will be continued. Once completed, ISIS covers more than 80% of the ultimate goal: a physical representation of the world's main soils. The remaining gaps and poorly represented areas will be filled when the occasion arises. Therefore, analytical work for traditional soil characterization of the present stock will gradually shift to other use of the reference collection as well as to other database-related work (e.g. data validation and verification for applications; hydraulic data generation by pedotransfer functions).

able 1 : an example of an ISIS profile print-out

SIS 4.0 data sheet of monolith CN019 Country : PEOPLE'S REPUBLIC OF CHINA Print date (dd/mm/yy) : 01/06/94

AO/UNESCO (1988) : Veti-Haplic Acrisol (Pachic and Xanthic) (1974 : Ferric Acrisol)
SDA/SCS SOIL TAXONOMY (1992) : Typic Kandiudult, clayey, kaolinitic, isohyperthermic (1975 : Typic Paleudult)
STC (1991) : Argillic latored soil

IAGNOSTIC CRITERIA FAO (1988) : ochric A, argic B horizon
USDA/SCS (1992) : ochric epipedon, kandic horizon
Soil moisture regime : udic

OCATION : Hainan, 15 km north of Tong Zha City, about 500 m from road to the Antenne
Latitude : 18 45' 00" N Longitude : 109 28' 45" E Altitude : 770 m a.s.l.
UTHOR(S) : Kauffman, J.H. / Wang Date (mm/yy) : 10/92

ENERAL LANDFORM : mountain Topography : steeply dissected
HYSIOGRAPHIC UNIT : Toen-ling mountains
LOPE Gradient : 40% Form : straight
OSITION OF SITE : middle slope
ICRO RELIEF Kind :
URFACE CHAR. Rock outcrop : nil Stoniness : nil
Cracking : nil Slaking/crusting :
Salt : nil Alkali : nil
LOPE PROCESSES Soil erosion : not observed

ARENT MATERIAL : residual material derived from coarse-acid igneous rocks (granite)
Weathering degree : high

FFECTIVE SOIL DEPTH : > 250 cm

ATER TABLE : not observed
RAINAGE : moderately well to well
ERMEABILITY : no slowly permeable layers
LOODING Frequency : nil
OISTURE CONDITIONS PROFILE : 0 - 10 cm dry 10 - 250 cm moist

AND USE : (semi-) natural vegetation
EGETATION Type : semi deciduous forest Status : secondary

DDITIONAL REMARKS :
N019 is representative for soils of the central highlands, consisting of middle high mountains, dominantly composed of ranite. The depth of the solum may vary from shallow to very deep. The underlying granite is nearly always strongly eathered.
he original forest has been cut over large areas, replaced by secondary forest, but generally natural grassland (tuffed all grasses) takes over.
he first half meter below the A-horizon (approx. the AB and Bw1 horizons) have common coarse old root channels filled ith dark topsoil material. The AB horizon is multicoloured. Besides the given matrix colour, frequent patches of A and w1 colours occur.
he soil has nearly a ferralic B horizon below 46 cm, however, silt/clay ratio is a too high. The requirements for a andic horizon are met which starts at about 30 cm depth.

LIMATE : Köppen: Am
TATION : QIONGZHONG (19°2″North / 109°50″East, 250 m a.s.l.) 30 km West of site. Relevance: moderate

		No. years of record	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
an evaporation	mm	20	95	101	163	200	218	195	218	185	150	127	90	84	1824
elative humidity	%	21	87	87	83	82	82	84	82	86	89	88	89	88	86
recipitation	mm	21	37	39	44	101	239	226	253	306	484	451	208	59	2447
o. of raindays		21	14	13	10	11	18	18	17	21	22	19	17	14	194
mean	C	21	16.5	17.7	21.2	23.8	25.9	26.4	26.6	25.9	24.8	22.9	20.0	17.5	22.4
max	C	21	21.8	23.2	27.2	30.1	32.2	32.1	32.4	31.5	29.9	27.4	24.4	22.3	27.9
min	C	21	12.7	14.0	16.8	19.2	21.5	22.5	22.4	22.3	21.6	19.8	16.9	14.0	18.7
indspeed(at 2m)	m/s	21	0.8	1.0	1.3	1.3	1.0	1.0	1.1	0.9	0.9	0.9	0.6	0.6	1.0
right sunshine	h/d	21	3.6	3.8	4.8	5.9	6.4	5.6	6.6	5.6	4.7	3.9	3.2	3.3	4.8
right sunshine	%	21	33	33	44	47	49	43	50	44	39	33	29	31	40

SIS 4.0 data sheet of monolith CN019   Country : PEOPLE'S REPUBLIC OF CHINA   Print date (dd/mm/yy) : 01/06/94

ROFILE DESCRIPTION :

ery deep, well drained, yellowish brown sandy clay derived from granite with a prominent thin dark topsoil.

h	0 - 11 cm	Very dark grayish brown (10YR 3/2, moist) sandy clay; weak to moderate fine to medium subangular blocky structure; slightly sticky, slightly plastic, friable, slightly hard; many fine and common medium random tubular pores; many fine and common medium roots throughout; clear smooth boundary to
B	11 - 22 cm	Dark yellowish brown (10YR 4/4 moist) sandy clay; moderate fine to medium subangular blocky structure; slightly sticky, slightly plastic, friable; few fine distinct clear yellowish red (5YR 5/6) mottles and many fine faint diffuse mottles; many fine and few medium random tubular pores; many fine and few medium roots throughout; clear wavy boundary to
w1	22 - 46 cm	Yellowish brown (10YR 5/6, moist) sandy clay; weak medium subangular blocky parting to weak fine subangular blocky structure; slightly sticky, slightly plastic, friable; few fine faint mottles; many fine tubular pores; common medium and many fine roots throughout; gradual smooth boundary to
w2	46 - 80 cm	Brownish yellow (10YR 6/6, moist) sandy clay; weak medium subangular blocky parting to weak fine subangular blocky structure; slightly sticky, slightly plastic, friable; many fine tubular pores; many fine roots throughout; diffuse smooth boundary to
w3	80 - 140 cm	Yellowish brown (9YR 5/8, moist) sandy clay; weak medium subangular blocky parting to weak fine subangular blocky structure; slightly sticky, slightly plastic, very friable; many fine tubular pores; common fine roots throughout; diffuse smooth boundary to
w4	140 - 200 cm	Strong brown (7.5YR 5/8, moist) sandy clay; weakly coherent porous massive structure; slightly sticky, slightly plastic, very friable; many fine tubular pores; few fine roots throughout.

NALYTICAL DATA :

Hor. No.	Top - Bot	>2 mm	2000 1000	1000 500	500 250	250 100	100 50	TOT SAND	50 20	20 2	TOT SILT	<2 m	DISP	BULK DENS	pF- 0.0	1.0	1.5	2.0	2.3	2.7	3.4	4.2
1	0 - 11	-	8	17	14	12	4	55	2	16	18	27	13.8	-	-	-	-	-	-	-	-	-
2	11 - 22	-	9	16	12	9	6	52	7	14	21	27	15.5	1.23	50	48	45	42	41	38	28	21
3	22 - 46	-	10	14	10	9	4	46	5	14	20	35	19.9	1.40	44	44	41	39	38	37	32	25
4	46 - 80	-	9	13	9	7	4	42	2	13	16	42	7.4	-	-	-	-	-	-	-	-	-
5	80 - 140	-	10	11	8	8	3	40	6	13	19	41	5.5	1.27	47	46	44	42	42	40	37	27
6	140 - 200	-	7	12	9	8	5	41	4	14	18	41	3.0	-	-	-	-	-	-	-	-	-

Hor. No.	Top - Bot	pH- H2O	KCl	CaCO3 %	ORG- C %	MAT. N %	EXCH CAT. Ca	Mg	K	Na	sum	EXCH AC. H+Al	Al	CEC soil	clay	OrgC	ECEC	BASE SAT %	Al SAT %	EC 2.5 mS/cm
							cmol(+)/kg													
1	0 - 11	4.6	4.0	-	2.22	0.16	0.6	0.3	0.4	0.1	1.4	1.5	0.9	6.2	23	7.8	2.9	23	15	0.07
2	11 - 22	4.4	4.0	-	1.26	0.10	0.0	0.3	0.2	0.0	0.5	1.8	1.4	3.9	15	4.4	2.3	13	36	0.05
3	22 - 46	4.2	3.9	-	0.61	0.07	0.0	0.0	0.1	0.0	0.1	1.8	1.6	3.7	11	2.1	1.9	3	43	0.03
4	46 - 80	4.2	4.0	-	0.62	0.06	0.0	0.0	0.1	0.2	0.3	2.1	1.8	4.3	10	2.2	2.4	7	42	0.03
5	80 - 140	4.5	4.1	-	0.62	0.06	0.2	0.0	0.1	0.0	0.3	1.8	1.4	4.1	10	2.2	2.1	7	34	0.02
6	140 - 200	4.3	4.1	-	0.34	0.04	0.2	0.0	0.1	0.1	0.4	1.7	1.4	4.4	11	1.2	2.1	9	32	0.02

LAY MINERALOGY (1 very weak, ..., 8 very strong)   EXTRACTABLE Fe & Al by Na DITHIONITE   AVAIL. P (Bray)

Hor. No.	Top - Bot	MICA /ILL	CHLO	KAOL	MIX	GIBB	GOET	Fe	Al	mg/kg
1	0 - 11	3	3	8	3	3	3	1.0	0.2	0.0
2	11 - 22	3	3	8	3	3	3	1.1	0.2	0.0
3	22 - 46	3	3	8	3	3	3	1.6	0.3	0.0
4	46 - 80	3	3	8	3	3	3	1.9	0.4	0.0
5	80 - 140	2	3	8	3	3	3	2.0	0.4	0.7
6	140 - 200	1	2	8	2	3	3	2.1	0.4	0.0

2.1.2 World Soil and Terrain Database (SOTER)

SOTER forms the core of ISRIC's database activities. During the 16th World Congress of Soil Science, Montpellier, France in August 1998, highlights and constraints in SOTER developments were presented by ISRIC to the Working Group DM: "World Soils and Terrain Digital Databases", operating under Commission V of the International Union of Soil Science (IUSS). Relevant sections of the progress report follow.

The demand for accurate, up-to-date and readily accessible data about natural resources is repeatedly expressed and is also reflected in various recently formulated international research and development initiatives (e.g. the Global Terrestrial Observing Systems initiative (GTOS); the Soil, Water and Nutrient Management initiative (SWNM); the FAO strategy for Planning for Sustainable Use of Land Resources: Towards a New Approach; the Land Quality Indicators initiative (LQI); and the Global Eco-regional Initiative on Sustainable Mountain Agricultural Development, also known as Global Mountain Initiative (GMI).

> "We lack the data to detect, monitor or understand the changes in natural (and socio-economic) resources caused or reinforced by unsustainable land use. Quantitative and qualitative improvements in the data and understanding of the spatial extent of terrestrial ecosystems are a prerequisite for better natural resources planning and early warning of global change" (GTOS, 1995).
>
> "An action programme on land resources information to be developed to systematically identify sustainable land uses and production systems for each land and climatic zone, to control inappropriate land use and to take into account the actual potential carrying capacities and limitations of land resources is called for" (SWNM, Greenland et al., 1994).
>
> "In order to improve and strengthen planning, management and evaluation systems for land resources the collection and evaluation of relevant information is essential to permit the decision-maker, whether it be a farmer or a government to optimize the achievement of their objectives" (Sombroek and Sims, FAO, 1995).
>
> Maintenance of the productive potential of land resources and checking of land degradation is a fundamental element of sustainable land use. In order to achieve this, there is a fundamental need for indicators of the land quality. Development of land quality indicators requires primary data on the attributes of the land, which can be analyzed as land qualities (World Bank, 1995).
>
> "One of the main purposes of the GMI is to enable comparison of land use patterns, extrapolation of technological options, and exchange of experiences across the three tropical mountain regions. "In order to do so, basic geo-referenced data on natural resources and their use is an asset" (CIP, 1995).

Nevertheless, it appears increasingly difficult to convince potential donors to support database development activities. During the reporting period, in particular FAO, UNEP, and ISRIC provided financial resources and in-kind inputs to execute SOTER programmes, while in some cases bilateral or multilateral funds were obtained.

The SOTER programme during the reporting period 1997-1998 was continued at two levels of detail: the development of a SOTER database at "continental" scale (1:5 M). Simultaneously efforts were continued to implement SOTER activities at "national" scales (1:1 M or at higher resolution). These national activities are executed by national organizations, or in some instances, by a consultant or an international consulting firm working in close cooperation with national soil scientists. Some SOTER activities at national scale were carried out independently of ISRIC and of the Land and Water Development Division of FAO. In most cases, however, ISRIC provided technical assistance through training workshops, trouble-shooting and field visits for correlation. In many instances the staff at ISRIC also assisted with error checking of the databases and with the development of thematic outputs.

In recent years at ISRIC emphasis was placed on the development of applications of the SOTER database, the creation of more user-friendly software, and on the preparation of outputs that make SOTER more readily usable.

Often ISRIC is approached by national natural resources organizations to provide training and technical assistance for SOTER. ISRIC, as a small non-profit organization cannot commit its resources any further than it has done in the past and national organizations should approach donors themselves. SOTER needs an international consortium of representatives of organizations that have indicated their interest in SOTER in order to convince potential donors to support the programme.

2.1.2.1 SOTER developments at "Continental" scale (1:5 Million)

"The SOTER approach applied at scale 1:5 M is seen by UNEP, FAO, and ISRIC as the official strategy to replace the FAO-Unesco Soil Map of the World in the near future". This statement was made during an ad-hoc SOTER meeting at FAO, Rome in June 1995, attended by representatives of these three organizations. FAO/AGLS aims to produce a 1:5 M Global SOTER by the time of the IUSS Congress in the year 2002.

THE LATIN AMERICA AND CARIBBEAN SOTER DATABASE

The compilation of a SOTER database for South and Central America at scale 1:5 Million, started in 1993 with six Latin American countries; Argentina, Uruguay, south Brazil, Venezuela, Cuba and Mexico. After obtaining additional funding from FAO, UNEP and the International Potato Institute (CIP), this activity was continued as the SOTERLAC database in 1995. It included then the remaining South and Central American countries and the Caribbean. Already at the end of 1996 all major national databases had been received and compiled into one joint continental data set and SOTER map. The display of thematic maps, compiled on basis of the SOTERLAC database, showed a number of discrepancies in the border areas of most countries.

Therefore, in early 1997, a mission was carried out to correlate the database for the border areas of Brazil, Bolivia, Peru, Ecuador, Colombia and Venezuela, in particular on landforms, soils and lithology. This has resulted in a number of adjustments in the national SOTER maps and databases, so that a consistent continental data set could be created. The remaining data gaps were filled with information on terrain and from soil classification where no profile attribute data were available. Despite these gaps, the database still contains approximately 90% of all the available attribute data.

These final results, in the form of maps and data sheets, were sent to all participating institutes and resource persons for verification, additions and comments. A final version of the database was released in April 1998.

A CD-ROM with the SOTERLAC database was officially released during the 16th International Congress of Soil Science in Montpellier. The CD-ROM contains information on 1490 SOTER mapping units. These SOTER units are further defined in the database by 2008 terrain components with one or more soil components (3580). A total of 1828 soil profiles of representative soils can be found in the database. The geometric data files on the CD-ROM are in ARC-info export format (E00), while the attribute data are stored as DBF format. A CD-ROM with the SOTERLAC database was officially released end 1998 as DBF format. The CD-ROM can be obtained from FAO, *Digital Media Series No. 5*.

For users that do not have access to GIS software, ISRIC developed a SOTERLAC Database Viewer. This viewer is a map-oriented software tool for the display of data from the SOTERLAC 1:5,000,000 soils and terrain database. The Viewer may be considered as an alternative for the larger and more complex (and therefore harder to handle, and more expensive) Geographical Information Systems. Its simplicity makes the Viewer eminently suitable for the inexperienced GIS user, and for use on relatively simple computer systems.

The idea to build a viewer for the data in a SOTER project was first conceived in the autumn of 1996. This idea was elaborated and implemented in the course of 1997. In August 1997 a first evaluation version of the Viewer (beta 1.0) was sent to all participants in the SOTERLAC project for comment.

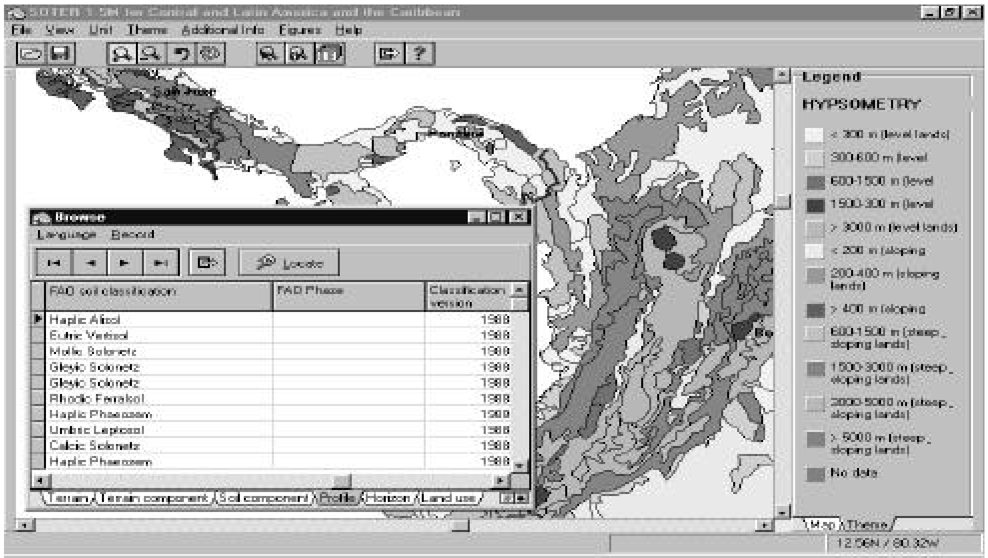


Figure 1 Screen from SOTERLAC database viewer

The most important requirements the Viewer should meet were:

- a single Windows 3.x executable that is easy to distribute and to install;
- robust and stable;
- visually attractive, with a well thought-out screen lay out;
- clear and intuitive user interface;
- essentially extendable, i.e. transferable to
    - other SOTER regions (possibly differing in scale)
    - similar ISRIC projects; GLASOD, WOCAT, ASSOD, etc.
- all help information should be accessible from within the Viewer.

The current version of the Viewer (beta 1.02) opens with a political map of the SOTERLAC project region. This map can be used to zoom in on the underlying and considerably more detailed SOTER map. Until now seven map themes - with legend - are available in the beta version, but essentially every theme that can be resolved into the SOTER map of the region can be displayed by the Viewer. Furthermore, the entire SOTERLAC attribute database has been included. Attribute data can be displayed as a table or – to a limited extent – as a map (Figure 1). ISRIC intends to customize the Viewer for other SOTER projects and scales, and ISRIC activities of a related nature.

Several staff members of Research & Development were involved in the development of the Viewer. All attribute data had to be scrutinized and, where necessary, amended. Cross-border data correlation featured largely in this verification process. Likewise, the GIS resource person verified the SOTER map of the project area, and anatomized the map coverage into its basic geographical elements. The actual Viewer as well as auxiliary tools for pre-processing the data and building the Viewer map files were coded by ISRIC's programmer.

The SOTERLAC Database Viewer version (beta 1.02), that was demonstrated at the 16th World Congress of Soil Science at Montpellier, France, will be available in the near future at ISRIC's World Wide Web site (*www.isric.nl/SOTER/Viewer/Vwr102b.exe*), through the *products* page. The Viewer has also been included on the FAO Land and Water Digital Media Series no. 5: *Soil and Terrain Digital Database for Latin America and the Caribbean.*

SOTER FOR ASIA

South and Southeast Asia

At FAO's request ISRIC prepared a draft 1:5 M physiographic map and database of Asia (excluding the former USSR and Mongolia), using the SOTER methodology. The South and Southeast Asian section of this product was then used for the preparation of a 1:5 M assessment of the status of human-induced soil degradation for South and Southeast Asia (ASSOD), which was funded by UNEP. In close cooperation and through subcontracts with soil research organizations, participating in the Asian Network of Problem Soils, the project was finalized early 1997 (see also Section 2.2.9).

Despite recommendations of the Expert Consultation of the Asian Network of Problem Soils (October 1995) to prepare with FAO/ISRIC assistance a regional (= continental) SOTER database at scale 1:5 M, a project proposal, jointly prepared by FAO and ISRIC, could not find an interested donor.

In close cooperation with IBSRAM, ISRIC prepared another project proposal (Southeast Asian Land Resources Information System: SALRIS) with more emphasis on applications of the database. This received a positive response from both national and international agricultural research systems and funding is presently being sought.

Northern Asia

A land characterization for the former Soviet Union, Mongolia, and China followed the SOTER approach. This activity was initiated within the framework of the project on Modelling Land Use and Land Cover Changes in Europe and Northern Asia (LUCC), executed by the Institute of Applied Systems Analysis (IIASA) in cooperation with FAO and the V.V. Dokuchaev Soil Science Institute in Moscow. To-date the three layers of SOTER (terrain, terrain unit and soil component according to the FAO classification) are completed. Soil profile data still have to be entered.

SOTER FOR AFRICA

Eastern and Southern Africa

Important building blocks for the Eastern and Southern Africa SOTER at scale 1:5 M are: the FAO digital soil map of East Africa; the UNEP-funded KSS/ISRIC SOTER database for Kenya (see 3.3); and information from independent consultants. When complete, the information will form a SOTER-like database for Angola, Botswana, Mozambique, Namibia, Tanzania, Swaziland and Malawi.

A soil degradation study to assess its impact on food productivity for Zimbabwe has been formulated (May 1998) and will be receiving UNEP support. The Institute of Soil, Water and Climate in South Africa has received approval from their Ministry to prepare a SOTER database for South Africa (June 1998). The wealth of information for Southern and Eastern Africa, both already available and to be collected, could be condensed in SOTER 1:5 M product.

West Africa

Efforts to begin SOTER activities in West Africa have not yet yielded any project financing, although the need for an environmental information system in West Africa has been frequently expressed.

A new initiative, tentatively entitled: *Establishment of an integrated land resources information system for the conservation and rehabilitation of land resources in West Africa (WALRIS)* was launched late 1998 and received strong support from both national, regional, and international agricultural research organizations. Funding for a regional workshop in February 1999 was obtained.

North Africa and the Arab Region

Short training courses on SOTER in May 1997 and September 1998 were given in the framework of a project sponsored by CEDARE and the FAO regional office for the Near East at the premises of ACSAD in Damascus.

Participants came from a wide array of organizations, some already experienced in building SOTER databases, others were newcomers to this field. Many Middle East countries were represented in either one or both of the workshops: Egypt, Jordan, Iran, Kuwait, Lebanon, Libya, Palestine, Syria, Tunisia, Turkey, United Arab Emirates and Yemen. The first training session concentrated on SOTER methodology and the compilation of its databases from existing sources.

The course was given by one ISRIC staff member while the second training exercise, handling applications of the database, was conducted by two staff members. As a direct result of the training, SOTER databases at various scales were made in Egypt, Lebanon and Syria. Technical support was given for these activities.

SOTER FOR EUROPE

Europe

Contacts have been established between FAO and the European Soils Bureau (ESB), at Ispra, Italy to integrate the Soil Geographic Database of Europe at scale 1:1 M into the Global Soils Database. It appears that this European database contains a wealth of information that could be condensed for use in a continental European SOTER database at scale 1:5 M.

Central and Eastern Europe

A Dutch-funded FAO project was implemented in 1997 by ISRIC in close cooperation with 13 countries in Central and Eastern Europe for an inventory of the current status of soil degradation and for an assessment of the vulnerability of soils to certain chemical components (SOVEUR). As a first essential step a SOTER database at scale 1:3 M will be compiled (see Section 2.2.2 for further details).

SOTER FOR NORTH AMERICA AND AUSTRALIA

The IUSS working group DM has approached relevant agencies to produce SOTER-shells for these regions. At this stage there are no operational plans.

2.1.2.2 SOTER developments at national scale (1:1 Million or larger)

Argentina

A total area of 460,000 km^2 now been entered in the 1:1 M SOTER database by INTA, while it is also preparing a 1:2.5 M SOTER database for the entire country. Specific areas will be covered at 1:100,000 scale.

Benin

As part of a GTZ cooperation project between the University of Hohenheim, Stuttgart, Germany and the Institut National de Recherches Agronomiques du Bénin, a two weeks workshop on SOTER was conducted in March 1998 by ISRIC in Cotonou at the premises of the Centre National d'Agro-Pédologie. Staff of CENAP were introduced to the concepts of SOTER for storing, retrieving and analysing soil and terrain data. The workshop consisted of theoretical and practical parts based on the interior of Benin where the methodology was applied at a scale of 1:250,000. A project proposal for the compilation of a national database was drafted for submitting to donors.

China

- In a cooperative project towards sustainable land management (SULAMA) between the Wageningen Agricultural University (WAU) and the China Agricultural University (CAU) in Beijing, research is done on crop modelling in the semi-arid lands along the tributaries of the Yellow River in Hebei province, China. For such investigations soil data are a prerequisite and ISRIC was asked to conduct a two-weeks training course on soil databases for MSc and PhD students at CAU. The training focussed on the SOTER methodology and its applications. During a three-months visit of the PhD students at WAU later that year, further discussions were held.

- The SOTER project in Hainan Province, south China is discussed separately in Section 2.2.1.

Chile

The Forestry Institute INFOR together with DHV Consultants have developed a 1:250,000 SOTER database in six watersheds in a project financed by the Interamerican Development Bank covering a total area of 50,000 Km^2 (SOTER Newsletter 9).

Ethiopia

In 1997 three missions were carried out for DHV Consultants in the framework of the Tekeze River Basin Development Master plan and the Mereb River Basin Development Master plan Projects, which were being executed for the Ministry of Water Resources of Ethiopia. Already in 1995, a short period of training had been given to the international and national project staff on mapping and application of the SOTER methodology. Soils and terrain (SOTER) data for both projects were collected at scale 1:250.000 for a total area of about 100.000 Km^2. As the projects terminated in 1997, the consultancies were particularly intended to assist project staff with the interpretation of the natural resources data, the land evaluation and reporting for the Master plan. The studies of both river basins resulted in a contribution to the overall master plan of a 40 year projection of food production potentials of the area in relation to population growth.

Hungary

The HUNSOTER database was prepared by RISSAC in collaboration with ISRIC (training) at scale 1:500,000 (with financial support from UNEP). The database was completed in 1995 (for details see SOTER Newsletter 9). In follow-up studies RISSAC used HUNSOTER for various applications (see SOTER Newsletter 11). In June 1995 a regional workshop was organized for countries in Central and Eastern Europe.

India

- *Improving Access to Spatial Information for the Indo-Gangetic Plains Ecoregion*

Rice-Wheat Consortium for the Indo-Gangetic Plains, a regional network of international and national agricultural research organizations in Bangladesh, India, Nepal and Pakistan, expressed the need for an information system capable of managing and making available to all stakeholders available spatially referenced data. Together with the IAC and the SC-DLO, ISRIC participated in a planning workshop in August 1998 at ICRISAT, India, where the set-up of a spatial information system was one of the objects. An initial short term project was drafted defining a meta-database on spatial information of the IGP. Later that year a more formal project was formulated in which ISRIC was assigned tasks on prototype development and evaluation of the data that will be entered. This project proposal was submitted to the Ecoregional Fund at the end of the year. In the period before approval and financing, a beta version of the metadatabase software was compiled by SC-DLO in cooperation with ISRIC and IAC.

- *Land Resources Information System for India*

Preliminary discussions were held early 1998 with the National Bureau of Soil Survey and Land Use Planning (Nagpur), the M.S. Swaminathan Research Foundation (Chennai), and the Indian Council of Agricultural Research (New Delhi) on the feasibility to develop a Land Resources Information System for India. All parties expressed the need for the development of a SOTER database for India in order to harmonize all available information. This activity could be incorporated in the World Bank funded National Agricultural Technology Project. So far these discussions have not yet resulted in any definite arrangements.

Jordan and Syria

Under a UNEP-sponsored activity both countries implemented a 1:500,000 scale SOTER database. The first results (1996) were then used to prepare a soil desertification map. ICARDA has indicated its interest to use the database for a water erosion risk assessment study along the lines of the SOTER Water Erosion Assessment Program (SWEAP).

Kenya

The UNEP-funded SOTER database for the entire country at scale 1:1 M was completed by KSS with training and technical backstopping from ISRIC by late 1994. This database was subsequently used in a follow-up activity for a land degradation assessment for the entire country. KSS/ISRIC prepared a water erosion risk assessment for Kenya. In the framework of UNEP's Global Environmental Outlook programme (GEO) ISRIC prepared on the basis of the KENSOTER database an assessment of the impact of water erosion on food production. (A similar study was also performed for Uruguay and parts of Argentina.) For details see SOTER Newsletter 10 and ISRIC's Bi-Annual Report 1995-1996. The report was published in 1997.

In March 1995 a regional workshop was held at the premises of KSS to demonstrate the utility of the KENSOTER database to representatives of Eastern and Southern African countries.

Niger

The University of Hohenheim uses the SOTER structure as a planning basis and tool for land evaluation in SW Niger at scale 1:200,000 (see SOTER Newsletter 10).

Russia

SOTER activities in Russia started in 1992. A Russian SOTER pilot area (200,000 km^2) was selected and a Russian SOTER procedures manual was prepared. ISRIC assisted the executing body (V.V. Dokuchaev Soil Science Institute) through a training programme (SOTER Newsletter 11).

South Africa

Initial contacts were established with the Institute of Soil Water and Climate in Pretoria for possible technical assistance to an upcoming SOTER activity in and financed by South Africa. As both UNEP, in the form of a project proposal "Impact of Land Degradation on Food Productivity in Zimbabwe" and FAO (SOTER databases in South Africa, Zambia and Zimbabwe) were interested in sponsoring a SOTER activity in Southern Africa a joining of resources was proposed. This resulted in 1998 in the signing of a Letter of Agreement between FAO and ISRIC for technical assistance to a workshop in the region for the implementation of SOTER.

Some preparatory work was already done at the end of 1998 in the form of a short mission by a local consultant to make an inventory of the bottlenecks in the application of the methodology in South Africa and to discuss the correlation between the national and international soil classification. Further activities are foreseen for 1999.

Uruguay

The entire country (170,000 km^2) has been entered in a 1:1 M SOTER database. The national soils department (DSA-MGAP) has commenced to cover specific areas at scale 1:100,000 and is now also preparing a 1:500,000 SOTER database for the entire country.

Yemen

At request of FAO, a one month's training was given to FAO's Environmental Resource Assessment for Rural Land Use Planning Project, to assist the Land Resource Section of the Renewable Natural Resources Research Centre of the Ministry of Agriculture and Irrigation of Yemen in establishing a soil and terrain database according to the SOTER methodology. The training focused on the application of the SOTER methodology and its applications on recently collected data at a mapping scale 1:100.000. The compilation of a national SOTER database at a scale of 1:0.5 M was started. This SOTER map will be the basis for the assessment of soil degradation at national level.

After termination of the SOTER training, a two weeks training was given to staff of the Land Degradation Unit of Subprogramme 2 of UNDP's Sustainable Environmental Management Programme in the concepts and application of Human-Induced Soil Degradation assessment according to the GLASOD/ASSOD methodology.

2.1.2.3 SOTER Procedures Manual

The 1993 SOTER Procedures Manual has been reworked and a new document, edited by V.W.P. van Engelen (ISRIC) and T.T. Wen (FAO consultant) was published in March 1995. A French version under the title: "Bases de Données Numériques sur les Sols et le Terrain au Niveau Mondial et National (SOTER)" was published in May 1995 (translation by M. Lozet).

So far all SOTER activities are based on this Manual. During the application of SOTER in various projects discussions on the technical correctness of parts of the approach have taken place (e.g. definitions of landform; optimal database structure; how to include Digital Elevation Models). A technical evaluation will take place in 1999.

2.1.2.4 The uses and users of SOTER

USES OF SOTER

The SOTER database, whether at 1:5 M or at 1:100,000 should be seen as a tool. This environmental information system is, in our opinion, indispensable for contributing to the global challenge of providing sufficient food for the growing world population, while preserving the biophysical potential of natural resources and minimizing environmental degradation. Once established SOTER databases can be used to provide spatial information of an infinite number of single-value and composite value thematic maps and statistical summaries, depending on the demand of the user.

During the past period ISRIC developed and tested different software programs to assess water erosion hazard (top soil losses), land suitability, food productivity and salinity/sodicity conditions of soil profiles. Existing models were used and adapted to the data stored in the SOTER database. The soil salinity assessment is presently being tested with the SOTER database for Syria. These software programs are of particular interest at a national level.

Global datasets are of special significance for Global Change programmes (such as the International Geosphere, Biosphere Programme) and for Global Food Security studies. The Global Soil Data Task of IGBP-DIS recently indicated that the limiting factor in global soils data has now become the absence of a suitable global soils map. "This reality and the importance of quality soil data for all current global-change models and for international treaties, needs to be communicated to decision makers" (June 1998, oral communication). Once established global spatially referenced Soil and Terrain data can generate spatial products, such as organic carbon stocks, available-water capacity, etc.

USERS OF SOTER

Soil and Terrain information, although not explicitly mentioned, seems of imminent importance in almost all GEF-supported conventions (biodiversity; tropical forest; desertification). In a different context SOTER information, especially the landform and terrain component layers, are important assets for the WOCAT (World Overview of Soil Conservation Approaches and Technologies) programme. It is WOCAT's intention to use the SOTER physiographic units for their inventory works, wherever SOTER is established.

The World Bank Environmental Information Systems programme (EIS) appears to be perfectly complementing the SOTER concept: "In the context of EIS, Geographic Information Systems (GIS) serve to combine geo-referenced information on natural resources with other essential data, such as demographics, to support planning, management and decision-making" (Yves Prevost, the Environmental Group, AFTEN, World Bank, in EIS News, October 1997).

CONCLUSIONS

- The demand for SOTER has been growing steadily during the reporting period.
- SOTER donor support is not overwhelming.
- The three international organizations (UNEP, FAO, ISRIC) have a joint stand on developing the Global SOTER database.
- Development of application tools to convert SOTER data into derived informative products is essential.
- SOTER activities at national level are executed worldwide, although activities in Asia are less prominent compared to Africa and Latin America.
- There is an urgent need for an in-depth SOTER evaluation, both its technical aspects as well as its impact at national and global level.
- SOTER needs an international consortium of representatives of producer and user organizations. Such a body would be in a good position to approach bilateral and multilateral donors.

2.1.2.5 New name and new chairman of the Working Group DM

The Working Group DM of the International Union of Soil Science, convened during the 16th World Congress of Soil Science in Montpellier (August 1998), in view of the shifting emphasis from pure database development to data information provision proposed the following name for the Working Group DM: ***Land Resources Information System for Assessment and Monitoring (SOTER)***. The meeting unanimously agreed to nominate Dr. W.G. Sombroek as the new chairman of Working Group DM. This nomination was approved by the Council of the IUSS.

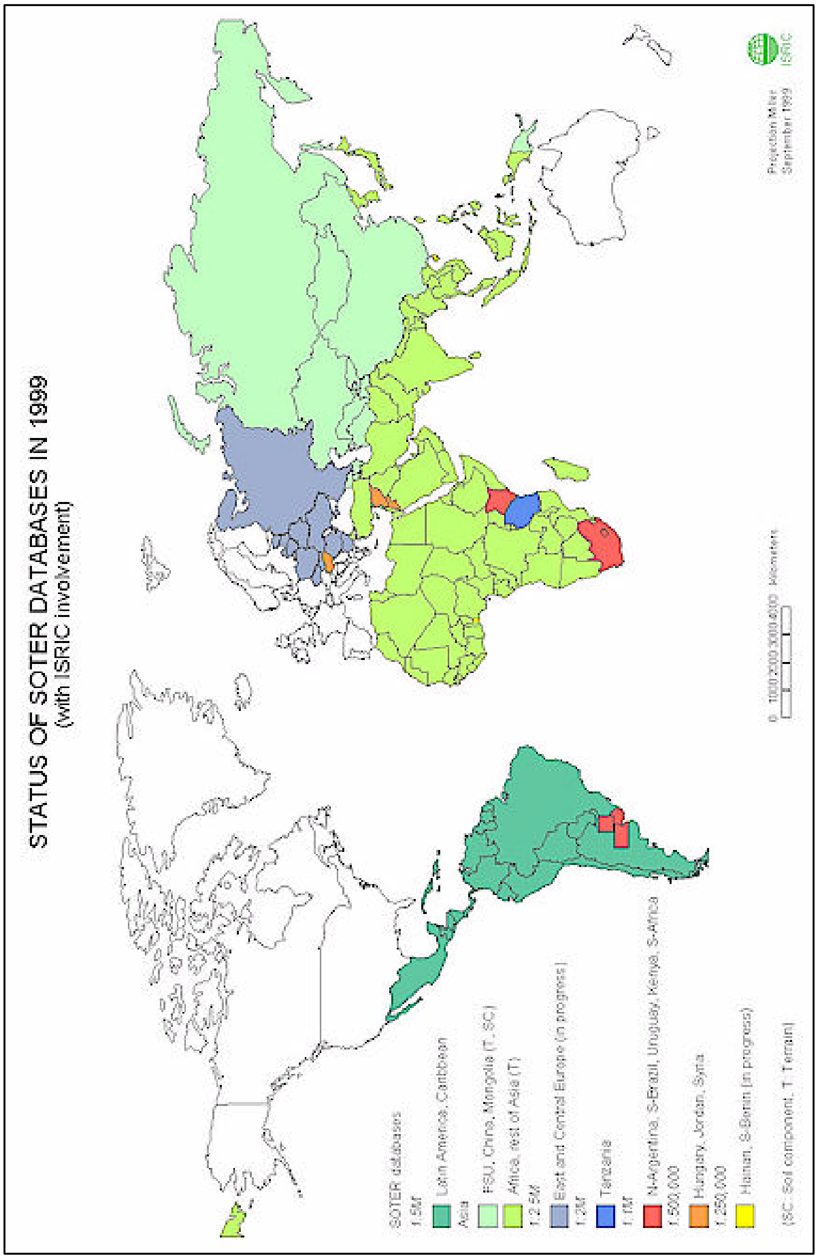


Figure 1 Status of SOTER databases

2.2 ASSESSMENT OF SOIL AND TERRAIN RESOURCES FOR SUSTAINABLE MANAGEMENT

2.2.1 SOTER Hainan project

The UNDP supported SOTER-Hainan project aims at the sustainable development of the agricultural sector of Hainan Province in South China. It will provide training of national and provincial agricultural research and extension staff. The project goal is to complete a Soils and Terrain Information System of Hainan, support agricultural demonstration sites and so be of benefit to subsistence farmers. The information system has the potential to address a wide array of agro-environmental concerns, such as soil fertility management, land degradation (water erosion), crop suitability/evaluation for sustainable utilization of the land resources. The project will extrapolate the results of the demonstration sites to county and provincial level, indicate sound land uses of these demonstration sites, and disseminate information about improved land management, including soil conservation, soil fertility and alternative crops.

INSTITUTIONAL ARRANGEMENT

- Executing agency: China International Centre for Economic and Technical Exchanges (CICETE);
- Implementing agencies: Chinese Academy of Tropical Agricultural Sciences (CATAS)
- Institute of Soil Science, Academia Sinica (ISSAS):
- Cooperating agency: International Soil Reference and Information Centre (ISRIC)
- Project duration: 1 December 1997 - 1 December 2001

MAIN PROJECT ACTIVITIES AND RESULTS

Hainan SOTER Information System

The proposed Hainan Soils and Terrain Information System (HSIS) will contain a comprehensive soil and terrain database linked to a land-unit map. ISSAS and CATAS will both work on the establishment of the Hainan SOTER Information System. ISSAS will be responsible for the development of the Hainan SOTER Information System (HSIS) at the provincial level at a scale of 1:250,000, and CATAS for the County SOTER Information System (CSIS) at county level at a scale of 1:50,000.

Application tools

Specific application tools (software programs) will be developed, the objectives of which are to translate the data in the HSIS and CSIS databases into meaningful information for agricultural planning, research agencies, soil and land conservation services and nature conservation services at provincial and county level. Three fields have been specified for these tools:

1) Land evaluation on issues related to sustained agricultural production, with focus on tropical crops, fruits, vegetables and seed production.
2) An interpretation of land degradation vulnerability and risk assessment with emphasis on soil erosion hazard under various land management scenarios.
3) An analysis of the present soil fertility status and the need for fertilization to combat the present nutrient mining of the soils under current land use.

SOTER derived products

Some examples of possible project deliverables are given here.

1) A series of thematic maps, easy to derive directly from the databases, such as terrain form, land cover, soil parent material, slope gradient class, soil reaction, organic matter content, plant nutrients, etc.
2) A series of thematic maps showing results from the applications tools, presented in the form of wall maps, an (electronic) atlas, CD-ROM or other media. Examples of such maps are:
3) Geographic distribution of the soils classified in prime land and land with specified major soil-related constraints.
   - Geographic distribution of classified risks of soil water erosion risk
   - 'Hot spot' analysis, such as on plant nutrient decline, acidification, etc.
   - Yield gap analysis (difference between potential and actual land productivity)
   - Agricultural production decline caused by simulated water erosion
4) Extrapolation of the results of the four Demonstration Sites to the appropriate agro-ecological zones of Hainan.

Demonstration sites

Sustainable Land Management Demonstration Sites will be established in four counties to strengthen extension work. These sites will form the most detailed level of information, and are included in the County SOTER information system.

For a schematic view of the main components of the Hainan-SOTER Information System, information flows and feedback from user groups, see Figure 2.

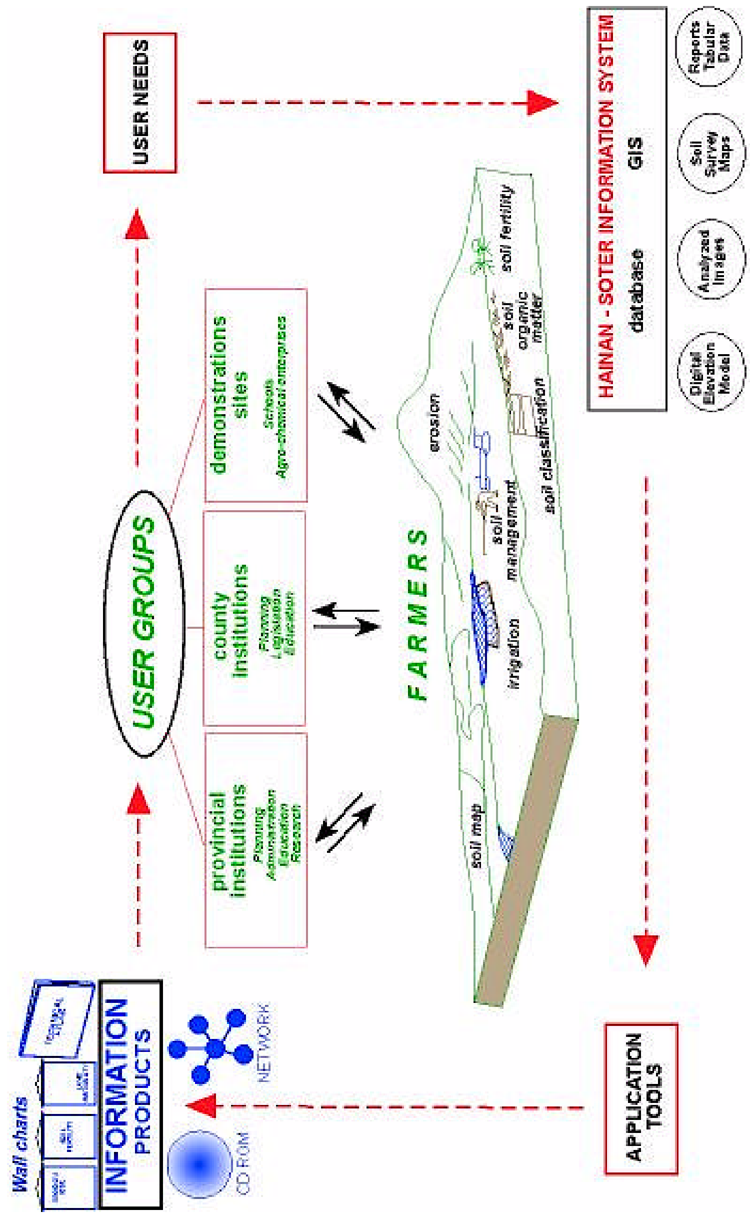


Figure 2 – Main components of the Hainan SOTER Information System

ACTIVITIES CARRIED OUT IN 1997 AND 1998

An implementation workshop of the project was held in January 1998 in Danzhou, Hainan at the premises of the South China University of the Chinese Academy of Tropical Agricultural Sciences. Large number of potential users coming from a wide array of Provincial Organizations, staff members of the executing agencies and donors participated. Following the workshop the users were interviewed on their needs for project outputs and the results were published as a User Inventory Report.

A week's training was given at Institute of Soil Science for staff responsible for the compilation of the 1:250,000 SOTER database of Hainan. As well as ISS staff, soil scientists from a dozen other Chinese institutes and universities also took part in the training exercises.

The first results of database compilation by ISS were discussed during a two-weeks' mission to Hainan in May 1998. Besides verification of the work in the office and technical discussions on the application of the methodology, a field correlation trip through the island was made together with ISS and CATAS staff responsible for the compilation. Most of the work related to checking of the landform/lithology unit definitions while little time was available for the soils part of the database. Later during the year the first version of the SOTER unit map was digitized by ISS and sent to ISRIC for comments, together with a small part of the attribute database.

Discussions were held with CATAS on possible applications, which reflected the outcome of the user inquiry. In future, the focus will be on land evaluation for tropical fruit trees and vegetables, fertility studies and an assessment of the risk of soil erosion.

View on central mountains of Hainand Island

2.2.2 Mapping of Soil and Terrain Vulnerability in Central and Eastern Europe (SOVEUR)

The quality of Europe's environment has decreased as a result of pollution, notably in the former centralized economies of Central and Eastern Europe. In contrast with the earlier concern for the atmosphere and hydrosphere, the need to protect the soil has been appreciated only more recently. Soil pollution can severely affect food production, the quality of surface and groundwater, and ultimately biodiversity and human health. A preceding study of the status of human-induced land degradation worldwide showed 22 million hectares have been polluted, of which 19 million occur in Europe (including the former USSR). Loss of fertile topsoil, as a result of erosion by rainfall, was estimated at 114 million hectare. About 30 percent of Europe's agricultural land has been affected adversely by physical and chemical degradation. Policy measures and conservation methodologies thus are needed to halt and reverse this trend.

The capability of a soil to be harmed in its ecological functions - its vulnerability - varies with climate, soil type, land use, the chemicals involved, and the degree of loading with these contaminants. Once degraded, for example by water erosion, heavy metals or acid deposition, the ecological functions of soils will return only slowly. Thus, knowledge of the currently degraded land and areas potentially at risk (vulnerable land) is critical for sustainable development and the formulation of conservation or remediation technologies.

A two year project on Mapping of Soil and Terrain Vulnerability in Central and Eastern Europe (SOVEUR) was signed between the Food and Agriculture Organization of the United Nations (FAO) and the Government of The Netherlands, within the Framework of the FAO/Netherlands Government Cooperative Programme. The project is being implemented by FAO in cooperation with the International Soil Reference and Information Centre (ISRIC) under a sub-contract. The project calls for the compilation of an environmental information system for 13 countries in Central and Eastern Europe, enhancing scientific cooperation between Eastern European countries on issues of soil degradation and pollution.

SOVEUR is being carried out in close collaboration with specialist institutes in Belarus, Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Moldova, Poland, Romania, Russia (west of the Urals), Slovak Republic and the Ukraine.

The main objectives in the SOVEUR project are to strengthen regional awareness of the significant role soils play in protecting food and water supplies, and to demonstrate the need for environmental protection through:

- Development of a soils and terrain digital (SOTER) database, at 1:2.5 million scale for the 13 countries under consideration.
- Development of a data base of the status of soil degradation, with a special focus on pollution.

- An assessment of the vulnerability of soils to selected categories of pollutants, using the SOTER geographic and attribute data. The ultimate aim of this part of the project is the identification of broad areas of soils considered at risk from re-mobilization of specific contaminants following environmental changes.

In order to achieve the SOVEUR project goals, methodologies for the three project activities enumerated were prepared. These guidelines were presented and discussed during a workshop held at ISRIC (October 1-3, 1997). Aspects of data availability, accessibility and comparability were discussed in relation to the stated project objectives and methodologies proposed for the various tasks, based on written and oral contributions from the various national participants. Subsequently, working groups determined realistic goals for the project implementation phase, and this notably in terms of methodological approaches and feasible outputs in relation to overall data availability. Upon reaching a consensus on methodological issues and the approach to be followed, work plans for the implementation phase were developed.

Subsequent to the workshop and signing of Memoranda of Understanding (MOUs), in late 1997, national representatives started developing the data sets for their respective countries. By mid 1998, the first data sets started coming in. After checking and validation at ISRIC, the data sets are being merged into a common SOTER and Soil Degradation Status database for the region. Procedures for assessment of the vulnerability of soils to selected pollution scenarios are under development.

In late 1999, all SOVEUR collaborators will convene in a Central Eastern European country to discuss the interim results and to reach agreement on any outstanding issues, including cross-border correlation and refining of the procedures for assessing soil vulnerability.
Subsequently, final databases and selected (digital) maps of degradation status and soil vulnerability will be prepared for final presentation on a single CD-ROM for use by the modelling community.

SOVEUR workshop

2.2.3 World Inventory of Soil Emission Potentials (WISE)

From September 1991 to December 1995, staff at the International Soil Reference and Information Centre (ISRIC) developed a digital database to permit a better quantification of the role of soils in controlling processes of global change. This database, currently known as the World Inventory of Soil Emission Potentials (WISE) database, is a combination of soil area data and soil attribute data. The former, based on a digitized and edited version of the 1:5 M Soil Map of the World prepared by the Food and Agriculture Organization (FAO), specifies the type and relative extent of the main soil units for each 2° latitude by 2° longitude grid. The properties of the soil units shown on the map have been characterized using a set of representative soil profiles, which are held in the WISE profile-attribute database (see ISRIC Bi-Annual Report 1995-1996).

Following an exchange of views, in December 1996, between IIASA, ISRIC and FAO on the application and analysis of the full WISE profile database for future use in the global AEZ, a short project was initiated. The resulting report presented statistics for 20 soil attributes identified as being critical for land evaluation in the context of AEZ studies. Information on several other parameters still has to be inferred directly from the Soil Map of the World. In a follow-up activity, coordinated by IIASA, in which about 20 soil experts have been asked to fill-in the gaps that remain in the preliminary data set.

2.2.4 Possibilities for enhanced organic carbon sequestration in the soil (SOC-NOP)

This baseline study, initiated in mid 1998, is carried out within the framework of the Netherlands National Research Programme on Global Air Pollution and Climate Change (NRP Project: 952282). It comprises a review of published data on the capability of soils for enhanced carbon sequestration, through: (1) improved and sustainable soil management practices or (2) the physiological 'CO_2-fertilization' effect, associated with increased atmospheric CO_2-levels, and the associated improved water-use efficiency and more favourable temperatures and increased anthropogenic nitrogen emissions. The emphasis in the study is on item (1). First, a wide range of international experts, known to ISRIC, have been asked to provide information on topics such as "where long-term Soil Organic Carbon field experiments have been carried out" and "what did this give in terms of increased CO_2 sequestration". This information, is being supplemented with a survey of the peer-reviewed literature. In a third stage, preliminary GIS-based studies will be made to attempt a global quantification of possibilities for enhanced carbon sequestration in the soil, in first instance using broad assumptions and necessarily coarse scenarios. The results will be presented by mid 1999, as a Technical Paper series of NOP.

2.2.5 Assessment of the Potential of Low External Input Agriculture in Ecological Zones with Edaphic Constraints

ILEIA-ISRIC SOIL STUDIES IN GHANA, PERU, AND PHILIPPINES

Background

At the end of 1995 the Information Centre for Low-External-Input and Sustainable Agriculture (ILEIA) and ISRIC signed a cooperation agreement to carry out a number of soil investigations in pilot areas located in Ghana, Peru, and the Philippines. ILEIA's research programme is focussed on the question whether LEISA is a valid option in different agro-ecological and socio-economic conditions. One of the first research activities focused on the characterization and evaluation of soils of in total six pilot areas in the three countries by both farmers and soil scientists. ISRIC requested three national soil institutions[6] to work in close cooperation with farmers and NGOs in the pilot areas to realize this task. The comparison and integration of views of farmers and scientists on soils is the central activity of the project, with the object of contributing to a participatory process to solve soil-related production constraints of farming. A schematic presentation of main activities is given in Figure 3.

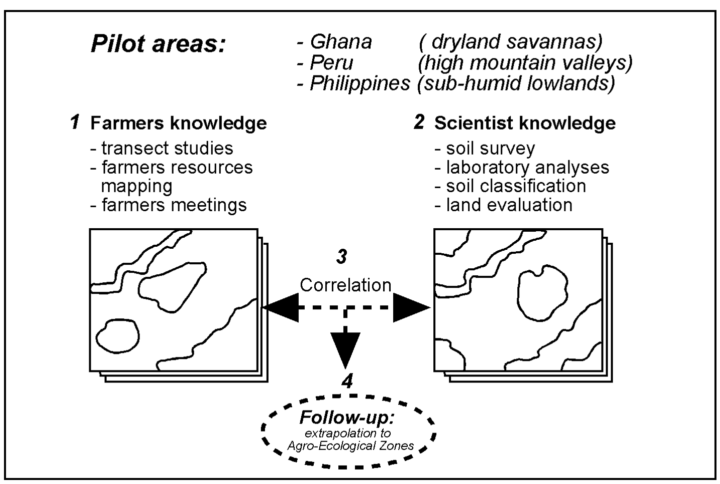


Figure 3 – A schematic presentation of four major project activities

[6] Institute of Soil Research, Kumasi, Ghana (contact person R. Asiamah); Bureau of Soil and Water Management, Manila, Philippines (R. Concepcion); Soil Department of the Universidad Nacional de la Molina, Lima, Peru (M. Valencia).

Results

The field surveys were executed by the national soil institutions in close collaboration with ISRIC's soil scientists in 1996 (see ISRIC Bi-annual report 1995-96). The detailed information resulting from these farmers/scientists soil studies are presented in reports published in 1996 and 1997 by the national soil institutions in the three countries, and copies can be requested from these institutions. In addition for each country a summary report was published by ISRIC in 1997 and 1998, and copies can be obtained from ISRIC. For full references of these reports, see section ISRIC's publications (Reports 97/03, 97/04 and 98/03).

The project provided the soil and natural resource scientists with a unique experience in working directly with the local communities with a particular focus on comparing and integrating classical methodologies of soil survey with local knowledge of soils and their agricultural potential.

Conclusions

To a certain extent it is possible to correlate farmers soil knowledge with regular soil science. However, correlation can not always be consistently made, because of the different criteria and rules used by farmers and scientists. Farmers have a flexible way of characterizing and classifying soils, based on a strong practical focus. For example, it will be based mainly on topsoil properties when considering agricultural soil use. When considering soil as a building material, generally only subsoil properties are considered. Soil scientists view soil properties over the entire soil depth for multi-purpose assessments. An additional difficulty is the variation in local soil names, which can be very large, depending on the variation in idioms and languages in a country. Nevertheless, at local level it is recommended that the potential use of indigenous soil names should be maximally explored for strengthening communication between the stakeholders.

There is more scope in how farmers and scientists look at soil-related constraints for agricultural production. From the soil studies in the three ILEIA pilot areas, it is concluded that farmers and scientists identify and agree on soil-related production constraints, soil management techniques and potential solutions how to overcome the limitations. The three main soil-related production constraints, indicated by both farmers and scientists in the three ILEIA countries, are related to water availability, plant nutrient availability (soil fertility) and soil degradation.

2.2.6 National Studies on Impact of Water Erosion on Crop Production (Kenya, Argentina, Uruguay)

Early 1997 a UNEP sponsored impact assessment study of water erosion on crop production was finalized. The study was done in collaboration with the Netherlands Institute of Public Health and Environment (RIVM), within the framework of UNEP=s Pilot Global Environmental Outlook project. The main issue was to assess the importance of scale and structure of environmental databases and model formulation on the possible level of detail and conclusions drawn with respect to the assessment/quantification of the impact of water erosion on food production. This study supports the general notion that the impact of soil erosion on land productivity varies between soil and terrain units.

On the basis of 20 year simulated erosion it was concluded that the deep, organic matter rich soils which predominate in Uruguay and Argentina will be less affected than many of the deeply weathered soils in Kenya. This was most clear for the scenarios in which production decline was calculated as a function of the nutrients lost with the eroded topsoils.

In Uruguay the major cause of yield decline are the altered soil hydraulic properties as a consequence of 20 year of simulated topsoil erosion. Argentinian soils are least affected and scenario studies indicated that these generally deep and fertile soils are resilient to water erosion. In Kenya the environmental conditions are altogether much more variable. In the very steep patches of land in the central and central western part of Kenya, yield decline is more than 50% as a consequence of soil physical changes induced by water erosion.A clear decline in maize yields was predicted as a consequence of nutrients lost through prolonged sheet erosion.

2.2.7 Biodiversity Project (Peru)

BACKGROUND

The EU-funded STD3 Biodiversity project with the title "An integrated study of land properties, their floristic indicators and appropriate farming systems in an acknowledged biodiversity centre in Amazonian Peru" started with a workplan formulation workshop in December 1994 and was concluded with the presentation of the final results in the book "Geoecologia y desarrollo Amazonico, estudo integrado en la zona de Iquitos, Peru", 1998, ed. Risto Kalliola and Salvador Flores Paitan, Turun Ylioposto, Turku (Finland).

The project combined geological and biological approaches to gain understanding of the ecological constraints of agricultural production in an area around the city of Iquitos, Peru. It assisted in finding realistic alternatives to migratory farming in Amazonia. The study is a combination of fundamental and applied research. The fundamental studies attempt to gain understanding of the variation in site edaphic conditions using aspects of geography, geology, pedology and biology. The applied studies try to develop appropriate farming systems for the dominant soil types.

PARTICIPANTS

- Turku University, Turku, Finland: project coordination, remote sensing, floristic and geology studies.
- Universidade Nacional de la Amazonia Peruano [UNAP], Iquitos, Peru: forestry-fallow, agro-forestry experiments and soil survey investigations.
- Instituto Nacional de Recursos Naturales [INRENA], Lima, Peru: remote sensing, geology and deforestation studies.
- Forschungsinstitut Senckenberg, Wilhelmshaven, Germany: clay mineralogy
- ISRIC, Wageningen, Netherlands: soil characterization, classification and land evaluation aspects, and the analyses of soil samples.

ACTIVITIES

- A summary of ISRIC's main activities over the project period:
- Participation in fieldwork and the 1st and 3rd Workshop at UNAP, Iquitos, Peru.
- Various logistic support.
- Participation in the 2nd Workshop at Turku University, Turku, Finland, in which a framework for the book presenting the final project results was discussed.
- Soil analyses by ISRIC laboratory: chemical, physical and mineralogical analyses of about 200 soil samples taken by the botanists, geologists and soil scientists.
- Together with UNAP's soil scientist prepare the chapter *Soils of the Iquitos Region*.

RESULTS

The soil study of the Iquitos region includes a review of the soil surveys of the past 20 years, the study of new field sites, representative of the main soil types, and the analysis of soil horizons up to maximum depth of 6 to 7 metres. This study focuses on the non-flooded upland area, the *Tierra Firme*. At present vast areas of *Tierra Firme* are still covered with tropical rain forest except for the marginal land along the rivers and the area South of Iquitos, which areas are used for various agricultural land uses. A series of thematic maps was prepared, showing key soil characteristics. The Iquitos region has several strongly contrasting soils, distribution of which is shown in a simplified schematic cross-section. The soils were classified according to international soil classification systems (FAO and Soil Taxonomy), and correlated with earlier soil survey studies of the Iquitos and Yurimaguas areas. The problem of classifying soils either as Acrisol or Ferralsol (FAO), and Ultisol or Oxisol (Soil Taxonomy) is discussed. For the purposes of field experiments and soil management five main soil groups in the *Tierra Firme* are proposed, which are correlated with landform, soil permeability, soil tillage and soil fertility.

I. Slightly leached smectite-clay containing soils (Gleyic and Dystric Cambisols)
II. Strongly leached kaolinitic clay soils (Ferralsols and Acrisols)
III. Strongly leached loamy soils (Ferralsols or Ferralic Cambisols)
IV. Strongly leached sands (Arenosols and Podzols)
V. Poorly drained soils, nearly all months saturated with water, of various textures situated in valleys and depressions, which include peat soils (Histosols) and mineral soils (Gleysols).

The agro-ecological potential of these five soil groups was evaluated by assessing eleven land qualities. Major agricultural production constraints were identified and potential soil improvements and management techniques discussed.

The main conclusions and recommendations include the following:
The preparation of an updated soil map based on the present study and the results of soil surveys over the past 20 years. *Tierra Firme* soils are dominantly strongly leached and very acid, hence poor in plant nutrients. A minor part of the *Tierra Firme* soils has a substantial reserve of plant nutrients, which is based on the presence of relatively unleached Tertiary alluvial clay deposits (e.g. Pebas formation). These soils seem mainly to be restricted to the denudated land along rivers, valleys, and depressions. A soil survey of the central parts of the *Tierra Firme* land is needed to confirm this theory.

In view of the persistent soil constraints of the dominant part of the *Tierra Firme* soils, further research in local institutions is recommended. This should include a study of the soil organic matter, which, according to our dataset, is rather inert from the viewpoint of plant nutrient retention. The use of trees in land use systems should be maximized in order to mimic the plant nutrient cycling mechanism of the tropical rain forest.

2.2.8 Forest Inventory and Monitoring Project (Indonesia)

PROJECT DESCRIPTION

The Forest Inventory and Monitoring Project (FIMP) aims to strengthen the Indonesian Ministry of Forestry's capacity for forest planning and management at the provincial level. ISRIC provided consultancy services for this European Union-funded project under a subcontract with SCOT Conseil. Techniques have been developed for medium-scale (1:50.000) forest mapping and inventory. In four pilot areas in the south of Sumatra field information on vegetation, fauna, soils and landforms is gathered along transects. Socio-economic surveys are held in villages bordering the forest in the pilot areas. Data are stored in the Integrated Forest Resource Information System (IFRIS), which was designed for this purpose.

FOREST SOIL INVENTORY AND DATABASE DESIGN

As part of FIMP survey design soil data are routinely collected in the project pilot areas. Assistance was provided in the collection of soil data in Bengkulu, South Sumatra. Soil inventory methodology as carried out by FIMP was assessed. Recommendations on future inventory and use of soil data were given. Soil and site data were compiled in a database. Support programs for data quality control and data extraction were written. Principle Component Analysis was used to characterize and explain soil variation on three pilot locations in South Sumatra. Soils varied mainly between locations. Variation within and between transects on one location was limited, with the main variation caused by drainage and position (valley bottom soils versus slope and crest soils).

SOIL-LANDSCAPE-VEGETATION RELATIONSHIPS

No individual forest communities could be distinguished within the primary rain forest by remote sensing. So far, only broad vegetation and landcover types could be mapped. Therefore no link can be established between tree species data from inventory plots and remotely sensed data. As spatial patterns in structure and composition of primary forests are related to variations in past and present biotic environment, the delineations of landforms, parent materials and soils may serve as a basis for mapping primary forest tree species associations. A knowledge-based approach to predict *potential* occurrence of rain forest communities on the basis of land characteristics was evaluated. An existing system was adapted for use at the eco-system level. The method yielded variable results and it was concluded that this approach was not adequate to assess the 'ecological suitability' of areas for forest communities. As an alternative, a method for direct gradient analysis (Canonical Correspondence Analysis) – that allows study of vegetation variation as a function of environment gradients – was applied to the data of one pilot area. Results were promising and it was recommended to be applied to the whole database for exploration of the relation between floristic patterns and variation in land units (soil, parent material, and slope position).

2.2.9 Berau Forest Management Project (Indonesia)

Consultancy services were rendered to the European Union funded Forestry Project in Kalimantan, Indonesia. The Berau Forestry Management project is subcontracted to DHV as a cooperative study between the EU and the Indonesian Ministry of Foresty and Estates.

PROJECT DESCRIPTION

The objectives of the Berau Forest Management Project (BFMP) are to develop and implement methodologies for sustainable production forest management. BFMP is co-operating with a local concession holder in East-Kalimantan, where selective logging is practised. The focal aspect of the project is the effective transfer of research results into practical forest management on an operational scale, optimizing financial, social, and environmental benefits.

ENVIRONMENTAL FRAMEWORK

Soil and terrain characteristics are determinants of site qualities relevant for both forest management and forest growth and yield. Data on soils and terrain conditions, climate, vegetation, and hydrology, stored in a geo-referenced database and linked to a map forms an environmental framework. Such a framework provides a basis for planning and can be used for management zonation, land suitability assessment, a stratification for inventory and consequently for tree growth and yield prediction, and it forms a base line for monitoring environmental changes. As part of the development of such an environmental framework a soils and terrain reconnaissance survey of the Labanan concession area, Berau, East-Kalimantan was carried out. For the inventory a 'stratified systematic approach' was followed.

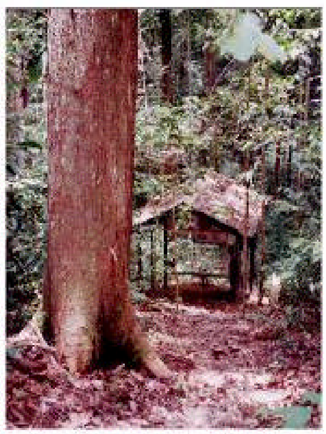
RESULTS

Red-Yellow Podzolic soils (Acrisols) are dominant in Labanan, but wide variation in terrain and soil conditions was found. The dominant Acrisols are well drained, very deep, poorly fertile, and aluminium toxic. These soils are found on the slopes and the hilltops of plains and hills overlying sedimentary rocks. Other soil units are mainly related to: 1) *parent material*: neutral and heavy clay soils overly limestone in undulating plains with rock outcrops, 2) *topography*: in very to extremely steep parts of the area eroded and shallower soils are found, and 3) *drainage conditions*: in the flat areas adjacent to the meandering rivers imperfectly to very poorly drained soils are found.

Differences in limitations and potential for management and use are associated with this variation. Vulnerability to erosion of most soils in Labanan is a major constraint for forest use and management and possible alternative land uses. A hierarchically structured soils and terrain database was developed and an intermediate database was designed that links the soils and terrain database to the forest management planning tools. The advantage of an intermediate database for all applications is that it uses a single, standardized input format and that derived data can be included where necessary, thereby preserving the integrity of the basic database. The taxonomic homogeneity of the soil components in the soil and terrain map units was generally satisfactory with 70 % or more observations matching the legend description. In an exploratory analysis the possible association between two forest tree species and single soil variables was studied. A method was proposed for implementation of long-term monitoring of erosion as a means to objectively quantify the environmental impact of different forest management practices.

The environmental framework as part of a decision support system for forest management was presented at a national workshop on forest growth and yield and an at international conference on data management and modelling using RS and GIS for Tropical forest land inventory, both held at Jakarta in 1998.

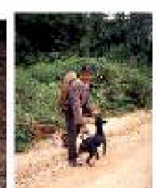
View on Labanan forest



Permanent soil excursion site

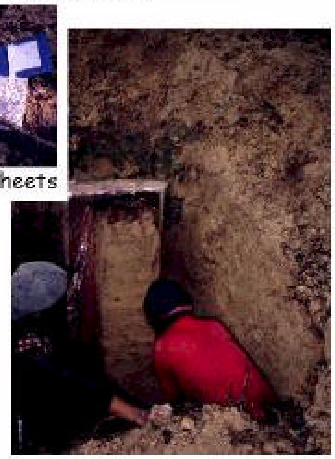
Hornbill

Data sheets



Forest hunter

Haplic Acrisol



Taking a soil profile

Assessment of Human-Induced Soil Degradation in South and Southeast Asia (ASSOD)

In 1997 ISRIC completed the 1:5M assessment of the status of human-induced soil degradation in South and Southeast Asia (ASSOD) that was started in 1995 in close cooperation with national institutes in 17 Asian countries with technical and financial support from UNEP and FAO.

After all data had been collected, reviewed and corrected in the preceding period, the final compilation was done in late 1996 and early 1997. A number of themes were selected for map preparation and a technical report was published by June 1997. This report describes the methodology and summarizes the results, illustrated in a number of graphs, tables and two A2 size maps, showing overall degradation on one map and four “windows” for specific types of degradation. Unfortunately there was no opportunity to discuss the results with the national institutions in a final meeting. However, correction and updating of the database remain possible in the future. Individual maps on specific themes or for specific regions can be produced on request.

ASSOD is a clear improvement of the GLASOD study by providing much more detail and country based data, while the increased consideration of productivity, management and degradation trends enhances its value for potential users such as policy makers and scientists.

In GLASOD the degree of soil degradation reflected the intensity of the degradation process itself, while in ASSOD the effect of this process is considered (its impact on productivity). Consequently it is possible, for instance, that in areas with deep fertile soils, erosion is quite intense, but the impact is only light or even negligible. In Table 2 the column "negligible" is thus not necessarily synonymous with "stable", which means no degradation.

RESULTS

The impact of human-induced soil degradation in South and Southeast Asia is summarized in Table 2 for the main types of soil degradation. Full details for individual countries can be found in the technical report (Van Lynden and Oldeman, 1997).

Table 1 Impact of human-induced soil degradation in South and Southeast Asia (expressed in million hectares)

Degradation type	negligible	light	moderate	strong	extreme	total
Water erosion	82	202	116	43	8	451
Wind erosion	2	83	38	70	1	194
Nutrient decline	68	68	45	1	1	183
Salinization	5	22	14	2	1	44
Aridification		24		1	--	25
Waterlogging	11	19	5	3	--	38
Compaction, crusting	6	3	1			10
Miscellaneous types	4	9	5			18
Total	178	436	224	120	11	963

Water erosion covers some 46% of the total degradation area, being predominant in large parts of China, on the Indian subcontinental, and in the sloping parts of Indo-China. Loss of topsoil is identified as the most common subtype of water erosion, but generally having negligible or slight impact.

Wind erosion (20% of all identified degradation occurrences) is mainly concentrated in the most western and northern arid and semi-arid regions of Pakistan, India, and China. Although large parts of these regions may be considered deserts, some human-induced wind erosion was indicated by the national institutions.

The distribution of chemical degradation is quite varied. About 25% of the degradation types are attributed to chemical degradation. Relatively, high extents are observed in Bangladesh, Cambodia, Sri Lanka, Malaysia, Pakistan, and Thailand. The most common subtype is fertility decline (70% of all chemical degradation). It occurs in all countries, but is of particular significance in Thailand (25 Mha) and Pakistan (18.5 Mha). Salinization is second in importance, obviously in the drier areas of India, Pakistan, and China. In contrast to fertility decline the impact of salinization is more pronounced.

The occurrence of physical degradation is dispersed and infrequent, affecting about 9% of the total degraded area. Waterlogging and aridification are the main subtypes, especially in Bangladesh, China, India, and Pakistan.

While certain hot spots can be identified on the maps and in the statistical data derived from these maps, it is clear that for detailed planning at (sub) national level a more detailed and more quantitative approach is required.

Information from ASSOD is extensively used in the second (revised) edition of the World Atlas of Desertification, which has recently been published by UNEP.

COOPERATING INSTITUTIONS:

- FAO Regional Office for Asia and the Pacific (Bangkok)
- Soil Resources and Development Institute (Dhaka, Bangladesh)
- Institute of Soil Science, Academia Sinica (Nanjing, China)
- National Bureau of Soil Science (Nagpur, India)
- Centre of Soil and Agroclimatic Research (Bogor, Indonesia)
- Malaysia Agricultural Research and Development Institute (Kuala Lumpur, Malaysia)
- Myanmar Agriculture Service (Yangon, Myanmar)
- Department of Soil Conservation (Kathmandu, Nepal)
- Land Resources Research Institute (Islamabad, Pakistan)
- Bureau of Soils and Water Management (Quezon City, Philippines)
- Natural Resources Management Centre (Peradeniya, Sri Lanka)
- Department of Land Development (Bangkok, Thailand)
- Institute for Soils and Fertilizers (Hanoi, Vietnam)
- Academy of Agricultural Sciences (Pyongyang, DPR Korea)
- National Agricultural Science and Technology Institute (Suweon, Korea)
- Research, Extension, and Irrigation Division (Timphu, Bhutan)
- Soil Survey and Land Classification Centre (Vientiane, Laos)

2.2.10 World Overview of Conservation Approaches and Technologies (WOCAT)

WOCAT was launched in 1992 by the World Association of Soil and Water Conservation (WASWC) and is coordinated by the Centre for Development and Environment of the University of Berne. While GLASOD/ASSOD provides a qualitative overview of human-induced soil degradation, WOCAT collects examples of successful soil and water activities worldwide.

WOCAT contributes to the sustainable development of natural resources by presenting lessons learned from successful examples of soil and water management. WOCAT is organized as a consortium of international, regional, and national institutions. ISRIC has been associated with WOCAT since 1992.

In 1997 and 1998 ISRIC continued and even strengthened its involvement in the WOCAT Programme. Particular highlights in this period were:

- contribution to the WOCAT chapter in the Second Revised Edition of the World Atlas on Desertification published by UNEP (January-April 1997)
- contribution to a full colour 16 page brochure (May 1997)
- participation in the Second Annual International Workshop in Murten, Switzerland (August 1997)
- technical assistance to DLD in Bangkok for "THAICAT" (November 1997)
- participation (resource person) in ADB funded WOCAT workshop in Fujian Province China (November 1997)
- participation in Management Board meeting at FAO, Rome (December 1997)

- revision of the questionnaires (ongoing, 1997 - 1998)
- technical meeting in Bern, Switzerland (February 1998)
- contribution to a CD ROM containing all preliminary results and other outputs to date of WOCAT (April-June 1998)
- inputs and comments to an external Review (May 1998)
- co-authoring draft guidelines for regional initiatives (April-June 1998)
- participation in the Third Annual International Workshop in Twann, Switzerland (August 1998)
- preparation of a draft proposal for "HIMCAT": WOCAT in the Hindu-Kush-Himalayas region, in collaboration with ICIMOD.

Since the Second Annual International Workshop in Murten, WOCAT is organized as a consortium of international institutions and coordinated by a Management Board selected from those institutions, of which ISRIC was selected as one. In the period 1997-1998 WOCAT has seen considerable progress and a growing interest among national and international institutions. The emphasis has now shifted from methodology development towards implementation and production of outputs.

An external review was held in 1998 resulting in a strong recommendation to continue and further develop the activities, with a greater orientation towards decentralization and more responsibilities for national institutions outputs, supported by a WOCAT "core" team. Also a shift in focus was envisaged from methodology development in the preceding period towards production of outputs. Although ISRIC has been involved in all aspects of the programme, its major technical contribution has been in the development of a methodology for mapping the distribution of Soil and Water Conservation Technologies and related GIS activities.

LIST OF COLLABORATING AND FUNDING INSTITUTIONS (MARCH 1998)

ADB	Asian Development Bank, Manila, Philippines
ASOCON	Asia Soil Conservation Network, Jakarta, Indonesia
CDCS	Centre for Development Co-operation Services, Vrije Universiteit Amsterdam, the Netherlands
CDE	Centre for Development and Environment, University of Berne, Switzerland
CIAT	Centro International de Agricultura Tropical, Cali, Colombia
DLD	Department of Land Development, Ministry of Agriculture and Cooperatives, Bangkok, Thailand
FAO	Food and Agriculture Organization of the United Nations, Rome, Italy
FSWCC	Fujian Soil and Water Conservation Centre, Fuzhou, China
GTZ	Gesellschaft für Technische Zusammenarbeit, Eschborn, Germany
IBSRAM	International Board for Soil Research and Management, Bangkok, Thailand
ICARDA	International Center for Agricultural Research in the Dry Areas, Aleppo, Syria
ICIMOD	International Centre for Integrated Mountain Development, Kathmandu, Nepal
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics, Niamey, Niger
IDRC	International Development Research Center, Ottawa, Canada
IRE	Institute of Resources and Environment, University of British Columbia, Vancouver, Canada
ISCW	Institute for Soil, Climate and Water of the Agricultural Research Council, Pretoria, South Africa

ISRIC	International Soil Reference and Information Centre, Wageningen, The Netherlands
OSS	Observatoire du Sahara et du Sahel, Paris, France
PASOLAC	Programa de Agricultura Sostenibile en Laderas de América Central, Managua, Nicaragua
RELMA	Regional Land Management Unit (former RSCU), SIDA, Nairobi, Kenya
SDC	Swiss Agency for Development and Cooperation, Berne, Switzerland
UNEP	United Nations Environment Programme, Nairobi, Kenya
WASWC	World Association of Soil and Water Conservation, Ankeny, USA

2.2.11 Contribution to the World Atlas of Desertification

In September 1997 the second revised edition of the World Atlas of Desertification was published by UNEP (edited by N. Middleton and D. Thomas). This revised edition contained various materials from the first edition that appeared in 1991, such as a chapter on the GLASOD map, but a considerable amount of new material was added. ISRIC contributed significantly by providing ASSOD data, a chapter on KENSOTER and part of the chapter on WOCAT. These data had to be restricted to the “susceptible dryland” areas in view of the focus of the Atlas.

2.2.12 ISRIC Soil Laboratory Research

Linked to the SOVEUR study the laboratory commenced correlation studies of analytical methods used in the past in Eastern Europe with methods used elsewhere in the world. Such studies are necessary if results obtained by these methods are "mixed" with other data in databases.

Hydraulic data of soils are relatively scarce. The main reason for this is the tediousness and high costs of their determination. This particularly applies to hydraulic conductivity, which can best be done in situ. Although moisture retention characteristics are somewhat easier to determine these are lacking in many databases. ISRIC's data on Ferralsols were used to develop pedotransfer functions (PTF's) by which the available water storage capacity (AWC) can be estimated from other, easily measured soil properties. In this way, databases can be supplemented. It is intended to expand this exercise to other soil groups.

In cooperation with the consulting company IWACO in studying waste-incinerator bottom-ash (a volcanic ash-like material with environmental problems) was continued. It has now been expanded with research on fly-ash. Dumps of this material are present in many places in the world, including developing countries (e.g. India). Studies focus on the ameliorating influence of agriculture on these potentially hazardous, heavy metals-rich dumps.

2.3 STRENGTHENING THE CAPACITIES OF SOIL INSTITUTIONS

ISRIC's programme "Strengthening the capacities of natural resources institutes, and enhancing the interaction between producers and users of soil information" is implemented in various ways:

2.3.1 Training and technical support in the development of soils and terrain databases

- SOTER related workshops were held in China (Hainan and Beijing); Middle-East countries (Syria), Benin, Ethiopia, Yemen;
- SOVEUR related training was given in Hungary
- WOCAT workshops in which ISRIC provided training were organized in China (Fujian Province) and Thailand

2.3.2 Establishment of national soil reference collections (NASREC)

The NASREC programme was formally terminated in 1995, when existing and potential collaborators together with resource persons reviewed the performances of the NASREC programme (see ISRIC Bi-Annual Report 1995-1996). Based on the conclusions and recommendations of the NASREC workshop a new initiative was developed for the Southeast Asian region. The project concept for the Establishment of a Southeast Asian Land Resources Information System (SALRIS) received encouraging support from national and international agricultural research and natural resources institutions. Funding is being sought.

At present ISRIC is only involved in a traditional NASREC activity in Kenya in close cooperation with the Kenya Soil Survey . Early 1997 ISRIC's soil analytical laboratory carried out additional soil analyses, necessary for the characterization of diagnostic horizons and properties for about 70 selected reference profiles.

In the course of 1998 this information has been added to the descriptions and all Kenyan reference profiles were classified according to the FAO Revised Legend of the Soil Map of the World (1988) and the Soil Taxonomy (1996 version). The KENASREC project will be terminated in 1999.

NASREC ACTIVITIES IN INDIA

ISRIC participated in the opening ceremony of the Tamil Nadu University Soil Reference Centre in Coimbatore, which received technical assistance from ISRIC in previous years. Subsequently ISRIC received requests for technical assistance to develop similar centres at Assam Agricultural University, Acharya N.G. Ranga Agricultural University, the University of Agricultural Sciences, Dharwad. Universities were encouraged to pass their requests through the National Bureau of Soil Survey and Land Use Planning at Nagpur to obtain funding.

2.3.3 Assistance with establishment of laboratories for soil analysis and their quality management

CENTRAL LABORATORY AT FAYOUM, EGYPT

ISRIC was commissioned by DGIS to assist in the planning, equipping and starting up of a new soil, plant, and water laboratory in the Fayoum region in Egypt, where salinity is a major problem. Considerable delay in the construction of the building was encountered because of local logistic problems. However, during the first half of 1998 sufficiently progress had been made to allow an ISRIC laboratory technician to make a first assistance and training mission. Two further missions are planned for 1999.

GUIDELINES FOR QUALITY MANAGEMENT IN SOIL AND PLANT LABORATORIES

After several working drafts, the *Guidelines for Quality Management in Soil sand Plant Laboratories* were finalized and published as FAO Soils Bull. 74 (1998). In this text book, the principles of Good laboratory Practice (GLP) are molded into practical guidelines to set up a system of Quality Assurance and Quality Control enabling test laboratories or small research laboratories with limited budgets to produce quality data. Emphasis is placed on achieving an improvement of performance by adopting a number of relatively simple rules and inexpensive measures. These include the drafting of proper operating procedures and protocols, the systematic keeping of records, as well as the use of quality control charts and the preparation of essential control samples. To allow proper validation of obtained results, some basic statistics are discussed also. ORSTOM is presently translating the guidelines into French.

A useful tool in quality management is *SOILIMS*, an inexpensive user-friendly computer programme specially designed for the same type of laboratory for which the Guidelines for Quality Management were drafted. This system was further improved and expanded with attributes for water analysis.

Training activities were continued in the framework of the annual Postgraduate Course on Soil and Plant Analysis and Data Handling (a joint project with the Wageningen Agricultural University and the International Agricultural Centre at Wageningen).
A francophone course in SOILIMS was given in 1997 for SPALNA (Soil and Plant Analytical Laboratory network of Africa) at the IITA premises in Cameroon.

To promote a consciousness of the importance of data quality and the available tools to maintain quality standards, ISRIC participated in a workshop held late 1998 by IBSRAM in Bangkok to initiate SEALNET, a S.E. Asian Laboratory Network of soil, plant, and water laboratories.

2.3.4 Lecturing at international courses

Having a cooperative agreement with the International Institute for Aerospace Survey and Earth Sciences (ITC), Enschede, ISRIC staff members lectured at the Professional Master (PM) and Master of Science (MSc) courses of ITC on "Geoinformation for Sustainable Soil Resource Management". Subjects taught were "Introduction to physico-chemical aspects of soil formation" (by L.P. van Reeuwijk) and "Introduction to global soil classification systems" (by D. Creutzberg and O.C. Spaargaren, focussing on the USDA Soil Taxonomy, the FAO Revised Legend of the Soil Map of the World, and the World Reference Base for Soil Resources).

Starting in 1999, ISRIC has been requested to participate in lecturing at the International Institute for Infrastructural, Hydraulic and Environmental Engineering (IHE), Delft, on "Soil Quality Management" for their international Master's programme in "Environmental Science and Technology.
An ISRIC staff member (J.H.V. van Baren) gave an introductory one-day lecture on "Soils of the World" for the international course in Soil Physics, bi-annually organized by the International Centre for Theoretical Physics (ICTP) in Trieste, Italy.

In 1998, first contacts were made by ISRIC to take part in refresher courses for teachers of secondary schools and technical colleges in the Netherlands, participating in the international GLOBE programme (GLOBE: Global Learning and Observation to Benefit the Environment). It is anticipated that ISRIC may play a facilitating role in the courses with a prominent soil component.

2.3.5 Consultancy services

As reported in the previous section (2.2.7) ISRIC developed Letters-of-Agreement with various consulting bureaus (e.g. DHV, SCOT Conseil) as well as with FAO to provide technical expertise in programme activities of these agencies during the reporting period.

ISRIC also provided analytical services for third parties. In 1997, work for the Ecuador Biodiversity project (Turku University, Finland) continued and was concluded. For several consulting companies soil characterization analyses were carried out (e.g. inventory projects in Brazil and Albania). In addition, requests for quality control (verification) analyses on tropical soils were received.

As usual, analyses were carried out for several departments of ITC, ISRIC's parent institute. Interestingly, one such investigation unexpectedly revealed the presence of zeolite in Argentinian soils. In another one, analytical soil and plant data were used to calibrate satellite spectral images.

Although it was not the first forensic investigation in ISRIC's history, the laboratory was asked to help in solving a huge gold theft during a cargo trip from Africa to Canada: soil that was used to substitute for the gold had to be characterized to establish its origin.

Several other requests for analytical work were received from various companies, institutes, or organizations. Among these were: Biochem Environmental Laboratory, Zoetermeer; Natufresh Europe, Huizen; Rosenberg Environmental Technics, Ter Heijden; IWACO Environmental Laboratories, Rotterdam; DHV, Amersfoort; GeoDelft (previously Delft Geotechnics); Delft; FAO (El Salvador Project).

Unfortunately, it seems that requests for analytical work from third parties are dwindling. In an effort to join forces to obtain more orders for laboratory work, provisional agreement was reached between four laboratories in Wageningen to offer expertise, experience and capacity to each other as well as to third parties. These four laboratories constituting this *WaLab* alliance are those of the Dept. of Soil Science and Geology, the Dept. of Soil Science and Plant Nutrition, both of the Wageningen Agricultural University, the Winand Staring Centre (SC-DLO, now called *Alterra*), and ISRIC. Restructuring in the Wageningen University (WAU) and in the Agricultural Research Institutes (DLO) has been focussed on internal changes rather than on external services. A market research is being investigated to expand the services and client base.

2.3.6 Organizing international workshops

During the reporting period ISRIC organized and co-organized various international workshops, both at its premises in Wageningen as well as in countries where ISRIC is a partner in project activities (see previous Sections).

WORKSHOP ON "SCALING OF TRACE GAS FLUXES"

The world's terrestrial and aquatic ecosystems are important sources of a number of greenhouse gases and aerosols that cause atmospheric pollution and disturb the energy balance of the Earth atmosphere system. In January 1998, ISRIC organized an international workshop to review the state-of-the-art in the field of scaling of fluxes of greenhouse gases and ozone and aerosol precursors. The workshop focussed on identification of gaps in knowledge and in finding solutions and determining future research directions. The peer-reviewed, invited papers and working group discussions will be published by Elsevier in 1999 (Bouwman, A.F. (Ed.), 1999. *Approaches to Scaling of Trace Gas Fluxes in Ecosystems*. Elsevier, Amsterdam in press).

2.4 ENHANCEMENT OF ACCESSIBILITY OF SOIL AND TERRAIN INFORMATION

ISRIC's mandate is formulated as: *Collection and dissemination of scientific knowledge about soils for a better understanding of their formation, characterization, classification, distribution and capability for sustained land use at local, national, regional and global scale.*

ISRIC has traditionally placed strong emphasis on the establishment of a documentation facility on world soil resources in the form of books, technical reports, maps, and soil monoliths. It is a depository of books for the International Union of Soil Science. ISRIC attracts visitors from all over the world to see its unique collection of soil monoliths, a selection being permanently exhibited in its Soil Museum. In order to further improve its function as centre for dissemination of information on soils ISRIC has further expanded its own Home Page on the Internet as an effective mechanism for information exchange.

2.4.1 ISRIC Soil Reference Collection

During the last two years efforts were focussed on re-examining ISRIC’s vast global soil reference collection (presently some 940 soil monoliths from more than 70 countries) in terms of condition of the soil monolith, its representativeness, both according to soil type and geographic location, and completeness of the accompanying data. At the same time, some soil monoliths were selected to be made available for (semi-)permanent loan to universities, high schools and other educational facilities. Presently, soil monoliths from the ISRIC collection can be viewed at the Catholic University of Leuven, Belgium, the Natural History Museum in London, UK, and the Royal Tropical Institute in Amsterdam, the Netherlands, in addition to the permanent exhibition of some 80 soils at ISRIC.

At the request of the organizers of the 16th World Congress of Soil Science, ISRIC provided six soils for display during the soil educational exhibition in August 1998 at the Forum in Montpellier, France. The selected soils, examples of positive and negative human interference in soils, drew much attention during the congress.

During the past two years fifteen new soil monoliths were added to the collection. Four examples of high altitude soils with different types of organic matter were collected from the Blue Mountains in Jamaica, in collaboration with the Free University, Amsterdam, the Netherlands. Ten more examples came from West Africa (four from Benin, four from Niger, one from Togo and one from Burkina Faso), acquired in collaboration with the University of Jena, Germany. During the 16th World Congress of Soil Science one soil monolith was taken from the "Domaine de Restinclières" northeast of Montpellier, where an educational catena of soils can be inspected.

2.4.2 ISRIC documentation facilities

ISRIC has continued to enlarge its systematic collection of books and reports, especially so-called "grey literature", soil maps and related thematic maps, data and slides. In view of the increasing demand coming to ISRIC to make its documentation on the soils in the world more readily available, the documentation section is familiarizing itself with possibilities to enhance accessibility in an electronic way, and to make the information available on-line.

BOOKS AND JOURNALS

In the past the acquisition policy of the library has been focused mainly on books dealing with soil science, and the most prominent soil science journals. Recently, a shift in emphasis can be noted towards reference books and journals on environmental and global change issues, however, not neglecting new publications more directly related to soils.

During the reporting period, over 1,600 books and reports, partly new and partly obtained through legacies, have been added to the library, bringing its number of title holding to more than 15,000. This includes increasingly more documents in digital format (e.g. CD-ROMs of conference proceedings, global and regional datasets, photo CDs, etc.). ISRIC subscribes to about 40 journals and receives many bulletins, newsletters, etc., from all over the world free of charge or on an exchange basis.

SOIL MAPS AND REPORTS

ISRIC is steadily expanding its worldwide collection of soil maps and reports, with an emphasis on the developing world. This collection is available for consultation and provides material for updating the FAO-Unesco Soil Map of the World and the compilation of the Global Soils and Terrain Database (SOTER) at a scale of 1:1 million.

Emphasis is placed on the collection of small-scale maps at 1:200,000 or smaller of each country, and a reference system of soil surveys carried out at any scale. Presently, linkage is provided between the map and the library holdings for Africa and Asia.

The collection consists of more than 6,000 maps and some 600 photo-negatives. More than 3,500 map descriptions are entered in a database using Cardbox Plus for Windows.

SLIDES

The collection of nearly 20,000 slides includes soils, landscapes, vegetation, crops, as well as data tables and diagrams, from sites throughout the world. It is a much sought-after resource for teachers, publishing companies, etc. The descriptions of a large part of the slide collection are listed in a database which, however, cannot yet be consulted on-line.

2.4.3 World Reference Base for Soil Resources (WRB)

ISRIC, together with the ISSS (presently IUSS) and FAO, played a major role in the development of the World Reference Base for Soil Resources, also known as WRB. During the reporting period its first edition was completed. It was officially presented to the international soil science community during the 16th World Congress of Soil Science in Montpellier, France.

The first edition comprises three publications, two of which are published by ACCO in Leuven, Belgium, and one by FAO:

a) *World Reference Base for Soil Resources. Introduction.* This book aims to serve as a first entry into the knowledge of soil diversity and soil distribution, accessible to disciplines other than soil science *sensu stricto* and to a wider public. The 30 Reference Soil Groups and their salient features are discussed by briefly highlighting history, connotation, correlation with other systems of soil classification, concept and morphology, properties, geography, linkages with other Reference Soil Groups, land use and management. The link to the "real world" is made by providing for each Reference Soil Group typical colour pictures as well as typical landscapes in which these soils commonly occur.

b) *World Reference Base for Soil Resources. Atlas*. This booklet provides maps depicting the world distribution of the 30 Reference Soil Groups, together with brief information about the mode of formation, soil profile feature, the environment in which they form, and landforms upon which they occur. A brief description and distinct picture of a representative profile, taken from ISRIC's soil reference collection, is given for each Reference Soil Group, together with their analytical data required for correct identification. The maps have been compiled from the geographical database of the digital Soil Map of the World, released by FAO (1995), using the WRB terminology. The maps can also be viewed on-line at http://www.fao.org/waicent/FaoInfo/Agricult/AGL/AGLS/WRB/Default.htm

c) *World Reference Base for Soil Resources.* This publication is the technical document for WRB, giving the definitions of the diagnostics and the key necessary to identify the soils and to arrive at the level of subdivision required for the purpose it is used for. This document is issued by FAO as its World Soil Resources Report no. 84, and can also be consulted on-line at http://www.fao.org/docrep/W8594E/W8594E00.htm

The completion of the first edition of the WRB came about after a series of meetings of which the last two one, Argentine and Austria (1997) fall within the reporting period. During the Argentine meeting, which was organized by the Asociación Argentina de la Ciencia del Suelo (AACS) and attended by participants from Argentine, Colombia, Germany, Russia, UK, Uruguay and USA, soils with dark coloured, base-saturated and humus-rich surface horizons (Chernozems, Kastanozems and Phaeozems) were discussed, and their definitions and subdivisions finalized. The meeting in Vienna, Austria, attended by representatives of the ISSS, focussed on the adoption of the text of the first edition by the ISSS Working Group Reference Base.

During the 16th World Congress of Soil Science the Council of the ISSS formally adopted the World Reference Base for Soil Resources as the international nomenclature of the society, and recommended that WRB terminology is being used in peer-reviewed and other journals. During a press conference, the chairman of the Working Group RB presented the first copies of the WRB publications to representatives of the three organizations, which collaborated in the preparation, viz. the IUSS, FAO and ISRIC, as well as to the organizers of the congress.

In line with its mandate the working group RB received permission during the 16th World Congress of Soil Science to hold field meetings in order to promote the use of WRB; a field tour was organized at the end of 1998 through Vietnam and China. The meeting focussed on typical strongly weathered tropical soils (Ferralsols, Nitisols and Acrisols) in Vietnam, and man-made soils (Anthrosols) in China. The tour was attended by participants from Belgium, China, Germany, Netherlands, USA and Vietnam.

2.4.4 Land Quality Indicators Metadata Information System (LQI)

During 1996, ISRIC participated in the Land Quality Indicators (LQI) initiative, developed by the World Bank, FAO, UNEP, and the CGIAR. The initiative called for the development of a metadatabase, describing datasets relevant to land qualities (for more details reference is made to ISRIC's Bi-annual Report 1995-1996).

As a follow-up of the first phase of the World Bank sponsored project on the development of a Land Quality Indicators Metadata Information System, ISRIC cooperated in a strategic alliance including SC-DLO, AB-DLO, and the Department of Soil Science and Geology of the WAU, to develop and test two land quality indicators, viz. yield gaps and nutrient balances. ISRIC’s involvement has been the provision of soil data for the models used in the yield gap and nutrient balance studies. The studies were focussed on three levels of detail: the Sub-Saharan region of Africa, Kenya, and Kisii District in Kenya. The results were presented during a satellite symposium of the 16th World Congress of Soil Science on "Land Quality Indicators".

2.4.5 CST/UNCCD network survey project

At the instigation of UNEP and with the approval of the Conference of Parties (COP) to the UN Convention to Combat Desertification (CCD), ISRIC took part in a world-wide consortium of organizations and institutions to carry out a preliminary survey and evaluation of units working on desertification issues, particularly existing networks, and to suggest a methodology for a later in-depth evaluation of such units at regional and subregional level. Other consortium members are: ACSAD, AOAD, DESCONAP, EEA, FAO, KCL, OSS, RIOD, UNEP, UNSO/UNDP, UoA and WMO.

In the context of the project, ISRIC was asked to be part of the Questionnaire Working Group in order to contribute to its design, to collect descriptive information on networks including linkages, users, and capacity to implement the CCD, to analyze the questionnaire returns, and to compile a database.

Furthermore, ISRIC is to contribute to the development of

- criteria to evaluate the effectiveness of institutions, agencies and networks in contributing to the implementation of the CCD,
- a cost-effective methodology for regular updating of the survey,
- a methodology for in-depth surveys.

Activities for the project started early in 1999.

2.4.6 ISRIC Home Page on Internet

Since 1996, ISRIC maintains a site on the World Wide Web - http://www.isric.nl
During the period under review the initial site content has been completely restyled and enhanced.

In the near future ISRIC intends to use the Internet as the main outlet for its products and services (datasets, documents, maps, programs, etc.). Because ISRIC will also host products from other sources - e.g. datasets not generated by ISRIC - future Internet services will have to meet high standards.

Within ISRIC=s Information and Communication Technology (ICT) framework the prospects for additional on-line information services (on-line databases, multiple mailing list management, FTP server, etc.) as well as their financial and organizational consequences are currently explored.

At the time of writing, the ISRIC site is hosted by Digital Valley - DiVa - Internet Professionals.

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ISRIC at the ISSS congress at Montpellier - France 1998

Arrival of the exposition materials

Exposition of soil monoliths

Posters at the educational exposition

The ISRIC booth

Field activities at Restinclières

Taking a soil profile

Presentation of the WRB

After a day of hard working

4 TRAVEL AND MEETINGS

Related to ISRIC's programme and project activities as discussed in Sections 2, 3, and 4 of this report, ISRIC staff participated as resource persons in training workshops, both at its facilities in Wageningen and abroad. ISRIC has also been invited to present papers and posters at workshops, international conferences and symposia. Unfortunately, because of limited staff and restricted budget for international travel, ISRIC could not respond to all invitations it received.

A major event during this reporting period was the 16^{th} World Congress of Soil Science at Montpellier, France in August 1998. ISRIC's involvement in this congress is briefly reported here.

ISRIC at the 16^{th} World Congress of Soil Science

From 19 to 26 August 1998, the International Society of Soil Science (ISSS) held its 16^{th} World Congress of Soil Science at Montpellier, France. It was attended by some 2,600 participants from 99 countries.

Seven members of the ISRIC staff attended the congress, several of them presenting papers and posters during one of the 50 symposia and workshops. ISRIC activities and products were presented in the ISRIC booth which was much frequented by the participants of the congress.

ISRIC contributed substantially to the educational exhibition "A la Découverte des Sols", which was designed for the general public, by setting up a soil monolith display showing positive and negative influences by men on soils, and by preparing a number of posters. During two field sessions the technique of collecting an undisturbed soil profile was demonstrated to the public at Restinclières north of Montpellier, where a series of permanent soil pits give insight in the variability in soils over short distances.

During the congress a business meeting was held of the ISSS Working Group DM: “World Soils and Terrain Digital Databases (SOTER)”. A clear agenda for the coming 4 years was formulated, while Dr. Wim Sombroek, former director of ISRIC, was elected as the Working Group chairman. It was agreed that in the next four years ISRIC should function as the SOTER co-ordination focal point. The ISSS Council expressed its appreciation for the SOTER achievements over the past period.

Much attention was drawn in the ISRIC booth to the recently developed SOTER Viewer, allowing for a rapid inspection of the data held in the SOTER database of Latin America (SOTERLAC).

Another highlight was the official presentation during a press conference of the "World Reference Base for Soil Resources (WRB)". The WRB is designed as an easy means of communication amongst soil specialists and interested scientists from other disciplines dealing with soils and land, and serves as a common denominator through which national soil classifications can be compared and correlated. ISRIC, together with ISSS and FAO, has been instrumental in developing the WRB during the past six years.

It is felt that the main objective of ISRIC's participation in the congress was clearly achieved: presenting its activities and products, establishing and renewing contacts, and gaining experience in providing information in different manners (posters, PowerPoint presentations, brochures, publications, etc.

5 PERSONNEL

(As per December 1998)

5.1 BOARD OF MANAGEMENT

- Dr.Ir. A.W. de Jager (Chairman), Enschede
- Prof.Dr. J. Bouma, Department of Soil Science and Geology, Wageningen University and Research Centre (on behalf of the Scientific Advisory Council of ISRIC)
- Ir. W. van Vuure, Wageningen University and Research Centre (on behalf of the Ministry of Agriculture, Nature Management and Fisheries)
- Prof.Dr. M.J. Kropff, Department of Theoretical Production Ecology, Wageningen Agricultural University (on behalf of the Board of Wageningen University and Research Centre)
- Dr. A.N. van der Zande, Winand Staring Centre for Integrated Land, Soil and Water Research (SC-DLO), Wageningen (on behalf of the Agricultural Research Department of the Netherlands)
- Prof.Dr. Ir. K. Harmsen, International Institute for Aerospace Survey and Earth Sciences, Enschede (on personal title).

Changes

In view of his full-time assignment at ITC, Enschede as Professor in Spatial Information Production from Photogrammetry and Remote Sensing, Prof.Dr.Ir. M. Molenaar resigned as Board member of ISRIC. He was succeeded by Prof.Dr.Ir. K. Harmsen (Rector ITC) as of July 1998. Professor Molenaar had been associated with ISRIC since 1992.

5.2 SCIENTIFIC ADVISORY COUNCIL

- Prof.Dr. J. Bouma (Chairman), Dept. of Soil Science and Geology, Wageningen Agricultural University and Research Centre
- Ir. G.W. van Barneveld, DHV Consultants, Amersfoort
- Prof.Dr. W.E.H. Blum, International Society of Soil Science, Vienna, Austria
- Dr. R. Brinkman, Rome, Italy (formerly FAO, Rome)
- Prof.Dr. P.A. Burrough, Fac. of Geographical Sciences, Institute of Geography, University of Utrecht
- Dr.Ir. P.M. Driessen, Dept. of Soil Science and Geology, Wageningen University and Research Centre
- Dr.Ir. G.W.W. Elbersen, International Institute for Aerospace Survey and Earth Sciences (ITC), Enschede
- Dr. F. Fournier, Unesco, Paris, France

- Prof.Dr.Ir. H. van Keulen, Research Institute for Agrobiology and Soil Fertility (AB-DLO), Wageningen
- Ir. M.J.H.P. Pinkers (formerly: International Institute for Land Reclamation and Improvement (ILRI), Wageningen)
- Ir. B.J.A. van der Pouw (formerly: Winand Staring Centre for Integrated Land, Soil and Water Research (SC-DLO), Wageningen)
- Prof.Dr. J. Sevink, Inter-University Centre for Geoecology Research, Amsterdam
- Prof.Dr.Ir. L. Stroosnijder, Dept. of Irrigation and Soil and Water Conservation, Wageningen University and Research Centre
- Dr. C. Valverde, International Service for National Agricultural Research (ISNAR), the Hague

5.3 STAFF OF ISRIC

(see also http://www.isric.nl/Organization.htm)

Directorate

L.R. Oldeman *(Director)*: oldeman@isric.nl
J.H.V. van Baren (*Deputy Director, until October 1997)*
J.H. Kauffman *(Deputy Director)*: kauffman@isric.nl
Y.G.L. Karpes-Liem *(Secretary)*: karpes@isric.nl

Changes: Ir. J.H. Kauffman succeeded Drs. J.H.V. van Baren as Deputy Director after Van Baren's retirement on 1 October 1997.

Research and Development

V.W.P. van Engelen (*Head*; SOTER/GIS; application research): vanengelen@isric.nl
N.H. Batjes (SOVEUR, WISE projects; soils and global change): batjes@isric.nl
J.A. Dijkshoorn (soil survey interpretations): dijkshoorn@isric.nl
G.W.J. van Lynden (soil degradation and conservation): vanlynden@isric.nl
S. Mantel (land evaluation): mantel@isric.nl
J.W. Resink (GIS *analyst*, spatial analysis): resink@isric.nl
P. Tempel (*application programmer*): tempel@isric.nl

Information, Documentation and Educational Affairs

J.H.V. van Baren (*Head, until October 1997)*
O.C. Spaargaren (*Head*; World Reference Base, ISIS): spaargaren@isric.nl
M. Ahmad (soil monolith preparation): soil@isric.nl
W.C.W.A. Bomer (*cartographic designer*): bomer@isric.nl
A.B. Bos (information/communication technology; facility management): bos@isric.nl
J.C. Jonker-Verbiesen (*librarian*): library@isric.nl
H.F. de Ridder-Helder (*secretary, library assistant*)
B.H. Thalen (cartography): maps@isric.nl

Laboratory

L.P. van Reeuwijk (*Head*; soil and plant analytical services, GLP/LIMS): vanreeuwijk@isiric.nl
J.R.M. Huting (soil and plant analytical services): huting@isric.nl
N. Manuchehri (soil and plant analytical services): laboratory@isric.nl
A.J.M. van Oostrum (soil and plant analytical services): vanoostrum@isric.nl
R.A. Smaal (soil and plant analytical services)

General Support (Directorate)

J. Brussen (financial administration): brussen@isric.nl or: shop@isric.nl (publications)
K.J. Berendsen (*system operator*; information technology): berendsen@isric.nl
S. Vriend (general support) soil@isric.nl

Guest Researchers

J.H.V. van Baren (*Deputy Secretary*, IUSS) iuss@isric.nl
W.G. Sombroek (Global Change, GTZ/Amazon) sombroek@isric.nl
D. Creutzberg (micromorphology)
J.A.K. Boerma (Glinka Memorial Collection)
J. Brunt (*consultant*, SOILIMS)
E.M. Bridges (editorial)
G.A. Bartels (*trainee*, development SOTER viewer, January-July 1997)

APPENDIX: ACRONYMS

AB-DLO	Research Institute for Agrobiology and Soil Fertility, the Netherlands
ACCO	Academische Cooperatief C.V., Belgium
ACSAD	The Arab Center for the Studies of Arid Zones and Dry Lands, Syria
AEZ	Agro-Ecological Zone
AFTEN	Environmentally Sustainable Development, Africa Technical Department, World Bank
ALES	Automated Land Evaluation System
AOAD	The Arab Organization for Africultural Development, Sudan
ASSOD	Assessment of Human-induced Soil Degradation in South and Southeast Asia
AWC	Available Water Storage Capacity
BFMP	Berau Forest Management Project, Indonesia
CATAS	Chinese Academy of Tropical Agricultral Sciences, P.R. China
CAU	China Agricultural University
CCD	UN Convention to Combat Desertification
CEDARE	Centre for Environment & Development for Arab Region and Europe, Egypt
CENAP	Centre National d'Agro Pédologie, Benin
CGIAR	Consultative Group on International Agricultural Research
CICETE	China International Center for Economic and Technical Exchanges, P.R. China
CIESIN	Consortium for International Earth Science Information Network, U.S.A.
CIP	Centro Internacional de la Papa, Peru
COP	Conference of Partners
CSIS	Country SOTER Information System
CTA	Centre Technique de Coopération Agricole et Rurale, the Netherlands
DESCONAP	Regional Network of Research and Training Centres on Desertification Controls in Asia and the Pacific
DGIS	Directorate-General for International Cooperation, Ministry of Foreign Affairs, the Netherlands
DHV	DHV Consultants, the Netherlands
DLO	Dienst Landbouwkundig Onderzoek, the Netherlands
DSA-MGAP	Dirección de Suelos y Aguas, Ministerio de Ganaderia, Agropecuaria y Pesca, Uruguay
EEA	European Environmental Agency, Denmark
EIS	Environmental Information System
ESB	European Soils Bureau
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FIMP	Forest Inventory and Monitoring Project, Indonesia
GDE	Group for Development and Environment, Switzerland
GEF	Global Environmental Facility
GEO	Global Environmental Outlook programme
GIS	Geographic Information System
GLASOD	Global Assessment of Soil Degradation project, ISRIC
GLP	Good Laboratory Practice
GMI	Global Mountain Initiative
GTOS	Global Terrestrial Observing Systems
GTZ	Gesellschaft für Technische Zusammenarbeit, Germany
HSIS	Hainan Soils and Terrain Information System
HUNSOTER	SOTER, Hungary
IAC	International Agricultural Centre, the Netherlands

IBSRAM	International Board for Soil Research and Management, Thailand
ICARDA	International Center for Agricultural Research in the Dry Areas, Syria
ICIMOD	International Centre for Integrated Mountain Development, Nepal
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics, Niger
ICSU	International Council of Scientific Unions
ICT	Information and Communication Technology
ICTP	International Centre for Theoretical Physics, Italy
IFPRI	International Food Policy Research Institute, U.S.A.
IFRIS	Integrated Forest Resource Information System
IGBP	International Geosphere-Biosphere Programme
IGBP-DIS	International Geosphere-Biosphere Programme, Data & Information System
IGP	Indo-Gangetic Plain project
IHE	International Institute for Infrastructural, Hydraulic and Environmental Engineering, the Netherlands
IIASA	International Institute for Applied Systems Analyses, Austria
IITA	International Institute of Tropical Agriculture, Nigeria
ILEIA	Information Centre for Low External Input and Sustainable Agriculture
INFOR	Forestry Institute, Indonesia
INRENA	Instituto Nacional de Recursos Naturales, Peru
ISIS	ISRIC Soil Information System
ISNAR	International Service for National Agricultural Research, the Netherlands
ISS-AS	Institute of Soil Science, Academia Sinica, P.R. of China
ISSS	International Society of Soil Science
ITC	International Institute for Aerospace Survey and Earth Sciences, the Netherlands
IUSS	International Union of Soil Sciences
IWACO	IWACO b.v., the Netherlands
KCL	King's College London, United Kingdom
KENASREC	NASREC, Kenya
KENSOTER	SOTER, Kenya
KSS	Kenya Soil Survey
LEISA	Low External Input for Sustainable Agriculture
LIMS	Laboratory Information Management System
LQI	Land Quality Indicators
LRIS	Land Resources Information System
NASREC	National Soil Reference Collections, ISRIC
NGO	Non-Governmental Organization
NOP	Dutch National Research Programme on Global Air Pollution and Climate Change, the Netherlands
ORSTOM	Institut français de recherche scientifique pour le développement en coopération, France
OSS	Observatoire du Sahara et du Sahel, France
PIK	Potsdam Institute for Climate Impact Research, Germany
PTF	Pedo Transfer Function
RIOD	International NGO Network on Desertification
RISSAC	Research Institute for Soil Science and Agricultural Chemistry, Hungary
RIVM	National Institute of Public Health and Envrionmental Protection, the Netherlands
SALRIS	Southeast Asian Land Resources Information System
SC-DLO	The Winand Staring Centre for Integrated Land, Soil and Water Research, (now: *Alterra*), the Netherlands
SDC	Swiss Development Cooperation
SEALNET	SE Asian Laboratory Network
SIDA	Swedish International Development Authority
SOC-NOP	Soil Organic Carbon, Dutch National Programme on Global Air Pollution and Climate Change project

SOILIMS	Soil Laboratory Information and Management System, ISRIC
SOSA	Salinity Status Program
SOTER	Land Resources Information System for Asssessment and Monitoring, IUSS
SOTERLAC	SOTER project, Latin America and the Caribbean
SOVEUR	Soil and Terrain Vulnerability Mapping Europe, ISRIC
SPALNA	Soil and Plant Analytical Laboratories Network of Africa
STD3	Science and Technology for Developing Countries
SULAMA	Sustainable Land Management project
SWC	Soil and Water Conservation
SWEAP	SOTER Water Erosion Assessment Programme
SWNM	Soil and Water Nutrient Management
UNAP	Universidad Nacional de la Amazonia Peruviana, Peru
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNSO	Office to Combat Desertification and Drought
UoA	University of Arizona, U.S.A.
USDA	United States Department of Agriculture
WALRIS	Land Resources Information Systems for sustainable management of natural resources in West Africa
WASWC	World Association of Soil and Water Conservation
WATSAT	Water balance model
WAU	Wageningen Agricultural University, the Netherlands
WCMC	World Conservation Monitoring Centre
WISE	World Inventory of Soil Emission potentials
WMO	World Meteorological Organization
WOCAT	World Overview of Conservation Activities and Technologies, Switzerland
WOFOST	World Food Study model
WRB	World Reference Base for Soil Resources
WUR	Wageningen University and Research Centre, the Netherlands