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World Soils and Terrain Digital Database

(SOTER)

Past, Present, and Future

L.R. Oldeman

Discussion note, prepared for the
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"Past, Present, and Future"[1]

by

L.R. Oldeman[2]

1 BACKGROUND

1.1 Period 1984-1990

Exactly ten years ago, Dr. W.G. Sombroek prepared a discussion paper under the title "Towards a Global Soil Resources Inventory at scale 1:1 Million" (ISRIC, 1984). Based on the substantial interest arising from this paper, a provisional Working Group on Digital Mapping of Global Soil Resources was established within the ISSS under the aegis of Commission V. The recommendations of the first workshop (January, 1986) on "The Structure of a Digital International Soil Resources Map annex Database" resulted in the preparation of a Project Proposal: World Soil and Terrain Digital Database at a scale 1:1 Million, acronymed SOTER, which was formally endorsed by the provisional Working Group during the XIII International Congress of Soil Science in Hamburg (1986).

In 1987, the United Nations Environment Programme (UNEP) convened an ad-hoc expert meeting in Nairobi to discuss the application of SOTER for preparing soil degradation assessment maps. One working group was charged to develop Guidelines for a World Soils and Terrain Digital Database at a 1:1 M scale. Later that year, UNEP formulated a project document: "Global Assessment of Soil Degradation" and asked ISRIC to coordinate activities to 1) compile a World Map on the Status of Human-induced Soil Degradation; 2) develop a procedures manual for SOTER and to test the methodology in a pilot area in South America, covering portions of Argentina, Brazil, and Uruguay.

The first draft of a Procedures Manual for small-scale map and database compilation was prepared under a subcontract by the Land Resource Research Centre of Agriculture Canada and discussed at the First Regional SOTER workshop in Montevideo (March, 1988). Subsequently, correlation teams in Argentina, Brazil and Uruguay implemented activities for the preparation of a SOTER database, with technical backstopping from ISRIC.

Based on the experience gained in this pilot area, in another pilot area covering portions of Canada and the U.S.A., and in a separate study in central Brazil, the procedures manual was modified. Results of the studies in the pilot areas were presented at the XIV International Congress of Soil Science in Kyoto (1990) where the Working Group on Soil and Terrain Databases endorsed the SOTER activities. ISRIC was asked to continue its coordinating role in the execution of SOTER.

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[1]Discussion note, prepared for the Working Group DM on "World Soils and Terrain Digital Database".

[2]International Soil Reference and Information Centre (ISRIC), Wageningen, the Netherlands.

1.2 Period 1990-1994

1.2.1 Evaluation of SOTER

During these four years, the SOTER methodology was further refined. In 1992, UNEP convened another ad-hoc expert meeting to discuss Global Soil Databases and Appraisal of GLASOD/SOTER. At this meeting, the following operational approach for SOTER was recommended:

Phase I: "SOTER shell" — to provide and to guarantee a standardized, uniform database and map for a whole continent (e.g. South America) with the input of readily available soil and terrain data. This initial task would be done by 1-2 regional correlators within about two years.

Phase II: The initial SOTER shell would be supplemented and completed with the cooperation of national soil agencies; the SOTER project would provide the necessary technical assistance (SOTER manual, uniform guidelines, training, the experience of the pilot areas, etc.) for the national participants thus ensuring the necessary homogeneity of the prepared SOTER mosaics.

The expert meeting also proposed a role of SOTER in the improvement and updating of the FAO-Unesco Soil Map of the World (SMW). After testing the value and applicability of the SOTER map for such an improvement and updating on the basis of the existing 3 pilot areas, it might then be desirable to update the SMW for the whole of South America, upon compilation of the SOTER map and attribute database.

The group also recommended a final revision of the SOTER manual and to publish this as a joint effort of ISRIC, ISSS, FAO, and UNEP. With respect to the international coordination of SOTER activities, the group proposed to establish a SOTER coordination entity for managing various global, regional and national projects. In the initial phase of the SOTER project, ISRIC has provided the coordination and management functions. For future operational SOTER expansion careful attention must be given to the required institutional structure. It was recommended, provided financial support would be forthcoming in the near future, that ISRIC continue providing the coordination of SOTER activities until adequate funding could be obtained for the operational phase of the SOTER project. It was also recommended that a technical advisory committee be constituted to provide a broad base of expertise to SOTER development.

1.2.2 Achievements during 1990-1994

1. SOTER Procedures Manual. In a joint effort between FAO and ISRIC, the SOTER manual was refined and published under the title: "Global and National Soils and Terrain Digital Databases (SOTER), Procedures Manual". In March 1993 the manual was released as a joint UNEP, ISSS, ISRIC, FAO publication in English. A Spanish version was released in November 1993. The SOTER manual is also published by FAO as World Soil Resources Report 74.
2. A bilingual attribute data input model (running under dBase 4) was developed.
3. A SOTER/GIS training manual was prepared and two training courses were conducted in South America (Montevideo, March 1992; Buenos Aires, April 1994).
4. A UNEP project was implemented in September 1993 for the preparation of a SOTER database for Uruguay and for 460,000 Km^2 of Argentina at scale 1:1 Million with a few windows at scale 1:200,000 and 1:100,000.
5. A UNEP project was implemented in Kenya in March 1993 for the preparation of a SOTER database of Kenya at scale 1:1 Million.

5. A UNEP project was implemented in Hungary in December 1993 for the preparation of a SOTER database in Hungary at scale 1:500,000.
6. A UNEP, FAO, ISRIC initiative for the preparation of a continental SOTER database was implemented in October 1993. The first phase of this project includes 6 Latin American countries (Argentina, Brazil-30% initially, Cuba, Mexico, Uruguay, and Venezuela).
7. To demonstrate the usefulness of SOTER, application programmes were initiated related to land degradation (i.c. water erosion hazard assessment), and qualitative land evaluation.

The achievements to-date are demonstrated at the XV World Congress of Soil Science in the UNEP/ISRIC/FAO booths.

2 INTERNATIONAL RECOGNITION

The ad-hoc expert meeting (Nairobi, 1992) recommended to promote the SOTER concept through presentation in international fora. Throughout its ten year history, the SOTER programme has been promoted. An excerpt of international comments is given:

IFDC, 1989. "A global soils and terrain digital soils database is a very desirable goal and I believe the database would be of considerable value to many of our fertilizer related projects." (Donald L. McCune, Managing Director).

FAO, 1990. "I am pleased to advise — to whoever it may concern — of FAO's strong endorsement of the concept and methodology so far developed for the World Soils and Terrain Digital Database at 1:1 Million scale (SOTER). Only through the application of such techniques can we catalyze the required breakthroughs in land resources use which are essential to halt and reverse current degradation in developing countries." (G.M. Higgins, Director, Land and Water Development Division).

ISNAR, 1990. "According to me, SOTER is a service which the donor community should provide to most developing countries. SOTER will develop the tools, useful first and foremost by the national research systems, but also by the donors and others. You find in me a supporter of your approach and work." (C. Bonte-Friedheim, Director-General).

UNEP, 1991. The Governing Council (Nairobi, 20-31 May 1991) noted that "UNEP's Global Assessment of Soil Degradation (GLASOD), the preparation of a World Atlas on Desertification, and the Soils and Terrain Digital Database were capable of providing essential ingredients for the formulation of national soil policies." (UNEP, Regional Bulletin for Europe, no. 9, 1991).

World Resources Institute, 1992. The SOTER activity of UNEP and ISRIC plans to use properly structural ground assessments to create a baseline georeferenced database on soil, soil degradation, and terrain over the next 10-15 years if funds become available. These data would be invaluable to local and national planners and to those seeking to set priorities for global action and environmental assistance. "The World Resources Institute supports your plans to create a World Soils and Terrain Database System, to develop national information on soil degradation and its socio-economic consequences." (Gus Speth, President WRI, 1992).

The expert consultation of the Asian Network of Problem Soils (1993). This group recommended: "to establish national SOTER databases at a scale of 1:1 Million or larger, to prepare a regional soil degradation database at a scale of 1:5 Million, leading to the eventual establishment of a regional SOTER database. International funding support would facilitate the speedy completion of these activities, particularly with regard to the establishment of national SOTER databases." (Bangkok, October 1993).

IGBP-DIS Global Soils Data Task Group, 1994. "IGBP-DIS should support a global 1:5 Million SOTER exercise as a long-term objective actions: IGBP-DIS to notify ISSS of their interest in a global 1:5 Million SOTER, IGBP-DIS should conduct a feasibility study, before June 1995, of assembling a funding consortium to pay for a global SOTER." (Minutes meeting in Washington, April, 1994).

At national level, ISRIC has received requests for the implementation of SOTER from countries all over the world. Most recently, participants of a workshop: "SOTER in Latin America" (Buenos Aires, April 1994), coming from Argentina, Brazil, Colombia, Chile, Cuba, Ecuador, Mexico, Paraguay, Peru, and Uruguay, indicated that "the organisation of information on natural resources in digital databases is a fundamental support for the definition of development policies and of sustainable economic growth. The use of the SOTER methodology 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".

3 THE NEED FOR BASELINE INFORMATION ON NATURAL RESOURCES

International and national agricultural research and policy making entities concerned with environmental management and environmental changes have repeatedly expressed the need for baseline information on natural resources.

3.1 The Consultative Group on International Agricultural Research

At the 1993 Mid-Term Centers Meeting, a task force was appointed to formulate an action plan to follow-up on UNCED quoting chapter 14.29 of Agenda 21: "International institutions, such as FAO and IFAD, international agricultural research centres, such as CGIAR, and regional centres should diagnose the world's major agro-ecosystems, their extension, ecological and socio-economic characteristics, their susceptibility to deterioration and their production potential. This could form the basis for technology development and exchange of regional research collaboration". The paper, developed by this task force, suggests among others:

- "that the CGIAR should respond forcefully to Agenda 21, which calls for more environmental concern in research, by launching a Global Marginal Soils Initiative";
- "that the CGIAR joins with UNEP/GRID to provide an initiative on geographical information system (GIS) and minimal global data sets for agro-ecological research".

The International Agricultural Research Centres (IARCs) have a growing need for data relating to the physical, biological and social environments of their research domains. Environmental databases, coupled computer-based geographical information system offer useful tools for this. Although they have been successfully employed by some IARCs, the construction and maintenance of high-quality databases, the need to achieve data consistency, and the desire to communicate through standard interfaces to institutions outside the CG system are major tasks. Members of the CG Task Force are: Drs. Stein W. Bie (Chair), Jain C. MacGillivray, Pedro A. Sanchez, Hubert Zandstra, and Carlos Zulberti. The SOTER approach could serve the needs, at least for soils and terrain information, expressed by these initiatives.

3.2 International Geosphere-Biosphere Programme (IGBP)

The Global Change and Terrestrial Eco-systems programme of IGBP has as major objective (IGBP, Report 21):

1. To predict the effects of changes in climate, atmospheric composition and land use on terrestrial ecosystems, including agricultural and production forest systems.
2. To determine how these effects lead to feedbacks to the atmosphere and the physical climate system.

Activity 3.3. related to Effects of Global Change on Soils (Leader: Dr. P.B. Tinker) states: "Changes in climate and atmospheric composition will impact on the world's soils, and changes in land use have already had, and continue to have, substantial impacts, notably in the tropics. GCTE will continue to strengthen collaborative links with research programmes investigating alternations in soil biological processes, soil degradation processes, greenhouse gas emissions from agricultural soils. In order to extend the results of soils research at specific sites or networks through global interpretation and modelling, better geo-referenced soil databases are needed. Such databases should include information not only on soils but also on terrain and land use. The Data Information Systems activity of IGBP (IGBP-DIS) is working with other international and national agencies to develop a global soils database as a matter of high priority".

The Global Soils Data Task group of IGBP-DIS has endorsed the global 1:5 Million SOTER initiative. As an intermediate step international database holders (FAO, SCS, ISRIC and possibly CIRAD) are presently developing a world pedon database linked to the FAO-Unesco Soil Map of the World.

3.3 Other Global Programmes

The World Resources Institute and the California Institute of Technology initiated a series of workshops on "Global Environmental Monitoring: Pathways to Responsible Planetary Management". In the preamble for this proposal, they state that "in order to manage our planet's environment rationally, we must understand Earth system processes, obtain a measure of the baseline conditions of Earth resources, and monitor and report on changes in Earth resources and environmental quality. While research in Earth processes is well funded, efforts to collect baseline data on the conditions of Earth resources and efforts to monitor, analyze and report on changes in those conditions are few and poorly funded". While they recognize the SOTER initiative invaluable to those seeking to set priorities for global action and environmental assistance, they indicate that there is no global institution envisioned that would then monitor soil changes subsequent to SOTER.

In this respect UNEP's programme Earthwatch/Global Environmental Monitoring Systems (GEMS) should be mentioned. In December 1993, a first meeting of the ad-hoc Scientific and Technical Planning Group for a Global Terrestrial Observation System (GTOS) was organised, an initiative co-sponsored by FAO, WMO, Unesco, UNEP, and ICSU. Within GTOS a working group was formulated on Data Management, Access and Harmonization, chaired by Dr. Marion Baumgardner. There are obvious links between this working group and SOTER.

3.4 National Soil Resources Institutions

There is a wealth of information on soil and terrain resources generated by national soil survey institutions which is stored and compiled in different forms: maps, tabular data, descriptive reports. Each new soil survey report published in a country is more advanced, more complex and technically more difficult. This information is therefore often not readily available, or not in a format readily accessible for interpretation by users, who are often not technically trained in soils. During the recent International Workshop for Heads of National Soil Survey Institutions on the topic: Soil Survey: perspectives and strategies for the 21st century" (ITC, November 1992), it was recognized that soil survey remains a vital activity for gathering data and generating interpreted information on the use, management and conservation of the soil resources. "There are still ample needs in developing countries to justify the continuation of systematic, multi purpose-oriented surveys. However, traditional demand sources are changing their request to more purpose-specific soil information that can be integrated into large projects for sustainable development or environmental management. Soil survey organisations therefore must undergo a modernization process, supported by the implementation of new soil concepts, the use of advanced survey techniques and information technologies." (A. Zinck, 1993).

There is an increasingly felt demand, which will become more and more pressing, for soils information at national, district and farm level. This needs to be coupled with a computerised geographically referenced system to store, organise and access the data. A long-term initiative was formulated recently by the Land and Water Development Division of FAO to develop a programme to introduce the use of database methods and procedures to more and more countries, through visits and training courses, together with a programme in each country to establish an on-going soil mapping programme to provide for present and future needs in that country.

Soil survey methods and techniques are well known, and training courses are widely available. The basic tool for the computerized storage and analysis of soil survey information is also available. The FAO/ISRIC Soil Database (SDB) is designed to store relevant information on site conditions, soil horizon, descriptions and laboratory analysis. This information can now be transferred (still to be tested) to the UNEP/FAO/ISSS/ISRIC SOTER database, which produces a standardized soil and terrain database containing digitized map unit boundaries in a GIS and their attribute database in a database management system.

It is proposed to establish a low key, low cost programme of long duration with the emphasis on provision of the minimum of technical and financial assistance, using local regional or local technical inputs whenever possible, which would permit creation by the countries themselves of a sustainable national soil mapping programme and soil condition monitoring programme, using appropriate information technology, at the rate appropriate to their own aspirations, resources and conditions.

4 A SOTER STRATEGY FOR THE FUTURE

It is proposed to develop SOTER programmes at two levels of detail. In order to satisfy the demand for a global coverage within a reasonable time frame, we suggest to develop a SOTER database at continental scale (1:5 Million). The SOTER manual has already been adapted and the Latin American SOTER project is in an advanced stage. The first step is to outline a draft physiographic map of the continents, using SOTER terminology. These map units can serve as basic SOTER units. Physiographic maps have been prepared under a contract with FAO for Latin America, Africa, and most recently, for Asia and for the former Soviet Union. The next step is the preparation of a SOTER database with a limited set of attributes. Results for six countries in Latin America are shown in the SOTER corner of the FAO booth during the Congress. This work was done by the national soil survey organisations under a subcontract between FAO and ISRIC and financed by UNEP. Some interpretative single value maps are also prepared. The total budget for a complete coverage of the Latin American continent in SOTER 1:5 M is around US$ 200,000, of which US$ 72,000 is provided at this moment. We expect that similar amounts would be needed for Africa and for Asia. Considerably less is needed for the continents of Europe, North America and Australia, provided countries are willing to carry out these activities on a voluntary basis.

Simultaneously with the continental SOTER, we should continue our efforts to implement SOTER activities at national level at scales of 1:1 Million or at higher resolution if desired. We are presently negotiating SOTER pilot activities in China and Indonesia with financial inputs from the Asian Development Bank. UNEP, which programme has so far been highly instrumental in formulating SOTER projects in Argentina, Uruguay, Kenya, and Hungary, has approved another national SOTER initiative for Syria and Jordan. However, it should be realized that UNEP cannot continue to fund national SOTER projects. The projects so far implemented with UNEP funds should be seen in the light of its catalytic role. Efforts to obtain funding for developing SOTER activities in West Africa from the European Union has so far been futile.

Our strategy at present is to implement a national SOTER programme at 1:1 M in one key developing country of medium size: normally a two-year project which requires around US$ 250,000. The results including the preparation of some interpretative thematic maps and complementary statistics will then be demonstrated at a regional workshop, inviting representatives from neighbouring countries. They should then, if interested in implementing SOTER, look for bilateral donors.

In order to convince potential donors of the need for natural resource databases, SOTER needs an international consortium of representatives of organisations that have indicated their interest. I have indicated the kind of international users that might be approached. Together, they may have sufficient power to convince international and bilateral donors to contribute to SOTER, both at continental and at national level.

Finally, the SOTER working group should indicate which organisation should be assigned to play the management and coordinating function of SOTER in the future. ISRIC is certainly prepared to keep that role, provided that funding does not dry up.

Suggested Time frame and estimated Budget
SOTER 1994-1998

	Region/Country	Period	Donor (if known)	Budget		Total
				Provided or Approved	(additional) needs	
I	**Continental SOTER 1:5 M**					
	1. Latin America	Oct 93 - Jun 95	UNEP + FAO	70	130	200
	2. Asia + CIS	Oct 94 - Jun 96	UNEP + ADB + FAO	115	350	465
	3. Africa	Sep 95 - Dec 97			500	500
	4. C. + E. Europe	Oct 94 - Oct 96	Neth. (EZ)	250		250
	5. N. America	Sep 95 - Sep 96			25	25
	6. W. Europe	Sep 95 - Sep 96			25	25
	7. Oceania	Sep 95 - Sep 96			25	25
	8. Coordination, Reporting	Oct 94 - Jun 98			100	100
			Total	435	1155	1590
II	**National SOTER 1:1 M**					
	1. Kenya	Jan 93 - Feb 95	UNEP	185		185
	2. Uruguay + Argentina	Sep 93 - Jun 95	UNEP	234		234
	3. Syria + Jordan	Nov 94 - Nov 96	UNEP	220		220
	4. Hungary	Dec 93 - Dec 94	UNEP	190		190
	5. SE. China	Mar 95 - Mar 97	ADB (?)		280	280
	6. S. Sumatra (Indonesia)	Mar 95 - Mar 96	ADB (?)		150	150
	7. Burkina Faso, Zimbabwe	1995 - 1998	?		500	500
	8. India, Philippines	1995 - 1998	?		500	500
	9. Peru, Mexico, Cuba	1995 - 1998	?		600	600
	10. Russia	1995 - 1998	?		350	350
			Total	830	2380	3210