INTERNATIONAL SOIL REFERENCE AND INFORMATION CENTRE

ISRIC

BI-ANNUAL REPORT

1993 - 1994

Wageningen, The Netherlands

1995

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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CONTENTS

1 ORGANIZATION

1.1 The long term strategy of ISRIC

The International Soil Reference and Information Centre has a unique collection of information about the soils of the world and is the World Data Center-C for Soil Geography and Classification of the International Council of Scientific Unions. The Centre has a permanent exhibition of the soils of the world which can be visited by arrangement, and the expertise of the staff can be consulted by private individuals and organisations. As a reference centre, ISRIC has a collection of soil monoliths, representative of the units of the 1:5M FAO-Unesco Soil Map of the World. The chemical and physical characteristics of these soils have been analyzed by the Centre's laboratories using standard analytical methodologies. ISRIC has collected soil maps and accompanying reports from all over the world; it has a well-stocked library on soils and related fields of interest; it has large collection of visual aids to illustrate the soils and their place in the landscape; and finally, it has a collection of thin sections for the study of soil micromorphological features. Emphasis has been placed on information about reference soils of the developing countries. Such a collection is open-ended and never complete, therefore ISRIC will continue in the future to acquire further profiles from different parts of the world.

With the rapid emergence of information technology since the mid eighties, ISRIC has significantly increased its emphasis on the provision of information in an computer-compatible, electronic format. In close cooperation with the International Society of Soil Science (ISSS), the United Nations Environment Programme (UNEP), and the Food and Agriculture Organization of the United Nations (FAO), ISRIC has developed methodologies for the development of a soil and terrain digital database. The long-term objective is to prepare a World Soils and Terrain Database (SOTER) at scale of 1:1 Million, in which soil and terrain attributes are stored in a database management system. The soil data are linked to physiographic mapping units through a Geographic Information System. All field and analytical data from ISRIC's own collection of reference soil profiles are stored in a Soils Information System (ISIS). The system of geo-referenced pedon data and terrain characteristics has as its major objective to make pedological information more accessible to users.

Up to the present day, ISRIC has provided reference information mainly to fellow soil scientists. However, it has become increasingly obvious, that a much wider group of users could benefit from the use of soil information. At its meeting in February 1993, the Scientific Advisory Council of ISRIC recommended that the Centre should direct more attention towards non-soil scientists and also to policy makers. Applications of soil survey information in the field of sustainable agriculture and rural development, land use planning, construction (of settlements and roads), environmental protection (environmental impact analysis, land degradation control), and disaster preparedness (planning) are issues that are well-known to all soil survey specialists. It is now essential that interpretation of information derived from soil survey data about soils and their management should be made more intelligible to the layman and made available in a form suitable for use by persons not trained in soil science.

Through a variety of programmes and activities, ISRIC will continue to play a role in developing methodologies to derive useful and relevant information from available soils and terrain data and to pass this information to the non-specialist users and policy makers. For example, these people not only want to know the present status of soil degradation, but also the effect soil degradation has on agricultural productivity. They require information about the potential productivity of the land under various management scenarios, and also the impact of different forms of husbandry on the rate of soil degradation, including fertility decline, salinization, as well as the rate of physical deterioration of soils which leads to reduced water holding capacity, lower infiltration rates and stagnation of water in the profile.

A prerequisite to guaranteeing the use of soil and water resource information by a wide range of non-specialized users at national, district and local level is increased attention to education and the role of extension services. In this, ISRIC can contribute to meeting the need, expressed by policy-makers, administrators and the scientific community, for readily accessible soil and terrain data through point and spatial databases.

Through an integrated package of technology containing elements of SOTER, NASREC, GLP/SOILIMS, and STRING, discussed in detail elsewhere in this report, ISRIC can assist soil survey institutions in developing countries to train a cadre of soil scientists for the initiation and maintenance of geo-referenced soil and terrain databases. Essential links between soil survey institutions, the agricultural extension services and other users should be encouraged, providing them with information about the potential and constraints of the major soils in their ecological setting. To establish, through training, good laboratory practice in soil analytical laboratories so that reliable soil chemical and physical data can be produced. Systematic national documentation in a digital format containing a basic inventory of the relevant literature, maps, and institutions, can stimulate a dynamic exchange of information through a soils and terrain data network.

The collection of soils and terrain information, the development of computerized pedon and spatial databases, the interpretation of information to solve practical problems, and the exchange of knowledge about these methodological developments with soil survey and natural resources institutes, especially in developing countries, are the main themes of ISRIC programmes.

1.2 Programmes and Activities

Since 1993, ISRIC has been developing a programme of work in four related themes. A brief review of each theme is given here and detailed information can be found in subsequent sections of this report.

Theme I — The Development of World Soil Reference Databases

Over the past 25 years, ISRIC has collected a wealth of information on soil reference profiles with a worldwide coverage, including field, chemical and physical data analyzed by ISRIC's laboratories. A major project has been to make these data more readily accessible to potential users through the compilation of a series of "Country Reports" and "Soil Briefs". Each series contains useful information for both the soil scientist and the general public.

In a joint programme of collaboration, information from other custodians of soil data holdings, namely FAO and the Natural Resources Conservation Service of the US Department of Agriculture, were combined in the World Inventory of Soil Emission Potentials (WISE). This project was funded by the Dutch National Research Programme on Global Air Pollution and Climate Change. This international database was augmented with soil profile data collected from a wide range of literature, available in ISRIC's library. The WISE database contains nearly 4400 soil profiles and has subsequently been accepted as the foundation of a global database for the International Geosphere-Biosphere Programme's Data Information Systems activity. Ultimately, the WISE soil pedon database will be linked to the World Soils and Terrain Digital Database (SOTER).

During the reporting period 1993-1994, SOTER activities were implemented in several countries and at different scales. The United Nations Environment Programme played a significant role in the formulation and funding of national SOTER projects in Kenya, Hungary, Uruguay and Argentina. The Kenya Soil Survey is developing a SOTER database for their country at scale of 1:1 Million; in Hungary, a SOTER database a scale of 1:500,000, is being implemented by the Research Institute for Soil Science and Agricultural Chemistry (RISSAC); in Uruguay, UNEP has funded the completion of a SOTER database of that country and an area of 460,000 km^2 in Argentina at scale 1:1 Million. In the two latter countries, detailed SOTER databases for selected areas at scale 1:100,000 have also been compiled.

Jointly with FAO, UNEP also supported the first part of a continental SOTER for Latin America at a scale 1:5M. By July 1994, the SOTER database was available for Argentina, Brazil (south of 18°S), Uruguay, Venezuela, Cuba, and Mexico. In all these SOTER projects, ISRIC provided technical assistance and training. In close cooperation with FAO, the Procedures Manual for Global and National Soils and Terrain Digital Databases (SOTER) was published in 1993 (English) and 1994 (Spanish). Early in 1995 a French edition will be published. This manual is published also as World Soil Resources Report 74 by FAO.

A full review on the past, present and proposed future activities within the SOTER framework was presented to the Working Group DM of the International Society of Soil Science at its meeting in Acapulco. Wide support has been received from international and national organizations for the concept of SOTER and providing funding is secured, the programme of both the World SOTER project at 1:5M to 1:1M and national SOTERs at larger scales will be continued.

Theme II — Transfer of Technology for the Assessment of Soil and Terrain Resources in Developing Countries

Activities in this theme aim to strengthen national capabilities of land resources/soil survey institutions to deliver accurate, timely information on natural resources. The National Soil Reference Collections and Database Programme (NASREC) has received financial support from the Dutch Government since 1990, but this financial support ended during the reporting period. On-the-spot training was given in Nigeria and India, and National Soil Reference Collections were installed in China, Costa Rica, Cuba, India, Nigeria, Peru, and Zimbabwe. At the request of DGIS (Directorate General for International Cooperation) of the Ministry of Foreign Affairs of the Netherlands, the NASREC programme was evaluated by an international panel, which concluded that the objectives with regard to training, education and extension have been achieved. The panel recommended that NASREC activities be continued in a new phase with increased attention being given to information transfer and dialogue between different groups of users. This should be done by selecting new collaborating institutes as focal points in strategically placed countries. The panel also recommended holding an international NASREC workshop which would bring together existing and potential collaborators. Following exhaustive negotiations, arrangements have been made for this workshop, sponsored by DGIS, the European Community, le Centre Technique de Coopération Agricole et Rurale (CTA), and FAO, to be held in the autumn of 1995.

Training courses on methodology and use of databases were held in the SOTER programme at Buenos Aires, Nairobi, and Budapest. The Latin American course was followed by a workshop attended by participants from 10 countries. They formulated the following general recommendation: "In Latin America a general tendency exists towards the creation of a common market and therefore common politics in the area of environment and production across national boundaries must be developed. The organization of information on natural resources in digital databases is a fundamental support for the definition of development policies and of sustainable growth. The use of the SOTER methodologies and the interpretation of the information contained in the SOTER database of different kinds and in different scenarios will be a very important tool in decision-making at continental and regional level".

ISRIC's soil laboratory programme has placed great emphasis on the development of guidelines for Good Laboratory Practices (GLP) and a user-friendly software package for a Soil Laboratory Information Management System (SOILIMS). In cooperation with the International Institute of Tropical Agriculture (IITA), a training workshop on GLP and Laboratory Information Management was organized for senior African laboratory technologists and laboratory supervisors by the Soil and Plant Analytical Laboratories Network of Africa (SPALNA). At the conclusion of this workshop (25 June-9 July 1994) the participants from seven African countries stated that "they were very impressed by the usefulness of the course which will increase the quality, efficiency and productivity of their laboratories. In order to make full use of this course participants will need to acquire the computer software SOILIMS and for those laboratories that have not yet a computer additional hardware will be needed as well". An introduction to GLP and SOILIMS is also given annually during the post-graduate course on Soil and Plant Analysis and Data Handling, organised by the Wageningen Agricultural University in cooperation with International Agricultural Centre (IAC) and ISRIC.

Theme III — Use of Soil Databases through Applied Research

Soil databases, whether in the form of pedon databases or of spatially geo-referenced soil and terrain databases, should not be considered as end products. Databases are tools for handling of raw data. ISRIC has therefore placed an increasing emphasis on research to develop applications of databases. Databases linked to delineated mapping units through a Geographic Information System offer unlimited possibilities for the preparation of thematic maps and complementary statistics on attributes of the soil landscape and other interpretative products. An increasing interest has been expressed about soil and terrain databases by the international global change modelling community. ISRIC has participated actively in the IGBP-DIS soils task force and in the working group for Global Terrestrial Observing Systems (GTOS).

In the framework of the Dutch National Research Programme on Global Air Pollution and Climate Change (NOP-MLK), ISRIC concluded a project on Geographic Quantification of Soil Factors and Soil Processes that Control Fluxes of Greenhouse Gases. The aim of this project was to develop a database of soil profiles for a World Inventory of Soil Emission Potentials (WISE). Although the contract and funding ended in December, 1994, work is continuing on applications of the WISE database.

In cooperation with the National Institute of Public Health and Environmental Protection of the Netherlands (RIVM), ISRIC has participated in a pilot Global Environmental Outlook (GEO) scheme. RIVM was designated by UNEP as "Collaborating Centre for International Environmental Reporting, Assessment and Forecasting". The key questions in the pilot GEO are how the quality and quantity of the world's land resources are changed by land degradation, the dependence of this change on social and economic conditions, and how these changes will affect food production. In this respect, the Global Assessment of Human-induced Soil Degradation (GLASOD), coordinated by ISRIC, is considered to be an important starting point, but should now be followed by more detailed and in-depth studies.

An expert consultation organized by the Asian Network of Problem Soils (Bangkok, October 1993) on the Collection and Analysis of Land Degradation Data agreed to adopt the GLASOD methodology as a basis for assessment of soil degradation. It was further agreed that the SOTER methodology using a physiographic approach, was needed to form a geo-referenced database for land degradation survey. Subsequently, FAO requested ISRIC to prepare a 1:5 million physiographic base map in a digitized format of Asia. Following these actions, UNEP formulated a project document for the Assessment of the Status of Human-induced Soil Degradation in South and Southeast Asia (ASSOD). This project was approved in December 1994 and has a duration of 18 months. The work will be done in close cooperation with 15 Asian countries extending from Pakistan to China, and from Korea to Indonesia.

In order to move information between databases, such as the ISIS database, the FAO-ISRIC Soil Database (SDB), the SOTER database and the WISE database, software has been developed to facilitate this transfer. These databases contain fundamental information and powerful database management systems are tools which can be used to provide assessments for soil degradation hazard, for development of sustainable land use scenarios, for food productivity at different management options, and for global change. Agenda 21, endorsed by the 1992 Earth Summit in Rio de Janeiro, provides options for combating degradation of the

land, air, and water, as well as conserving forests and biodiversity. It is a blueprint for social, economic and environmentally sustainable development. The availability of the data handling techniques for natural resources helps to make this an achievable objective.

ISRIC has developed programmes to assess water erosion hazard, potential food productivity and crop suitability under different management scenarios by utilizing attributes contained in its databases in models such as USLE and SLEMSA (for water erosion), ALES (for land evaluation) and WOFOST (for food productivity). These programmes were tested using the SOTER databases of Uruguay, Argentina, and Kenya.

In mid-1994, the Dutch government made available funds for a UNEP project entitled "National Land Degradation Assessment and Mapping in Kenya". The preliminary results of the Kenya SOTER programme executed by the Kenya Soil Survey (KSS) will be an important basic input for the computer models to be used in the assessment. ISRIC provides advice, technical support and on-site training services on the application of the SOTER Water Erosion Assessment Program (SWEAP) for Kenya under different land use scenarios, based on KENSOTER database at a scale of 1:1M. In addition, ISRIC collaborates with the Department of Environmental Studies of the Free University of Amsterdam to develop methodologies for selection, documentation and analysis of socio-economic indicators of land degradation.

As an outcome of the international workshop on the feasibility of a project on Soil Vulnerability Mapping for Europe (SOVEUR), a project resumé was submitted through FAO to the Ministry of Economic Affairs of the Netherlands entitled: "Mapping of Soil and Terrain Vulnerability in Central and Eastern Europe". Although the project was submitted in late 1993 and received strong positive endorsements from national governments of Central and Eastern Europe, a final decision to implement activities has not yet been taken.

In a joint programme with the V.V. Dokuchaev Institute of Soil Science at Moscow, research continued on the comparison of soil monoliths from different parts of the former Soviet Union, collected in the 1920's by K.D. Glinka, with newly collected soil samples from the same locations. The 1920 samples and profiles represent soil conditions in the pre-acid rain, pre-pollution and pre-nuclear bomb days. So far, six soils have been re-sampled and analyzed. The impact of soil pollution during the last 70 years, in particular toxic metal concentrations in the topsoil have been investigated. It is hoped that further funding will become available to continue this interesting study.

At the request of the Group of Soil Conservation Specialists of the Council of Europe, ISRIC has prepared an introduction and the first four chapters of a Handbook for Soil Conservation in Europe. This was presented to the Group in December, 1993. The Directorate General XI of the Commission of the European Communities requested ISRIC to prepare an updated pan-European version of the Map of the Current Status of Human-induced Soil Degradation. The revised map was submitted to the Commission in late 1993.

The project concerned with the Collection of Reference Laterite Profiles (CORLAT) dates back to 1982, when a plenary session of the Second Seminar of the Unesco-sponsored IGCP Project 129: Laterization Processes, recommended the compilation of a Handbook on the description of laterites and laterite profiles for interdisci-

plinary use. When the European Community, DG XII, Life Sciences and Technologies for developing countries (STD 3) offered to fund the production costs for this handbook in 1991, ISRIC's guest researcher, Dr. G.J.J. Aleva, indicated his interest and willingness to compile the materials for this book. Under the title: Laterites, concepts, geology, morphology and chemistry, it was published in 1994.

In 1992, the Chairman of ISSS Commission V (Soil Genesis, Classification and Cartography) requested that ISRIC would act as the coordinating centre for preparation of a World Reference Base for Soil Classification (WRB). The objective of WRB is to provide scientific depth and background to FAO's Revised Legend of the Soil Map of the World (1990), incorporating the latest knowledge relating to the global soil resources and inter-relationships. A draft of the WRB was compiled and edited at ISRIC and published jointly by FAO, ISSS, and ISRIC in 1994 on the occasion of the XVth World Congress of Soil Science, held in Acapulco. The draft is the conclusion of a long process of consultation, proposals, modifications and consensus over an extended period of time. The WRB is based on contributions from almost 40 soil scientists from all corners of the world.

Early 1993, ISRIC asked an ad-hoc advisory group, composed of micromorphologists from the Winand Staring Centre and the Wageningen Agricultural University, to advise on the place of micromorphological research within ISRIC. The panel recommended that the collection of thin section and related slides should be well documented for scientific interpretation by soil scientists with micromorphological experience. Since ISRIC's own soil micromorphologist retired in early 1993, it was decided that future micromorphological research will no longer be carried out by ISRIC staff, but would be delegated to micromorphologists at the University or the Staring Centre. This decision was formally approved by ISRIC's governing board.

Theme IV — Dissemination of Information

Throughout the reporting period, ISRIC has played an active role in the dissemination of soil information. Staff members participated and presented papers on ISRIC activities at various international workshops, conferences, symposia and congresses. Papers were published in a wide range of scientific journals or in conferences proceedings. ISRIC's programmes and projects were highlighted during the XVth World Congress of Soil Science at Acapulco, Mexico (July, 1994) where ISRIC was allocated a permanent booth, located between the booths of UNEP and FAO. Throughout the congress period the booth was visited by many soil scientists from both developed and developing countries. Publications prepared by ISRIC staff are listed elsewhere in this report.

Internally, ISRIC has made its library, slide and thin section more accessible to visitors by storing all information in digital format. Only ISRIC's map collection has still to be consulted manually. ISRIC also joined the Geoscience Network of the Netherlands for International Cooperation — GEONETH. Geoneth is a cooperative association of Netherlands research, information and training institutes, foundations, university faculties and government agencies sharing a common field of interest in geosciences in the broadest sense.

In a separate activity, ISRIC has developed a computerized bibliographic and cartographic information system of soil and terrain resources for the region of the

Sahara and Sahel Observatory, within the framework of the 1993 Programme of Activities of the International Association of the Sahara Sahel Observatory. The final document of this one-year project was submitted late 1993. The project was financed by the Caisse Française de Dévéloppement. The major objective of the project was the provision of an appropriate basis for the creation of an information network among SSO member countries.

1.3 Institutional developments

In 1993, ISRIC changed its status to become a Foundation, having a co-operation agreement with the International Institute for Aerospace Survey and Earth Sciences (ITC). The Centre had its origins in a resolution of the International Society of Soil Science, which at its 7th Congress in 1960 recommended the establishment of an International Soil Museum. At first, the Museum's programme was to cooperate with FAO, Unesco and ISSS in the Soil Map of the World project which began in 1961. Shortly after the 1964 ISSS Congress, Unesco agreed to include the Soil Museum concept in its programme of Earth Sciences, and in the same year the General Conference of Unesco accepted an offer from the Netherlands Ministry of Education and Science (MOW) to have the Museum in the Netherlands.

The formal inauguration of the "International Museum of Soil Standards" was in January, 1966 when it was temporarily located in the Institute of Soil Science of the University of Utrecht. Shortly afterwards, MOW asked ITC to provide administrative services in respect of personnel and financial affairs with core funding provided by the Dutch Directorate General for International Cooperation of the Ministry of Foreign Affairs (DGIS). Although the Centre was at first called The International Museum of Soil Standards, it soon became the International Soil Museum, and in 1984, the present name of "International Soil Reference and Information Centre" was adopted.

In 1976, the Board of Governors of ITC instituted a Provisional Board to develop detailed proposals for the organizational functioning of the Centre and in 1978 a full-time Director was appointed. Unesco installed an International Advisory Panel to evaluate the performance of the Centre every five years and a Netherlands Advisory Council met annually to discuss the centre's programme. Both panels have now been integrated into one body, the Scientific Advisory Council which convened for the first time in 1993.

Since ISRIC now had its own mandate, determined its policy independently from ITC, and was also engaged in the acquisition of external funding for its activities, it was felt that there was a need for a more independent organizational structure. A general meeting of all ISRIC's employees asked the Provisional Board to explore how the independent status of the Centre could be achieved. The Provisional Board recommended that the status of a "Foundation" would meet the requirements of ISRIC and consultations took place with the Board of Management of ITC, and the Employees Councils of both ITC and ISRIC. With the cooperative agreement of ITC the formal act of establishment of the Foundation took place at the Offices of R.G. Fierst van Wynandsbergen in Wageningen on Monday 19 December, 1994. On the same day, the document outlining the framework for cooperation between ISRIC and ITC was signed by the Chairmen of the Boards of ITC and ISRIC.

Signing ceremony of Foundation ISRIC
(From left to right: Dr. L.R. Oldeman; Dr. A.W. de Jager; Prof. J.A. van Ginkel; and Mr. A. Brown)

2 ARTICLE

Development of a Global Soil Database for Modelling Soil Gaseous Emissions

E.M. Bridges and N.H. Batjes

Introduction

The subject of global climate warming emerged as a significant field of scientific research during the past decade. The observed increase in carbon dioxide has been well documented throughout the 19th and 20th centuries, but significantly, the recent rapid increase of other radiatively active gases led to concern by the scientific community for the effect these gases would have upon the global climate (Houghton *et al*, 1990; Prinn, 1994). At first, climatologists, oceanographers and atmospheric chemists involved in modelling the effect of the increase of these gases took into consideration the ocean-atmosphere interaction. The links between the atmosphere and the hydrosphere have been appreciated, but a similar inter-relationship between the atmosphere gases and soils was less well understood. Consequently, difficulties were encountered in balancing the values found in the atmosphere with known values for emission and destruction of the natural trace gases such as carbon dioxide, methane, nitrous oxide in the global equation. For soil scientists, it is gratifying that acknowledgement is now given to the significant part soils play in the generation and absorption of these gases (Walker, 1994).

Awareness of the influence of soils upon atmospheric chemistry was brought to the attention of the scientific community in 1989 by the conference held at ISRIC entitled Soils and the Greenhouse Effect (Bouwman, 1990). This conference identified many of the pedological aspects which needed to be addressed in order to provide the answers to questions about the role of soils in emitting and absorbing these gases that have the power to absorb heat energy from the sun and retain it in the atmosphere. It was against this background that the World Inventory of Soil Emission Potentials (WISE) project was conceived. Its aim is to attempt a geographical quantification of soil factors and processes that control fluxes of greenhouse gases, at a resolution of 30' latitude by 30' longitude (Batjes and Bridges, 1994).

WISE: The First Phase

The three-year WISE project has been accomplished in two distinct phases. The first year was devoted to a literature study of the current state of knowledge of the chemical, physical and biological factors controlling the gaseous exchanges involved (Batjes and Bridges, 1992a). This study formed the basis for discussions during an international workshop which formed the culmination of the first phase of the WISE project. The aims of this workshop were two-fold; firstly to place before an international panel of experts the proposed plan for further research and secondly to receive the advice of the panel in refining the terms of the original research proposal.

The outcome of this Workshop has been documented in the proceedings (Batjes and Bridges, 1992b) which also served as a vehicle for the publication of a series of state-of-the-art papers delivered by the panel of experts assembled to discuss the WISE project. The advice received from the panel could be grouped into three categories, these were: use of the FAO-Unesco Soil Map of the World, development of a global soil database, and use of the database linked to a geographical information system to make, in the first instance, a global inventory of soils with high methane emission potentials. It was concluded that the only viable geographical base map was the Soil Map of the World (FAO-Unesco, 1971-1981). Now available in a digital format, with errors corrected and boundary changes included, this map can be used to provide a uniform, mechanically produced data set, free from the variability of human interpretation (FAO, 1991).

It was recommended that development of a global database should take place, based on the present international data sets held by the International Soil Reference and Information Centre (ISRIC), the Natural Resources Conservation Service of the United States (NRCS) and the Food and Agriculture Organization (FAO), together with regional and national data sets where these were available. The resources of the ISRIC library collection would also be used. The soil attributes needed to develop the WISE database were identified in a survey of the literature and discussed during the workshop (Batjes and Bridges, 1992a and 1992b). The attributes to be collected may be considered in three groups: general information, physical data and chemical data. These attributes, which are common to both the European soil database, and subsequent proposals for an IGBP-DIS World Soil Database (Scholes *et al*, 1994) appear to have gained wide support amongst the scientific community. A list of soil attributes included in the WISE database is given in Table 1.

The workshop was interested in the potential uses of the WISE database and several recommendations were put forward for collaboration with other interested groups of scientists. After compilation of a database, the first use to which it would be put should be to study potential methane production and emission from wetland soils. For this part of the work close collaboration with the field scientists and modellers who have the relevant expertise would be necessary. The WISE project was advised that they should co-operate with staff of the International Rice Research Institute (IRRI) and Nagoya University in the collection of field data and the development of modelling techniques for soil methane production. Collaboration with other institutes would be essential for obtaining field measurements of gaseous emissions from a wide variety of soils. A further recommendation was that a questionnaire about the methodology and results of methane emissions measurement be compiled in conjunction with the IRRI and circulated amongst interested research groups.

To enable a satisfactory development of the WISE database for a wide variety of potential uses, it would be necessary to link it to a geographical information system. In combination with the climatic classification and nature of land use, it would be possible to assemble new statistical data about the FAO soil groups and to bring together the many different combinations of soil attributes to reveal fresh relationships as well as to enable a more satisfactory calculation of the potential soil emissions of the different greenhouse gases.

Table 1. List of attribute data for the SITE and HORIZON data files of the WISE profile database (Batjes, 1993a).

SITE data	HORIZON data
WISE_ID (unique identifier of profile)	WISE_ID + HORIZON_NO (unique reference number for horizon within a profile)
Soil classification and source	*General attributes*
FAO-Unesco classification (1974 Legend)	Horizon designation
Phase	Depth, top
Topsoil texture class	Depth, bottom
FAO-Unesco classification (1990 Revised Legend)	Matrix colour (dry and moist)
Phase	Mottling
USDA subgroup level classification	Presence of roots
Edition (year) of Soil Taxonomy	
Local classification	*Chemical attributes**
Source of data	Organic Carbon
Name of laboratory where analyses were made	Total N
Soil profile description status	Available P
Date of description	pH-H_2O
Location	pH-KCl
Country	pH-$CaCl_2$
Location of soil profile, descriptive	Electrical conductivity (EC)
Latitude (deg/min/sec)	Free $CaCO_3$
Longitude (deg/min/sec)	$CaSO_4$
Altitude	Exchangeable Ca^{2+}
	Exch. Mg^{2+}
General site data	Exch. Na^{+}
Major landform	Exch. K^{+}
Landscape position	Exch. Al^{3+} + H^{+} (exchangeable acidity)
Aspect	Exch. Al^{3+} (exchangeable aluminum)
Slope	Cation Exchange capacity (CEC)
Drainage class	Effective CEC (at field pH)
Groundwater depth	Base saturation (as % of CEC)
Effective soil depth	
Parent material	*Physical attributes**
Köppen climate classification	Structure type
Land use	Particle size distribution:
Natural Vegetation	weight % sand
	weight % silt
	weight % clay
	Stone and gravel content
	Bulk density
	Volume per cent water held at specified suctions
	Hydraulic conductivity at specified suctions

*: Analytical methods are specified in a separate key-attribute file.

Development of the Database

The second phase of the WISE project developed rapidly after the Workshop with the compilation of the guidelines for the selection of soil profiles and a protocol for completing the manual process of extracting soil profile data from the literature (Batjes, 1993a). Software capable of handling the soil profile data was written and tested (Batjes, 1993b).

In parallel with these activities, colleagues at FAO have developed software and prepared the basic soil area data relevant to each terrestrial 30' x 30' grid cell of latitude and longitude (Nachtergaele, unpublished data). The integrated WISE system consists of two components which may be referred to as the soil profile attribute files and the soil unit and area files (Fig. 1).

The configuration of the WISE database consists of (Batjes, 1992):

1. A GIS file with information on the component FAO soil units of each 30' x 30' degree grid cell. This is the area component.
2. A suite for soil profile data for the respective FAO soil units with accompanying files listing analytical methods and source of the data. This is the attribute data component.
3. A file of derived data of characteristics for topsoil and subsoils of the respective FAO soil units. This is the component which will provide a uniform basis for subsequent modelling activities.

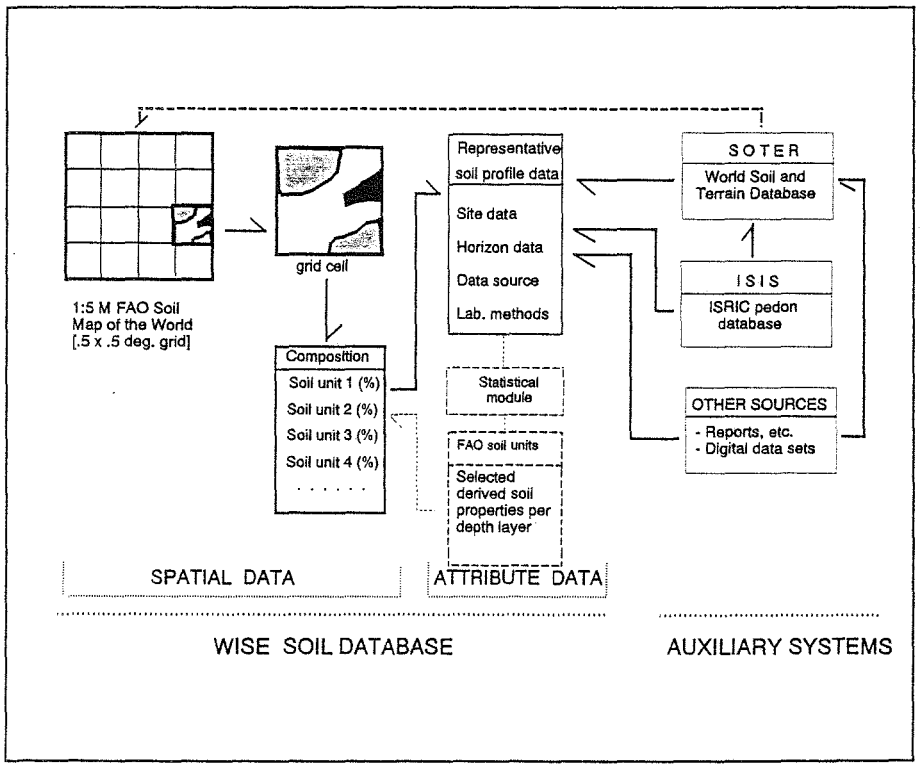

Fig. 1. Schematic representation of the WISE database (Batjes, 1992).

The Soil Profile Attribute Files

Collection and processing of soil profiles took place on a uniform basis according to the format developed for the WISE database. Regrettably, the response to an internationally distributed request for soil descriptions with associated analytical data of regionally representative profiles from the various countries of the world has been limited. Such is the depth and impact of world economic recession that several countries were forced to admit that they had neither time nor financial flexibility to employ staff to respond to the WISE request for profiles. ISRIC is, therefore, extremely grateful to those organisations and individuals who have been able to reply.

Following discussions held in June 1993 at Lincoln, Nebraska, the USDA Soil Conservation Service (now NRCS) has supplied the WISE project with a selection of profiles from the United States and elsewhere in the world from its central database. Attempts to obtain profiles from the digital European Community data set largely failed because the working group responsible for its collection has not yet made decisions on the issue of copyright. As a result, greater reliance than had been expected fell upon the data held in ISRIC library. Thus, a major activity of WISE personnel in 1993 was the processing of profile data from ISRIC's reference library for manual inclusion in the database.

As a result of experience gained in the earlier stages of operation, the database handling system for the WISE profile database has been expanded and improved. Version 2.0 now includes new selection modules, and a comprehensive data-checking module (Batjes, 1994). It operates under dBASE IV, release 1.5, unlike the initial version which operated under dBASE III$^+$. This change means that all databases developed by ISRIC (ISIS, SOTER and WISE) now use the same commercial software package, thereby enhancing data compatibility, both within the Institute and internationally.

Great stress was laid upon the systematic collection and recording of data as well as careful consideration of the laboratory methods by which the analytical results were obtained in the field and laboratory. A review of the comparability of some analytical methods was compiled under the aegis of ISRIC's database development activities (Vogel, 1993). All profiles are printed-out for a visual check of the data entered, and the computerized data check supplements the visual checks of manually entered data. At the end of 1993, and again at the end of the project in December 1994, all the current data sets were validated. Table 2 gives an overview of the distribution of the profiles entered in the WISE database by broad geographic area.

Staff at ISRIC have been involved in the development of software to mechanically transfer data held by the major data holders from one database to another. A module has been developed to down-load data from the ISIS soil profile database of ISRIC to WISE; after testing it was used to transfer the data quickly and effectively. A similar module for the transfer of data from the USDA-NRCS soil profile database to WISE has also been prepared (Tempel, 1994).

Table 2. Summary of number of profiles present in WISE per broad geographic area*

Area	Number
AF: Africa	1595
AN: South West and North Asia	478
AS: China, India and Indonesia, and Philippines	424
AT: Antarctica	0
AU: Australia and Pacific Islands	85
EU: Europe	490
NA: North America	122
SA: South America and Caribbean	486
Total:	3680

* An additional 650 profiles from the NRCS data set, including 260 profiles from the USA will be added in 1995.

The Soil Unit and Area Files

In the context of the WISE project, the predictive use of the edited and digitized Soil Map of the World (FAO-Unesco, 1971-81) is of significant importance as the soil units shown on the map were used as the cartographic basis for the production a data set in which the area of soil units occurring in each 30' x 30' terrestrial rectangle of latitude and longitude are listed. This grid cell size is commonly used in global change research. The cartographic base has been built up by identifying the soil units which occur in each 5' x 5' grid-cell according to composition rules developed by FAO (1991). The next step involved computing the percentage area of each soil unit present in the 36 cells which make up the 30' x 30' grid cell. Compared with Zobler's (1986) world soil file, based on the soil at the centre of a one degree grid, this represents a significant improvement upon the pedological input to the modelling process. Additionally, each area on the map is linked by the FAO-Unesco map legend descriptors to a suite of representative soil profiles held in the soil profile data files which will increase the value of the geographical information.

The attribute data, and the area data derived from the Soil map of the World, form two major elements of the WISE data base. In order that this information can be effectively used, it was linked through a geographical information system (GIS) where the soil information can be brought together with other databases containing climatic, land use and hydrological information to establish the areas where potential methane production and emissions are most likely to occur.

Uses of the WISE Database

According to the original project proposal, the first application of the WISE database was to determine potential methane production and emissions from wetland soils. Although preliminary steps have been made in this direction with interested scientists, contradictory results of research carried out during the last two years has placed the possibility of an immediate modelling solution to the problem of methane emissions beyond the reach of the current project. In collaboration with the Wageningen Agricultural University, it is proposed to undertake incubation experiments to establish potential rates of methane production from wetland rice soils. This information is required to provide the basic data necessary for developing pedotransfer functions that could relate soil characteristics with potential methane production rates for FAO-Unesco soil map units.

Experience gained in the collection of soil profile data has shown that certain values, in most cases the physical values, are missing. In order that the WISE database should be of optimum usefulness for modelling purposes, it will be necessary to take advantage of any robust, well-established relationships between soil attributes so that reliable surrogate values can be determined. Such relationships can be utilized by the use of pedotransfer functions. These functions will allow certain values to be safely substituted in the file of derived data (Fig. 1). For example, procedures have been developed for the determination of saturated and unsaturated hydraulic parameters (Vereecken *et al*, 1992), and estimating the water-retention curve (Gregson *et al*, 1987).

At present there are many applications for a global soils database and the future holds as yet unforseen new opportunities. Currently, it can be seen that the availability of a database containing representative soil profiles can be used in global environmental studies for the derivation of more accurate estimates of the

potential of soils to interact with the atmosphere in the generation, emission and absorption of the radiatively active gases methane, carbon dioxide and nitrous oxide (Bouwman *et al.*, 1993). The availability of information about soil characteristics in a user-friendly form will encourage non-soil scientists to make greater use of the expert knowledge possessed by soil scientists. The vulnerability of soils to loss of solutes, (Wösten and Van der Zee, 1993), problems of dispersed soil pollution, and the movement of herbicides (Hollis *et al*, 1993) and other pollutants through soils can be modelled and explained if the soil moisture characteristics can be extrapolated geographically. A further application which can be envisaged is the use of the WISE database to predict areas of potential "chemical time bombs" (Hesterberg *et al*, 1992; Batjes and Bridges 1993) where hazardous substances are stored in soils until a change of environmental conditions triggers their release.

Conclusions

As the date for completion of the WISE project approached, requests for the database began to be received and discussions are currently taking place about the form in which data will be released. Some immediate applications are being investigated but many of the opportunities provided by the existence of new derived soils datasets remain to be exploited in the future by the international modelling community. Although attempts have been made in the past to use the FAO-Unesco Soil Map of the World as a basis for determining the nature of the soil cover for modelling purposes, the grid resolution used was coarse and the potential of the map as a source of information was only partially exploited. The griding procedure developed by FAO staff as part of the WISE project has greatly increased the amount of information about the world soil pattern which can be derived from the FAO-Unesco Soil Map of the World at a scale of 1:5 M. The WISE database has assembled, in a uniform manner, over 4000 representative soil profiles with their morphological, chemical and physical attributes in a single user-friendly data base. This represents a major achievement in soil science and it should provide a useful international soil profile data set for global modelling purposes.

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REQUEST FOR INFORMATION ON VISUAL TRAINING TOOLS

During the last decade a large increase in the use of films, slides and videotapes and other training aids have been produced by universities, agricultural high schools, training institutes, etc. This also applies to soil science. Unfortunately, there is no central listing of the available material.

In cooperation with the Secretariat of the ISSS a register of such visual aids is now being made. It will, in due course, appear in the Bulletin of the ISSS.

We would be grateful if you could send us a listing of available films, slides or slide sets, and videotapes on soil science *sensu largo*.

Please supply information on:

- title and main contents
- level of audience,
- size and length of film,
- type of sound track,
- video system type,
- year of preparation,
- availability and price,
- ordering/contact address.

The cooperation of yourself or your colleague is much appreciated!

REQUEST FOR MAPS AND REPORTS ON SOIL RESOURCES

Cartographic materials form an important part of ISRIC's documentation section. Geographic coverage of the collection is the whole world with emphasis on developing countries. The subject emphasis is on soils, but related geographic information on climate, ecology, vegetation, land use, land capability, geology, geomorphology, etc. is also important.

The acquisition policy is to obtain world coverage of maps at reconnaissance and smaller scale; examples of more detailed maps and index maps/lists of soil and related surveys carried out in a country. The selection criteria are relevance of the maps for soil science, agricultural development and environmental issues.

The major purpose of maintaining and enlarging the map collection at ISRIC is its use for updating the FAO-Unesco Soil Map of the World at scale 1:5 million and the compilation of the new World Soils and Terrains Digital Database (SOTER) at 1:1 million.

The map collection serves also as a source of basic information for scientists and students using ISRIC's facilities for guest research or training.

ISRIC is willing to reimburse you for the material and mailing charges.

3 ACTIVITIES

Theme I:
The Development of World Soil Reference Databases

3.1 ISRIC Soil Information System (ISIS)

Background

When ISRIC was established in 1966 as the International Soil Museum, its main objective was to assemble soil profiles, analyze soil samples and collect associated information to illustrate the units of the FAO-Unesco Soil Map of the World. At present, the world soil monolith collection consists of over 900 profiles from 64 countries together with their analytical and environmental data. In addition, the monolith collection is supported by a soil map collection, a soil report library and a slide collection. To facilitate the storage and management of the soil and environmental data, a computerized database management system, called the ISRIC Soil Information System (ISIS), has been operational since 1986.

The following data are stored in ISIS:
site data: about 60 attributes on location, geology, landform, soil surface properties, hydrology, land-use and vegetation;
climatic data: average monthly data of meteorological elements of one or more meteorological stations relevant to the site;
soil data: includes
- 11 attributes for soil classification in the FAO-Unesco Soil Map of the World Legend, the USDA Soil Taxonomy and the national system,
- soil profile description according to FAO guidelines;
- 103 physical, chemical and mineralogical attributes;

other: additional relevant information.

Activities in 1993-1994

At the end of 1994 information about 628 reference soil profiles was available in ISIS (see table below). This means an increase of 283 reference soil profiles in comparison to the situation at the end of 1992. This expansion of the ISIS database is result of:

a) Transferring field information of 160 reference soil profiles, collected before 1986, from manual archives to the database. Verification, completion, coding and input of the coded information are the main activities. The major part of this work has been accomplished with the assistance of ISRIC temporary staff members who came to ISRIC for work-experience.
b) Entering field information of 108 new reference profiles acquired through NASREC countries (see section 3.5 on NASREC).
c) Verification and completion of the analytical information of 283 reference soil profiles and the complete analyses of soil samples from the 108 newly acquired reference profiles (see section 3.7 on analytical laboratory).

Work on the revision of ISIS version 3 programme resulted in:

a) Development of a proto-type of ISIS version 4 for testing purposes by Mr. J. Verhagen (Wageningen Agricultural University) at the beginning of 1993.
b) The distribution of an operational version 4 to users at ISRIC in January 1994. Further adjustments and additions to the programme were made in the course of 1994 based upon comments from ISRIC users of ISIS, such as the compilers of Country Reports. The additional programming required for version 4 of ISIS was written.
c) Updating of the ISIS manuals resulted also in revised draft texts for Guidelines for Field Description and Coding of Soil Data and the *ISIS User Manual*.

In order to transfer data between different databases a data transfer facility, called Landslide, was developed. At present Landslide can be used to transfer data to/from ISIS from/to the following databases: FAO/ISRIC-Soil Database, USDA-NRCS pedon database, the WISE database, and the SOTER database.

Dissemination of the information held in ISIS is in the form of Country Reports. These reports contain data about the reference soils of specific countries, and the associated environmental information. Additionally, a Country Report includes an introductory section on major ecological zones and the soils, a series of small scale maps and diagrams, bibliographic references and relevant additional information about the reference soils, and concludes with lists of soil/landscape photographs and thin sections for micromorphological study available at ISRIC.
Country Reports are jointly published by national institutions and ISRIC. Draft versions of 11 Country Reports were presented at the XVth World Congress of Soil Science.

Future activities

The work of expansion and improvement of the field and analytical information contained in ISIS will continue. In ISRIC's archives there remain 304 reference soil profiles which were sampled and studied before 1986. Depending on the availability and quality of information, a number of these profiles will be transferred to ISIS. Addition of new reference soils to the database will probably be less, compared with the past period, because of the termination of the external funding of the NASREC project (see section 3.5) and will be mostly restricted to filling gaps in the world reference soil collection (such as sampling reference soils of Tibet in 1994). It is estimated that the ISIS database will be complete by the end of 1997 and results presented at the XVIth ISSS Congress in France.

It is planned to release ISIS version 4 during the course of 1995, in particular for use by participants of the NASREC workshop.

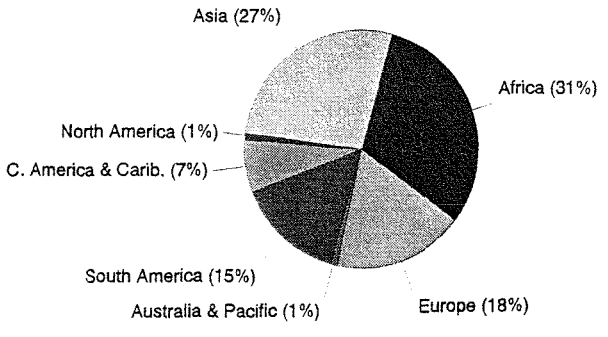
The dissemination of ISIS information by printed publications such as Country Reports and Soil Briefs will be continued. In addition, the use of ISIS data will be stimulated by developing or adapting available database application programmes in the fields of graphical presentation, land evaluation and land degradation (see section 3.5).

Database status

The following table summarizes by country the status of data of reference profiles stored in ISIS (as of December 1994).

Country	ISIS	Archive	Country	ISIS	Archive
Australia	3	36	Mozambique	9	
Belgium		4	Namibia	3	6
Botswana	7		New Zealand		5
Brazil	28	1	Nicaragua	11	
Cameroon	1		Nigeria	28	
Canada		21	Norway	2	1
China	51		Oman	4	
Colombia	18	1	Pakistan	6	
Costa Rica	12		Peru	21	
Côte d'Ivoire	7		Poland	14	8
Cuba	22		Philippines	6	
Czech Republic		8	Romania	11	
Denmark		8	Rwanda	10	
Ecuador	20		South Africa	12	9
Finland		5	Spain	19	
France	11	1	Sri Lanka	4	
Gabon	6		Sweden	5	14
Germany	14	3	Switzerland		1
Ghana	1	5	Syria		4
Greece	15		Thailand	13	
Greenland	1		Turkey	16	
Hungary	3	16	United Kingdom		11
India	12	18	Uruguay	10	
Indonesia	46		USA	4	21
Ireland	3	7	former USSR	2	60
Italy	17		Venezuela	1	
Jamaica	4		West Samoa	5	
Japan	4		Yugoslavia		3
Kenya	68	3	Zambia	11	
Malaysia	18		Zimbabwe	13	
Malawi	1				
Mali	8	1	TOTAL (1994)	652	296
			total (1992)	*375*	*440*

Soil profiles in database



3.2 World Soils and Terrain Digital Database (SOTER)

Background

After an initial workshop at Wageningen in 1986, during which the aims and scope of a SOTER programme were discussed, the programme received endorsement by the XIII International Congress of Soil Science in the same year. Subsequently, UNEP formulated the first project covering parts of Argentina, Brazil and Uruguay where the SOTER methodology was tested. The trials were accompanied by several international workshops, both locally and at ISRIC in Wageningen, resulting in an improved methodology. In 1989, a second trial of the methodology took place in the border area between Canada and the USA.

Activities in 1993-1994

The SOTER methodology was further refined in close cooperation with FAO, and at the beginning of 1993, this culminated in the publication of the SOTER Procedures Manual jointly issued by FAO, ISSS, UNEP and ISRIC. A Spanish version was also published and FAO issued an English version separately as World Soil Resources Report 74. At the end of 1994, a first draft of the French version was completed. The methodology is now fully developed and can be applied in a routine manner.

LASOTER

The first SOTER pilot area continued to receive financial support from UNEP through an extension of the SOTER project in Latin America (LASOTER) under the title of 'Reinforcement of the Regional and National Capabilities for Soil Degradation/Desertification Assessment and for Soil and Terrain Database Compilation in Latin America'. This support began in June 1993 and will continue until June 1995.

The main activities outlined in the agreement document were:

1. to produce a digitized national soil and terrain database for Uruguay at scale 1:1 M (completed);
2. to produce a digitized national soil and terrain database for Argentina at scale 1:1 M, covering 460,000 km^2 (completed);
3. to produce a digitized soil and terrain database for windows of 5,000 km^2 and 7,000 km^2 within the study areas in Uruguay and Argentina respectively, at scale 1:100,000 (completed for the Uruguayan window);
4. to hold training workshops:
   In April 1994, a 3-weeks workshop was organized in Buenos Aires at the premises of INTA, the Argentinean partner in the LASOTER project. The workshop consisted of three parts:
   - A refresher course on GIS and SOTER for the participants of the 1992 Montevideo training workshop. Nine scientists (5 from Argentina, 2 from Brazil and 2 from Uruguay) received training in some advanced GIS techniques and applications of the SOTER database.
   - A Latin American workshop to discuss the current state of natural resource inventories and the possibilities to start a 1:5 M SOTER in the participating countries.
   - A one-week training course to familiarize national staff of soil institutes in Argentina (14 persons) and Uruguay (2 persons) in the SOTER methodology.

KENSOTER

In March 1993, a SOTER activity with financial support from UNEP and FINNIDA began. Entitled: 'Compilation of a Soil and Terrain Database in the Republic of Kenya (KENSOTER) for National and Local Agricultural Planning Purposes', it started with an implementation workshop at the Headquarters of the Kenya Soil Survey in Nairobi. ISRIC, as executive agent for the project and Kenya Soil Survey, signed a Letter of Agreement specifying the allocation of tasks and financial arrangements.

During 1993 and 1994 two joint KSS-ISRIC field correlation trips were held to discuss problems arising in the database compilation. The first phase of the database compilation ended in July 1994. Error checking and filling of missing data continued for the rest of 1994.
A two-weeks training workshop on applications of the database, land evaluation and soil erosion assessment, was held in Nairobi for fifteen KSS staff members. Requests for use of the database have come from various institutions including the Kenya Land Degradation Project, a FAO-IIASA study.

HUNSOTER

In October 1993, UNEP funded a project for the 'Compilation of a Soil and Terrain Database and Establishment of a Comprehensive Land Resources Information System for Sustainable Agriculture and Environmental Protection in Hungary' (HUNSOTER). ISRIC's role in this project is confined to technical assistance, while the execution lies in the hands of the Research Institute for Soil Science and Agricultural Chemistry (RISSAC) of the Hungarian Academy of Sciences.

In January 1994 a workshop was held in Budapest to implement the project, discussing the SOTER methodology and creating a workplan for the project. During a second workshop in June 1994, progress to date and a presentation of the preliminary results at the XVth World Congress of Soil Science were discussed.

SOTER-LA

The need for correlation between FAO's work of updating the Soil Map of the World, starting in South America and the opportunity for a rapid coverage of a continent using SOTER resulted at the end of 1993 in a UNEP-financed project of 14 months duration entitled: 'Compilation of a Soil Map and database of Soil and Terrain Attributes for South and Central America to Assess Desertification/Land Degradation with Emphasis on the Dryland Zone'. ISRIC obtained a sub-contract from FAO to compile a SOTER database for 6 Latin American countries (acronym SOTERLA). Letters of Agreement were concluded with Argentina, Brazil, Cuba, Mexico, Uruguay, and Venezuela to create such a database. Guidelines were issued on how to make such a product and changes with respect to the original 1:1 M approach were made, mainly in the number of attributes of the soils. The preliminary results were presented at the XVth World Congress of Soil Science in July 1994.

Applications

A new SOTER Procedures Manual has been issued and with it an input module for attribute data was developed using dBase IV. Previously developed in 1992, the application of SOTER for water erosion assessment was completely overhauled in 1994. The programme now has an automatic transfer of data from SOTER and it has been thoroughly tested with data from northern Uruguay. A new application of SOTER for land evaluation was developed in 1994, linking ALES — Automated Land Evaluation System, developed by Rossiter and Van Wambeke of Cornell University, to SOTER.

3.3 Physiographic Maps of Africa, South America and Asia

In order to be able to assess adequately the potential capacity of land for sustainable agricultural production, or indeed any other land use, it is necessary to have a comprehensive inventory of all the natural resources. Factors such as climate, soil, vegetation and water obviously must be taken into consideration, but it is often overlooked that the physiography of the land surface is an important feature which may be a factor which limits land use options. Soil scientists have long appreciated the linkage between topography and the nature of the soil developed at any particular place, but a suitable map has not been available for use with modern data-handling techniques.

The present FAO-Unesco Soil Map of the World does not have a physiographic basis as such, only the dominant slope in three classes is indicated: level to undulating ($0\text{-}8^0$), rolling to hilly ($8\text{-}30^0$) and mountainous ($>30^0$). This is too generalized for all but the most simplest of applications and does not adequately describe the nature of the terrain. Also, there is no possibility of linking slope classes to soil associations. With the methods of data-handling developed during the past decade at ISRIC, it is now possible to hold information about landforms in a digital database, using SOTER methodology, at a scale which matches the 1:5,000,000 Soil Map of the World. As FAO is now in the process of updating the Soil Map of the World in South America, and is actively using the SOTER methodology in the process, it was logical to develop further a suitable physiographic base map which could be included in the supporting database.

During 1993, draft physiographic maps were prepared using the facilities of ISRIC. These two maps, commissioned by the Land and Water Development Division of FAO, were of Africa and South America. Compilation was the work of visiting research scientists J.A. Eschweiler and T.T. Wen respectively. The basic task was to produce with currently available information, maps at a scale of 1:5,000,000 showing the distribution of landforms, accompanied by reports describing the physiography of the two continental areas.

Also, at the request of FAO, a draft 1:5,000,000 physiographic map of Asia (excluding the former Soviet Union and Mongolia) was compiled during 1994, using the same SOTER methodology. In addition to the use of this map for the physiographic basis of a revised Soil Map of the World, the physiographic map of Asia will provide the base map units for an Assessment of Soil Degradation in Asia, a project which began just before the end of 1994.

Methodology

Soils and terrain are two closely linked natural phenomena which together determine to a large extent the suitability of land for different uses. An integrated concept of land has been adopted in the SOTER methodology viewing "land as being made up of natural entities consisting of a combination of terrain units and soil individuals". The draft physiographic maps have been prepared following this concept and are based, with minor modifications, on the hierarchy of landforms used in SOTER. Topographic maps of various scales and variable quality were used to obtain the required information, whereas for some areas satellite imagery served as the main source of information. All data were entered into a database linked to a GIS.

Landform classification in SOTER is based on morphological criteria, in particular slope gradient. First, three major landform categories are distinguished on the basis of the *"characteristic slope"*: steep land, sloping land and level land. This is the dominant (not average) slope gradient within a terrain unit. The criteria are not the same within each major landform class:

1. For steep land (slopes >30%) relief intensity is more than 600 m/km and the *relative height above the local base level* defines the hypsometric class. This may create some confusion, as mountains with highly divergent absolute heights above sea level will not necessarily belong to different hypsometric classes, as is demonstrated by the Southeastern ranges of the Himalayas running along the Salween and Mekong rivers with an altitude decreasing from well over 6000 m a.s.l. in Southern Tibet to about 3500 m a.s.l. in Burma, but always more than 3000 m above the local base level (Salween and Mekong rivers). Similarly, 6000-7000 m high mountains in Tibet, rising only some 1000-1500 meters above the surrounding elevated plateau, belong to the same class as rather low mountains along the South Chinese coast. In contrast, the Himalayas rise over 8000 m above the Indian plains and thus both have a high relative and absolute hypsometric class.
2. For sloping lands (slopes 8-30%) the same hypsometric criteria are valid as for steep land, but relief intensity may be less than 600 m/km, while always more than 50 m/km.
3. For level land (slopes < 8%) the relief intensity is always less than 100 m/km while the *absolute level above sea level* is taken as hypsometric criterion.

Further subdivision of these three main categories is achieved through *classes of relief intensity, position of the unit in relation to surrounding land and hypsometry.* Further delimitation is achieved according to the *relative position of a terrain unit vis-a-vis the surrounding terrain.* This for example distinguishes plains (not enclosed by steeper land) from plateaus (on at least one side bounded by sloping and lower land) or depressions (surrounded by higher and steeper land on all sides). It must be noted, however, that scale plays an important role here. This for instance explains why some very large plateaus (Tibet, Deccan) or depressions/basins (Tarim, Tsaidam) are not necessarily classified as such, since at this scale they are too large to fall within a single landform subdivision. Conversely, other units may be too small to be observed at either the working scale or represented at the publication scale.

3.4 World Reference Base for Soil Resources (WRB)

During the reporting period several ISRIC staffmembers were involved in the discussions and establishment of the World Reference Base for Soil Resources (WRB), a project of the International Society of Soil Science (ISSS), the Food and Agricultural Organization of the United Nations (FAO) and ISRIC.

A world reference system for soil resources is a tool for the identification of pedological characteristics and their significance. It serves as a basic language for soil science and facilitates:

1. scientific communication,
2. the implementation of soil inventories and transfer of pedological data; assists with the elaboration of different systems of classification having a common base; interpretation of maps, etc.,
3. the international use of pedological data, not only by soil scientists but also by other users of soil and land, such as geologists, botanists, agronomists, hydrologists, ecologists, farmers, foresters, civil engineers, architects, etc., with the specific object of improving upon:
   - the use of soil data for the benefit of other sciences,
   - the evaluation of soil resources and the potential use of the different types of soil cover,
   - the monitoring of soils, particularly soil degradation which is dependent on the way soils are used by the human community,
   - the validation of experimental methods of soil use for sustainable development, which maintain, and if possible, improve the soils' potential,
   - the transfer of soil technology from one region to another.

The objective of the WRB is to provide scientific depth and background to FAO's Revised Legend of the Soil Map of the World (1988), incorporating the latest knowledge relating to the global soil resources and inter-relationships. In order to include some of the most recent pedological studies, and to expand the use of the system from an agricultural base to a broader environmental one, it was recognized that a limited number of important changes to the 1990 Legend were necessary.

For this purpose, ISRIC staff members attended the WRB meetings in Silsoe, UK, Rome, Italy, and in Leuven, Belgium. Over 40 soil scientists from around the world contributed sections to the proposed World Reference Base.

The draft World Reference Base for Soil Resources was jointly published by the ISSS, ISRIC and FAO, and distributed to all participants of the XVth World Congress of Soil Science. At a symposium on WRB during this congress, the proposals were discussed thoroughly. Also, the ISSS Council decided to reinstate Working Group RB under Commission V.

Theme II:
Transfer of Technology for the Assessment of Soil and Terrain Resources in Developing Countries

3.5 National Soil Reference Collections and Databases (NASREC)

Background

The National Soil Reference Collection and Database programme (NASREC) aims to strengthen the capability of National Soil Institutions (NSIs) to disseminate information about the major soils of their country to a wide range of user groups. Joint NSI-ISRIC projects have resulted in the establishment of soil expositions and the development of soil databases with published accompanying documentation in 11 countries. These successful projects should make a significant contribution to bridging the communication gap between the soil science community and user groups of soil/land information.

A soil exposition contains a selection of soils representative of major ecological zones. Ideally, it should contain all those soil types which are of interest for agricultural and environmental organisations. Presentation should be simple and clear. Despite over-simplification of the distribution of soil types in a country for the purposes of display, the aim should be to also convince non-soil scientists of the value of soil information and to encourage their interest in the subject. The soil database includes information about the soil profiles of the exposition as well as that of other profiles, representing the major soil types of a country and their variations. The field and analytical information stored in the database is made available to land resource scientists in both digital and printed format as a Country Report.

In addition to information on soil/land properties, a soil reference collection should have ample information on the assessment of soil/land qualities and management aspects. Questions of what can be done with a specific soil, what kind of measures/improvements have to be taken for its sustainable use and how to cope with the resilience of the soil/land for specific land-uses should be answered in an accompanying publication. For this purpose, ISRIC has developed the Soil Brief. For more details on the soil exposition, the database and publications, reference is made to NASREC Newsletters 1 to 3, copies of which can be obtained from ISRIC.

By the beginning of 1995, 15 institutions in 11 countries had cooperated with ISRIC in the NASREC programme. Most participating institutions finalized their NASREC projects by the end of 1994. The NASREC programme was supported by the Directorate General for International Cooperation of the Netherlands within UNEP's Action Plan of National Soil Policies, the European Community, and the Royal Dutch Academy of Arts and Sciences (KNAW).

Activities in 1993-1994

In the following section, a table summarizing the progress in each country is followed by information about the activities of the participating institutions.

Summary state-of-affairs of NASREC's at the national institutions
(beginning of 1995)

COUNTRY	No. collections	MAJOR PHASES OF A NASREC PROJECT						
		FIELD WORK	LAB Nat.	LAB ISRIC	EXPOSITION	DATA-BASE	COUNTRY REPORT[g]	SOIL BRIEF[h]
NIGERIA	1	+	+	+	(+)	+	comp	(8)
ZIMBABWE	1	+	+	+	11/93[d]	+	comp	(8)
COSTA RICA	1	+	+	+	(+)	+	draft	(5)
NICARAGUA	1	+	?	+	o?	o?	draft	3
PERU	3	+	+?	+	12/94[e]	+	draft	(8)
CUBA	1	+	+	+	7/94[f]	+	draft	8
VENEZUELA	2	+	+	[c]	+	o	o?	o?
INDIA	3	+	+?	[c]	o	o	o	(16)
PAKISTAN	1	o?						
CHINA	1	+	+	+	+	+	first	6(7)
KENYA	1	+[a]	[b]	[b]	o	o	comp	2(?)

+	finished	Fieldwork	Fieldwork, collection of soil monoliths
(+)	nearly finished	Lab Nat.	Soil analyses at national laboratory
o	in progress	Lab ISRIC	Soil analyses at ISRIC laboratory
a)	additional fieldwork is scheduled	Exposition	Installation of soil monoliths exposition
b)	data to be completed	Database	Establishment of the soil profile database
c)	samples/monoliths not yet received at ISRIC	Country Report	Accompanying publications
d)	date of inauguration of soils exposition	Soil Brief	Accompanying publications
e)	Iquitos expo inaugurated, Lima and Arequipa planned		
f)	inauguration of exposition during ISSS soil excursion		
g)	status of Country Report: comp = compilation, draft = draft version, first = first edition		
h)	status of Soil Briefs: 6(7) = 6 Soil Briefs published and 7 Soil Briefs in preparation		

Nigeria

University of Ibadan [UI] - Departments of Agronomy and Geography, Ibadan

The soil collection at the University of Ibadan includes 15 profiles from four major ecological zones of Southern Nigeria: the humid tropical rain forest, humid woodland, sub-humid open woodland and the delta of the river Niger. The exposition is housed in a large hall in the Department of Agronomy. It is envisaged that the Country Report of Nigeria and 8 Soil Briefs will be finalized in the course of 1995.

Zimbabwe

Chemistry and Soil Research Institute [CSRI], Harare

The soil collection at the Chemistry and Soil Research Institute in Harare includes 15 profiles representative of the high, middle and low altitude major ecological regions. The soil exposition was inaugurated on the occasion of the EC Workshop on Benchmark Soil Sites which took place in November 1993. The Country Report of Zimbabwe and a series of Soil Briefs will be published in 1995.

Additional fieldwork is planned with the University of Zimbabwe and will include the sampling of a series of representative soils of broad, wet valley bottoms, known as Dambos.

Costa Rica / Nicaragua

Centro Agronómico Tropical de Investigación y Enseñanza [CATIE], Turrialba

The collection includes 20 soil profiles from the major ecological zones in Central America: deeply weathered soils (Ferralsols, Acrisols/Ultisols) of the humid tropical rainforest; soils derived from volcanic deposits of the temperate humid central highland; relative shallow, soils (Andosols, Cambisols/Inceptisols) and pseudo-Vertisols of the tropical dry forest of the Pacific region.

120 duplicate soil samples were analyzed at the soils laboratory of ISRIC for comparative purposes and assistance with laboratory quality control.

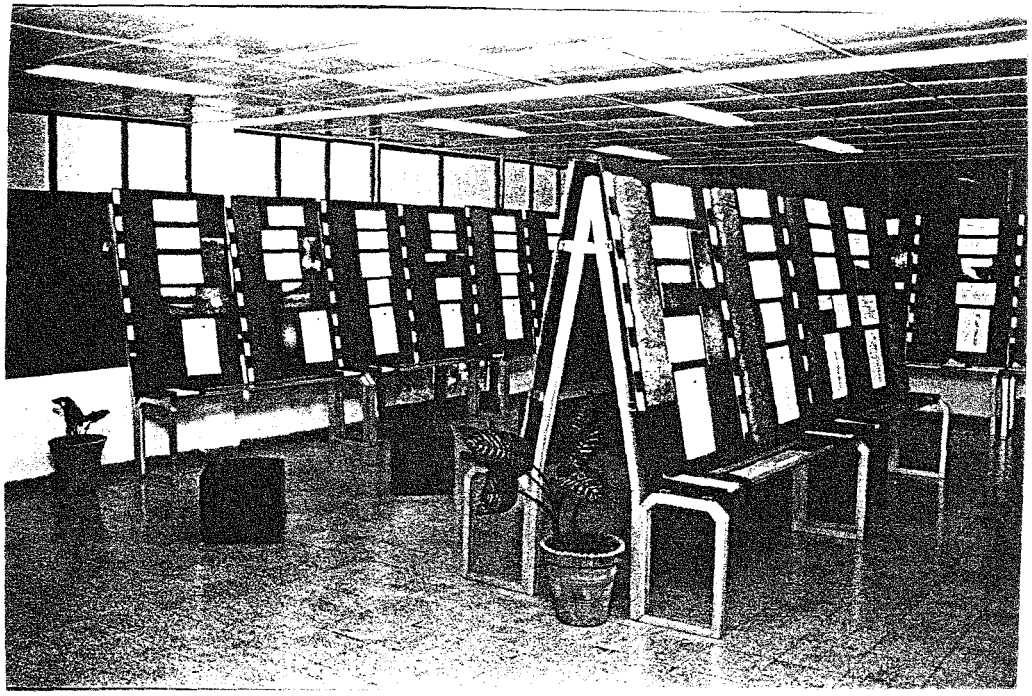
Some of the Nicaraguan soil monoliths were lost in transit between Nicaragua and Costa Rica. The re-sampling took place in 1994. The soil exposition in Costa Rica is housed in an easily accessible, former laboratory at CATIE. Draft Country Reports were completed for Costa Rica and Nicaragua by mid-1994 and these will be published, with a series of Soil Briefs, in 1995.

Cuba

Instituto Nacional de Investigación de Caña de la Azucar [INICA], Havana

The soil collection consists of 22 contrasting soils from different parts of the island. The soils exposition is housed at INICA's Experimental Station in Vila Clara. The inauguration of the exposition took place during the pre-congress soil excursion of the XVth World Congress of Soil Science in July 1994. The draft Country Report of Cuba and 8 Soil Briefs were available for participants of these excursions and other visitors to the exposition.

Opening NASREC in Cuba by L.R. Oldeman in the presence of Dr. Rafael Villegas Delgado, Vice-Director INICA



Soil exposition at INICA, Santa Clara, Cuba

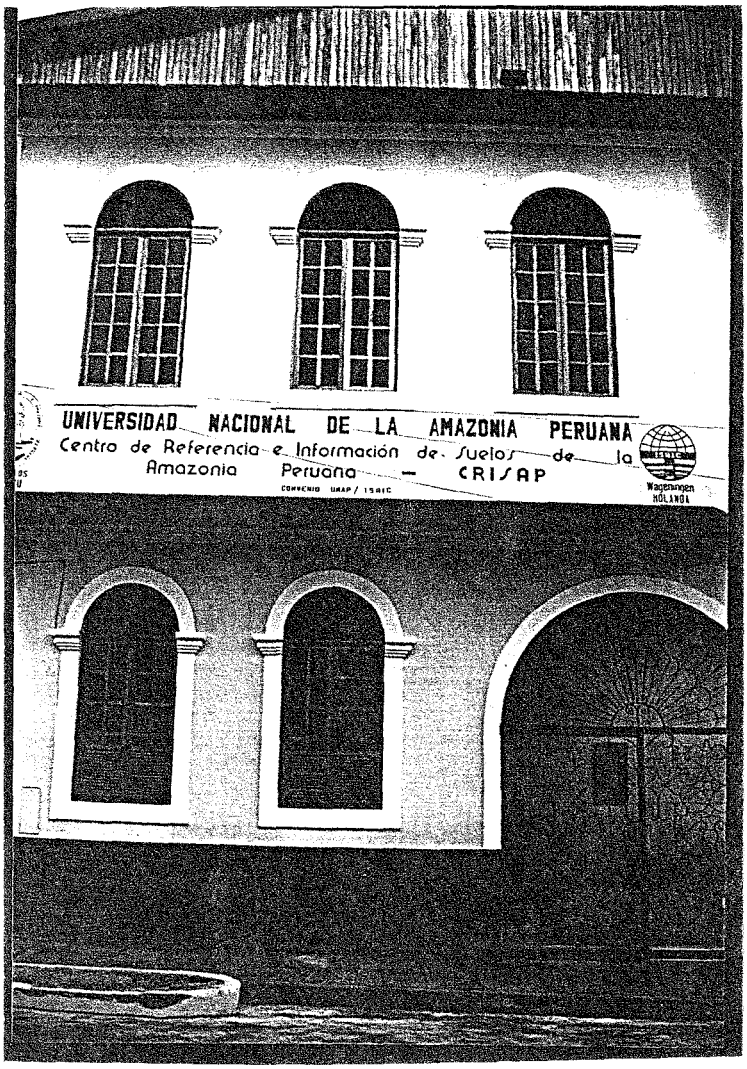
Peru

- *Instituto Nacional de Recursos Naturales [INRENA] and the Universidad Nacional Agraria de la Molina, Lima*
- *Universidad Nacional de la Amazonia Peruviana [UNAP], Iquitos*
- *Universidad Nacional San Agustin [UNSA], Arequipa*

Three soil profile collections are in preparation in Peru. A national collection is being brought together in Lima and two regional ones, of the Amazon region at Iquitos and of South Peru at Arequipa. The Amazonian soil collection includes Acrisols, Podzols, Arenosols and Fluvisols and is situated in a new building in Iquitos. The building was specially designed to house the collection and has an exposition hall, an auditorium and several offices. The 'Centro de Referencia y Informacion de Suelos de Amazonia Peruana' (CRISAP) was officially inaugurated on 9 December 1994. The present soil collection will be expanded in the period 1995-1997 with about 8 or 10 representative soils from the Iquitos - Nauta and Rio Nanay area with financial support from an European Community Bio-diversity project. The soil collection at Arequipa includes the hilly Coastal region with representative soils of the 'Andenes' irrigated man-made terraces, irrigated valley-bottom and the 'Pampas', flat areas with irrigation potential, all soils having a great variation in texture, salt content and other properties. (Regosols, Cambisols, Fluvisols and Andosols). The collection includes also four soils from high altitudes in the High Andes "Puna" region. The national collection in Lima includes duplicates of all soils in the regional collections at Iquitos and Arequipa.

The fieldwork for the three collections, the creation of the database and the preparation of Soil Briefs were realized by INRENA, UNAP and UNSA. For optimal use of the national collection in Lima it was decided in mid 1994 that the soil monolith exposition would be housed by the Universidad Nacional Agraria La Molina (UNALM). Following the transfer of soil monoliths, accompanying photographs and poster information, the official inauguration will take place in 1995. A draft Country Report was prepared in 1994 and will be published in 1995. A start has been made with 8 Soil Briefs which will also be published in 1995.

Soil Reference and Information Centre at UNAP, Iquitos, Peru



Venezuela

- *Universidad del Zulia, Departamento de Agronomía, Maracaibo*
- *Universidad Central de Venezuela [UCV], Maracay*

Representative soils from the region of Lake Maracaibo are on display in the Soils Department of the Universidad del Zulia. A second soil collection from the Maracay region is housed in the "Centro de Información y Referencia de Suelos", located at UCV in Maracay. Considerable delays have occurred in the transport of soil samples and duplicate monoliths from Venezuela to ISRIC.

India

- *Kerala Agricultural University [KAU], Trivandrum*
- *University of Agricultural Sciences [UAS], Karnataka*
- *Tamil Nadu Agricultural University [TNAU], Coimbatore*

Agricultural Universities in three southern States of India, Karnataka, Kerala and Tamil Nadu are simultaneously working on three University Soil Reference Collections (USREC). The collections will include about 10 to 15 representative soil profiles from each State. The fieldwork for the three collections was completed in

1994. The second NASREC training course took place at Tamil Nadu Agricultural University in Coimbatore from 4-18 June 1994, in which 7 staff members from the three Universities participated. In the first week of the course, the focus was on monolith preparation and input of data into the database. The second week concentrated upon an introduction to potential applications of the database and the planning of follow-up actions, such as the preparation of a Country report (in this case, three State Reports) and 16 Soil Briefs.

Inauguration of soil exposition at UAS, Bangalore, India

Pakistan

Soil Survey of Pakistan [SSP], Lahore

No progress to report to date, but at the beginning of 1995 news reached ISRIC that a joint Pakistan-Netherlands Project (PC1), which includes a NASREC component, had been approved. It is envisaged that before the end of 1995 a start can be made with the NASREC project, for which a detailed workplan was prepared in 1990.

China

Institute of Soil Science - Academia Sinica [ISS-AS], Nanjing

Within the framework of the EC-STD2-China Soils Project* a NASREC project was finalized in 1994. The soil collection includes 51 reference soils from most of China's major ecological zones. Additional fieldwork to study and sample four soils of the Tibet high plateau was accomplished by ISS-AS in mid 1994. Duplicate samples and monoliths will be sent to ISRIC. A draft Country Report and 6 Soil Briefs were available at the end of 1994. (See EC-STD2 project section).

* "Erosion assessment, classification and soil reference collection of soils in (sub)tropical China project", supported by the Life Sciences and Technologies for Developing Countries (STD2) programme of the European Community

Activities at ISRIC

ISRIC supported the participating NASREC institutions with financial help and technical assistance in the fields of soil analysis, photography, database development, database application programs and the publication of Country Reports and Soil Briefs. A summary of these activities follows:

Ten technical assistance missions took place to NASREC institutions (major mission objective between brackets): China (2 fieldwork missions), India (2nd NASREC training course), Kenya (workplan), Zimbabwe (inauguration of the soil exhibitions), Costa Rica (training), two missions to Cuba and Peru (training and inauguration of the national soil exhibition). In addition to the primary mission objectives, other activities included on-the-spot training during fieldwork, short database courses and advice on organisational aspects in support of soil exposition inaugurations.

In addition to the analyses by national soil laboratories, about 500 samples were also analyzed by ISRIC in 1993/94, for cross-checking purposes.

Support also included duplication of slides, enlargements of photographs, lay-out and printing of information posters, etc. ISRIC contributed to the development of pedon databases, with the screening of datasheets, the completion of missing analytical results and the preparation of small scale maps for Country Reports.

ISRIC assisted the NASREC institutions with dataprocessing activities by further developing the graphical programme for soil and climate data (SOLGRAPH). The programme has been made with LOTUS and dBASE IV and the second version became operational in 1994.

In 1994 the programme STRESS, an ALES model based on FAO's Framework for Land Evaluation was developed at ISRIC and became available for testing purposes. STRESS aims at a rapid determination of climate, soil and land management related constraints for rain-fed agriculture. Automation of the time-consuming manual procedure developed earlier, and further adaptions and improvements were made in the course of 1994. This version will be further tested and modified in the first half of 1995 and it will be made available to NASREC project participants and other external users during the NASREC workshop in October 1995.

The crop simulation model WOFOST (World Food Studies), for which a user-friendly shell has been developed, with revised soil and climate data files, will be further tested in 1995. The input of quantitative results of the WOFOST model in the STRESS model will be further investigated.

ISRIC is continuing to help with the preparation of Country Reports and reviewing draft Soil Briefs prepared by national soil institutions. In addition, ISRIC assists with the lay-out and reproduction of pages with colour photographs of soils and landscape. Support was given for the preparation of Soil Briefs of Chinese, Costa Rican, Cuban and Nicaraguan soils, the draft results of which were presented at the XVth World Congress of Soil Science. Work on Soil Briefs is progressing for Ecuador, Jamaica, Nigeria, and Zimbabwe.

During the reporting period ISRIC received monoliths for its world collection from the following NASREC countries: China (34), Costa Rica (12), Cuba (20), Nigeria (15), Nicaragua (11), and Zimbabwe (12).

NASREC evaluation and follow-up

At the request of the main sponsor of the NASREC programme, the Netherlands Directorate General for International Cooperation (DGIS), an external evaluation was made by an international panel in September 1993. The panel consisted of the following members:

Ir. W. Andriesse, coordinator of the panel (Head, Department of International Cooperation, DLO Winand Staring Centre, Wageningen, The Netherlands)
Dr. Ir. R. Brinkman (Chief, Soil Resources Management and Conservation Service, AGLS, FAO, Rome, Italy)
Dr. F. N. Muchena (Director, National Agricultural Research Laboratory, Kenya)
Prof.Dr. F. Penning de Vries (Head, Agrosystems Research, DLO Centre for Agro-Biological Research, Wageningen, The Netherlands)
Dr. Ir. N. G. Röling (Department of Extension Service, Wageningen Agricultural University)
Dr. C. Valverde (ISNAR, The Hague, The Netherlands)

The detailed findings of the panel and its recommendations were presented in the Evaluation Report of the National Soil Reference Collection and Databases Project (NASREC). A brief summary of the report is as follows:

"Considering the efforts made so far and the stage reached in implementation of NASREC-2, the Panel concludes that the objectives of NASREC-2 have been achieved to a great extent. Training courses were successfully held. Education and extension objectives have been achieved through the mobilization of the information to users. The establishment of databases has gone beyond the terms of reference. This refers in particular to the development of user-friendly additional database applications."

"The Panel recommends that NASREC activities be continued in next phase (NASREC-3) with the following modifications compared with NASREC-2:

- *increased attention to information transfer and dialogue with different user groups of users of soils information, particularly at the national level, the non-specialist professionals, farmers, and the public at-large.*
- *selection of a few (2-3) new collaborating institutions in strategically-placed countries to improve geographical balance and coverage.*
- *continued support for selected activities at established collaborating institutions, rather than continued general support.*

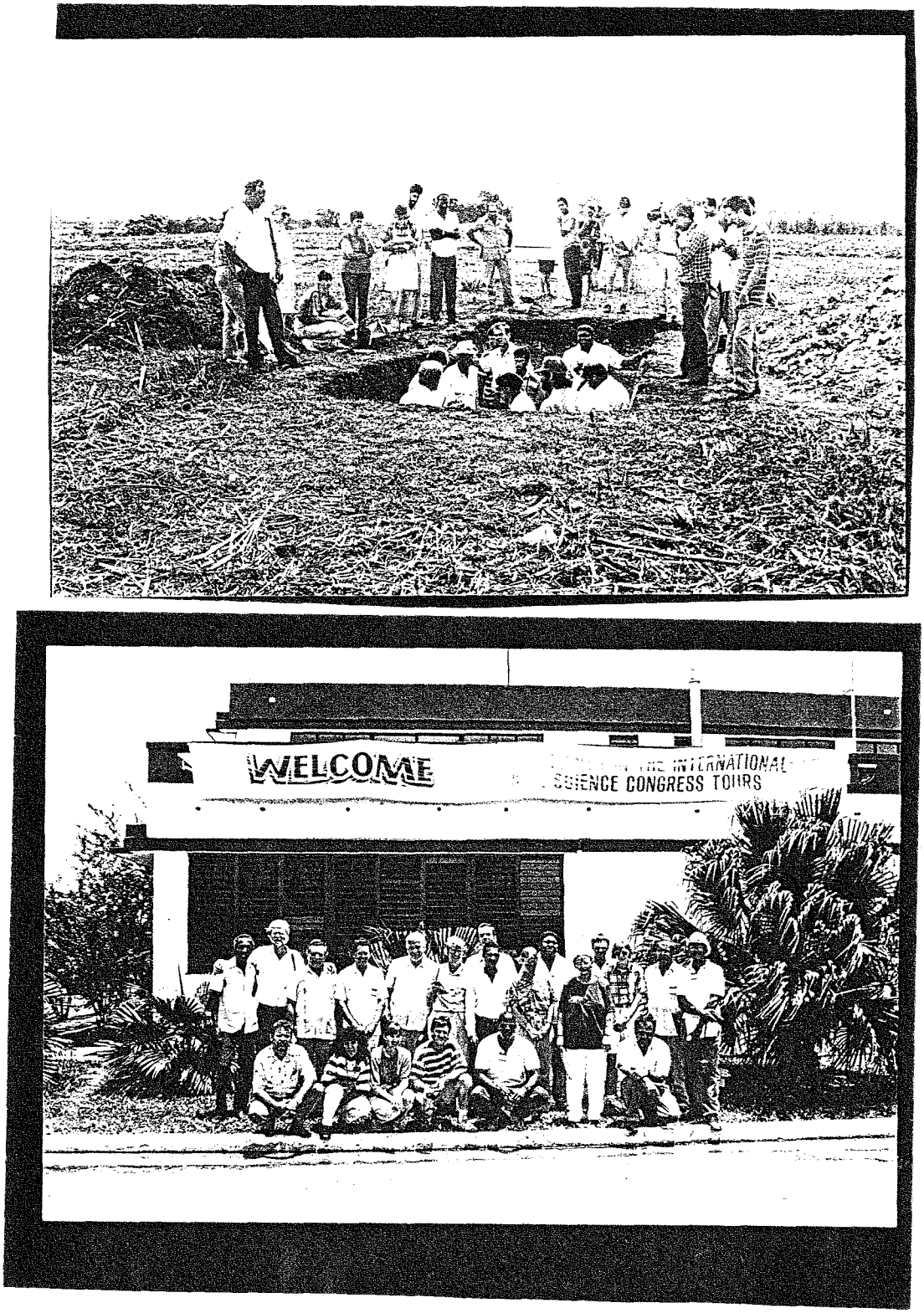
The Panel proposes to initiate under NASREC-3 assistance to build regional training possibilities at a number of national collaborating institutes ..."

"The Panel recommends the development of a global NASREC network to promote the exchange and use of soil information and experiences between the participating institutes and countries, and to improve links with international institutions and other networks with similar complementary objectives and functions".

"The Panel recommends ... an international workshop that brings together existing and potential collaborators and other resource persons to:

- *review the past performance, present their results, exchange information, and share experiences, in order to:*
- *finalize a workplan for implementation of NASREC-3 and map out a collaborative strategy and network structure."*

The recommended International Workshop will take place in autumn, 1995.
Since the start of NASREC phase 2, ISRIC has received requests for training and support to set up reference collections and databases from 30 institutions and individuals in 20 countries. Representatives of national institutions having prepared plans for NASRECs will be invited to the international Workshop.



Pre-Congress soil excursion Cuba,
XVth World Congress of Soil Science

3.6 EC-STD 2 China Soils project

Background

Upon the advice of the Life Sciences and Technologies for Development Programme (STD) of the European Communities (EC), three soil-oriented programmes of four European institutions cooperating with the Institute of Soil Science - Academia Sinica (ISS-AS) were combined into one project. Coordinators at ISS-AS are Professor Zhao Qiguo, Director and Professor Gong Zitong, Head of the Geography Department. The participating institutions are the Institut für Pflanzenernährung, Kiel, Germany (IPB), the Justus Liebig Universitat, Giessen, Germany (JL), the Institut Français de Recherche Scientifique pour le Développement en Coopération (ORSTOM), and the Rheinischen Friedrich Wilhelms Universität (RFW), Bonn, Germany and ISRIC, which is also coordinating the project. The following table shows the framework of the three sub-projects concerned.

Sub-project	A	B	C
Scale	Detailed	Reconnaissance	Exploratory
Objective	- Soil erodibility study(#) - Soil variability study	Transects study	Major soil types study.
Area	Yingtan Red Soil Station (4×6 km) and direct environment	Transects: Yingtan (200 km), Guangdong (200 km), Hainan (200 km)	Major ecological zones in Hainan, Guangdong and Jiangxi provinces (including A + B areas)
Results	- soil erodibility indices - detailed erosion model/GIS	- (pedogenetic) rules for major soil type distribution/evaluation	- soil reference collection - prototype small scale pedon database (SOTER)

ISRIC's task is to implement sub-project C: "Establishment of a soil reference collection and pedon database at ISS-AS and ISRIC", which is a NASREC oriented project (see section 3.5). Sub-project C aims at the study and sampling of sites in SE, NE and SW China, which supplements earlier soil collection missions in 1983 and 1986.

Northeast China

Co-operation between ISRIC and the Institute of Soil Science of the Academia Sinica (ISS-AS) has been supported by the Life Sciences and Technologies for Developing Countries Programme (STD-2) of the European Community. The funding allowed the collection of representative soil profiles from the northeast provinces of Heilongjiang, Jilin and Liaoning. Field work was accomplished during the months of June and July, 1993 by Luo Guobao, Huang Biao of ISS-AS and J.A.K. Boerma of ISRIC. Excellent co-operation was given by the Chinese authorities which enabled this project to be carried out with a minimum of difficulties.

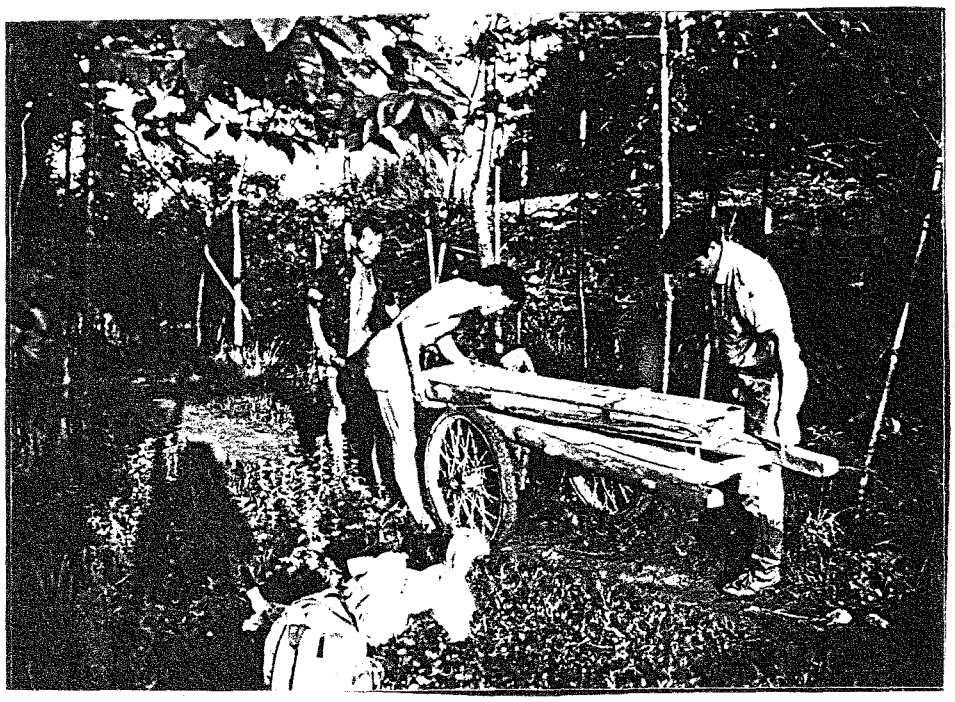
Unfortunately, all the notes concerning the visit including the soil descriptions were stolen from a car two weeks after the return from China to the Netherlands. However, the situation was improved six weeks later when the notes, abandoned by the thieves, were recovered. Although damaged by rainwater and partly eaten by slugs, it was still possible to use about 90 per cent of the material in the preparation of five Soil Briefs.

Each booklet will contain an ecological characterization of northeast China, a description of the area where the representative soil occurs, the full soil description and complete analytical details. The genesis and classification of the soil will be discussed as well as its suitability for different uses. These four booklets will be available early in 1995.

Future activities

Besides general administration for the whole project, the coordination work for the three sub-projects includes compilation of an executive summary, based on the technical papers prepared by the participants of sub-projects A, B and C. During the fieldwork all descriptions and other collected data have been entered in a database by using portable PCs.

The follow-up project proposal on a Soils and Terrain Digital Database for two areas in S. China submitted to the STD3 Commission of the European Community in November 1992 was well evaluated but did not receive financial support. The proposal was submitted through ISS-AS to the Asian Development Bank in the second half of 1994.



Soil monolith collection in southern China

3.7 The analytical laboratory

The report on the work of ISRIC's laboratory first deals with activities in support of ISRIC's programme for the development of National Soil Reference Collections and Databases (NASREC). In a second section, developments concerning the Good Laboratory Practice/SOILIMS project are described.

Laboratory

The work of the laboratory was characterized by two major activities: analysis of NASREC profiles and the completion of several contracts for third parties. The former included profiles from China, Costa Rica, Cuba, Nicaragua, Nigeria, Peru, Russia and Zimbabwe (in all, some 95 profiles). The latter included work commissioned by the Tropenbos Foundation (Guyana project), Forests Absorbing Carbon Dioxide Emission (FACE) with analysis of andic soils from Ecuador, analyses for DHV Consultants (Qatar), and analytical assistance with a project of the Directorate General for International Cooperation of the Netherlands in Sri Lanka.

Meanwhile, the occasion of the XVth World Congress of Soil Science and the planned presentation of many Soil Briefs and Country Reports required the completion of a large number of analyses, particularly those which had been omitted previously (e.g. X-ray diffraction of clay fractions). Also, more intensive and better quality control of data implied a greater amount of verification work. (The laboratory is trying to approach the generally accepted norm of spending some 15 to 20% of the time on quality control activities.) This work on samples from almost 30 countries, together with the Acapulco dead-line necessitated a temporary increase of laboratory staff.

Additionally, regular analytical work for ITC Enschede doubled during this period as there was a strong increase in demand for analyses in support of projects by postgraduate students. Virtually all targets had been met by the end of the reporting period.

The laboratory also took an active part in research on the properties of waste incinerator bottom-ash. This material has some similarities with volcanic ejecta and its use as hardcore or dumping in landfills can present environmental problems. Several co-authored publications evolved from this study (see list of publications).

GLP / SOILIMS

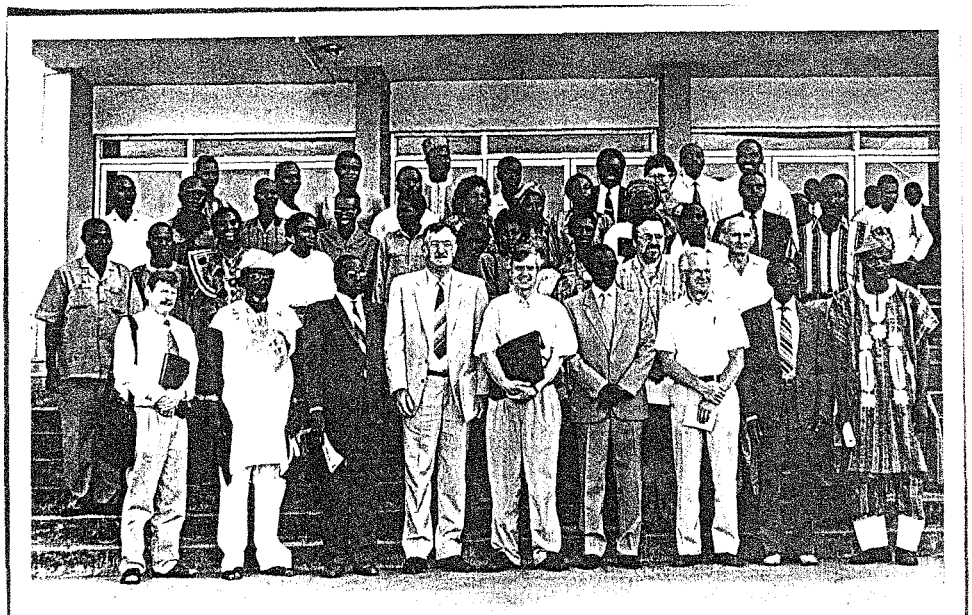
The laboratory work described in the preceding section implied a rather intricate analytical programme. This provided a good opportunity to test ISRIC's own laboratory information and management system SOILIMS©. Not surprisingly, this intensive testing revealed several "bugs" which needed to be eliminated, as well as a number of features which could be added to make the system more versatile.

The IITA Soils, Plant and Water Laboratory at Ibadan, Nigeria, one of the first laboratories to acquire SOILIMS, was also a useful test case for the programme. IITA was visited twice to update Version 1.0 and accommodate most, if not all, wishes of this large laboratory. With the release of Version 1.2 the system is now considered to be fully operational. Hopefully, it may find its way into many other laboratories, as it proved to be of great assistance in the organization of the routine

work, as well as in data quality control. By the end of 1994, some 75 demonstration versions of SOILIMS had been dispatched to laboratories in response to enquiries received.

The end of 1994 also saw the completion of the final draft of the Guidelines for Good Laboratory Practice in Soil and Plant Laboratories for which co-sponsorship of FAO was obtained. The development and use of both SOILIMS and the Guidelines for Good Laboratory Practice were encouraged by the interest of SPALNA (Soil and Plant Analytical Laboratory Network of Africa). During a 2-weeks SPALNA course at IITA, Ibadan, Nigeria, training in both these aspects were given to participants from 7 African countries. This led to a SPALNA proposal to donor agencies for the acquisition of 20 copies of SOILIMS and 10 PCs for their application.

The ISRIC contribution to the postgraduate course on Soil and Plant Analysis and Data Handling (including SOILIMS) was continued for the 4th and 5th year. This course is a joint project involving the co-operation of the Department of Soil Science and Plant Nutrition of Wageningen Agricultural University, the International Agricultural Centre and ISRIC.



SPALNA training course participants, Ibadan, Nigeria

Theme III:
Use of Soil Databases through Applied Research

3.8 World Inventory of Soil Emission Potentials (WISE)

This report covers the final two years work on the WISE project, sponsored by the Dutch National Research Programme on Global Air Pollution and Climate Change (NOP-MLK). Two main objectives were set in the original proposal, these were to establish a global soil database and secondly to attempt an estimation of soil methane emission potentials. Advice was sought in an international workshop, called in August 1992, and from that meeting the research proposals were refined and agreement reached with the sponsor over the changes made. During the following two years these revised proposals have been acted upon. This report covers the second part of the project, during which the WISE personnel were fully involved in numerous tasks including collection of data, development of software, preparation of a questionnaire for the methane survey and preparation of material for presentation and publication at national and international conferences. A full overview of the project is presented in Chapter 2 of this Bi-annual Report.

Arising from the need to develop a uniform code of practice for abstracting, entering and handling the soil profile data, two manuals were compiled. The first concerns the protocol to be used in abstracting data from the literature and the methodology of coding it for entry into the database. The second manual refers to the technical specification of the database itself. Requests were sent to known soil survey organisations throughout the world asking that they select from their own country a suitable number of representative soil profile descriptions and analyses based on the units of the FAO-Unesco Soil Map of the World known to be present. The response was limited, and so greater reliance than had been anticipated was placed in the collection of soil data in the ISRIC Library. Grateful acknowledgement is made to those individuals and organisations who were able to accede to our request.

In late 1993, and throughout 1994, our collaborators in FAO's Land and Water Development Division in Rome began to supply the gridded digital version of the 1:5 M Soil Map of the World which forms the geographical basis for developing the spatial element of WISE database.

At the end of the project, 3680 soil profiles (excluding USDA profiles) had been entered into the database and checked both by a visual inspection of a printed copy of each entry and also by several mechanical checks by the computer of the data entered. In addition to the work on the WISE database itself and its checking routines, software has been developed by ISRIC Staff to enable the automated transfer of data from the international databases such as FAO and USDA-NRCS to WISE. This automated soil data transfer facility, currently being tested, is referred to as "Landslide".

At the request of the WISE Workshop in August 1992, a questionnaire was prepared jointly with IRRI to assess the methodologies in use and the measurements being made of methane emissions from paddy rice soils. This questionnaire elicited a 43% response, but its results were not as informative as the Workshop participants hoped. However, the exercise had the benefit of

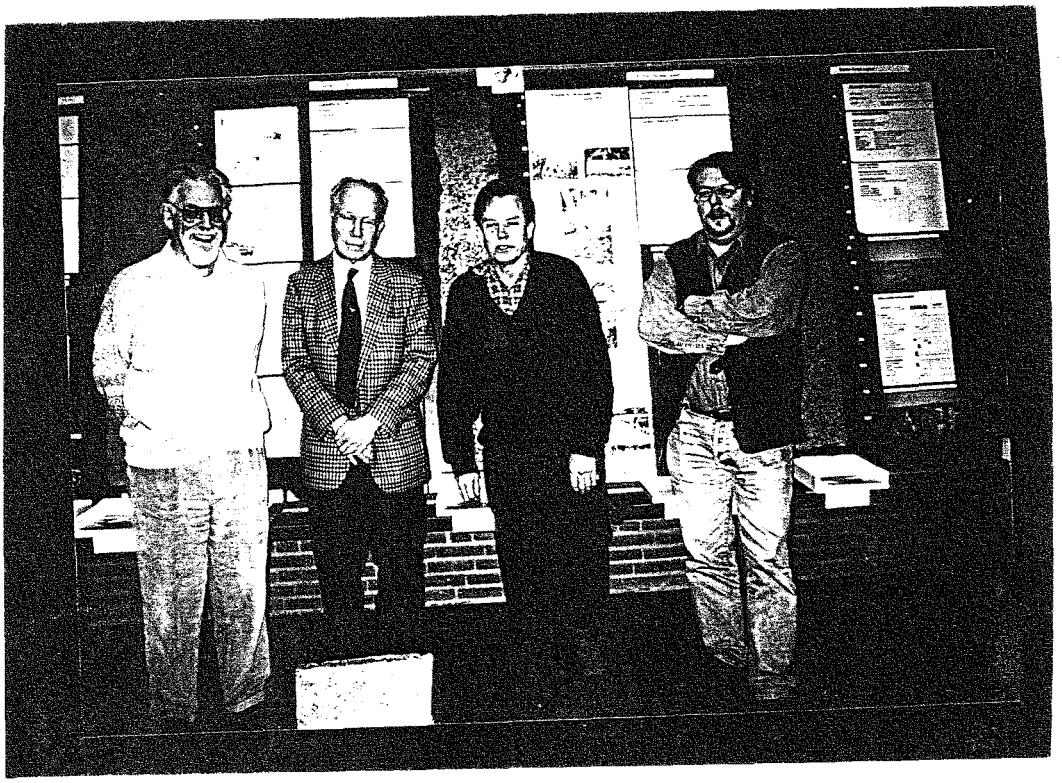
establishing contact with a network of field workers. Such contacts will be helpful for information regarding any future modelling activities on potential methane emissions.

Although the formal period of the WISE project has come to an end, activity is continuing in the development and use of the database. Data sets have been produced using the database showing the global distribution of wetland soils, pH values and a start has been made on the use of the database for arriving at a better definition of the soil units used on the FAO-Unesco Soil Map of the World. The possibilities of future modelling activity, using the WISE database, are being explored with colleagues at RIVM. The structure of the WISE database and its international holdings have been adopted by the International Geosphere-Biosphere Project - Data Information Service (IGBP-DIS) as the nucleus of their global pedon database.

3.9 Collection of Reference Laterite profiles (CORLAT)

Following the CORLAT Workshop, reported in the previous Bi-annual Report, which was assembled to discuss the first draft of the CORLAT Handbook, work continued with the incorporation of new sections provided by several of the workshop participants and improvements to the parts of the first draft which were found to be acceptable. This work was undertaken by guest researcher Dr. G.J.J. Aleva, who compiled the final draft which then passed through its editorial stages, supervised by D. Creutzberg. The text and illustrations were brought together and the book published in 1994 with the imprint of the European Commission Directorate-General XII for Science, Research and Development and ISRIC under the title of "Laterites: concepts, geology, morphology and chemistry". Publication of this book completed the first part of the CORLAT programme.

The interest of ISRIC in developing the second part of the CORLAT programme, a collection of laterite profiles and their chemical and physical properties was continued by representation at a EUROLAT meeting held in Belfast, September, 1994. When visiting Northern Ireland, the opportunity was taken to inspect lateritic profiles developed in basaltic lava flows and subsequently preserved by later flows. When the opportunity is presented collection of profiles will commence; through the generosity of individual scientists, a beginning has already been made with a collection of hand specimens illustrating the different forms of laterite and lateritic ironstone. The collections of Dr. G.J.J. Aleva and the late Dr. R. Schmidt-Lorentz were handed over to ISRIC.



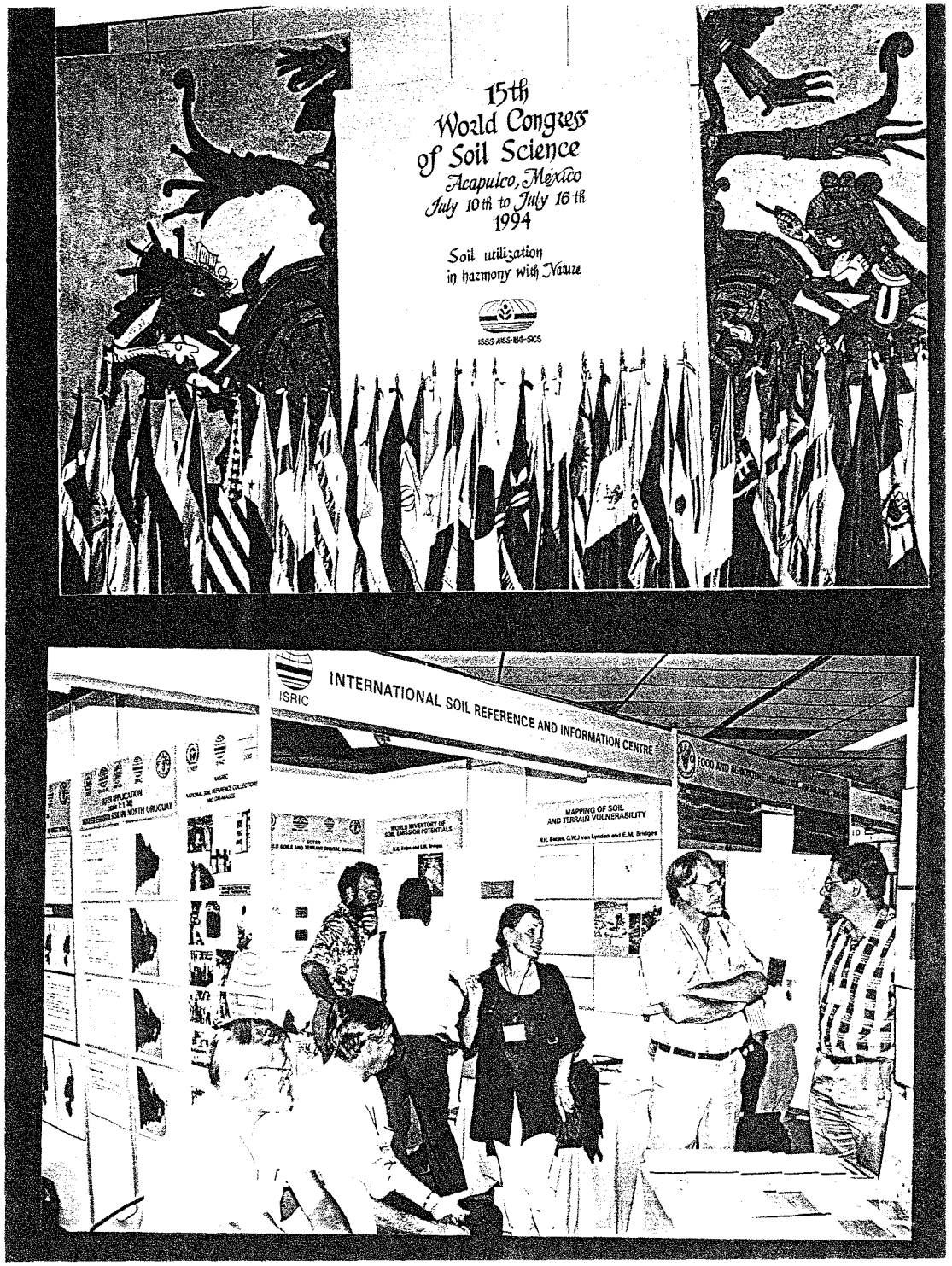
Collaborators Laterites Book
(From left to right: Dr. E.M. Bridges, Dr. G.J.J. Aleva, D. Creutzberg, and W.C.W.A. Bomer)

3.10 Glinka Memorial Collection

Following a feasibility study conducted in cooperation with the Dokuchaev Institute, reciprocal visits have been made by Dr. V. Stolbovoy to ISRIC and of ISRIC staff to Moscow and St Petersburg to further this interesting project. The invaluable collection of soil profiles, obtained under the direction of K.D. Glinka for the first International Congress of Soil Science, represents a picture of soil conditions in the 1920s which can be compared with those of the present day. The archives of the Dokuchaev and Williams Institutes in Moscow are being searched for historical records surrounding the collection of these soils. Some profiles in the St Petersburg area have been re-sampled at the original sites to enable the comparative work to begin.

The study of soil samples of the 1920's and the 1990's has as its objective to assess soil changes over the 70 year period, to investigate the effect of pollutants on the soils, especially radionuclides, acid rain and impact of fertilizers, changes in organic matter and its rate of turnover in soils, and to develop a technological package of management techniques which would avoid the negative effects of pollution and misuse of similar soils in the future. The analysis of these soils will provide a measure of the amount of pollution which has affected these soils during the past 70 years and incidentally will provide both ISRIC and the Dokuchaev Institute with monoliths of soils representative of a wide area of Russia and the states of the former Soviet Union.

Funding is being sought to collect the 1990's duplicate profiles and to carry out the historical investigations necessary to complete the story of these soil profiles. Meanwhile, a limited amount of research in the archives in Moscow is continuing and plans are ready for both laboratory and field work to begin should the opportunity arise.



ISRIC at the XVth World Congress of Soil Science

Theme IV:
Dissemination of Information

3.11 ISRIC at the XVth World Congress of Soil Science

The occasion of the 15th World Congress of Soil Science provided ISRIC with an excellent opportunity to display the range of activities currently in progress at the Centre. Altogether, a group of nine staff members, some accompanied by their wives, travelled to Acapulco to participate in the Congress and accompanying field excursions. In his capacity as Deputy Secretary General of the International Society of Soil Science (ISSS), J.H.V. van Baren was responsible for organizing the smooth running of several activities at the Congress.

Papers were delivered in scientific sessions during the congress in the sessions on a World Reference Base for Soil Resources (Spaargaren, Bridges and Creutzberg), and Utilization of Soil Information in Systems Modelling for Sustainable Agriculture and Global Climate Change (Batjes). A discussion paper was presented on "World Soils and Terrain Digital Database: past present and future" to the ISSS Working Group DM (World Soils and Terrain Digital Databases) during the Congress (Oldeman). A further contribution was made to the Symposium on Education in Soil Science (Nortcliff and Bridges). A poster presentation was made on Talpetate indurated horizons of Ecuadorian soils (Vogel) and a contribution to the poster exhibition in the Soil Horizons Task Force booth (Bridges). The "showpiece" for ISRIC activities was a booth where posters showing the work of ISRIC was presented. At the centre was a general ISRIC Poster giving a broad overview of the Centre's activities (Bomer, Van Baren).

After many years development and testing, the welcome recognition of the value of SOTER as a means of handling the large amount of available data on soils and terrain is apparent. With the support of UNEP and FAO, SOTER programmes are now in operation in a number of countries and others are planned. Posters demonstrating this work were presented by Van Engelen, Van Lynden, and Peters, and for Hungary, in association with the Hungarian Research Institute for Soil Science and Agricultural Chemistry (Varallyay, Pásztor). A poster displaying the progress being made with the Glinka Memorial Collection was presented (Boerma) in conjunction with the Dokuchaev Institute in Moscow (Stolbovoy). In addition, displays showing the results of WISE and SOVEUR (Batjes and Bridges), NASRECs in several different countries (Kauffman) and GLASOD (Oldeman) were also presented as posters, illustrating the aims, objectives and results of their work. The booths of UNEP, FAO and ISRIC were all adjacent, allowing the joint projects between the three organizations to be presented in a uniform manner, to make one of the most comprehensive displays at the Congress. ISRIC Staff were rewarded by the great amount of interest shown by members of the Congress in the general activities of the Centre as well as in the individual projects. Considerable interest was generated in a series of practical demonstrations of SOILIMS (Vogel) which has subsequently resulted in enquiries from many laboratories around the world.

3.12 World Overview of Conservation Approaches and Technologies (WOCAT)

ISRIC has participated actively in the WOCAT project which was launched in 1992, as an activity of the World Association of Soil and Water Conservation (WASWC). WOCAT, an acronym for "World Overview of Conservation Approaches and Technologies", is intended to promote the integration of successful soil and water conservation into farming systems worldwide. The project, in which many organizations and institutions are actively participating, is coordinated by the Group for Environment and Development of the Geographical Institute of the University of Berne, Switzerland.

Why WOCAT?

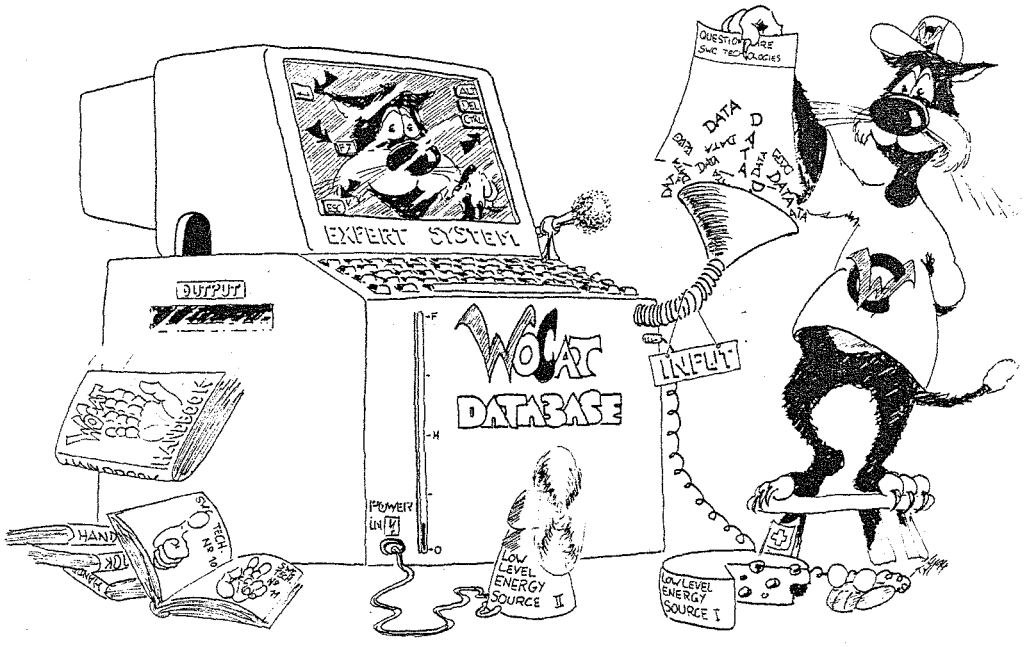
There is a considerable body of knowledge about approaches to soil and water conservation and its technology, but much of this information is not readily available, or clearly presented. It exists in unpublished "grey" literature; project documents, or is hidden in the papers and minds of soil and water conservation experts. The aim of WOCAT is to review this information, and in particular to look for the advantages and disadvantages of soil and water conservation systems, and the reasons why they have been accepted or rejected by local land users. WOCAT intends to collate this information and make it available to policy makers, specialists and field staff involved in soil and water management.

Achievements

After a series of international workshops and task force meetings in which ISRIC was actively involved, WOCAT is at the point of initiating a global data collection, and with collaborating institutions, has already started to undertake regional evaluations in Africa, Asia, and elsewhere. Three questionnaires for the collection of soil and water conservation data have been compiled and are being distributed. From these, WOCAT hopes to identify elements of soil and water conservation which have been successful under specific conditions, as well as those elements which were considered failures.

As shown in the cartoon, each of the three components of the programme will have its own specific output: a report on approaches to soil and water conservation, a handbook of soil and water conservation technology, and a world map depicting the location of successful schemes. This will be supplemented by a computer-based expert system. For complete implementation of the project, on a continental or global scale, additional funds are being sought.

Cooperating institutions: The project is coordinated by the Group for Development and Environment (GDE), University of Berne, Switzerland and actively supported by many institutions: International Soil Reference and Information Centre (ISRIC), Wageningen (The Netherlands); Centre for Development Cooperation Services (CDCS), Vrije Universiteit Amsterdam (The Netherlands); Asia Soil Conservation Network (ASOCON), Jakarta (Indonesia); Gesellschaft für Technische Zusammenarbeit (GTZ), Eschborn (Germany); Observatoire du Sahara et du Sahel (OSS), Paris (France); Food and Agriculture Organization of the United Nations (FAO), Rome (Italy); Resource Management Science (RMS), University of British Columbia, Vancouver (Canada); Regional Soil Conservation Unit (RSCU), SIDA, Nairobi (Kenya).
Financing institution: SDC (Swiss Development Cooperation) Berne, (Switzerland).



Source: K. Herweg, WOCAT, Bern

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Batjes, N.H., Van Engelen, V.W.P. and Oldeman. L.R., 1993. Proposed assessment of the vulnerability of European soils to chemical pollution using a SOTER-shell approach. *Land Degradation and Rehabilitation* **4**:223-231.

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Reports and Publications issued in the framework of Theme IV (Classification, Micromorphology and Education)

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Bridges, E.M., 1993. Soil Horizon Designations; Past Use and Future Prospects. *Catena* 20;(4) 363-373.

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Co-operative (Edited) Publications

Ter Meulen, G.R.B., Stigliani, W.M., Salomons, W., Bridges, E.M. and Imeson, A.C. (eds), 1993. Chemical Time Bombs. Proceedings of the European State of the Art Conference on Delayed Effects of Chemicals in Soils and Sediments. Foundation for Ecodevelopment "Stichting Mondiaal Alternatief" Hoofddorp. pp 279.

Bridges, E.M., Muchena, S.C., Prasad, G. and Williams, M. (eds), 1994. A Holistic Approach to Sustainable Soil Use in SADC Countries. (Presented by M. Catizzone and S.C. Muchena), European Commission Directorate General XII for Science, Research and Development, Life Sciences and Technologies for Developing Countries (STD3). Part I, 27pp. Part II, 58pp.

Reports and Publications issued in the framework of Theme III (CORLAT)

Joint ISRIC-European Communities Publication

Aleva, G.J.J. (ed. D. Creutzberg) 1994. *Laterites: concepts, geology, morphology and chemistry.* ISRIC/EC DGXII. Wageningen. pp 169.

Other Papers and Reports

Articles in Refereed Journals and Published Proceedings

Batjes, N.H., 1994. Agro-Climatic Zoning and Physical Land Evaluation in Jamaica. *Soil Use and Management* **10**:9-14.

Bridges, E.M., 1993. Land Use and Soil Contamination in the City of Swansea. *Land Contamination and Reclamation* **1**;83-91.

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Spaargaren, O.S., 1994. FAO-Unesco Soil Map of the World. Lecture notes ITC, Enschede.

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5 TRAVEL AND MEETINGS

During the period under consideration, ISRIC staff have participated in many international and national conferences, workshops and other activities associated with the projects or within the general sphere of interest of the four major themes encompassed by the Centre's mandate. Representation of ISRIC is requested for numerous international conferences, but regrettably it is impossible for the Centre to be present at all the meetings to which its staff are invited. Despite an enforced selection, participation in over 70 activities in 34 countries has enabled ISRIC to maintain a significant role in the affairs of soil science as befits the World Data Centre-C for Soil Geography and Classification of the International Council of Scientific Unions (ICSU). Whenever possible, staff members try to make a visit serve a number of purposes, particularly where meetings are held a great distances from The Netherlands as in Asia, southern Africa or South America, thus making the best use of travel funds.

Theme I deals with the development of a world soils reference database. Almost all ISRIC staff are involved to some extent as projects overlap, but the nucleus of this theme is the ISRIC Soil Information System (ISIS) used for internal data holdings and SOTER which has been developed for international data holdings. Further details are given in the sectional report, but ISRIC staff have been involved in meetings in Argentina, China, Hungary, Indonesia, Jordan, Kenya, Thailand and Uruguay either to initiate or to support SOTER activities already in progress. Training workshops for SOTER participants were held in Budapest, Nairobi and Buenos Aires. ISRIC's cooperation in the GTOS programme has necessitated visits to Geneva, Washington and Zürich.

Theme II concerns the transfer of technology and involves the NASREC programme. Visits by ISRIC staff to China, Costa Rica, India, and Peru have taken place. A training workshop held in Bangalore, India was presented by three ISRIC staff members. ISRIC laboratory staff presented a workshop on Good Laboratory Practice and laboratory Information Management in Nigeria in co-operation with the International Institute of Tropical Agriculture.

Theme III, the use of soil databases through applied research, brings ISRIC staff into a wide range of activities connected with practical applications of soil information. Staff of the WISE project have made presentations at conferences in The Netherlands, UK, France, Israel, and the USA organized by the International Geosphere-Biosphere Programme (IGBP), the Global Change in Terrestrial Ecosystems (GCTE) and the Global Emissions Inventory Activity (GEIA). The use of GLASOD methodology in an assessment of the status of human-induced soil degradation in southeast Asia was the subject of an expert consultation in Bangkok.

The dangers of soil degradation and measures for soil protection are at the forefront of many international programmes for the sustainable use of the land. This brings into sharp focus the necessity for soil conservation and also rehabilitation of degraded soils. ISRIC staff have attended meetings and presented papers in Accra, Ghana (CTA/SRI seminar), Budapest, Hungary (Harmonization of Soil Conservation Monitoring Systems), Strasbourg, France; Bern and Geneva, Switzerland (WOCAT and GTOS), London and Malvern, UK (International Convention for Conservation

of Sites of Geological and Associated Natural Ecosystems), Djerba, Tunisia (Restoration and Rehabilitation of Degraded Lands in the Arid and Semi-arid Zone), Santiago, Chile (ICSU General Assembly) and Pasadena, USA (World Resources Institute and California Institute of Technology workshop on Global Environmental Monitoring), New Delhi, India and Kathmandu, Nepal (ISCO Conference and ICIMOD). ISRIC staff participated in the Expert Consultation of the Asian Network of Problem Soils held in Bangkok in discussions of data collection and analysis for studies of land degradation.

Theme IV, cooperation with the Dokuchaev Institute in Moscow over the Glinka Memorial Collection of soil profiles has resulted in an exchange of visits to Russia and The Netherlands of staff of the two institutes. ISRIC staff have participated in meetings of the World Reference Base for Soil Resources (WRB) held in Italy at FAO Headquarters, Rome, at Silsoe College, UK and Leuven, Belgium. A continuing topic during the two year period has been the development of holistic ideas in soil science, first proposed at Rennes in 1991, and developed at an international workshop in November, 1993. Two staff members attended this workshop which was held in Harare, Zimbabwe, supported by the Life Sciences and Technologies for Developing Countries of the European Commission.

Also under the activities of Theme IV, visits have been made during 1993 to several of the states of North Africa, including Egypt, Kenya, Morocco, Niger and Tunisia, participants in the Soil and Terrain Resources Information Network Generation (STRING) programme. At the XVth World Congress of Soil Science in Mexico, members of ISRIC staff participated by presenting papers, posters and discussing demonstrations with visitors to the ISRIC booth (see section 3.11).

6 PERSONNEL

6.1 Board of Management (December 1994)

- Dr.Ir. A.W. de Jager (Chairman), Board of ITC, Enschede
- Prof.Dr. J. Bouma, Department of Soil Science and Geology, Wageningen Agricultural University
- Ms Prof.Dr.Ir. L.O. Fresco, Department of Agronomy, Wageningen Agricultural University
- Ir. G.A. Oosterbaan, The Winand Staring Centre for Integrated Land, Soil and Water Research (SC-DLO), Wageningen
- Prof.Dr.Ir. M. Molenaar, Department of Land Surveying, Photogrammetry and Remote Sensing, Wageningen Agricultural University

Changes:

In view of retirement as Director of the Department of Science and Technology, Ministry of Agriculture, Nature Management and Fisheries, the Hague, Prof.Dr. K. Verhoeff resigned from his position as a member of the Board as of November 1994. Mr. W. van Vuure has been appointed as his successor on behalf of the Ministry of Agriculture, Nature Management and Fisheries.

6.2 Scientific Advisory Council (December 1994)

- Prof.Dr J. Bouma (Chairman), Dept. of Soil Science and Geology, Wageningen Agricultural University
- Dr. A.T. Ayoub, UNEP, Nairobi, Kenya
- Ir. G.W. van Barneveld, DHV Raadgevend Ingenieursbureau BV, Amersfoort
- Prof.Dr. W.E.H. Blum, International Society of Soil Science, Vienna, Austria
- Dr. R. Brinkman, FAO, Rome, Italy
- Prof.Dr. P.A. Burrough, University of Utrecht
- Dr.Ir. P.M. Driessen, Dept. of Soil Science and Geology, Wageningen Agricultural University
- Dr.Ir. G.W.W. Elbersen, 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, ILRI, Wageningen
- Ir. B.J.A. van der Pouw, The Winand Staring Centre for Integrated Land, Soil and Water Research (SC-DLO), Wageningen
- Prof.Dr. J. Sevink, University of Amsterdam
- Prof.Dr.Ir. L. Stroosnijder, Dept. of Irrigation and Soil and Water Conservation, Wageningen Agricultural University
- Dr. C. Valverde, ISNAR, the Hague
- Ir. M.M. Vierhout, Haskoning Koninklijk Ingenieurs- en Architectenbureau, Nijmegen
- Ir. W. van Vuure, Dept. of Science and Technology, Ministry of Agriculture, Nature Management and Fisheries, the Hague

Mr. A.L.J. van den Eelaart, Euroconsult BV, resigned from his function as member of the Scientific Advisory Council, no successor was suggested for his replacement.

6.3 Staff of ISRIC (December 1994)

DIRECTORATE: L.R. Oldeman (Director); J.H.V. van Baren (Deputy Director)
Y.G.L. Karpes-Liem (Secretary)

PRODUCTION DIVISION
(Programmes and Projects)
L.R. Oldeman

Soil Analytical Laboratory
P.R. van Reeuwijk (GLP, SOILIMS)
J. Brunt (SOILIMS)
J.R.M. Huting
N. Manuchehri
A.J.M. van Oostrum
R.A. Smaal

Pedon Databases
J.H. Kauffman (NASREC, ISIS)
N.H. Batjes (WISE, SOVEUR)
J.A.K. Boerma, guest researcher (GMC)
E.M. Bridges, guest researcher (WISE, SOVEUR)
E.E. van Loon (ISIS)

GIS, Databases
V.W.P. van Engelen (SOTER)
G.W.J. van Lynden (GLASOD, WOCAT)
S. Mantel (SOTER)
J.W. Resink (SOTER, GLASOD)
A.F. Rotmans (SOTER)
P. Tempel (SOTER, ISIS)

ADMINISTRATION DIVISION
(Education, Documentation, Administration)
J.H.V. van Baren

Education and Documentation
G.J.J. Aleva, guest researcher (CORLAT)
M. Ahmad
W.C.W.A. Bomer
A.B. Bos (ISIS)
D. Creutzberg, guest researcher (CORLAT)
J.C. Jonker-Verbiesen
O.C. Spaargaren (WRB, ISIS)

Support Services
K.J. Berendsen
J. Brussen
M-B.B.J. Clabaut
Y.G.L. Karpes-Liem
H. Soekhram

Staff changes:

The following changes have taken place:

* Mrs. L. Awad	January 1994 - July 1994	(data typist)
Mr. K.J. Berendsen	from August 1993	(computer systems manager)
* Mr. R.O. Bleijert	until December 1993	(micromorphology technician)
* Mr. J. Brunt	until December 1994	(soil scientist, computer applications)
Mr. D. Creutzberg	until March 1993	(micromorphologist)
* Mrs. M. de Groot-Sot	February 1994 - June 1994	(laboratory analyst)
Mr. S. Mantel	since January 1994	(soil scientist, SOTER projects)
* Mr. P.J.M. Mulder	until September 1993	(geographer, STRING project)
Ms. J.W. Resink	since January 1994	(GIS operator)
Mr. O.C. Spaargaren	since June 1993	(soil scientist, World Reference Base)
Mr. P. Tempel	since January 1993	(computer programmer)
Mr. E.E. van Loon	since August 1994	(soil scientist, ISIS)
* Mr. T. van de Ven	September 1993 - August 1994	(soil scientist, NASREC)
* Mr. H.C. Vellema	May 1993 - July 1993	(soil scientist, WISE)
* Mr. A.W. Vogel	March 1993 - September 1994	(soil scientist, NASREC)
* Mr. W. Zunnenberg	November 1993 - April 1994	(soil scientist, SOTER)

(* former ISRIC personnel)

Messrs. Bleijert and Creutzberg formed the Micromorphology Section, which ceased operations. They both joined ISRIC a short while after its foundation and have taken their share in building up the Section as an integral part of the overall activities of the Centre. Mr. Creutzberg was also for many years responsible for the services rendered to visitors and he was lecturing at ITC, Enschede, for nearly two decades. Although on early retirement, he continues working at ISRIC for 3 to 4 days per week.

APPENDIX

Acronyms used in Bi-Annual Report 1993-1994

AB-DLO	Research Institute for Agrobiology and Soil Fertility, The Netherlands
ALES	Automated Land Evaluation System
ASOCON	Asian Soil Conservation Network, Indonesia
CATIE	Centro Agronomico Tropical de Investigación y Ensenanza, Costa Rica
CDCS	Centre for Development Cooperation Services, The Netherlands
CORLAT	Collection of Reference Laterite profiles, ISRIC
CRISAP	Centro de Referencia y Información de Suelos de Amazonia Peruana, Peru
CSRI	Chemistry and Soil Research Institute, Zimbabwe
CTA	Centre Technique de Coopération Agricole et Rurale, The Netherlands
DGIS	Directorate-General for International Cooperation, Ministry of Foreign Affairs, The Netherlands
DHV	DHV Consultants, The Netherlands
DLO	Agricultural Research Department of the Netherlands
EC/STD	Science and Technology for Development Programme, European Community
EC	European Community
FACE	Forests Absorbing Carbon Dioxide Emission
FAO	Food and Agriculture Organization of the United Nations
FINNIDA	Finnish International Development Agency
GCTE	Global Change in Terrestrial Ecosystems
GDE	Group for Development and Environment, Switzerland
GEIA	Global Emissions Inventory Activity
GEO	Global Environmental Look, RIVM/UNEP project
GEONETH	Geoscience Network of the Netherlands for International Cooperation
GIS	Geographic Information System
GLASOD	Global Assessment of Soil Degradation project, ISRIC
GLP	Good Laboratory Practice
GMC	Glinka Memorial Collection, ISRIC
GTOS	Global Terrestrial Observing Systems
GTZ	Gesellschaft für Technische Zusammenarbeit, Germany
HUNSOTER	SOTER project, Hungary
IAC	International Agricultural Centre, The Netherlands
ICIMOD	International Centre for Integrated Mountain Development, Nepal
ICSU	International Council of Scientific Unions
IGBP	International Geosphere-Biosphere Programme
IGBP-DIS	International Geosphere-Biosphere Programme, Data & Information System
IGCP	International Geological Correlation Project
IITA	International Institute of Tropical Agriculture, Nigeria
ILRI	International Institute for Land Reclamation and Improvement, The Netherlands
INICA	Instituto Nacional de Investigación de Cana de la Azucar, Cuba
INRENA	Instituto Nacional de Recursos Naturales, Peru
INTA-CIRN	Instituto Nacional de Tecnologia Agropecuaria, Centro de Investigaciones de Recursos Naturales, Argentina
IPB	Institut für Pflanzenernährung und Bodenkunde, Germany
IRRI	International Rice Research Institute, Philippines
ISCO	International Soil Conservation Organisation, India
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
JL	Justus Liebig Universität, Germany
KAU	Kerala Agricultural University, India
KENSOTER	SOTER project, Kenya
KNAW	Royal Dutch Academy of Arts and Sciences
KSS	Kenya Soil Survey
LASOTER	SOTER project, Latin America
LIMS	Laboratory Information Management System
MOW	Netherlands Ministry of Education and Science

NASREC	National Soil Reference Collections, ISRIC
NOP-MLK	Netherlands National Research Programme on Global Air Pollution and Climate Change
NRCS	Natural Resources Conservation Service of the United States
NSI	National Soil Institution
ORSTOM	Institut français de recherche scientifique pour le développement en coopération, France
OSS	Observatoire du Sahel et du Sahara
RFW	Rheinischen-Friedrich Wilhelms Universität, Germany
RISSAC	Research Institute for Soil Science and Agricultural Chemistry, Hungary
RIVM	National Institute of Public Health and Envrionmental Protection, The Netherlands
RMS	Resource Management Science, Canada
RSCU	Regional Soil Conservation Unit, Kenya
RUSOTER	SOTER project, Russia
SAC	Scientific Advisory Council of ISRIC
SC-DLO	The Winand Staring Centre for Integrated Land, Soil and Water Research, The Netherlands
SDB	FAO-ISRIC Soil Database
SDC	Swiss Development Cooperation, Switzerland
SLEMSA	Soil Loss Estimation Model for Southern Africa
SOILIMS	Soil Laboratory Information and Management System, ISRIC
SOTER	World Soils and Terrain Digital Database, ISSS
SOTER-LA	SOTER project, Latin America
SOVEUR	Soil and Terrain Vulnerability Mapping Europe, ISRIC
SPALNA	Soil and Plant Analytical Laboratories Network of Africa
SRI	Soil Research Institute, Ghana
SSO	Sahara and Sahel Observatory
SSP	Soil Survey of Pakistan
STRING	Soil and Terrain Resources Information Network Generation, ISRIC
SWEAP	SOTER Water Erosion Assessment Programme
TNAU	Tamil Nadu Agricultural University, India
UAS	University of Agricultural Sciences, India
UCV	Universidad Central de Venezuela
UI	University of Ibadan, Nigeria
UNALM	Universidad Nacional Agraria La Molina, Peru
UNAP	Universidad Nacional de la Amazonia Peruviana, Peru
UNEP	United Nations Environment Programme
UNSA	Universidad Nacional San Agustin, Peru
USDA	United States Department of Agriculture
USLE	Universal Soil Loss Equation
VROM	Ministry of Housing, Physical Planning and the Environment, The Netherlands
WISE	World Inventory of Soil Emission potentials
WOCAT	World Overview of Conservation Activities and Technologies, Switzerland
WOFOST	World Food Study model
WRB	World Reference Base for Soil Resources

PUBLICATIONS

Soil Monolith Papers

SMP 1 Thionic Fluvisol (*Sulfic Tropaquept*) Thailand, 1981
SMP 5 Humic Acrisol (*Orthoxic Palehumult*) Jamaica, 1982
SMP 6 Acri-Orthic Ferralsol (*Haplic Acrorthox*) Jamaica, 1982
SMP 7 Chernozem Calcique (*Vermustoll Typique*) Romania, 1986

Technical Papers

TP 1 Procedures for the Collection and Preservation of Soil Profiles, 1979
TP 2 The Photography of Soils and Associated Landscapes, 1981
TP 5 The Flat Wetlands of the World, 1982
TP 7 Field Extract of "Classification des Sols", 1984
TP 9 Procedures for Soil Analysis, 1986; 2nd ed., 1987; 3rd ed., 1992
TP 10 Aspects of the Exhibition of Soil Monoliths and Relevant Information (prov. ed., 1985)
TP 11 A Simplified New Suction Apparatus for the Preparation of Small-size Porous Plate Clay Specimens for X-ray Diffraction, 1986
TP 12 Problem Soils: Their Reclamation and Management (copied from ILRI Publication 27, 1980, p. 43-72), 1986
TP 13 Proceedings of an International Workshop on the Laboratory Methods and Data Exchange Programme: 25-29 August 1986, Wageningen, the Netherlands, 1987
TP 14 Guidelines for the Description and Coding of Soil Data, 1988. Revised ed. in prep.
TP 15 ISRIC Soil Information System - User and Technical Manuals, with Computer Programme, 1988. Revised ed. in prep.
TP 16 Comparative Classification of some Deep, Well-Drained Red Clay Soils of Mozambique, 1987
TP 17 Soil Horizon Designation and Classification, 1988
TP 18 Historical Highlights of Soil Survey and Soil Classification with Emphasis on the United States, 1899-1970, 1988
TP 19 Soil Horizon Designations, 1990
TP 20 FAO-Unesco Soil Map of the World. Revised Legend, field edition, 1989
TP 21 Technical Report on Agroclimatic Characterization of Madagascar, 1990
TP 22 Methodological Guidelines for Forecasting the Geochemical Susceptibility of Soils to Technogenic Pollution, 1991
TP 23 A Review of Soil Factors and Processes that Control Fluxes of Heat, Moisture and Greenhouse Gases, 1992
TP 24 SOILIMS Manual and Tutor, Version 1.2. Laboratory Information Management System, 1994 (with demo diskette or full version)
TP 25 SOLGRAPH: Soil and climatic diagrams and tabular single soil parameter assessments (includes diskette), 1994
TP 26 World Inventory of Soil Emission Potentials. WISE 2.1. Profile database user manual and coding protocols, 1994
TP 27 A Global Data Set of Soil pH Properties, 1995

Soil Monographs

SM 1 Podzols and Podzolization in Temperate Regions, 1982
with wall chart: Podzols and related soils, 1983
SM 2 Clay Mineralogy and Chemistry of Soils Formed in Volcanic Material in Diverse Climatic Regions, 1989
SM 3 Ferralsols and Similar Soils; Characteristics, Classification and Limitations for Land Use, in prep.

Wall charts

- Podzols and Related Soils, 67 x 97 cm, 1983 (see Soil Monograph 1)
- Soils of the World, 85 x 135 cm, 1987 (Elsevier Publ. Company, in cooperation with ISRIC, FAO and Unesco)

INTERNATIONAL SOIL REFERENCE AND INFORMATION CENTRE

Internationaal Centrum voor Bodem-referentie en -informatie
Internationales Bodenreferenz und Informations-Zentrum
Centre International de Référence et d'Information Pédologique
Centro Internacional de Referencia e Información en Suelos

GENERAL AIM

The collection and dissemination of scientific knowledge about soils for the purpose of a better understanding of their formation, characterization, classification, distribution, and capability for sustained land use at local, national, and global scales.

SPECIFIC AIMS

* To serve as a centre for documentation about the soils of the world as a natural resource. To assemble soil monoliths, reports, maps and other information with emphasis on soils of the developing countries.
* To contribute to an increased understanding about soils enabling their sustained utilization in a changing global environment.
* To improve the accessibility of soil and terrain information for the widest possible range of users through applied research, improvement of research methods, and advice on the establishment of soil laboratories, soil reference collections and databases.
* To contribute to developments in soil classification, soil mapping and land evaluation and in the development of geographically referenced soils and terrain digital databases.

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