ANNUAL REPORT 1982

International Soil Museum - Wageningen - The Netherlands

ISM 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.

Most of the ISM working funds are provided by the Dutch Ministry for Education and Sciences, and are accountable to the Directorate of Technical Assistance (DTH) of the Ministry of Foreign Affaires.

The constituing members of the Board of ISM are the International Institute for Aerial Survey and Earth Sciences (ITC) in Enschede, the Agricultural University of Wageningen (LH) and the Dutch Directorate of Agricultural Research (DLO).

Advise on the programmes and activities of ISM is given by an Unesco-FAO appointed International Advisory Panel (IAP) and by a Netherlands Advisory Council (NAC).

The financial-administrative responsibility for the working funds and for the permanent staff of ISM rests formally with the Board of Governors of the ITC.

CIP-GEGEVENS

Annual

Annual report / International Soil Museum. - 1979 - ...... -
Wageningen: International Soil Museum
Verschijnt 1x per jaar
Report 1982
ISBN 90-6672-013-1
SISO 563 UDC 55(060.55)
Trefw.: bodemkunde ; jaarboeken.

ANNUAL REPORT 1982

ISM

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1 INSTITUTIONAL DEVELOPMENTS

The report of the international Evaluation Mission of December 1981 (see previous Annual Report) provided a basis for many discussions and consultations on the future status and functions of ISM. The Mission, composed by Dr. F. di Castri and Dr. F. Fournier of Unesco and Dr. R. Dudal of FAO was requested by the Netherlands Government to make recommendations on the aims and scope of the future work of the ISM, its organisational structure, the personnel required, type of management, buildings and other material facilities. In addition an indication should be given of the relevance of the ISM's activities for developing countries in both qualitative and quantitative terms, which can be used as a point of departure for a decision by the Netherlands Government, in consultation with the appropriate international organisations, on the further financing and management of the ISM.

Upon reviewing ISM's activities the Mission stressed the representative value for the world's soils of the ISM monolith collection. It noted however the existence of geographic, taxonomic and thematic gaps, and called for a programme of action to fill them. Closely linked with the soil collection are the research activities on soil classification and correlation; the standardization of analytical methods; and the collection of small-scale soil maps, the latter especially in relation with the updating of the Soil Map of the World. The Mission voiced its concern that too little attention was paid to the practical application of the information gathered, like interpretation of soil data in terms of potential utilisation and production. The Mission approved ISM's programme for visiting scientists, training, documentation and publications. It also concluded that a major drawback for ISM to perform its basic tasks and function is formed by personnel and space problems. Consequently, the Mission identified five posts as the most urgent personnel needs, as follows: soil classification and correlation specialist; land evaluation and agricultural applications specialist; specialist for outreach programmes; laboratory technician; documentalist/librarian. Also, the Mission recommended to create 250 sq.m. additional floor space for offices, library and storage of soil profiles. On the matter of institutional arrangements, the Mission saw a need for establishing a clear line of authority on programming functions; for simplifying administrative procedures; and for having only one governing board, including representatives of Dutch institutions and of international sponsors, in order to ensure the integration of advice from the various parties.

The Mission recommended that the Netherlands authorities pursue their endeavour to clarify institutional arrangements of the ISM. Finally, the Mission fully recognized the relevance of ISM's activities for development purposes in Third World countries through its activities in the field of research and documentation, and its outreach programme of supporting the establishment of national soil reference collections in these countries. In this respect, the Mission pointed out that the name "International Soil Museum" might not adequately reflect its present involvement in development work, and that a change of name could be considered.

The Dutch Government, as main sponsor of ISM, indicated that it could not act upon the recommendation for more staff and more working space. In this situation, ISM's (provisional) Board of Management gave written comments on the Evalution report, eleborating on some points, summarizing others, indicating priorities and alternative lines of action. For this purpose, the Board made a distinction between four basic functions of ISM: *reference function, education and training function; documentation function; and backstopping function.* In the case of no additional funding, the Board proposed to use the core funding mainly for the two latter functions and to try to find project funding for the two former functions.

In view of the above functions, the Board suggested that an appropriate name for ISM would be "International Soil (Reference and Information) Centre", subject to approval by ISM's original founders Unesco and the International Society of Soil Science (ISSS).

Given the non-increase in Dutch resources for ISM, the Board and the Director actively explored possibilities for international funding and cooperation, both on project and programme basis. The ad-hoc financial support of Unesco for the annual training course at ISM may serve as example of project support. Contacts with the United Nations Envrionment Programme (UNEP) in Nairobi now resulted in a formal request for a four-year support at making the soil reference collection more representative geographically and soil-classification wise. This project has been accepted and incorporated in UNEP's World Soils Policy Plan-of-Action, for which funds may become available in 1984/1985.

Commitments for financial support to ISM tend to materialize more slowly than requests by international organisations for cooperation, of one kind or another. One such a request was addressed to ISM at the Second International Seminar on Laterite Research, Sao Paulo, Brazil in July 1982, asking to establish a reference collection of laterite weathering profiles at ISM, in analogy of the reference collection of soil materials.

2 REVIEWS AND ARTICLES

2.1 THE MERITS OF SMALL-SCALE MAPPING OF SOIL RESOURCES

W.G. Sombroek

Abstract

Past and present small-scale mapping of world soil resources is reviewed and the uses and limitations of this mapping are discussed. A plea is made to update the present 1:5 million Soil Map of the World, to harness the wealth of soil information becoming available at country and regional level. In future, a worldwide 1:1 million soil map could be produced, making ample use of computer facilities.

Introduction

The term "small-scale soil map" sometimes gives rise to confusion. Uncartographical scientists and planners, and the general public often associate it with detailed soil cartographic information at county or village level, that can be used directly for local development.

In fact, small-scale in relation to mapping refers to the smallness of the quotient of distances plotted onto the map and the real ones. A map of 1:10 000 (1 km in the field represented by 10 cm on the map) is therefore a large-scale map, and a map of 1:1 000 000 (one to one million map; 1 km in the field represented by only 1 mm on the map) is a small-scale map. A 1:1 million map covers 25 times the area of a 1:5 million map. In other words, *small-scale maps give little detail, but can accommodate large areas on one sheet.* They often encompass entire states, countries, or subcontinents (e.g. maps in world atlases).

In soil science, small-scale maps are known as generalized, exploratory or reconnaissance soil maps (often with scale increasing in that order), whereas large-scale maps are known as semi-detailed or detailed soil maps.

History

Very small-scale global or continental soil maps at scales of 1:100 million to 1:25 million or so were already being produced many decades ago. Such maps were mainly intended to reveal the climatic and genetic basis of broad soil patterns and were of limited value for the assessment of agricultural production potential. Furthermore, the field information (ground truth) available for many of the regions, especially the tropics and subtropics, was very scanty. Such maps are now mainly of antiquarian value.

After World War II, when the need for international co-operation in the field of agricultural research and development became urgent, efforts were made to instigate soil mapping per continent, at scales of 1:10 million to 1:5 million. One very laudable early example was the co-operative programme of African countries and/or their European associates, to combine French, English, Belgian and Portuguese data and approaches to soil mapping into one soil map for the whole continent, at a scale of 1:5 million. This programme was undertaken during the 1950s under the aegis of the

Commission for Technical Co-operation in Africa (CCTA), by a group of experts forming the Interafrican Soils Service. The resulting map and an explanatory note were published in 1964, in both French and English (D'Hoore, 1964). In the same period, a Bureau Interafricain des Sols/Interafrican Bureau of Soils (BIS) was established. This Centre, functioning first in Paris and later in Bangui, Central African Republic, is responsible for the central storage of the data collected, and also issues its own technical periodical, entitled "African Soils, Sols Africains". The inception of the BIS and the publication of the CCTA soil map of Africa meant that for the first time, African soil scientists had a common soil-technical vocabulary. Because the CCTA map legend had been systematically linked with major landforms, geological/lithological units and climatic regimes, the map could easily be used (e.g. by agronomists, development planners). Furthermore, several African countries (e.g. Nigeria) subsequently used the terminology of the CCTA map as a starting point for the national soil classification.

Undoubtedly stimulated by this experience and at the prompting of the International Society of Soil Science (ISSS), two specialized United Nations agencies, viz. FAO and Unesco, decided to instigate worldwide soil mapping at the same 1:5 million scale. In 1960, a World Soil Resources Office was set up for that purpose within the Land and Water Development Division of FAO. A small permanent staff of experienced soil survey specialists was established, headed by Dr. D. Luis Bramao and subsequently by Dr. R. Dual, who made contacts with their counterpart specialists at country level. The Rome office was assisted by young Dutch and Belgian soil science graduates, through the associate experts scheme of FAO and Unesco. Many regional meetings and roving field correlation tours were held. Through Advisory Panel meetings in Rome and elsewhere a legend terminology that was acceptable to all involved was gradually developed (cf. FAO's World Soil Resources Reports; Dudal, 1978). The soil groupings or units that emerged reflect genetic and geographic aspects as well as observable and measurable characteristics important for soil management. The mapping units show the associations or complexes of these soil groupings or units, the predominant soil textures, and the slope class of the mapping unit.

The first colour printed sheets of this FAO-Unesco Soil Map of the World project covered Latin America, and were published in 1970. The last sheet, covering Europe, was published in 1978. The maps are accompanied by substantive explanatory reports, giving details on: climate, vegetation, geomorphology and lithology; the distribution of the main soils; and their suitability for agricultural use. The appendices contain field and laboratory data on selected soil profiles (FAO-Unesco, 1970-81). All the sheets and the legend were published in English, French, Spanish and Russian. The reports were published in English and the three other languages wherever applicable.

As soon as they appeared, the maps and reports were put to use. The legend terminology served as a basis for communication in soil-related research. A number of countries decided to adopt it as a starting point for their own national soil classification systems (e.g. Mexico, Kenya, Indonesia). The maps provided the soil data base for a subsequent FAO programme: the global appraisal of crop production potential by agro-ecological zones (FAO, 1978-81). This, in turn served as natural resource base for a continentwise assessment of the capacity to support populations in the future, a co-operative programme between FAO and the United Nations Fund for Population Activities (FAO/UNFPA, 1980 et seq.). The FAO/Unesco map has also been used to assess the hazards of degradation and desertification in Northern Africa and the Near East (FAO-UNEP-Unesco, 1980).

In general, the soil map and the maps of agro-ecological zones serve as a geographical reference base for the transfer of agrotechnological experience from one country to another, and from one continent to another. Even those development agencies that use nationally developed soil classification systems such as the USDA "Soil Taxonomy" as the starting point to identify soil-related constraints to food production often refer to the FAO-Unesco Map legend to ascertain the geographical distribution and acreage of certain soil units, because it is as yet the only document of its kind.

The current situation

The preparation and publication of the FAO-Unesco world soil map at scale 1:5 million has given strong impetus to the quantitative characterization and mapping of soils in many countries. Moreover, new mapping tools such as aerial photographs, airborne radar pictures and satellite imagery have become available and this is speeding up actual mapping enormously. A wealth of new information has now become available, demonstrating that for many regions the soils pattern is substantially different from that recorded on the world map sheets. This applies, for instance, to the whole Amazon region and many parts of Africa, and also to several European and Asian countries (e.g. China). This discrepancy is particularly serious for Latin America and Africa, where no (new) field data have been incorporated since 1967 and 1970, respectively. Furthermore, it has been discovered that some definitions of soil units leave much to be desired (for instance the one on Nitosols, cf. Sombroek and Siderius, 1981).

It was soon realized that if the FAO/Unesco soil map was to continue as a useful reference base for worldwide soil geography it would have to be regularly updated. In 1978, FAO and ISM therefore agreed to keep the map up to date by incorporating new material and any necessary corrections and amendments on the various sheets (beginning with Latin America). This does not entail new printing, but involves adding new data to master copies of the sheets, so that blueprints of corrected areas can be made available to potential users upon request. Appeals were sent out to national soil survey organizations and individual soil scientists to send new map data and proposals for improvements, either to FAO or ISM. Unfortunately, a shortage of staff and working funds at both organizations have so far prevented this programme being effectively implemented. Therefore, a reiteration of the case for an effective updating programme might not be amiss:

a) Transfer of agro-technological experience

For the transfer of experience in the use and management of land between areas with analogous environmental conditions, reliable soil and agroclimatic information must be available. At present, soil data relevant to agriculture are not being used optimally, partly because the characterization and classification of soils are inadequate and partly because our knowledge about the global geographical distribution of soils is incomplete.

Improving the legend of the Soil Map of the World would be one step towards optimalizing soil use. A world soil map updated on the basis of a revised classification system would represent the geographical pattern more accurately than the present Soil Map of the World. Furthermore, there is an urgent need to combine agro-climatic information with the revised soil units, so that the suitability and production potential of these units for the production of major crops can be rated. These ratings should be regarded as essential basic information for optimal land use planning.

Some of the farming systems research done by the Consultative Group of International Agricultural Research (CGIAR) centres and co-operating institutes is aimed at alleviating specific soil constraints or developing soil management methods for specific ecological conditions. It is very important to know which areas the CGIAR research sites are representative of. Soil correlation studies and associated delineation of soil mapping units, even on a small scale, will enable sensible links to be made between research sites and farming practice and should prevent research being done on non-representative sites.

b) Ensuring ecologically sound development.

Updating will benefit the data banks that contain base-line information for assessing the ecological impact of development projects in the tropics and subtropics. Such assessment may involve:

- quantifying the present rate and the risk of land degradation (desertification) in semi-arid environments. Current efforts of doing this are largely based on incomplete, incorrect or inadequate field information. An example is the absence of reliable geographic information on those characteristics of topsoils that determine rates of degradation, e.g. absence or presence of surface sealing, and amount of organic matter. More precise information will improve the chances of success of measures to control desertification (reafforestation or afforestation; adapted range management; flood control when road building; water harvesting schemes, etc.);
- quantifying the hazard of extensive soil degradation (lateritization, white-sand formation, erosion and sedimentation), resulting from the destruction of tropical lowland forests. An example is the misguided publicity given to forest destruction in the Amazon region and Indonesia. This publicity is based on preconceived notions about the inherent fertility of the soils concerned, which are popularly believed to lose all potential for agriculture or reforestation within several years of deforestation, because of irreversible hardening or leaching. On the basis of recent data, however, the Amazon region alone can be subdivided into 5 or 6 major soil/ecological subregions that react very differently to forest-felling. These regions are not shown on the existing FAO-Unesco map sheet, because at the time of its compilation they were not known.

If national or international agencies had access to updated baseline information on tropical lowland forest soils, their current or proposed research on tropical forest ecosystems would be more likely to be successful;

- quantifying the hazard of soil salinization in alluvial areas resulting from the implementation of irrigation projects. The soils concerned differ greatly in their water-holding and transmission properties (independence of textures, hardpans, depth of water table, original salt and sodium content, etc.), and a preliminary estimate of the long term effects of irrigation and drainage on these soils can be derived from updated soil maps.

- quantifying the risk of extensive soil erosion in mountainous areas. Mountainous areas can have very different soils, with different susceptibility to gully erosion. The currently available soil maps of these areas are often too generalized to allow the seriousness of the problem to be assessed with a meaningful degree of quantification.

c) Food strategy programme

During the last decade numerous computer-assisted studies have been undertaken to estimate the food production potential, and hence the population supporting capacity of land resources at national, continental or global scale (Dudal, 1982). The quality of soil data is probably the weakest part of the physical data base used in these studies. Improved knowledge on the soil-geographical pattern and the introduction of more precise definitions of the soil units would certainly increase the accuracy of the yield projections.

The future

A 1:5 million world soil map, especially one that is updated at regular intervals, is undoubtedly useful. Its small scale, however, precludes it from being used for quantitative planning of development at national or state/provincial level, be it for irrigation development, for increased fertilizer use, for soil conservation programmes, or for the formulation of local food strategies. For these purposes, a scale of 1:1 million would appear to be more appropriate. The value of soil mapping at such a scale has already been realized by many countries and regional development agencies, and is now often given priority. Examples are:

- The Soil Map of Europe, initiated by FAO's European Commission on Agriculture, and co-ordinated at the Soils Department of the Geological Institute in Ghent, Belgium. Originally intended to encompass all of Europe except USSR territory, the printing programme is now restricted to the EEC lands (and possibly some adjacent parts of other European countries). It uses the FAO/Unesco legend terminology, with some extra subdivisions.
- The Soil Map of the Arab Countries, initiated by the Arab Centre for Semiarid and Arid Lands Development (ACSAD) in Damascus and financed by the League of Arab Nations. This map makes ample use of satellite imagery and its legend is based on the USDA Soil Taxonomy terminology (Soil Survey Staff, 1975). The first sheet, comprising Syria and Lebanon, has just been published (ACSAD, 1982).

- The regional inventory of agricultural resource bases, including a soil map, of the countries co-operating in the Southern African Development Coordination Conference (SADCC, Harare-Zimbabwe). The precise methodology of this joint mapping of nine countries is still under discussion.
- Country-level 1:1 million soil mapping has recently been completed or is in progress in Brazil, India, Kenya, Mali, Thailand, Venezuela, and Zambia, to name but a few.
- Mention should also be made of the work of the USDA Soil Conservation Service's World Soil Geography Office at Lanham, Maryland. Throughout the period 1940-1975 it kept track of new soils information from around the world, though with varying intensity and geographic attention. This information was incorporated in a set of 1:1 million base maps, applying the older US soil classification system (Baldwin, Kellogg and Thorp, 1938), but was never prepared for publication.

The approaches and criteria involved in these 1:1 million mappings differ between countries and between regions. This may not be detrimental at regional or national level. Inter-country and inter-regional comparisons and the effective transfer of agro-technology are, however, again in danger of being thwarted. This has already prompted UNEP, FAO, Unesco and ISSS to take a new initiative to produce an International Reference Base for soil classification (IRB). But there may also be a case for concerted international efforts to produce a world soil resources map at scale 1:1 million, applying a uniform methodology. For instance, if its various Soil Management Networks in the tropics and subtropics are to be effective, the International Board of Soil Resources and Management (IBSRAM), which will probably be created during 1983, will have to rely on soil and agro-climatic information presented in a standardized way at this scale. The same applies to the country-level computations of potential population supporting capacities currently being done by FAO, in co-operation with UNDP, UNFPA or others. Furthermore, an effective worldwide monitoring of the state of soil resources, as envisaged under UNEP's Global Environmental Monitoring System (GEMS), cannot do without a soil map that is of sufficiently large scale to enable rates of soil degradation to be computed so that soil improvement recommendations can be drawn up and remedial action can be instigated promptly at country or state level.

It is now theoretically possible to produce a 1:1 million soil map. This not only because of the recent vast increase in data, but also because of the wealth of satellite imagery at scale 1:500 000, the range of facilities now available to process these data and the advances being made in the computerized storage of soil information.

It is virtually impossible to carry out a colour-printing programme for such a worldwide exercise. Even if the map sheets measured 90 cm by 120 cm, 230 sheets would be required for all of the world's landmasses at 1:1 million scale, of which 130 would be required for the Latin American, African and South Asian countries alone. Such an enormous print run is, however, unnecessary. Instead, one could develop a programme for digitizing base maps and storing the resultant data in computers, subsequently feeding in soil unit boundaries. Computer files of soil profile/pedon characteristics and small-scale mapping units will be a prerequisite. Once the data for a region have been fully processed in this way (or re-processed, in the case of updating), printouts can be made available either on request or by linking a terminal with the central computer. These print-outs can then be handcoloured by the customer, so that the patterns become clearer.

An international working group of specialists - for example, one formed from the ISSS Working Group on soil information systems, augmented by representatives of UN agencies and of Agricultural Research Centres of the CGIAR system - will have to be formed to sort out all the implications of computerized mapping of world soils at a scale of 1:1 million. In fact, the computerized land resource study of tropical America currently being done by the Centro Internacional de Agricultura Tropical (CIAT), located in Cali, Colombia is an example of this approach. The experience gained with that programme - and with FAO's current effort to put its 1:5 million map on computer files - may be put to good use in developing a worldwide programme of soil mapping at a scale of 1:1 million. The preparation of a digitized topographic base map - an enormous task in itself - may benefit from help from the International Cartographic Association, and in turn could help similar mapping of agro-climatology, climatology, vegetation/land use, geology, etc.

In addition to careful planning, a 1:1 million mapping of world soil resources using modern techniques of computerization and reproduction, will require a very substantial financing for hardware and sofware and specialist staff. Such a mapping programme cannot be achieved without the co-operation of all national, regional and world-wide cartographic institutions, which may be even harder to effectuate.

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2.2 EVALUATING LAND EVALUATION

C.A. van Diepen

Abstract

The term "land evaluation" became current in the 1960s, after it became clear that the conventional approaches of soil interpretation based on soil survey needed to be augmented by assessments of economic factors if viable land use alternatives were to be produced for land use planners. Soil survey interpretation had itself developed in the first half of this century in response to the demand for soil investigations to remedy land use failures and to prevent similar mistakes being made in the future. By recounting the procedure followed in this aspect of soil science, and its historical development therefore, it will become clear which inadequacies and problems have led land use planners to rely more on land evaluation rather than on traditional soil survey interpretation. The scene will then be set for an evaluation of land evaluation as prescribed by the Framework for Land Evaluation (FAO, 1976) by presenting a critical review of some of the principles, basic concepts and procedures propagated in the Framework.

Soil survey interpretation: its development and its procedures

During the first half of our century land use failures created a public awareness of the need for soil investigations to remedy disastrous situations and to guide future land use developments. A soil survey has become a prerequisite for the preparation of land development projects. The soil survey provides an inventory of the soil, using concepts of natural soil bodies that enable soil scientists to determine the place of a particular soil among all other known soils. Unfortunately these concepts have little meaning for non-soil scientists. This obliges the soil surveyor to explain the edaphic (soil related) constraints for each unit of the soil map and the resulting implications for land use and soil management, and possibly also to make yield predictions. The appraisal of soils for agricultural uses on the basis of soil inventories is called *soil survey interpretation,* or briefly, *soil interpretation.*

Interpretative methods were first applied in soil science 100 years ago in Russia by Dokuchaev, the father of modern soil science. Since that time, but especially during the last fifty years, numerous soil interpretation systems have evolved in different countries, the best known being the USDA-SCS Land Capability System (Klingebiel and Montgomery, 1961), the USBR Land Classification for Irrigated Agriculture (USBR, 1953), and the Storie-index rating (Storie, 1937), all developed in the United States of America, but also widely used as models for soil interpretation systems elsewhere. These systems differ in the number and kind of soil properties they take into account, and in the logic of the procedures followed to arrive at a suitability rating. A common feature of "comprehensive" soil interpretation systems is that the soil surveyor in his role of soil interpreter has to estimate to what degree a given soil can support a specific farming system. His starting point is the notion that the function of the soil in a farming system is twofold: the soil should be accommodating to the farmer and accommodating to the crop. The farmer requires the soil to be workable (e.g. not stony, not sticky) and accessible. The crop requires good conditions for its roots (e.g. moisture, nutrients, ample rooting space, suitable temperatures, no problems of toxicity, acidity or salinity). The soil interpreter/surveyor bases his judgment on soil characteristics - i.e. features that can be measured directly, such as stoniness, clay content, chemical composition - and on soil qualities - which are learned only by inference, e.g. fertility, productivity, erodibility. He distinguishes between soil qualities that affect management (ploughability, bearing capacity) and those that affect plant growth (availability of water and plant nutrients). Although this approach is inherent to any soil interpretation for agricultural purposes, it lasted until the 1950s that its concepts were explicitly formulated: the term ''soil quality'' was first used by Kellogg (Kellogg and Davol, 1949) and the distinction between soil qualities and soil characteristics was described in the Soil Survey Manual (Soil Survey Staff) in 1951.

The soil interpreter/surveyor can present his judgment in a descriptive form but, if he is dealing with many soil units he will probably decide to rank them. In this ranking exercise he encounters the problems so typical for the classification of objects (here: soils) on the basis of dissimilar criteria. How do you evaluate the occurrence of temporary waterlogging in one soil against erosion hazard in another? The soil interpreter must somehow establish rating criteria for individual soil qualities and weigh different soil qualities against each other, remembering that sometimes these qualities overlap and interact. The lack of data on relationships between soil performance and soil quality means that the rating is largely intuitive. Indeed, the rating of soil properties and the grading in classes is the Achilles' heel of soil interpretation. Back in 1943 Simonson ans Englehorn warned ''the selection of criteria for the grading of soils into classes is one of the most perplexing problems in the present time and promises to remain so in the future''.

The rating of a given soil for a defined use proceeds in two steps:

1. A selected set of soil attributes (characteristics, qualities or both) that are considered to be relevant are rated.
2. The soil is assigned to a suitability class by combining the rating of separate soil properties into one class rating or index rating. Usually, multiple entry conversion tables are established for this.

Whatever the system followed, the soil surveyor/interpreter ultimately produces a soil map with explanatory reports, including the interpretation results in the form of tables, texts and maps. His work is then itself used for example by land use planners, farmers, fellow soil scientists. This use is not seldom beset by a further array of problems and misunderstandings not only arising from whether the map is complex or oversimplified but also from insufficient awareness of the aims of the original soil surveyor/interpreter when preparing and interpreting the soil map. In this context, Kellogg 1939, p. 258) saw a need for enlightening the procedures of the soil scientists, and called for a closer attention to the general objective of all soil research, i.e. ''to determine the capacities of each soil type for secure production under physically defined systems of management''.

The need for a clear understanding of the objectives of soil interpretation was repeatedly stressed in the 1940s (Orvedal and Edwards, 1942; Simonson and Englehorn, 1943). The difficulties of extrapolating from one system of interpretation to another, in a different country, further complicated the issue. Not surprisingly, over the years soil interpretations have given rise to many misunderstandings between soil scientists and economists, agricultural engineers and agronomists (Vink, 1960) - let alone between soil scientists of different countries! By 1970 the need for a standardization of terminology and of methodology was acute. The ''Framework for

Land Evaluation'', which was developed jointly by FAO and a Dutch working group (FAO, 1976) was hailed as fulfilling this need and as providing a broader base on which to assess the potential of land.

The Framework for Land Evaluation

The ''Framework for Land Evaluation'' sets out concepts, principles and procedures for land evaluation which are ''universally valid, applicable in any part of the world and at any level, from global to single farm''; in short, it supposedly provides the key to the solution of all land use problems. It has met with general approval, notably from international agencies, while Beek (1980), himself a major contributor, describes the Framework as the climax of this quarter century of international methodological reassessment, and as a milestone in the evolution of a realistic approach to land evaluation.

The overwhelming enthusiasm for the new approach needs some comment. First of all, it clearly conveys general dissatisfaction with previous approaches. Secondly, the Framework was conceived by pedologists and enthusiasm among economists has reportedly been less than among resource-minded scientists. Thirdly, while covering virtually all aspects of land evaluation the message of the Framework allows for great flexibility in its applications, to the extent that every pedologist/land evaluator can find supporting statements for his own preferred working method.

However, the proof of the pudding is in the eating and after 10 years of practical applications of the Framework it is perhaps time to attempt an evaluation of the Framework on the basis of its achievements.

A personal observation is that a rigid application of the Framework leads to frustation for the pedologist and leaves the planning economist in despair. Some of the problems find their origin in the concepts and principles underlying the Framework.

Principles of the Framework

The Framework mentions certain principles that are fundamental to land evaluation. They include the following:

Land evaluation is based on *interpretation of physical land attributes in respect to specified kinds of land use.* Agricultural land use, or Land Utilization Type (LUT) implies crop production that can be achieved in a particular farming system *on a sustained basis* (without environmental damage).

Land evaluation provides ratings of relative suitability of land for *two or more relevant land use alternatives.* The relevance of these land use alternatives is dictated by *the physical, economic and social context of the area concerned.*

The suitability classes are defined by economic criteria. This requires *a comparison of the benefits obtained and the inputs needed* for a given land use on different types of land. Such an economic comparison is called *quantitative* evaluation, but if the economic evaluation is not substantiated the land evaluation is called *qualitative*. In fact, most, if not all land evaluations are qualitative in the economic sense. This complicates the comparison of suitability ratings for a given tract of land for alternative uses, as there is no common denominator expressed in monetary units.

From the foregoing it will be clear that a *multidisciplinary approach* is required. The Framework calls for close co-operation between natural resource scientists, land use technology specialists, sociologists and planners.

Difference between land evaluation and soil interpretation

Land evaluation is born out of soil interpretation, but land has replaced soil as the basis for suitability evaluation. The difference is that land comprises climate, relief, hydrology and vegetation in addition to soil. However, more often than not soil units continue to serve as Land evaluation Units (LU), only split by agro-climatic zone if large areas are involved. While the purpose of soil survey interpretation was to make predictions of soil performance to guide profitable management on each kind of soil (Steele, 1976), land evaluation moves much further in the direction of recommending particular uses of land. It aims to provide land use planners with a choice of ready-cooked land utilization types (LUT) for each land unit (LU). According to the Framework the next step after land evaluation is selection of a preferred use for each type of land, i.e. land use planning proper.

Constraints arising from the principles enshrined in the Framework

Less concern for people than for land

The Framework allows for simultaneous land evaluation for LUTs of different levels of technology, from primitive to modern, acknowledging differences in social and economic conditions between farmers in the evaluation area. This represents an innovation of the Framework in relation to previous evaluation systems that paid only attention to mechanized farming. To judge by the emphasis on socio-economics in the principles and by the meticulous analysis of LUTs in some applications of the Framework, land evaluation seems to be oriented to people and social change. However, all this tends to obscure the notion that land evaluation is primarily concerned with land to benefit land use planning, which is but a part of overall development planning. The Framework attaches certain values to the productivity and conservation of the land, but is neutral with regard to people. The latter is not stated explicitly in the Framework; on the contrary, it suggests that what is good for the land is good for the people. But whereas the beneficial and adverse consequences for environment are compared, the social consequences of the relevant kinds of land use are always assumed to be beneficial, and there seem to be no losers. In fact, land evaluation is oriented to natural resources, not to people. It considers land resources in terms of physical and economic factors, but only considers people insofar as they participate in the relevant kinds of land use within the boundaries of the area to be evaluated. Other economic activities, and other people, not to be involved in land use within the are, are mentioned incidentally in the land evaluation in a socio-economic context, but are not a target of the land evaluation procedure.

Because of its politically neutral foundations, the Framework can either be applied to support land allocation to small farmers, or to evict them. This means that land evaluation could be abused to justify denying certain groups of people access to land resources, or even to justify blatant land grabbing. Such political goals could be easily brought into the land evaluation procedure, e.g. by considering subsistence farming to be an inappropriate land use alternative, or by classifying the land as unsuitable for subsistence farming and at the same time declaring it suitable for large-scale export crop plantations. Thus a preselected land use alternative may receive the lustre of scientifically proven viability. But the question, who will gain or lose as a result of planned development is not answered by the land evaluation procedure, but is decided upon in the political field of force.

Sustained use

Another field where the bias towards land resources becomes apparent lies in the statement: "that the kind of land use proposed will be *sustained,* that is capable of being continued over an *indefinite* period of time". In the practice of land evaluation, environmental degradation (soil erosion, soil salinization, pasture degradation) only concerns the land within the evaluation area. Although the Framework refers to off-site effects, it is not geared to the incorporation of comprehensive environmental impact statements.

To date, land evaluators have condoned land use systems that sacrifice many tons of oil, but no soil, and at the same time they advise against land use systems that sacrifice many tons of soil, but no oil (e.g. flower production in hot houses versus subsistence food production on hillsides). Also the reference to "an indefinite period of time" is made from a conservationist's viewpoint, but the duration of eternity is not compatible with the time spans commonly applied by economists, which cover periods of 5 or 10 years, and rarely exceed 30 years.

As far as sustained use is concerned, it may be more realistic to regard it not as a principle, but as a possible option in land evaluation, thereby specifying what kind of pressures on environment would be tolerated and to what degree.

No categorical distinction between economy and ecology

The crucial problem in land evaluation is that it deals concurrently with plant growth conditions, environmental aspects and economic considerations. The Framework approach leads to blending ecological and economic systems, rather than keeping them apart. It proposes measuring ecological factors by economic standards. For example, the Framework approach implies that if the price of cotton doubles, much more land will become suitable for cotton growing. But the construction of a new road will affect the economic suitability of land in a similar way. Thus land evaluation results soon become invalid, or need frequent revising. Because ecology and economy are amalgamated the land evaluator has to be prepared to adapt his edaphic suitability criteria to fit changing economic situations. If a purely ecological land evaluation is applied, the edaphic criteria will only need to be changed if the knowledge about edaphic conditions changes.

The great advantage of a separate ecological land evaluation rather than the uneasily amalgamated Framework approach is that it generates information of longerlasting value. For that reason soil survey organizations usually apply ecological approaches to land evaluation, resulting in a combined rating for crop growth, management and conservation aspects. However, they use the *normative* (good-bad) classes recommended by the Framework. This is inconsistent. A more logical solution for a rating system would be to use *indicative* (high-low) productivity class ratings, based on yield level for a specific LUT. This could be supplemented by separate ratings for special management inputs (insofar as these are not included in the average LUT under consideration) and for intensity of desirable soil conservation measures. The productivity classes could be defined as very high, high, medium, low, very low. This is more concrete than the Framework classes of highly suitable, moderately suitable, marginally suitable, currently not suitable, permanently not suitable land. The application of neutral-value, indicative classes leaves open the question of what productivity level corresponds to the lower economic limit of suitability.

Related to the lack of a categorical distinction between ecological and economic systems are the definitions of qualitative and quantitave land evaluation. According to the Framework they differ in the specification of economic. If a land evaluation presents land/land use combinations with pricetags, it is called quantitative; without price-tags it is qualitative. However, the Framework does not make a distinction on the basis of the quality of the data on which the calculations or guesses are based. It would be much clearer to distinguish between physical and economic evaluations, thereby allowing the results to be expressed either in precise terms or as estimates. The distinction between qualitative and quantitave is not helpful, because a general study may present its results numerically and would therefore be quantitative, whereas the results of a detailed study may be presented descriptively, and the study would therefore be ''qualitative'', in spite of its greater precision.

If the purpose of quantification is to work with a common denominator for comparing alternative land uses, some standards that could serve this purpose in ecological land evaluation are: dry matter increment or nutritive value in terms of energy or of proteins. It depends on the political priorities, which one is selected.

Parallel evaluations are not comparable

The Framework states (section 1.1) that the function of land evaluation is to present comparisons of the most promising kinds of land use. The comparison of several alternatives is even proposed as a basic principle. Elsewhere (section 3.4), however, the Framework states that suitability classes for different uses cannot be compared, because suitability class limits are defined separately for each use. This means that if a given piece of land is rated highly suitable for LUT 1 and moderately suitable for LUT 2, LUT 2 may yet give a higher net return than LUT 1, and thus be the most preferred land use on that particular piece of land. Thus, land evaluation would allow land units to be ranked according to their suitability for a given use, but not according to different use possibilities for a given piece of land.

In fact, it is even disputable whether the suitability ranking of different land units for a given use (LUT) is theoretically possible, because a LUT is partly defined by the properties of the land. If the land differs, the LUT must differ too. For example, dairy farming on excessively well drained sandy soils is different from dairy farming on moderately well drained clay soils, even if the socio-economic context is exactly the same. The dependence of LUTs on land units is most pronounced if the LUTs are specified in much detail in terms of key attributes such as use of fertilizers or machinery.

Its inability to present results that can be compared means that land evaluation inevitably betrays its very principle of comparability.

Parallel evaluations are not always needed

The Framework approach to land evaluation is likely to be most successful for land use planning where there is great freedom in choice to implement alternative land use options. This is especially the case in frontier areas to be reclaimed or ortherwise opened up by governments, or in situations where the decision-making about land use is strongly centralized. In such cases land evaluation comes up with the comprehensive specification of a set of alternative land utilization types for each land unit or combination of land units.

In areas with an established land use and with many decision makers, the relevance of land evaluation in the sense of the Framework is debatable. In such cases the questions that land evaluators are required to answer are much less comprehensive, and do not involve specifying entire farming systems, or classifying land for different uses. Instead, the questions involve specifying alternative land improvement measures that can be taken for a land use that has already been decided. For example, the question may be to ascertain the repercussions of lowering a shallow water table, which would increase the soil's bearing capacity, but render it more sensitive to drought. Contrary to popular belief, answering such practical questions is not land evaluation in the sense of the Framework. Similarly, many a soil surveyor, scouting around for land that is suitable for growing a crop e.g. cacao, is unaware of the fact that he violates a principle of land evaluation by considering only one kind of land use.

Multidisciplinarity is difficult to achieve

Land evaluation can be thought of as an attempt to reconstruct "rational" farmers' decisions to grow something in a certain place in a certain way in current or projected situations. If done in the sense of the Framework, land evaluation is multidisciplinary teamwork aiming to reconcile the findings of experts on land and on land development, on crops and on cropping, on environmental issues, and on economics. A synthesis should be made out of the various expert contributions. This involves more than compiling section papers in one report. The complex action of synthesizing dissimilar information is called matching.

The Framework (section 4.5.1) explains that:

> Matching represents the essence of the interpretative step following the resources surveys in the land evaluation procedure, and is based on the functional relationships that exist between the land qualities, the possibilities for land improvement and the requirements of the land use. In its simplest form matching is the confrontation of physical requirements of specific crops (or grasses, trees, etc.) with the land conditions to give a prediction of crop performance. Matching becomes more complex when the production factor is complemented by other performance conditioning characteristics of the land utilization type, including non-physical aspects like labour intensity and capital intensity.

Basically, matching is a kind of optimalization procedure. However, the Framework does not prescribe a methodology for matching, not even for matching in its simplest form, the purely physical matching, let alone for the more complex variant of matching. Beek (1978) proposes to apply systems analysis in specific purpose land evaluation but does not back this up with guidelines of how to achieve this in practice.

In the absence of prescribed matching techniques, land evaluators follow their intuition. They arrive at a synthesis straight away. This is much the same way that farmers assess land. Farmers take a holistic view of the land, and a group of farmers can quickly reach a consensus on the productive value of a piece of land, when they are asked to classify it using a scale with 10 or even 20 grades (the Framework recommends the use of only four grades of suitability). The farmers base their judgment on their experience, but the factors that play a role in their minds are not always easy to translate in terms of land properties.

The Framework stipulates that the land evaluator should base his judgment on matching, i.e. he must somehow reconstruct his judgment on the basis of the few land characteristics that happen to have been inventoried systematically. In practice, it is very difficult to construct a consistent set of rating and conversion tables for each LUT to substantiate the initial intuitive judgment. This results in discrepancies between the intuitive and the reconstructed suitability ratings.

The flimsiness of the matching procedures often creates friction in multidisciplinary teams. Instead of uniting the various disciplines, matching pits them against each other. The place of the land evaluator as team coordinator is contested, because his working procedures are not stipulated and give irreproducible results that can be revised in any direction. Precisely because it is so permeated with subjectivity, the place of land evaluation among other disciplines is difficult to define. The question is, whether it is a part of another discipline or disciplines (and, if so, of which), a discipline in its own right or even a superdiscipline? Ideally, a land evaluator should be familiar with all the contributing disciplines. Sound judgment requires him to view the land through the eyes of the farmer, and for the matching exercise he must be as lucid as a mathematician, as conciliative as a diplomat and as flexible as a politician. Theoretically, such a person may originate from any discipline, but in practice land evaluation is the domain of pedologists. But as long as certain concepts and procedures of land evaluation are defined ambiguously a true multidisciplinary effort cannot be realized. The concluding thoughts on matching in a paper on data analysis in land evaluation (Beek et al., 1980) are revealing:

We consider it of great importance to reach an agreement on matching procedures with economists, particularly in relation with detailed and semidetailed land evaluation, to avoid overlap between the work that is done by physical scientists and the economists.

On the other hand, we must confess to a certain concern that economists tend to draw their conclusions after synthesizing such a variety of social, economic and political factors that the role of the physical land variables may be underrated.

The question is whether we have progressed far enough with our methods of physical land evaluation to present the economists with acceptable proposals that can be incorporated in their established working methods. Are these land evaluation methods good enough to convince economists that they should reconsider some of their working methods? In our opinion the successful applications of land evaluation and its link with systems research and rural development depend on such cooperation.

It is probably unrealistic to expect economists to reconsider their working methods to incorporate ill-defined matching procedures that are unlikely to answer their questions. On the contrary, economists try to convince land evaluators to ponder matching procedures as a first step towards true multidisciplinary cooperation.

Basic concepts of the Framework: land qualities and land characteristics

The basic consepts of the Framework include land, land use, land utilization types, land characteristics, land qualities, diagnostic criteria, land use requirements and land improvements. Of these, the definitions of land characteristics and qualities differ slightly from the old American definitions for soil characteristic and soil quality:

- a land characteristics is an attribute of land that can be measured or estimated. Examples are slope angle, rainfall, soil texture, available water capacity, biomass of the vegetation, etc.:
- a land quality is a complex attribute of land which acts in a distinct manner in its influence on the suitability of land for a specific kind of use. Examples are moisture availability, erosion resistance, flooding hazard, nutritive value of pastures, accessibility.

Crop yield is considered to be an aggregate land quality. Land qualities are frequently described by means of land characteristics. However, a land quality can sometimes be measured directly, and would be a land characteristic as well.

The Framework recommends comparing land with land use in terms of land qualities, and not in terms of land characteristics, because of interaction between characteristics. This recommendation is largely invalidated by stating that either land qualities or land characteristics may be used as a basis for assessing the suitability of a given area of land for a specified use.

Constraints related to the concepts of land qualities and land characteristics

The suggestion in the Framework that the problem of interaction can be avoided by applying land qualities is an oversimplification. Many interactions and complementarities between land qualities give problems similar to those arising from the application of single characteristics. In the practice of land evaluation a land quality is often replaced by the land characteristic that is considered to have the greatest differentiating influence of all characteristics on that particular land quality. Furthermore, land characteristics that simultaneously influence many land qualities are used instead of the qualities themselves.

The concept of land quality is extremely useful to highlight why a particular land characteristic is important for a given land use. But once such a land characteristic has been identified, it becomes easier to work with it than with the land quality, because a quality cannot be measured and is therefore not an operational concept. Other arguments for working with land characteristics are that land mapping units are described in terms of land characteristics and that remedial action to improve the land is implemented by manipulation of land characteristics, not of land qualities.

The mapping unit as basis for suitability evaluation

Remember that a function of land evaluation is to bring about an understanding of mutual relationships between land and the use to which it is put. Suppose that a land evaluator must explain why a given land mapping unit is marginally suitable for arable farming. Compare the following descriptions of this mapping unit, the first in terms of land characteristics, the second in terms of land qualities:
- a shallow sandy soil on a hillside
- a soil having low moisture availability, high oxygen availability, low nutrient availability, low resistance to erosion, low trafficability, with respect to the requirements of arable farmings.

If the audience possesses a little more than rudimentary understanding of agriculture, it will probably accept the explanation that the land is marginally suitable for arable farming because the soil is shallow and sandy and on a hillside. But would an explanation of the suitability rating in terms of land qualities add much information to the first explanation?

Another mapping unit with a predictable set of land qualities would be a clay soil in an embanked flood plain with shallow groundwater table. This proves to be a soil having high availability of moisture and nutrients, low oxygen availability, high resistance to erosion, low trafficability, with respect to the requirements of arable farming.

The point to be made here is that a mapping unit represents tracts of land with a coherent set of land characteristics that *jointly* influence the land use potential. Therefore, an insight in this whole complex of land characteristics plus knowledge of the farming practice, can quickly provide an insight into the possible land/land use combinations. The Framework, however, suggests that such an insight can only be obtained by analyzing different land qualities that act *distinctly* on the land use potential. This suggestion opens the way to considering single land qualities separately from all other land qualities, and forms a justification for assessing land suitabilities on the basis of just one (rarely two) land qualities. These one or two land qualities that determine suitability class are singled out because they represent the most severe limitations that adversely affect the given kind of land use.

Still, the question remains whether this analytical splitting up of land use systems in the Framework approach does generate better and more useful information than can be obtained more simply by taking a holistic view of them. The two examples given above seem to indicate that analysis tends to blur the view of the land instead of clearing it.

Specification of improvements and management practices

One of the purposes of land evaluation is to permit specific management and improvement measures to be systematically determined for each land utilization type on each land mapping unit to which it is suited. The Framework gives a fine example of the use of land qualities and land characteristics in land evaluation for soil conservation (section 2.4):

> If land characteristics are employed directly in evaluation, problems arise from the interaction between characteristics. For example, the hazard of soil erosion is determined not by slope angle alone but by the interaction between slope angle, slope length, permeability, soil structure, rainfall intensity and other characteristics. Because of this problem of interaction, it is recommended that the comparison of land with land use should be carried out in terms of land qualities.

And in relation with the assessment of physical inputs (section 4.5.1):

> Maize cultivation, for example, is a form of land use involving periods in which the soil surface is bare. Erosion resistance is therefore a relevant land quality. The optimum conditions include level land, requiring no soil conservation works. Using such land characteristics as slope angle, soil permeability, structural stability and rainfall intensity, a parameter representative of erosion resistance is calculated for each relevant land unit. In a qualitative study, the erosion hazard might be divided into classes such as nil, slight, moderate and severe, and at least the last of these classed as Not Suitable.

This rating of the land quality "erosion resistance" should serve as a basis for specification of soil conservation works.

Suppose that in a land evaluation for farm planning a suitability unit S3e is distinguished. This unit represents a piece of land that according to land evaluators is only marginally suitable for the specific farm type, because of the hazard of severe erosion. If further explanation is not given in an accessible way, as is common practice in land evaluation, the only message of this evaluation to the farmer is that he should not expect much benefit from erosion control measures (the expenditure will be only marginally justified). This kind of evaluation does not propose any solution for the erosion problem. From erosion handbooks it may be learned that a severe erosion hazard requires measures to increase water uptake by the soil and to reduce and regulate surface runoff. But there are so many different ways of achieving erosion control that it is important to identify the most appropriate measures for each particular situation. The appropriateness of these measures, however, cannot be deduced from the severity of the land quality "erosion hazard", but will depend on the relative contribution of the interacting land characteristics to the erosion hazard, and on the ease of correcting them. Depending on the local situation, the remedy for the erosion problem may be sought in modifying slope angle, slope length, or soil surface configuration, or in protecting the surface against rainfall impact. These measures can be taken alone or in combination. If the land evaluator wants to convey a clear message to the farmer, he should make his judgment more explicit, even if this judgment is preliminary, and specify the kind of measures he has in mind for each suitability unit, for example: contour ploughing, vegetative strips, mulching, terracing, gully control. The Framework does recommend to make such specifications, but in no way does it make clear how these can be derived from land quality ratings.

The conclusion is that if the purpose of a land evaluation is to permit specifications for management and improvement to be systematically determined, then mapping units need not be expressed by rating the most limiting land qualities, because a straightforward description in terms of relevant land characteristics serves the purpose better.

Land evaluation procedures according to the Framework approach

Generation and reduction of data

The Framework is not very clear on *how* to carry out a land evaluation. But two important points deserve attention, one procedural and the other concerning the presentation of results. The Framework (section 4.1) states:

> It is important to note that there is an element of iteration, or a cyclic element, in the procedures. Although the various activities are here of necessity described successively, there is in fact a considerable amount of revision to early stages consequent upon findings at later periods.

This iteration makes land evaluation a very time-consuming activity.

The second point refers to how land evaluation should be presented. The Framework recommends minimizing the number of suitability classes and also using as few limiting land qualities as possible in the symbols that indicate the kind of limitations. One (rarely two) letters should normally suffice. This means that in land evaluations that follow the Framework, the tremendous amount of information generated by the interpretation of relevant land qualities is largely unused for the final suitability assessment. For example, suppose that fore a given LUT ten different land qualities are considered relevant. Then, for each land unit to be evaluated for this LUT, each of the ten land qualities must be rated individually. After this analysis of land qualities the most limiting is used for the suitability class rating, and the other nine are placed on the reserve list. The proportion of generated data actually used is definitely low; in the preceding example, a person with a feeling for land could reach the same conclusion as a person who follows the Framework, but by using only 10% of the data.

The circular arguments of matching

Matching is the pivot on which land evaluation turns. The process of matching has been most extensively discussed by Beek (1978), who proposes applying systems analysis in land evaluation. The system to be analyzed is the land use system (LUS) consisting of two subsystems: the land mapping unit (LU) and the land utilization type (LUT). Beek (1978) states:

> The systematic breakdown of the land use system into measurable land qualities, land requirements, inputs and outputs is the foundation for a systems approach to land evaluation.

He gives the following relation structure of the land use system (p. 280):

Land quality - output relations (1)
input - output relations (2)
input - land quality relations (3)

In a multidisciplinary land evaluation team, the planning economist is only interested in the second type of relations, the I/Y relations. These relations (2) can be directly obtained from surveys of farm economics or from productivity figures from trial sites located on representative types of land within the land evaluation area, or in similar areas.

The physical scientist in the team, however, also wants to know the two other types of relations for his matching procedures. As neither the functional relationships between land qualities and output (1) nor those between input and land qualities (3) are known, they are estimated by establishing rating and conversion tables.

These tables are then verified on the basis of productivity ratings (relations (2)). This leads to the curious situation that productivity ratings initially used to calibrate the system are presented as calculated output of the system in a later stage. As Beek (1978, p. 282) puts it: ''Productivity ratings can provide a useful check on the weights attributed to the land qualities that condition productivity''. And as one of this author's colleagues put it: ''This guarantees that you are always able to recover the egg you have hidden yourself''.

Veldkamp (1979) goes only half that way. By matching he determined a ''calculated ecological suitability'' of land for a crop by going through a large number of rating and conversion tables established by himself. He then compared this ''calculated ecological suitability'' with the expected yield for the same land/crop combination, established on the basis of direct yield measurements. Then, he continues (p. 110):

> If the difference is too large, the average value is considered to represent the ecological crop suitability. In this way, the available yield date are used to check the calculated suitability value.

In fact he did not take the average value, since further explanation (p. 140) reveals that after expressing the calculated ecological suitability and the expected yield in a four-class system in which 1 = high, 2 = moderate, 3 = restricted and 4 = low, the final ecological crop suitability was determined according to the formula:

1/3 (2 x calculated ecological suitability + 1 x expected yield)

By using this formula, a greater weight is given to the evaluator's intelligent guesstimate than to directly measured yields, because it is argued that the calculated suitability would be of a more fundamental nature than the directly measured value.

Not surprisingly, his conclusion is (Veldkamp, 1979, p. 178) that the evaluation revealed that the most suitable land use was almost identical with the current land use, and that it might be stated, therefore, that the study was done in the context of the present conditions.

Veldkamp's work is fundamental in the sense that it exposes the empirical foundations that underly qualitative physical land evaluation, but it does not give a fundamental explanation of the role of basic physical processes. For example, he assessed the availability of water in the rooting zone per season by adding, subtracting and multiplying the subratings of four aspects: groundwater class, height of capillary rise, available water holding capacity and seasonal specific overall wetness. But no attempt was made to find a quantitative expression of the availability of water by estimating the water balance in terms of inflow and outflow, which would require additional data on rainfall regime, evaporation regime, and hydraulic properties of the soil.

A great merit of Veldkamp's work is that it uncovers each step of a physical land evaluation procedure, recombining land characteristics into land quality ratings, comparing these with ratings of land requirements of specific crops, arriving at an ecological suitability index, and correcting the latter on the basis of a field check. In many land evaluation projects, underlying reasonings are not stated explicitly in the published reports and the suitability ratings appear out of the blue, although it is claimed that they have been calculated. Often the reason that the supporting evidence is omitted is that the rating rules are not consistent (i.e. are open to criticism) and are under continuous revision.

In the practice of land evaluation the results of a first round of matching may serve as a basis for identifying sites and subjects for research and development action. However, it is rare for the subsequent research results and development experience to be fed back to the original evaluation study for a next round of matching, because neither research nor development projects care for a retrospective refinement of land suitability classifications.

The importance of field checking as the final step of the matching procedure is confirmed by the Framework (section 4.7.1):

> A field check of the land evaluation is essential in order to ensure that the suitability classes arrived at by the above procedures are in accord with experienced judgement. Field checking is particularly important where a conversion table has been employed in the matching process, since rigid application of such tables can occasionally produce results at variance with common sense. The field checking should normally be carried out by a party including a natural scientist and one or more people experienced in the types of land use concerned, e.g. a farmer, agriculturalist, forester, engineer.

Here, the Framework seems to acknowledge that a holistic approach to land evaluation would give more consistent results than the analytical approach. The question remains whether matching serves as a check on field observation, or conversely, whether field observations should serve as a check of the results of matching. In this respect it is perhaps important to distinguish between the methodological needs of land evaluation research and the need for sound judgments and working speed in the practice of land evaluation.

Additional problems

Two problems in land evaluation that have received almost no attention in the Framework are the dynamic nature of land qualities, and the complexity of the land quality "nutrient availability".

The dynamic nature of land qualities may be illustrated by the availability of water. The amount of available soil water usually changes according to the seasons, depending on the climate. The influence of available water on crop performance also depends on the growing stage of a crop, and differences occur between crop types and between planting dates. If the Framework approach were strictly applied this would require that in a land evaluation separate comparisons must be made between water availability and water requirements for all land units, all management levels, all crops, all planting dates, all development alternatives. The proliferation of land conditions/crop growth combinations leads to large data bases that can only be managed with the aid of a computer. For the time being, computerization of comprehensive land evaluation in the sense of the Framework is still a research option. It should be kept in mind that computers can only do what they are told to do, and that methodological problems first have to be solved by the scientists themselves.

The second problem of nutrient availability has to do with the way that land mapping units are defined. The criteria for distinguishing mapping units are related more to stable subsoil properties than to the topsoil properties, which are variable in time and in space. Temporal variations are mainly seasonal, spatial variations are often related to differences in land use history. The result is that within a mapping unit there may be a large variation in topsoil properties. Yet soil fertility is affected more by the topsoil than by the subsoil. While it is already risky to predict fertilizer requirements on the basis of measured topsoil properties, because of uncertain interactions, it becomes even riskier to predict them on the basis of mapping units. This constraint is not inherent in the Framework, but concerns the general problem of linking the sciences of soil fertility and soil geography. Perhaps the fertility capability soil classification system (Sanchez et al., 1982) may help to bridge the communication gap between the two branches of soil science.

Conclusions and suggestions for further research

It is time for a thorough revision of the principles, concepts and procedures of the Framework for Land Evaluation. The best way to achieve this is probably by evaluating the applications for which the Framework has been used since its conception. The evaluation should reveal discrepancies between what is advocated in the Framework and what is done in practice. This should be followed by an assessment of whether the Framework approach or its so-called applications serve the intended purpose better, and finally, whether a completely different approach would be needed under the specific conditions of each application. Thus a kind of matching procedure should be set in motion, aiming

- to check the relevance and refine the rules of the Framework
- to permit a systematic determination of the necessary amendments to the rules of the Framework
- to estimate the efficiency of the Framework approach in each particular situation vis-à-vis other approaches.

Much information on land evaluation projects is contained in the FAO World Soil Resources Reports from no. 44 onwards. The European Commision is at present promoting Framework-based pilot studies in western Europe. Many development projects and soil survey organizations in the third world have also adopted the Framework approach, so that examples of land evaluations are amply available.

The subjects selected for an evaluation of land evaluations on methodological aspects should ideally range over a wide scale and could, for example, include the following studies: FAO Agro-ecological Zones Project (FAO, 1978) at continental scale, Kenya Soil Survey reports (e.g. Van de Weg and Mbuvi, 1975; Wielemaker and Boxem, 1982) at reconnaissance scale, the Leziria Grande project study in Portugal (Beek et al., 1980) at semi-detailed scale, a smallholder settlement scheme in Jamaica (Andriesse and Scholten, 1983) at detailed scale, and a case study in Nigeria (Veldkamp, 1979) at farm level.

But not only methodological aspects should be investigated. Other aspects that warrant special research is, firstly, to assess the impact of land evaluation studies on decisions on land use, and, secondly, if decisions on land use have been taken on the basis of land evaluation, to assess the predictive value of land evaluation by comparing the productivity after implementation with the land evaluator's original judgment of land suitability.

Anticipating the results of further research into land evaluation procedures it may be stated that the Framework is over-ambitious in aiming at multidisciplinarity, and that for physical land evaluation the prediction some 40 years ago by Simonson and Englehorn (1943) that the selection of criteria for the grading of soils into classes was to remain one of the most perplexing problems in the future, is still true in the current state of knowledge.

Acknowledgements

The author wishes to thank Mr.C. de Jong and Mr.P.J. Melitz for their advice and comments, Mr.W. Andriesse and Mr.R.F. van de Weg for their review of an earlier draft and Mrs. Joy Boenisch Burrough for her editorial assistance.

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3 ACTIVITIES OF THE SECTIONS

3.1 Soil monolith collection and exhibition

During the reporting period the number of soil monoliths increased with 25 to 553. A number of profiles have been collected, but have not arrived at ISM before the end of 1982, these have not been incorporated in the table on the next page.

Contacts with a large number of institutions and individuals exist about the increase of the soils collection, as well as on the supply of additional information on soils already sampled.

In the early days of ISM, most profiles were collected by its own staff. During the last five years however, there is a gradual increase in the number of profiles taken by soil scientists working in the countries concerned. In 1982 nearly all profiles were collected by non-ISM personnel. This trend is likely to continue, especially in those countries where national soil reference collections are being built up and where capable manpower and facilities are available. Most of these newly established collections have, or will have in future, personnel which has attended the ISM training course or which has received training on the spot (see section 6.2)

Acquisitions in 1982

Brazil: As may be read in section 8.1, ISM may play a role in the establishment of the International Interdisciplinary Laterite Reference Collection (IILRC). Billiton International Metals B.V., The Hague, The Netherlands, has collected a core of a 20 m deep lateritic bauxite, formed in Pliocene sediments near Trombetas, Amazone region Brazil. The top two meters constitutes a soil profile for the ISM collection. Billiton has kindly agreed to take and send the material to ISM without costs.

Gabon: Mr. A.J. van Kekem, Unesco associate expert in Nairobi, Kenya, collected one soil during a field trip.

Indonesia: In a cooperative effort, Mr. H. van Reuler, Unesco associate expert in Jakarta, and Mr. G.W. van Barneveld, Departement of Soil Science, Brawijaya University in Malang, collected six profiles on Java. The collection contains soils of the Benchmark Soils Projects sites, some paddy soils and a soil formed in deposits of the Krakatau volcano, which erupted in 1983. A request to WOTRO to subsidize a comparative study of some old and young volcanic soils on Java and some adjoining islands, was recently turned down.

Japan: As may be read in section 6, two Japanese soil experts will spend six to nine months each at ISM in 1982 and 1983. Dr. M. Okazaki, who stayed with ISM in 1982, and Dr. C. Mizota, collected four monoliths to show the influence of rice cultivation on an alluvial soil and on a soil formed in volcanic material.

Oman: As part of a contract, Consultants Groundwater Resources Development, in association with Hunting Technical Services Ltd., collected a series of eleven soil

monoliths for the Ministry of Agriculture and Fisheries in Muscat. ISM gave advice to the consultants on the best possible impregnation methods of mostly light textured soils in a dry and warm environment.
It is very gratifying to state that the consultants also collected four profiles for ISM on a complimentary basis.

Philippines: In a joint effort, soil scientists from the Bureau of Soils, the Benchmark Soils Project (BSP) and the International Rice Research Institute (IRRI), have collected six soil profiles. These belong partly to the BSP research sites and comprise also soils used for the cultivation of paddy.

Sri Lanka: Four soil monoliths, including soils under paddy, were taken by Dr. S. Somasiri of the Department of Agriculture, aided in part by Mr. H. van Reuler, Unesco associate expert in Jakarta, Indonesia.

Uruguay: One soil profile, as a fore-runner of about five more from Uruguay and possibly Argentina, was collected by Mr. R. Breimer, Unesco associate expert in Montevideo, and Mr. Alvaro Califra, Department of Soils, Ministry of Agriculture and Fisheries.

Australia	33	Mali	1
Belgium	4	Namibia	11
Botswana	7	Netherlands	19
Cameroon	1	New Zealand	5
Canada	21	Nigeria	14
Colombia	19	Norway	3
Czechoslovakia	8	Oman	4 (4)
Denmark (Greenland)	6	Philippines	6 (6)
Fed. Rep. of Germany	17	Romania	11
Finland	5	South Africa	20
France	11	Spain	18
Ghana	4	Sri Lanka	4 (4)
Greece	14	Sweden	17
Hungary	20	Syria	4
India	30	Thailand	13
Indonesia	16 (6)	Turkey	13
Ireland	11	United Kingdom	11
Italy	17	U.S.A.	10
Jamaica	3	U.S.S.R.	62
Japan	4 (4)	Uruguay	1 (1)
Kenya	27	West Samoa	5
Malaysia	10	Yugoslavia	3
Total 553 (25)		Zambia	10

Soils collected in Brazil, Gabon, and U.S.A., which have not arrived at ISM before the end of 1982 have not been entered in this table.

Future Acquisitions

Arrangements for collecting soil profiles have been made with a number of other countries. These plans are in various stages of implementation. It is foreseen that in the coming years soils will be collected in:

People's Republic of China: It is expected that a Chinese soil scientist will attend the ISM training course in 1983 in view of a possible improvement of the present collection of the Chinese Institute of Soil Science in Nanking. After this training, a concurrent building up of collections of soils for the Institute of Soil Science and ISM will take place, probably from 1983 onwards. This project could not be implemented in 1982. Its execution depends on financing by the Dutch Royal Academy of Sciences and the Academia Sinica within the framework of a scientific treaty between China and the Netherlands.

Kenya, Ruanda, Sudan: It is expected to carry out this work, originally planned in 1982, in 1983 or 1984. The Sudanese authorities have not yet agreed with ISM's work in South Sudan.

Mozambique: Concurrently with an enlargement of the soil monolith collection at the Department of Soils and Water, INIA, Maputo, about five soil profiles will be taken for ISM in Northern Mozambique.
This work is expected to be carried out in 1983 and will be coordinated by Mr. J.H. Kauffman of INIA.

Poland: As mentioned in earlier reports, profiles will be collected in this country, coordinated by Dr. H. Kern, Institute of Soil Science and Plant Cultivation, Pulawy. Some additional soils will be collected in 1983 and the shipment will probably arrive in 1984.

U.S.A.: It has already been reported earlier that about 30 profiles will be collected in continental U.S.A. Four soils have arrived in 1981, others will follow during the coming years. The programme is coordinated by Dr. J.M. Kimble, National Soil Survey Laboratory, Lincoln, Nebraska.

Vietnam: Concurrently with the establishment of a small reference collection at the University of Can Thó, Han Giang, soil profiles will also be collected for ISM. This project is carried out by Mr. M.F. van Mensfoort, Agricultural University, Wageningen, seconded to the University of Can Thó.

Ghana: It was mentioned in previous Annual Reports that profiles would be collected in this country. This plan has not yet been implemented.

General: More tentative arrangements for collecting soil profiles have been made with institutions and individuals in a number of other countries. Also some of these countries have plans for the establishment or enlargement of soil reference collections for their own purpose.
These countries include: Mexico, Venezuela, Brazil, Israel, Malaysia and several countries in North and West Africa and the Near East.

Preparation of monoliths

During the reporting period about 25 profiles have been impregnated and prepared for the exhibition. Priority was given to profiles from developing countries.

Search for alternative, less toxic chemicals for the impregnation of mineral and organic soils has not yet been successful. A new method developed in Canada by placing organic soils in a temperature of -18° cannot be recommended for use in developing countries, where our main interest lies. The submergence in polyethylene-glycol 1500 mentioned in Annual Report 1981 seems less suitable because of the hygroscopy of this impregnating material.

Exhibition

A start has been made with major changes in the display of the soils, in which more attention is given to soil sequences/catenas (a chrono-sequence on Serawak, Malaysia and a catena on Sumatra, Indonesia; each comprising of 5-6 monoliths), the influence of long-lasting paddy cultivation on soil characteristics (with examples from China, Indonesia, Japan, Philippines and Sri Lanka), and, in general, to soils from tropical and subtropical regions. Furthermore, several soil degradation features will be shown.

On the special topics mentioned above handouts will be prepared, one on the influence of rice cultivation on two Japanese soils has already been prepared by the ISM guest researcher Dr. M. Okazaki, another one on the toposequence in Sumatra will be made by Dr. C.G.G. van Beek, who also put the soil profiles concerned at the disposal of ISM.

These changes are in line with wishes expressed by visiting students and scientists.

3.2 Laboratory

Analytical work

The beginning of the year was marked by an all-out effort to complete analyses on the Jamaican monoliths (see section 6.1). The arrival of Dr. Okazaki brought about a sharp turn of the attention from strongly weathered tropical soils to paddy effects on a Fluvisol and an Andosol. His knowledge of the Japanese Andosols could directly be made to good use in the analysis of other Andosols ISM was working on (from Colombia and Hawaî), notably with respect to the peptization/flocculation problem of Ando clays.

Two other monoliths were analyzed in detail for the preparation of a Soil Monolith Paper viz. Uruguay 1 and Romania 2. For a paper presented at the Fifth International Soil Classification Workshop, Khartoum, the analysis of ten Vertisols were completed (mainly X-ray diffraction and particle size analysis).

An effort was made to tackle the long-existing backlog in routine analyses. It was decided that all profiles are subjected to a basic, minimum programme of analyses necessary for characterization and classification. Only for special studies such as for SMP's and by guest workers a more extensive programme is carried out. Core samples for pF curves are treated in any case.

In addition, the Ministry of Social Affairs made available the funds to employ two extra analysts for half a year to assist guest workers. This facilitated a more efficient running of laboratory work. ISM appreciates that both analysts decided to stay for some time on a pro deo basis after their official contract elapsed.

The equipment to determine soil moisture characteristics (pF) was extended by a silt and a kaolin bath so that some 200 core samples could be handled. The remaining 100 samples were kindly taken care of by the Soil Survey Institute (Stiboka).

The basic programme of routine analyses was carried out on monoliths of the following countries: Cameroon (1 monolith), Colombia (11), Kenya (13), Nigeria (4), Sri Lanka (4), USA (Hawaî) (3), Oman (4), Zambia (2).

Research

Like last year, the time spent on research was limited. Still in progress are the programs on carbonate/carbon determination, influence of different pretreatments on the particle size analysis, determination of specific surface area.

By the end of the year, Mr. M. Moura started work on the correlation of the rapid CEC determination by the silver thiourea method with other traditional methods.

With Dr. Okazaki, several procedures to determine phosphate retention were tested and compared.

Programme on comparison of methods, procedures and results of laboratory analysis for soil classification purposes (LABEX)

The statistical treatment of the data of the 20 participants took quite some time but the report on the pilot round of the programme could be presented at the Classification Workshop in Khartoum, Sudan in November. The report has been sent to all participants who are invited to comment and suggest further development. The outcome of this study strongly points to standardization of procedures and also to an extension of the programme with more soil types and more participants. Much of the success will depend on the availability of funds.

The second part of the programme, analysis of samples sent in by participants, was hampered to some extent by a technical imperfection: filter candles for the "standard" particle size analyis could not be purchased anywhere. Substitution of this tool is now beïng tested. The CEC data were made available by the Royal Tropical Institute by the end of the year and were forwarded to participants.

3.3 Micromorphology

Technical work

The preparation of thin sections is carried out by the technician of ISM at the laboratory of the Netherlands Soil Survey Institute.

Part of the work in 1982 concerned samples for the project: ''Micromorphological analysis and characterization of Benchmark Soils in India''. The project entailed the preparation of a total of 372 thin sections, of which the last 75 were prepared in early 1982. The follow-up of this work, including training of Indian micromorphologists and outfitting of a specialised laboratory at Nagpur-India, is being carried out mainly by the Dutch Soil Survey Institute.

79 thin sections have been prepared for the regular ISM collection, concerning 43 sections from Kenya, 4 from China, and 32 from Colombia.

39 sections from Japanese Paddy Soils were prepared for Dr. Okazaki, guestworker at ISM. Samples for special projects include 10 from Brazil (Dr. Sombroek) and 10 from Upper Volta (Dr. Siderius).

In 1982, 205 samples were received for treatment, most concerning the regular ISM collection, viz. 37 samples from Kenya, 61 from Colombia, 7 from the U.S.S.R., 39 from Japan, 6 from Uruguay, 3 from China, 21 from Sri Lanka and 31 from the Philippines.

A start has been made with experiments to improve preparation techniques, viz. the reduction of the hardening time of impregnated samples, using gammaradiation, in cooperation with Dr. M. Kooistra of the Dutch Soil Survey Institute.

Investigations

The regular description and investigation of thin sections has been seriously retarded in 1982 because the micromorphology staff spent most of their time on other activities (registration of the map collection, public relations, educational and organizational activities).

Descriptions and interpretations have been made of thin sections pertaining to a Humic Acrisol and Acri-orthic Ferralsol from Jamaica. The results have been published in ISM Soil Monolith Papers 5 and 6.

Guest researcher Dr. M. Okazaki has spent the greater part of two months in the micromorphology section. He has received an introductory course in the description and interpretation of thin sections. Under supervision, he has described and interpreted thin sections of soils from Japan to study the effects of paddy cultivation on an Andosol and a Fluvisol. Photomicrographs and diapositives have been made to illustrate his findings.

Three students of the MSc course of ITC, Enschede, have received an introductory course in micromorphology. For this purpose, a short introductory text on general concepts of soil fabric and microstructure was prepared. Under supervision of ISM staff the students have studied and interpreted thin sections pertinent to their MSc thesis. Photomicrographs and diapositives were prepared to illustrate the results of the study.

For the illustration of a forthcoming paper on the occurrence of plinthite in the Amazon-region in Brazil (Dr. W.G. Sombroek) thin sections were studied and photomicrographs were made for ISM incorporation in the paper. For the illustration of the forthcoming Soil Monolith Paper 4 on a Nitosol in Kenya (Dr. W. Siderius) photomicrographs and diapositives have been prepared. Photomicrographs have also been prepared for a poster session on the ISSS Handbook for Soil Thin Section Description on the 12th International Soil Science Congress in New Delhi, India in February 1982.

Photomicrographs of thin sections of Colombian soils were prepared for Dr. E. Olmos as a follow-up of the collection of soil monoliths of Colombian soils.

3.4 Documentation

Map collection and library

During 1982 ISM again received a substantial number (about 550) of maps and reports - mostly free of charge - from many organizations, institutes, societies and individuals. Special mention is made of the forwarding of a large batch of survey reports and maps by the Land & Water Development Division of FAO. However, an active aquisition policy as well as the day-to-day running of this collection and the library as a whole, is still seriously hampered by the lack of a regular librarian/documentalist/information specialist. To carry out the barest necessities, Mr. R.O. Bleyert, whose normal activities are in the field of soil micromorphology, temporarily spends part of his time on the map and report collection. He attended a 4-day course in title description and documentation of cartographic materials according to the "International Standard Bibliographic Description (for Cartographic Materials)". He also assessed the consequences if ISM would organize its collection according to the standards set by this ISBD(CM) as proposed by the International Federation of Library Associations and Institutions (IFLA). The need for such an organization is evident if ISM is to live up to the expectations of being a reference centre.

The building up of such a documentation and facilities for the exchange of bibliographic data should be entrusted to a qualified information specialist. The wishes to employ such an expert has been voiced many years ago, to no effect.

Also the book and serial and journal collection is steadily increasing. Cataloguing is done on a voluntary basis by Mrs. J.C. Jonker, who now receives training as a library assistant.

Soil profile documentation

From the onset it was regarded as a very important aspect of the soil monolith collection to have an up-to-date documentation on the soils collected and on revelant other items, such as yield data and management practices. This work has some serious backlogs and gaps. Towards the end of the reporting period the activities have been taken up again. They include for each soil not only the complete field descriptions of the site and soil, but also the arrangement of laboratory data, micromorphological description, slides, photographs, references to journal articles and relevant books, etc. It is hoped that this highly needed activity can be completed in 1984.

Sales section

In the reporting period some new publications, which are of interest to soil scientists and rather difficult to obtain otherwise, have been added to the sales collection. Requests for the ISM- prepared "Field Extract of Soil Taxonomy" are continuing. This is also the case for the slides collection and for the maps and explanatory texts of the FAO-Unesco Soil Map of the World.

The sale of the ISM Soil Monolith Papers has just started, three papers now being available. They are sold at minimal cost and it is expected that there will be a growing demand once a greater collection is available.

3.5 Education and Information

In 1982 the number of visitors to ISM increased slightly above the level of the preceding years. This is mainly due to an increase in the number of groups of non-professional visitors and of students from Dutch Agricultural Schools. The number of students of higher level education institutes both from the Netherlands and abroad, as well as the number of individual visitors remained at the same level.

Group visits

About 1400 people visited ISM in groups, mainly from educational institutions (universities, teacher courses, agricultural and technical colleges, high schools) and from international training courses and congresses (see Appendix). Visits to the ISM soil exposition has been incorporated in the study programme on regional Soil Science for students of the Agricultural University and the M.Sc. course on soil science in Wageningen, the Tropical Section of the Agricultural College of Deventer, and some international courses held in The Netherlands. In addition, regularly groups of students are received from Germany, England, Belgium and France.

Individual visits

The number of people coming alone or in very small groups that have signed the guestbook in the Exhibition hall after their visit amounts to 170 in 1982. It has been experienced that only a part of the visitors do sign their name in this book. Most visitors are professional soil scientists. Two thirds of them comes from abroad. No systematic records have been kept of visitors who come for consulting the library and map collection or for discussions with ISM staff.

4 PROJECTS

4.1 Unesco-ISM cooperative programme for soil studies in MAB project areas

The role of ISM in this cooperative programme is to provide technical and scientific support to three Dutch associate experts in ecological sciences (soil science) who are based at the Unesco Regional Offices for Africa, Latin America and Southeast Asia, respectively. Their task is to carry out soil studies in Man and the Biosphere (MAB) project areas. This work has taken shape gradually since their arrival at duty station in mid-1980, and has passed through the stages of establishing contacts and paying orientation visits towards elaborated soil studies in some cases. Progress till 1982 has been reported briefly in ISM Annual Reports 1980 and 1981.

In the beginning of 1982 all three MAB associate experts were on home leave, which they combined with visits to the ISM office, Unesco Headquarters and various other institutes in Europe. In addition they participated in the 12th International Congress of Soil Science, held in February 1982 in New Delhi, India, and to the post congress excursions. For the MAB soil scientists this period was very useful for the exchange of information and experience, and for comparison and evaluation of preliminary results of their soil studies.

Upon return at their duty station, activities were resumed, and during 1982 some of the most important soil studies undertaken in the framework of the programme so far have been finalised, or nearly so (for details per region, see below).

In addition, ISM has greatly benefitted from the programme by an increase in number and strength of international contacts, especially in relation with the selection and taking of soil profiles for the ISM collection (see section 3.1), with the establishment of national soil reference collections, with the international course on this subject organised by ISM, and with soil correlation in general.

As enrolment in the associate expert scheme is of limited duration (maximum 5 years) and requires intermediate transfer, some personnel actions will likely take place in 1983. It is anticipated that the MAB associate expert post for Africa will be transferred from Nairobi, Kenya, to Abidjan, Ivory Coast, that the post for Southeast Asia in Jakarta, Indonesia, will be maintained and that the post for Latin America and the Caribbean region in Montevideo, Uruguay, will be upgraded to the level of expert on Unesco's proper funding.

Conclusions on the programme accomplishments and future perspectives will be drawn during a workshop, that will be organised in June 1983 at ISM. On that occasion the three MAB soil scientists will present the results of their work in the different regions for an international group of experts. For the workshop a document will be prepared, discussing the methodology, three case studies from each region, followed by conclusions and recommendations. This document will serve as a basis for the preparation of a MAB technical note.

Progress per region

Africa (Mr. A.J. van Kekem, based at ROSTA, Nairobi, Kenya).
Most work concerned the soil studies in the Mount Kulal-Chalbi-Marsabit area of the Unesco/UNEP Integrated Project on Arid Lands (IPAL) in northern Kenya. The field work for the soil survey was completed in June 1982. A final field map at scale 1:100,000 of the study area of approximately 10,000 sq. km. with accompanying legend and description of the mapping units has been produced.The field map will be reduced to 1:250,000 by the Kenya Soil Survey. Laboratory analyses have been carried out by the National Agricultural Laboraties/Kenya Soil Survey and by ISM. During the study ample attention has been given to soil-vegetation relationships with the aid of remote sensing techniques.

A terminal soil excursion has been held in October, and the results of the study have been presented at an IPAL seminar. Finally, the MAB soil scientist participated in the drafting of a management plan for the IPAL area.

Another important soil study comprising one month of field work has been done in the Makokou Reserve in Gabon. In close cooperation with national soil staff the MAB soil scientist has carried out a detailed soil survey of the main research area (300 ha at field scale 1:5000) and a reconnaissance survey of the actual reserve (10,000 ha at field scale 1:50,000). Soil-vegetation relationships have received special attention. In addition a start has been made with the monitoring of soil fertility on experimental agro-forestry plots.

Further soil studies will probably concentrate on the Tai forest in Ivory Coast, on Yangambi in Zaire, and on Basse Lobaye in the Central African Republic.

Latin America and the Caribbean (Mr. R.F. Breimer, based at ROSTLAC, Montevideo, Uruguay).
Much work has been done on the report preparation and map complilation for the integrated study of the Mapimi biosphere reserve, Durango, Mexico. The survey report on landscape and soils has been incorporated in the integrated survey report on great units and elements of vegetation and environment. The soil map, originally prepared at scale 1:50,000 has been revised and reduced to scale 1:100,000 at ISM and is in print at ITC in Enschede, The Netherlands at the end of 1982.

Some ten days of field work were devoted to research in the Pampa de Achala, a reserve of 50,000 ha on the plateau of the Sierra de Córdoba, Argentina. In cooperation with staff of the National University of Córdoba the relationships between vegetation type and soil conditions were studied.
Maps at scale 1:5000 have been made of two pilot areas of 750 ha each and of the whole area at scale 1:18,000 approximately.

A mission has been made to Chile for the planning of an erosion study project of the Catholic University of Chile. An experimental design has been made for runoff measurements on slopes under varying grazing intensities.

A short visit has been paid to the San Carlos de Rio Negro project in Venezuela. With the aid of reports on previous research in the area it was possible to quickly obtain a good overview of the setting of forest types in relation with soil type and groundwater regime.

The MAB soil scientist participated in several meetings, notably the synthesis meeting of Andean projects, held in Montevideo, and the Regional Conference of the IGU in Rio de Janeiro, and the Synthesis meeting on the San Carlos project in Caracas.

The most important element of the next programme of work is likely to be the compilation of a soil map at small scale (1:250,000 probably) of the whole Amazon black water region of South Venezuela, east Colombia and adjacent Brazil that forms one geographic unit.

Southeast Asia (Mr. H. van Reuler, based at ROSTSEA, Jakarta, Indonesia). Activities concentrated on Indonesia, while no positive response could be obtained from other Southeast Asian countries to carry out soil studies in biosphere reserves. The only work executed outside Indonesia concerned the assistance with the taking of soil profiles for ISM on Sri Lanka.

Follow up activities have been undertaken for the survey of the Gunung Gede - Gunung Pangrango area in West Java. Preparations have been made for surveys of the Udjung Kulon National Park in southwest Java, for the Berbak reserve in Southwest Sumatra and for further study on soils developed in recent volcanic ash of the Krakatau.

The MAB soil scientist participated in an expedition to Krakatau in cooperation with the Centre for Soil Research and the Bogor Agricultural University. By the end of the year he joined an expedition, organised by the Rijksherbarium Leiden, The Netherlands and the Herbarium Bogor, Indonesia, to Bukit Raya in Central Kalimantan, to characterize soils of representative sites with specific undisturbed forest vegetation. The field work will take four months and will continue in 1983.

In 1982, the MAB soil scientist attended the First International Symposium on Soil Geology and Landforms, held in Bangkok.

Global correlation, comparison of ecosystems over continents

The soil studies in individual biosphere reserves carried out in the programme bear a special scientific interest because of the possibility to compare their findings with those from other reserves. This is due to the application of a fixed methodology in all study areas. Hence soils under similar ecological conditions can be correlated on a global scale.

As representative sites for well defined ecosystems in the tropics and subtropics may be considered the following:

(semi) arid grazing lands:	- Mount Kulal, Chalbi, Marsabit area in Kenya
	- Mapimi biosphere reserve, Durango, Mexico
tropical lowland rain forest:	- Makokou reserve in Gabon
	- Yangambi reserve in Zaire
	- Tai forest reserve in Ivory Coast
	- Amazon black water region in Venezuela, Colombia and Brazil
	- Central Kalimantan, Indonesia
mountainous ecosystems:	- Pampa de Achala, Sierra de Córdoba, Argentina
	- Gunung Gede - Gunung Pangrango, Indonesia

4.2 Contribution to the Polders of the World Symposium

The Organizing Committee of the Polders of the World International Symposium and Exhibition requested ISM to make an appraisal of the world's land area where polder techniques could be applied successfully for agricultural development. Ideally such an appraisal should be a pre-feasibility study on a global scale aiming to identify areas which could be considered as "empolderable". Mr. A Jansen, a soil scientist who had just returned from Mozambique offered his good services to undertake this task and he outlined a procedure for making an inventory of flat soils with impeded drainage on the basis of the FAO-Unesco Soil Map of the World. When he left ISM in April 1982 his task was taken over by ISM staff, reinforced with a draftsman, made available through the creation of a temporary job by the Ministry of Social Affairs. In addition a group of three students of the College of Forestry and Land and Water Management (HBCS) in Arnhem joined ISM to work out a similar study on the possibilities for empoldering on the South American continent. For this study the South America sheet of the World Soil Map had been updated for the parts covered by flat wet soils. The study was completed in June and their results have been incorporated in the global ISM study which used the unchanged sheets of the World Soil Map for all other continents.

Agro-climatic zones, based on temperature limitations to crop growth, as well as aridic zones were superimposed over the soil information.

Applying the finishing touch to the World Map of flat Wetlands at the Polders of the World Exhibition

On the other hand, hydrologic and socio-economic data were not readily available for systematic incorporation in the global inventory on the same scale, and within the short time available for its compilation.

Consequently the appraisal of the flat and wet soils of the world for their agricultural potential is based on soil and climatic information only, and can not be advertised as a potential polder map, because of this lack of hydrologic and socio-economic data. Unfortunately this was not understood by all symposium leaders, while press reports placed much emphasis on the enormous extent of so-called empolderable areas, quoting the ISM figures without mentioning that they would be much lower if hydrologic, socio-economic and environmental constraints were taken into consideration.

The methodology and results of the study has been laid down in a miscellaneous ISM publication entiteld "The soils of the flat wetlands of the world, their distribution and their agricultural potential" by A.J. van Dam and C.A. van Diepen.

A collation has been made of a hand-coloured set of maps at scale 1:5 million, showing inventoried soils, agroclimatic and aridic zones. This map has been mounted on a supporting frame, measuring 9 x 4 meters, at the entrance of the exhibition in Lelystad, where it attracted lots of visitors.

4.3 ISM-Elsevier Chart of World Soils

This cooperative project of ISM and Elsevier's Publishing Company, supported by Unesco and FAO, embraces the production of a wall chart of about 110 x 160 cm, showing photographs of soils and enlisting some soil classification systems.

The work of ISM involves the supply of high quality colour photographs of soil profiles illustrating the 106 units of the legend of the FAO-Unesco Soil Map of the World. ISM is greatly interested in seeing this idea materialize as well as possible.

About 80 units can be illustrated with soil monoliths in the ISM collection, the rest of the photographs should be obtained by correspondence. The involvement of ISM should preferably be completed in medio 1983.

The soils are all correlated with the units in the Australian, Brazilian, French, German, U.S.A. and U.S.S.R. soil classification systems. In a later stage, ISM is planning to bring out an explanatory booklet with description of site and soil and analytical data of the soils on the Chart.

Although some time has been spent on this project in 1982, the bulk is planned for 1983.

4.4 Small projects

Small projects include activities that do not form part of the regular work programme and that are carried out on regular ISM funds on request. It should be mentioned that only a part of the requests received can be honoured and that priority is given to work for developing countries.

Poster micromorphology. Preparation of a poster, illustrating the use of the new ISSS system for micromorphologic soil description. On request of the ISSS Working Group on Micromorphology for presentation at the 12th International Congress of Soil Science in New Delhi, India.

Gabon. Analysis of micromorphology, texture and mineralogy of a representative soil (Xanthic Ferralsol) from the Gabon-Makokou reserve. Requested by Mr. Layaud, Service des Sols, Gabon through Mr. A. van Kekem, Unesco-MAB.

Indonesia. Particle size analysis, CEC, base saturation and pH of two samples of the Galungun volcano, Java, in connection with possibility of resettlement of population (Haskoning).

Kenya. X-ray diffractometry and interpretation of the clay fraction of 100 soil samples, with special reference to palygorskite (Van Kekem, MAB).

Malaysia. pH values, weight loss on ignition of a peat profile (Centre for World Food Studies, SOW, Dr. P.M. Driessen).

Mexico. X-ray diffraction including interpretation of the clay of 36 soil samples from the Reserva de la Biosfera de Mapimi, Durango, Mexico. On request of Mr. C. Montana/Mr. R. Breimer, MAB.

Tanzania. X-ray diffractometry and Guinier X-ray photography including interpretation of 29 soil samples on request of Mr. J.K. Samki, director Agricultural Research Institute, Mlingana, Ministry of Agriculture.

Uruguay. X-ray diffractometry and Guinier X-ray photography of 59 soil samples with special attention to chlorite occurrences to provide clay mineralogical evidence on clay destruction through ferrolysis in different Planosols of the Laguna Merin area, which consists of a million hectares of potential rice growing land. On request of Mr. A. Duran, Direccion de Suelos y Fertilizantes, Uruguay.

Zambia. Micromorphologic identification of oxic and argillic horizons. Of all our Zambian samples soil acidity was measured: exchangeable acidity (H + Al), exchangeable Al, extractable acidity. On request of Dr. W.J. Veldkamp, Ministry of Agriculture, Zambia.

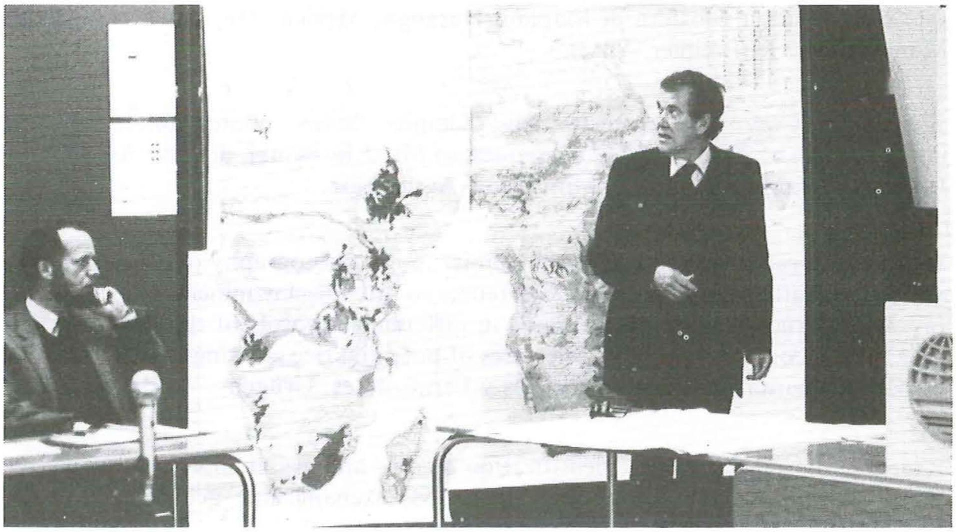
5 WORKSHOPS

5.1 Working meeting on the Comparison of Methodologies for quantitative Land evalation.

ISM closely follows new developments in land evaluation. During the last decade several studies have been undertaken that involve computer assisted models for quantitative land evaluation to make estimates of the land's productive capacity on the basis of soil, climate and crop data under specified technological conditions.

Two organizations that have made considerable progress in this field are the FAO through its Soil Resources Management and Conservation Service, in cooperation with the United Nations Fund for Population Activities (UNFPA) and the International Institute for Applied Systems Analyses (IIASA), and the Centre for World Food Studies in The Netherlands. Currently both organizations are working on country models for physical crop production. In view of the similarity of both approaches, ISM took the initiative for convening a working meeting on the comparison of methodologies involved. The Kenya Soil Survey was also invited to this meeting to present an agro-climatic inventory, made without computer assistance. The meeting was held at ISM on 6 - 7 April 1982 with 15 participants.

The meeting recognized the need for a common terminology and for a clear indication of main assumptions, and recommended application of both methodologies to a specific land area. In view of the lack of data for validation of models and for quantification of the effects on crop production of the various land qualities, the meeting recommended that studies be undertaken on basic relationships and processes in the soil-climate-crop performance sphere.



Mr. Higgins of FAO outlining the procedures of Agro-Ecological Zones project

5.2 IFIAS Save Our Soils Workshop

This workshop was held at ISM from 14 - 21 September 1982 to allow the contributors to the Save Our Soils (SOS) project of the International Federation of Institutes for Advanced Study (IFIAS) to review their results and to decide on a reasonably common format for the final analysis.

At the request of the Project Director, Prof. E.G. Hallsworth, ISM hosted the workshop and provided administrative, secretarial and logistic support. In all some 28 collaborators, representing studies from 11 countries, attended the workshop.

Studies of this project fall into three categories:

(a) Studies at the country level, in which attempts were to be made to relate the bio-physical features of an entire country and the population density, size of holding, etc., to the occurrence and severity of soil degradation. Such studies were made in Jordan, Kenya, Nigeria, Peru, Philippines, and Venezuela.

(b) Case studies, in which answers to the question of the extent to which socio-economic factors or inappropriate technology were related to the failure to apply modern knowledge of fertiliser use; soil conservation practices, or agro-forestry, were sought by questionnaires addressed to individual small farmers. In all some 8000 small farmers responded to the questions.
These studies were undertaken in Bangladesh, Colombia (2 studies), India (2 studies), Indonesia, Jordan, Kenya, Nigeria (2 studies), Peru, Philippines, Venezuela and Zaire.

(c) A comparative study of the laws relating to land tenure, soil conservation and forestry in the countries of the study.

The cost of the Wageningen workshop, and of all the case studies, except for contributions from local authorities in each country, were borne by the Netherlands Directorate General for International Cooperation.

6 GUEST RESEARCH AND TRAINING

6.1 Guest research

In 1982 guest research has been carried out by soil scientists, most of them Dutch nationals, returning from assignments abroad. One soil scientist from Japan worked at ISM on a grant of the scheme for OECD countries. ISM provides office and laboratory facilities to guest researchers, but is not in a position to pay any remuneration.
Guest research in 1982 included the following topics:

Preparation of two Soil Monolith Papers on representative soils from Jamaica
(Messrs. J.J. Scholten and W. Andriesse, coming from Jamaica)
Period: 1 January - 16 September 1982 with two months interruption of W. Andriesse for a consultancy mission.

The programme has already been given in ISM Annual Report 1981. Two Soil Monolith Papers have been completed on schedule (see section 9.1). Two articles on the genesis of three collected Jamaican soils and on quantitative land evaluation procedures for detailed rural planning in the Western Jamaican region are scheduled for publication in a scientific journal.

Preparation of a Soil Monolith Paper on a representative soil from Kenya.
(Dr. W. Siderius)
Period: 1 January - 1 November 1982.

Good progress has been made in preparing SMP4 on a Humic Nitosol from Kenya, but the paper was not yet completed when Dr. Siderius left ISM to take up a post as lecturer land evaluation at ITC in Enschede. It was therefore agreed upon that ISM staff will assist in finalizing the paper. In addition to the SMP Dr. Siderius has also greatly contributed to the article on Nitosols published in ISM Annual Report 1981.

Moreover, Dr. Siderius has been in charge of the "International Course on the Establishment and Use of Soil Reference Collections" held from 13 April - 14 May at ISM. Considerable time has been spent on the preparation, organization and follow-up of the course.

Establishment of mathematical relations between soil analytical data.
(Mr. D. Legger)
Follow up of guest research in 1981.

After his departure from ISM in September 1981, Mr. D. Legger has continued his research at the Agricultural University Wageningen making use of soil data from Brazil. He has prepared, with Prof. Dr. J. Bennema as co-author, an article provisionally entitled "The relation between the CEC per 100 gram clay and SiO_2 content, the Al_2O_3 content and the SiO_2/Al_2O_3 molecular ratio". ISM staff has provided assistance with the drafting of the article.

Characterization of four soils from Japan and comparison of micromorphological features related with gley
(Dr. M. Okazaki).
Period: 16 April - 15 October 1982.

Four Japanese soils have been collected, comprising paddy soils and adjacent non-paddy soils derived from volcanic ash and from recent fluviatile deposits. Dr. Okazaki has guided the complete laboratory analysis of these soils at ISM - including some particular analyses as total and free Fe and Mn, P adsorption in NH_4-production under waterlogged conditions - and the preparation of the monoliths. The soil monoliths form a special panel demonstrating the effect of long lasting rice cultivation on soil profile development.

The micromorphologic study concentrated on comparison of gleyic features in the two Japanese "paddy" soils, in a pseudogley and in a stagnogley profile. The purpose of this comparative study was to formulate criteria for the distinction between an "anthraquic" (man-made paddy) horizon and a "pseudo-gleyic" horizon in the forthcoming International Reference Base for soil classification (IRB).

Unfortunately "Paddy Soils" from other Asian countries were not available at ISM in time, and could not be included in the comparative study. In addition, the programme was somewhat overloaded and did not allow the guest researcher to do comparative study into alternative laboratory methods.

Preparation of a Soil Monolith Paper on a representative soil from Romania
(Mrs. N. Pons-Ghitulescu)
Period: 1 October - 31 December 1982.

Mrs. Pons will write a review of the FAO-Unesco soil Calcic Chernozem, using the ISM soil monolith R2 from Romania as reference. This profile has been collected for ISM by Mr. Oancea of ICPA (Research Institute for Soil Science and Agrochemistry) in 1976. The work done at ISM so far includes the preparation of seven thin sections, the complete range of soil analysis and preservation of the profile.

Literature is being consulted on the soil forming factors, notably the influence of parent material (Loess), biological activity, soil temperature regime (cold winters), erosion and rainfall energy. Correlation work is hampered by mapping errors in the Soil Map of the World, and by the fact that the concept of Calcic Chernozem is still floating for some requirements. An important source of information is the draft Soil Map of Europe at scale 1 to 1 million, on which contacts are maintained with Prof. Tavernier in Ghent, Belgium.

Inventory of flat, poorly drained soils.
(A. Jansen, coming from Mozambique)
Period: 1 February - 1 May 1982.

On request of the organizing committee of the Polders of the World Symposium ISM has engaged to make an inventory of the World's empolderable lands. During his short period at ISM Mr. Jansen has screened the possible sources of soil information (maps of various scales, satellite imagery) and devised a procedure to derive data from the FAO-Unesco Soil Map of the World. After his departure to the

Agricultural University of Wageningen his work has been taken over by ISM staff (see section 4.2).

Elaboration of data of the LABEX programme
(Mrs. C.H.M. Duijkers-van der Linden)
Period: 1 January - 1 March 1982.

Mrs. Duijkers has assisted with the elaboration of data of the Laboratory Exchange Programme.

International Interdisciplinary Laterites Reference Collection (IILRC)
(Mr. M.L. Moura)
Period: 7 July - 31 December 1982.

Programme: preliminary research on the International Laterites Collection to be housed at the ISM. The actual work concentrated on a review of literature; suggestions for an interdisciplinary collection of laterites (cooperation with ISM staff and Dr. G.J.J. Aleva, Billiton Geological Consultants, Netherlands); estimate of the costs for the international laterites collection and an inventarisation of the present laterite samples and profiles at the ISM, Wageningen.

Further work will concentrate on the acquisition of data from literature on selected laterite profiles. Mr. Moura will participate in the preparation of the first laterite profile (lateritic bauxite, Trombetas, Amazon, Brazil) and in some special research activities of the ISM laboratory.

6.2 Training

International Course on the Establishment and Use of Soil Reference Collections

In cooperation with and financially supported by Unesco, ISM offers an "International Course in the Establishment and Use of Soil Reference Collections". During this 5-weeks course participants, who are usually from developing countries, are trained in the setting-up of a reference soil monolith collection and the effective use that can be made of it.

The programme comprises all aspects involved, such as the taking of the profile in the field, its preparation and conservation in the workshop, sampling, collection of data, analysis and presentation of the material. An important aspect is the backstopping of the participants after their return to their home country. In this way ISM is promoting the establishment of national and regional soil reference collections.

In 1982, the course has been held for the second time from 13 April till 14 May under the direction of Dr. Siderius. The course has been attended by five persons, mainly from Latin America, as follows:

Mrs. A.M. Palacino de Walteros, Institut Geografico "Agustin Codazzi", Bogota, Colombia.

Mr. A. Califra, Direccion de Suelos, Montevideo, Uruguay

The participants of the 1982 International Course on the Establishment and Use of Soil Reference Collection.
From left to right: J. Onaldo Montenegro; A. Califra; A.M. del R. Palacino de Walteros; C.A. Ortiz Solorio

Prof. J. Onaldo Montenegro, State Government, Paraiba, Brazil
Prof. C.A. Ortiz Solorio, Universidad Autonomo Chapingo, Mexico
Dr. M. Okazaki, Tokyo University, Japan.

Preparations are being made for the 1983 Course with participants mainly from South and East Asia, while for the 1984 Course preference will be given to persons from Arab countries.

In exceptional cases the course may be given on an ad hoc basis. In October 1982 such a crash course has been given to Mr. A.C. Vermeer who was preparing his posting as soil scientist with INIA in Maputo, Mozambique.

Analytical methods

Mrs. A. Terzaghi, Uruguay. Two weeks training in X-ray diffraction analysis of clays (M.Sc. course Agricultural University).
Mr. R. Laing, Jamaica. Ten days training in particle size analysis and determination of soil moisture characteristics (DGIS).
Mrs. A. Legger, Indonesia. Training in various soil analytical techniques for work at the University of Malang (ca. 4 months, in return for analytical work).

7 TRAVEL AND MISSION REPORTS

(82/1,2) 12th International Congress of Soil Science, New Delhi, India, February 1982, organized by the International Society of Soil Science (ISSS). *Participants: W.G. Sombroek and J.H.V. van Baren.*

Participation to Congress: Sombroek in his capacity of Secretary-General of the organizing body, van Baren as representative of ISM, with the aim to keep abreast of developments in soil science and to renew and establish contacts in view of ISM activities. Sombroek reappointed as Secretary-General till next congress (Hamburg, August 1986).

Participation in post-congress tours no. 5 (Van Baren) and no. 6 (Sombroek), highlighting landscapes, soils and land use and including visits to agricultural research institutes in India.

(82/3) Third Expert Meeting on World Soils Policy, Geneva, Switzerland, March 1982, organized by UNEP. *Participant: W.G. Sombroek.*

Finalization of document ''Guidelines for national soil policies''. Identification of a total of 22 projects (including support to ISM) under the Plan-of-Action of a World Soils Policy, with UNEP as major executing agency. Incorporation of FAO's ''World Soils Charter''.

(82/5) Second International Seminar on Lateritisation Processes, Sao Paulo, Brazil. Visits to Unesco Regional Office for Latin-America, Montevideo, Uruguay and to National Soil Survey Services of Brazil and Uruguay, July 1982. *Participant: W.G. Sombroek.*

Presentation, jointly with senior Brazilian soil scientist, of a paper on Groundwater laterite and ironstone soils in Brazil, with examples for the Amazon region (Sombroek and Camargo); participation in working meetings on on-going international research programme IGCP-129 on lateritisation processes (Unesco-IUGS); agreement on the need for an international, interdisciplinary reference collection on lateritic materials, possibly at ISM.

Review of the progress-of-work of the Unesco associate expert soil science for the Latin American MAB biosphere reserves (Mexican, Chilean, Argentinian, Venezuelan and Uruguayan study areas).

Agreement with the Servicio Nacional de Levantamento e Conservacao de Solos (SNLCS-EMBRAPA) in Rio, and with the Direccion de Suelos y Fertilizantes (DSF)/Depto. de Suelos de la Facultad de Agronomia in Montevideo respectively, on cooperation in the establishment of national soil reference collections in the two countries, with the concurrent selection of extra soil monoliths for ISM; discussions on soil classification and laboratory exchange programmes (Brazil), on joint research and publication on Planosols and on methods for identification of marsh soils (Uruguay).

(82/6) Working visit to Agricultural Institute of Ireland, October 1982. *Participant: D. Creutzberg.*

Collection of information for ISM Soil Monolith Paper 3 and discussion of co-authorship of Mr. J. Kiely and Mr. S. Diamond. Discussions on future collection of Irish soils and on methods of preservation of organic and wet mineral soils.

(82/7) Fifth International Soil Classification Workshop, Khartoum, Sudan, November 1982, organized by the Soil Survey Administration of Sudan, with the cooperation of the Arab Centre for the Study of Arid Land and Dry Zones (ACSAD) and the Soil Management Support Services (SMSS) of USAID. *Participant: W.G. Sombroek.*

Progress in the international committees on Vertisols (ICOMERT), Aridisols (ICOMID) and soil moisture regimes in the tropics (ICOMMORT) towards the formulation of a basis for improved land management and transfer of technology.

Strengthening of contacts with representatives of national soil survey organizations of Arab countries and of international research programmes.

Presentation of three papers viz. ''A quest for an alternative to the use of soil moisture regimes at high categoric level in Soil Taxonomy'' (Sombroek), ''Vertisols in the collection of the International Soil Museum and some suggestions on classification'' (Van Baren, Sombroek and Kaplan) and a ''Report on the pilot round of the Laboratory Methods and Data Exchange Programme for Soil Characterization'' (Van Reeuwijk).

(82/8) Working visit to Unesco-Paris, Orstom-Bondy and IST-Dijon, France, December 1982. *Participant: W.G. Sombroek.*

Discussions on further Unesco-ISM cooperation and financial support of Unesco for ISM. Discussions on cooperation with ORSTOM on soil data bank, Labex programme, soil classification and exchange of publications.

Participation to presentation of doctorate thesis on tropical hydromorphic soils by Mr. Vizier at the Institut des Sciences de la Terre (IST).

8 INTERINSTITUTIONAL RELATIONS

8.1 International relations and activities

FAO

Common interests of FAO and ISM have stimulated regular contacts, notably on the elaboration of an International Reference Base for soil classification and on the updating of the FAO-Unesco Soil Map of the World. Representatives of the FAO/UNFPA/IIASA Project have participated in a working meeting on the "Comparison of methodologies for computer assisted assessment of the productive capacity of lands" convened by ISM (see section 5.1).

FAO has donated a substantial number of reports to the ISM library. In addition ISM has received copies of the topographic base map of the world scale 1:5 million.

FAO advises ISM with the preparation of the Elsevier Soil Chart of the World.

Unesco

Cooperation with Unesco, the formal international patron of ISM, continued to be very fruitful. Through its Division of Ecological Sciences the joint programme for soil studies in the MAB biosphere reserves and research sites in Latin America, Africa and Southeast Asia continues (see section 4.1). Financial support was given for backstopping visits of the Director ISM to the duty stations of two of the three associate soil scientist involved. A workshop on the first results of the studies is to be held in June 1983 in Wageningen.

Unesco also sponsored three participants from South America in the 2nd International Course on Establishment and Use of National Soil Reference Collections (see section 6.2), and is favourably inclined to support future backstopping missions of ISM staff to some Latin America countries, that are in the process of establishing national collections.

Through Unesco's International Geological Correlation Programme (IGCP) and its international working group on lateritisation processes (IGCP project 129) it was suggested that an international interdisciplinary reference collection of laterite profiles and materials be established at ISM. It would be used by geologists, mineralogists, geomorphologists, civil engineers and soil scientists. A first proposal on the scope of such a collection, and the likely requirements in staff and space, was prepared by ISM guest researcher Mr. Moura, and submitted to the authorities concerned.

Unesco also undertook to support the publication of an Elsevier-ISM Wall Chart of World Soils (see section 4.3).

UNEP

The Director took an active part in the formulation of a specific programme to be carried out under UNEP's Plan-of-Action to implement a World Soils Policy. The set of 22 identified programmes (cf. ISSS Bulletin no. 62 for details) was endorsed by the Governing Council of UNEP in May '82.

ISM staff was also involved in the formulation of criteria and methodologies for global soil and land resources monitoring, as part of UNEP's already existing programme on a Global Environmental Monitoring System (GEMS).

The standing request for a substantial programme support for ISM for four years was included in the World Soils Policy set of programmes, and a final decision on funding is awaited for May '83.

ISSS

ISM continued to house the Secretariat-general of this single international organisation of professionals in all branches of soil science (6500 members). At its twelfth international Congress in New Delhi - India, February 1982, a number of new Working Groups were established, several of them on subjects close to ISM programmes. Special mention is made of the new ISSS Commission V Working Group on the elaboration of an International Reference Base for soil classification (IRB). The Chairman of this working group, Prof. Dr. E. Schlichting (GFR) prepared a detailed project proposal, for funding by UNEP's Worlds Soils Policy plan-of-action. The project involves the establishment of a number of international committees to elaborate classification proposals for main natural groups of soils; while supporting technical units are to be established at FAO and ISM respectively, the latter mainly on the laboratory side along the lines of its current LABEX programme.

The much-needed updating of the existing FAO/Unesco Soil Map of the World is likely to be linked closely to the IRB programme.

The ISSS Subcommision on soil micromorphology requested ISM to assume a secretariat's function at the establishment of a reference and exchange collection of representative thin sections of major soil diagnostic horizons and properties, now that a unified system of soil micromorphological description is about to be published by the Subcommision.

European Commission

Some suggestions were submitted on specific projects (including research on soil degradation) to be supported by the new EEC programme on Tropical Agriculture (DG 12).

The European Commission recently designated Wageningen as seat for its documentation centre on the countries of Africa, the Caribbean and the Pacific, associated with the EEC (ACP countries). This opens prospects for future cooperation in the field of documentation on land resources management. A possible location for the temporary housing of the EC/ACP centre could be a topfloor on the ISM building yet to be constructed.

Others

The proposed International Board of Soil Resources Assessment and Management (IBSRAM) received an impulse through the funding by the Australian Centre for International Agricultural Research (ACIAR) of a fact-finding mission annex project formulation by two international experts. One of them visited ISM to establish how it can cooperate in one or more networks/cells for research on specific soil-related constraints for crop production in the tropics. The envisaged Board is to work in close contact with the International Agricultural Research Centres of the CGIAR system, but the funding and siting of a secretariat and of a central data bank is still in the balance.

Contacts were maintained with several of the CGIAR institutes, notably IITA as regards the need to study in depth soil degradation features at its experimental grounds in Nigeria. ISM also provided soil mapping data for an inventory of the various wetlands of West-Africa that are potentially suitable for paddy-rice cultivation; part of a cooperative project of IITA and several Dutch research institutions.

Contacts with the CGIAR institutes are expected to intensify in the near future, in connection with ISM's likely cooperation in the USAID supported IBSNAT project. This International Benchmark Site Network for Agrotechnology Transfer is to start studies of the basic relationships between soils, climate and crop-performance, including crop growth modelling, at experimental grounds of the CGIAR institutes and some major national institutes in developing countries.

ISM staff continued to participate in the work of the several international committees on the improvement of the US Soil Taxonomy System of soil classification, now under the umbrella of the USAID/USDA Soil Management Support Programme (SMSS). The latter programme requested ISM's cooperation in the establishment of an "International Pedon Data Records file" and an "International Soil Mapping Unit and Taxa file", both to be used for further standardisation of international soil classification and soil mapping. Contact were also maintained with several other groups working on the improvement of national or regional soil classification systems, notably the French ORSTOM and the Brazilian SNLCS-EMBRAPA.

8.2 National relations and activities

The following contacts were maintained as before:

- International Institute for Aerial Survey and Earth Sciences (ITC) in Enschede, and its Department of Soil Science in particular (lecturing, ad-hoc training cartography).
- Royal Tropical Institute (KIT) in Amsterdam, Department of Agricultural Research in general and its Division of Soil Science and Agrochemistry in particular (the joint ISM-KIT Laboratory Exchange programme LABEX).

- Agricultural University (LH) in Wageningen, in particular its Department of Soil Science and Geology (soil monolith collection and characterization), its Department of Soils and Fertilizers (fertility testing of selected soils) and its MSc. Course in Soil Science and Water Management (instruction).
- The Dutch Soil Survey Institute (STIBOKA) in Wageningen (micromorphology; determination of physical properties of soils; cartography; map cataloguing; project preparation; job mediation; assistance to research project on the characteristics and development of wetlands in tropical Africa for intensified production :IITA Wetland Utilization project).
- The Netherlands Foundation for the Advancement of Tropical Research (WOTRO) in The Hague (genesis and properties of soil developed on volcanic ash on Java, Indonesia, and their constraints for agricultural use; sealing phenomena of tropical soils).
- International Institute for Land Reclamation and Improvement (ILRI) in Wageningen, which convened the Acid Sulphate Soils Research Party. ISM participated, together with LH and STIBOKA in its Working Group on the Inventory, classification and evaluation of acid sulphate soils.
- International Agricultural Centre (IAC) in Wageningen and its Project Advisory Committee (fellowships; visitors accommodation; technical assistance projects; job mediation).
- The Royal Netherlands Academy of Sciences (KNAW) in Amsterdam (soil science exchange programme with China).
- The Directorates of Agricultural Research (DLO) and Agricultural Assistance Developing Countries (AHO) of the Dutch Ministry of Agriculture.

9 PUBLICATIONS

9.1 Soil Monolith Papers

In 1982 two publications in the series of Soil Monolith Papers (SMP) have been issued, each dealing with a soil from Jamaica that has been selected as a typical example of a soil unit according to the legend of the FAO-Unesco Soil Map of the World. The papers concerned viz. "SMP5, Humic Acrisol (Orthoxic Palehumult), Jamaica" and "SMP6, Acri-Orthic Ferralsol (Haplic Acrorthox) Jamaica" have been prepared by two guest researchers, Messrs. J.J. Scholten and W. Andriesse, supported by ISM personnel for laboratory analysis, micromorphologic descriptions, typing, illustrating, commenting and final editing.

As both authors worked full time on these publications an accurate account can be given of the workload of authorship, which amounted to 450 working days for two papers. The contributions of supporting staff can be estimated at one month of technical staff for handling the profiles, five months of the laboratory staff, two months of the soil micromorphological section, three months of clerical assitance and two months of the scientific staff, totalling to 13 months of work in addition to that of the authors.

Four other SMP's are still on the planning board, viz.:
SMP2, Orthic Ferralsol (Typic Haplustox), Zambia (Z2)
SMP3, Placic Podzol (Placaquod), Ireland (IRL9)
SMP4, Humic Nitosol (Oxic Paleustalf), Kenya (EAK16)
SMP7, Calcic Chernozem (Vermic Haplustoll), Romania (R2).

The authorship of these papers lies with either ISM staff or guest researchers. In view of the considerable amount of work required for the completion of a SMP up to the current standards it is unlikely that ISM will publish documentation in the form of SMP's on all the 106 FAO-Unesco soil units within a reasonable time span.

As the publication of such papers is related to ISM's role to stimulate developments in soil science in general and of soil classification in particular, ways and means should be found to pursue the task of documenting the world's soils on the basis of the ISM soil collection. Some alternative lines of action could be followed. Attention should be paid to the possibility that MSc students prepare SMP's as theses. The formula that guest researchers at ISM prepare SMP's has proved to be successful. Similarly, soil scientists based elsewhere, notably in the country of origin of a soil monolith could be senior authors of a paper, the more so as the three completed issues in the series may serve as a guideline for the set-up of additional papers. In any case some flexibility should be allowed as to the length and depth of discussions under the various topics, depending also on the background and interests of the individual authors.

9.2 Technical Papers

Spanish language editions of Technical Papers (TP) 1 and 2 are in preparation. The draft of the Spanish TP1 "Procedimientos para la relección y preservación de perfiles de suelo" has been used by the participants of the course in soil reference collections. Their comments have yet to be incorporated in a final version.

One of the course participants, Mr. A. Califra, has prepared a translation of TP2 "La fotografia de suelos y paisajes asociados".

Both papers will be published in 1983.

9.3 Monographs

The series "ISM Monographs" is intended for reporting on soil research at ISM, which cannot appropriately be published in a Soil Monolith Paper or a Technical Paper. The new series is open for a wide range of subjects in soil science. In particular it may report on studies in soil genesis and classification, laboratory methods, or land evaluation. The general aim is to strengthen the state of knowledge on the world's soil resources, for application in the field of land management and agro-technology transfer.

The first ISM Monograph, entitled "Podzols and Podzolization in Temperate regions" has been prepared by D.L. Mokma, guest researcher at ISM, and P. Buurman of the Agricultural University Wageningen. By the end of 1982 the paper is in print, while a colour plate "Podzols and related soils" showing 40 soil profiles will be published in early 1983. The plate will be available as annex to the paper or separately.

9.4 Annual Report 1981

An annual report over the preceding year has been issued as usual. It includes two articles, viz. "The case for soil reference collections" (Van Baren and Sombroek), and "Nitosols, a quest for significant diagnostic criteria" (Sombroek and Siderius). Reprints of these articles are available.

9.5 Miscellaneous

On various occasions ISM staff has presented papers which are available as publications, reprints of articles or in mimeographed form. They may be referred to as follows:

- Sombroek, W.G. (1982). A quest for an alternative to the use of soil moisture regimes at high categoric level in Soil Taxonomy. Fifth Int. Soil Class. Workshop Khartoum, Sudan. Mimeog. 8.pp.
- Sombroek, W.G. and N. Camargo (1982). Groundwater laterite and ironstone soils in Brazil, with examples from the Amazon region. In: Proceedings Second

International Symposium on Laterite Proceedings, Sao Paulo, Brazil, 1982.
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10 PERSONNEL

10.1 ISM Board of Management

Members of the Board of Management were on December 31, 1982:
- Prof. Dr. Ir. G.H. Bolt, Chairman Netherlands Advisory Council.
- Prof. Dr. L. van der Plas, Agricultural University Wageningen.
- Ir. J.B. Ritzema van Ikema, International Institute for Aerial Survey and Earth Sciences (ITC), Enschede.
- Ir. R.P.H.P. van der Schans, Division for Agricultural Research, Ministry of Agriculture and Fisheries, Wageningen (Chairman)
- Prof. Dr. Ir. T. Wormer (personal member)

10.2 International Advisory Panel

The International Advisory Panel (IAP) met in 1967, 1972 and 1979. The members of the IAP in 1979 were:

- Prof. Dr. G. Aubert, ORSTOM, Bondy, France.
- Dr. F. di Castri, Unesco, Paris, France.
- Dr. R. Dudal, FAO, Rome, Italy.
- Dr. S. Holzhey, USDA-SCS, Washington, USA.
- Dr. R. Herrera, IVIC, Caracas, Venezuela.
- Prof. Dr. V.A. Kovda, Moscow State University, Moscow, USSR.
- Dr. R. S. Murthy, National Bureau of Soil Survey and Land Use Planning, Nagpur, India.
- Dr. A.M. Osman, ACSAD, Damascus, Syria.
- Dr. S. Pereira Barreto, ORSTOM, Dakar, Senegal.
- Dr. L. D. Swindale, ICRISAT, Hyderabad, India.

10.3 Netherlands Advisory Council.

Members of the NAC on December 31, 1982 were:

- Ir.J.G. van Alphen, International Institute for Land Reclamation and Improvement (ILRI), Wageningen.
- Dr. J.P. Andriesse, Royal Tropical Institute, Amsterdam.
- Prof. Dr. Ir. J. Bennema, Department of Soil Science and Geology, Agriculture University Wageningen.
- Prof. Dr. Ir. G.H. Bolt, Departement of Soils and Fertilizers, Agricultural University Wageningen (Chairman).
- Dr. Ir. J.C. Dijkerman, M. Sc. Course Soil Science and Water Management, Agricultural University Wageningen.
- Prof. Dr. Ir. A. van Diest, Royal Netherlands Society of Agriculture, Wageningen.
- Dr. Ir. Th.J. Ferrari, Institute for Soil Fertility, Haren.

- Prof. Dr. Ir. D. Goosen, International Institute for Aerial Survey and Earth Sciences (ITC), Enschede.
- Ir. W.B. Hoogmoed, Tillage Laboratory, Agricultural University, Wageningen.
- Dr. F. Kadijk, Laboratory for Soil and Crop Testing, Oosterbeek.
- Prof. Dr. Ir. F.R. Moormann, State University Utrecht.
- Ir. J.C. Pape, Soil Sciences Society of the Netherlands, Wageningen.
- Dr. F.W.T. Penning de Vries, Centre for Agrobiological Research, Wageningen.
- Dr. Ir. J. Schelling, Soil Survey Institute (Stiboka), Wageningen.
- Drs. J.F. Th. Schoute, Free University, Amsterdam.
- Dr. Ir. P.K.J. Van der Voorde, Euroconsult, Arnhem.
- Prof. Dr. Ir. A.P.A. Vink, Laboratory for Physical Geography and Soil Science, University of Amsterdam.
- Ir. W. van Vuure, Division for Agriculture Research, Ministry of Agriculture and Fisheries, Wageningen.
- Dr. Ir. G.P. Wind, Institute for Land and Water Management Research (ICW), Wageningen.

10.4 ISM Staff

On December 31, 1982 the ISM staff members were:

Dr. Ir. W.G. Sombroek	: Director; soil classification and correlation
Drs. J.H.V. van Baren	: Curator; documentation
Dr. Ir. L.P. van Reeuwijk MSc	: Soil chemistry, mineralogy and physics
Drs. D. Creutzberg	: Soil micromorphology; educational affairs
Ir. C.A. van Diepen	: Publications; agricultural applications
Ir. A.J. van Dam	: Soil documentation
Ing. R.O. Bleyert	: Soil micromorphology; map documentation
Mr. A.J.M. van Oostrum	: Chief laboratory analyst, chemical
Mr. J.R.M. Huting	: Laboratory analyst, physical
Mr. R.A. Smaal (seconded by ITC)	: Laboratory analyst, physical
Mr. W. Bomer Sr.	: Monolith preparation; technical services
Mr. W.C.W.A. Bomer Jr.	: Technician, photography and drawing
Mr. J.D. Schreiber	: Technician, thin-section preparation
Mr. J. Brussen	: Internal administration*
Mrs.Y.G.L. Karpes-Liem Mrs. P.C. van Leeuwen	: Clerical services
Mrs. J.C. Jonker-Verbiesen Mrs. J. Nijhuis-Möller	: Maintenance services

In addition are working at ISM on a pro deo basis:

Mr. J.G. ten Bokkel	: Laboratory analyst
Mr. B. van Lagen	: Laboratory analyst
Mr. T. Wechgelaar	: Draftsman

*External administration by Managing Director, ITC, Enschede.

Staff mutations in 1982

- Mrs. A.C. Reyerse, secretary, left.
- Mrs. Y.G.L. Karpes-Liem, secretary, joined.
- Mr. J. van Welie, apprentice, worked in the workshop for 6 months.
- Mr. Th. Wechgelaar, draftsman, joined ISM on a six months contract.
- Mr. B. van Lagen, laboratory analyst, joined ISM on a six months contract.
- Ir. A.J. van Dam, soil scientist (joined ISM on a 18 months contract, instead of military service).

10.5 Guest researchers

The soil scientists, who have worked at ISM during 1983 as guest researchers, were:

Ir. W. Andriesse
Ir. C.H.M. Duijkers-van der Linden
Ir. A. Jansen
Ir. D. Legger
Dr. M.L. Moura
Dr. M. Okazaki
Mrs. N. Pons-Ghitulescu
Drs. J.J. Scholten
Dr. W. Siderius

Details on their work programme are provided in section 6.1.

10.6 Trainees

The soil scientist, who have received training at ISM in 1982, were:

Mr. A. Califra
Mr. R. Laing
Mrs. A. Legger
Dr. M. Okazaki
Mr. J. Onaldo Montenegro
Dr. C.A. Ortiz Solorio
Mrs. A.M. Palacino de Walteros
Mrs. A. Terzaghi

For details see section 6.2.

Appendix - Visitors in 1982

Groups of professional visitors

National

Agricultural University (LH), Wageningen	6 groups	145 persons
Assistant Agricultural Attachés		15 persons
Delft University of Technology (TH), Delft	2 groups	39 persons
Free University (VU), Amsterdam		14 persons
National Agricultural School (RHLS), Deventer	9 groups	186 persons
School of Agriculture (HLS), Den Bosch		24 persons
School of Agriculture and Horticulture (HLTS) Kerk Avezaath		25 persons
State University Groningen (RUG), Groningen		45 persons
Teacher College for Biology (Witte Lelie), Amsterdam	2 groups	44 persons
Teacher College for Geography (MO Aardr.k.), Utrecht		20 persons
University of Amsterdam (UvA), Amsterdam	3 groups	65 persons
Royal Geological and Mining Society Netherlands		25 persons
School of Agriculture, Dronten		24 persons

International

Agricultural University (LH), Wageningen, MSc course Soil Science	9 groups	225 persons
Agromisa International Course, Wageningen		12 persons
Fachhochschule Bochum, F.R. Germany		12 persons
Fachhochschule Osnabrück, F.R. Germany		25 persons
Group of students from Bonn, F.R. Germany		20 persons
International Course for development oriented Research in Agriculture (ICRA), Wageningen	3 groups	66 persons
Institut Nationale Agronomique, Paris-Grignon, France		10 persons
International Institute for Aerial Survey and Earth Sciences (ITC), Enschede, Netherlands		30 persons
International Institute for Land Reclamation and Improvement (ILRI), Wageningen, Drainage Course		30 persons
International Training Course (ITC), Gent, Belgium		25 persons
Portsmouth Polytechnic, Dept. of Geography, UK	2 groups	45 persons
IJsselmeerpolders Development Authority, Lelystad, Netherlands		11 persons
University Gent, Belgium		18 persons
University Götenborg, Sweden		8 persons
University of Osnabrück, F.R. Germany		21 persons

Group of non-professional visitors

National

Agricultural University (LH), Wageningen, personnel		30 persons
Free School, Zeist	2 groups	45 persons
Heldring College, Zetten		23 persons
School for analysts (STOVA), Wageningen	3 groups	67 persons

VISITORS FROM ABROAD IN 1982

Representatives of international organizations

Dudal, R. *(FAO)*
Gruner, G. *(EC)*
Hallsworth, E.G. *(IFIAS)*
Higgins, G. *(FAO)*

Visitors by country

Australia
Beattie, J.
Dexter, A.R.

Austria
Diepenhorst, H.W.A.

Bangladesh
Choudhury, A.T.
Fahdr-al-Miah
Harun-or-Rashid Md.
Islam, M.J.
Kalam Miah, M.A.
Mollah, M.M.H.
Muzil, M.A.

Belgium
Blandeel, R.
Boel, G.
Cuypers, E.
Debouck, K.
De Clerq, L.
De Tollenaere, B.
Haiden, F.A,
Haverbeke, L.
Hofman, G.
Idi, G.
Janssen, J.
Kartadji, B.
Kefjaar, G.
Schaumont, T.
Stoops, G.
Vandenabeele, J.
Van den Boogaerde, H.
Van Helewijk
Van Ruimbeke, M.
Van Walleghem
Van Wambeke, A.
Verbeek, K.
Volekaart, V.
Wegen, A.

Benin
Adoukonou, B.

Bolivia
Reynaert, E.
Salem, H.R.

Brazil.
Anzuateguiri, I.
Biersteker, R.R.
Da Costa, E.F.
Faria, R.T. de
Hennel, G.A.
Montenegro, J.O.

Bulgaria
Athanasova, T.

Burma
Nyo

Canada
Hunter,M.
McKeague, J.A.
Petch, B.

Chile
Garcia, R.

China (Taiwan)
Chang Hsi-Lih
Yang Wan-Fa

Colombia
Amparo Royas
Ashby, J.A.
Olmos, E.
Palacino de Walteros, A
Weeda, N.

Costa Rica
Monge, O.A.

Dominican Republic
Arrendono

Egypt
Abdel Malek, B.M.
Badr. N.M.
Farghaly, M.S.
Naguib, B.H.
Schaap, R.H.
Yandil, N.

Ethiopia
Bekele Tassen

Finland
Aalto
Matue, F.V.
Salt, V.

France
Baillet. F.
Bennet, R.
Bidanel, J.P.
Billon, F.
Boisson, C.
Bouchet, G.
Boullet,P.
Chautru, C.
Courty, M.A.
Dauphin, H.
De Milly, H.
Deygont, P.
Dijkman, J.H.
Fedoroff, N.
Feekes, A.M.A.
Goni, J.
Guillemin, C.
Herrault, Ch.
King, A.
Mamy, J.
Medioni, R.
Servant, J.

Gambia
Atou, I.S.
Njie, N.

Germany, Fed. Rep.
Auerswald, K.
Bailly, F.
Brouwer, P.B.J.M.
Esser, G.
Hilgeman, H.
Hoffman, C.
Lamp, J.
Leysmann, U.
Mähl, H.
Schaller, G.
Schmidt-Lorentz, R.
Schulze, D.
Speutzen, F.
Thiel, W.
Trautwein
Van der Sluis, L.
Viereck, A.
Vogl. W.
Volkel, M.

Ghana
Andoh
Tinzonku, W.A.

Guinea-Bissau
Dos Santos, B.
Talla, J.

Hungary
Ligetvári, F.
Muranyi, A.
Rajkai, K.

India
Arolkar, S.S.
Bali, Y.P.
Barshad, R.
Basu
Chawla, D.S.
Debadatta, B.
Kanwar, I.S.
Karale, R.L.
Kool, Y.M.
Manindra, P.
Misra, R.V.
Nikam, B.K.
Parshad, R.
Randhawa, N.S.
Roy, A.K.
Virmani, S.M.

Indonesia
Aboesoemono, I.
Aminuddin, N.S.
Anas, I.
Beerens, I.J.J.
Darwis, J.
Djamal, Z.
Hasan
Ismirham, M.
Julkifl, N.
Kadarusno
Kok
Kosirih, S.E.
Mader, Z.
Madjid, Sabar, A.
Manan, M.M.
McCauley, D.S.
Munaf, M.
Nawadi, D.
Nugromo, K.
Radjagukguk, B.
Raimadaya
Sudjiono, Hs.
Tamdjid, A.
Tri Tugaswati
Van Barneveld, B.
Van Reuler, H.

Israel
Ariadam, S.
Gafny, A.
Moché, R.

Italy
Frijlink, A.
Heidsma, J.
Hielkema, J.
Staners, M.

Ivory Coast
Van Walsem, J.

Jamaica
Daley,
Laing, R.

Japan
Fujisawa, T.
Imanishi, H.
Inowe, S.
Koyama, M.
Mizuno, N.
Okazaki, C.
Takashina, J.
Yazaki, J.
Yonemura, J.

Jordan
Arabiat, S.M.
Battikhi, A.
Qasem, J.M.H.

Kenya
Okongo, A.
Ongweny, O.
Mohamed, A.
Muturi, M.S.
Van Kekem, A.J.

Korea
Han Myeang Kim
Kim Deok Chee

Lebanon
Faour

Lesotho
Khohlokwane, M.J.

Malawi
Manda, D.R.B.

Malaysia
Bah, C.S.
Evsof, Z.
Hibsa, M.H.
Hussain, S.A.
Lee Chock Seng
Mokhtar, S.
Sei Ping Chew

Mali
Bouaré, S.
Traoré, G.

Mexico
Anaya, M.
Garduno, M.A.
Ortiz Solerio, C.A.
Ponce, R.H.
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Cutler, E.J.B.
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Ahmed, N.
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Khatoon, S.
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Wike, E.A.

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Regis
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Librero, F.
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Rijk, A.G.
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Uggle, Z.
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Terberg, G.J.M.

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Noppaporn
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Sukanya

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Sönmez, B.
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United Kingdom
Andrew, M.J.
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Boughton, D.
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Burgess, T.
Camp, D.C.
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Dohurty, P.
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Hinsherwood, A.
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Slingenberg, M.H.
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Uruguay
Breimer, R.F.
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Vessuri, H.

Yugoslavia
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Pavletíc, L.
Telisman

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Mahimba, B.

Zambia
Comissaris, A.L.T.M.
Henneman, R.
Mulanga, N.
Sevenhuysen
Veldkamp, W.J.

ISM PUBLICATIONS

The ISM Soil Monolith Papers

1. Thionic Fluvisol *(Sulfic Tropaquept)* Thailand, 1981
2. Orthic Ferralsol *(Typic Haplustox)* Zambia, in prep.
3. Placic Podzol *(Placaquod)* Ireland, in prep.
4. Humic Nitosol *(Oxic Paleustalf)* Kenya, in prep.
5. Humic Acrisol *(Orthoxic Palehumult)* Jamaica, 1982
6. Acri-Orthic Ferralsol *(Haplic Acrorthox)* Jamaica, 1982
7. Calcic Chernozem *(Vermic Haplustoll)* Romania, in prep.

The ISM Technical Papers

1. Procedures for the Collection and Preservation of Soil Profiles, 1979
   (Spanish version in preparation)
2. The Photography of Soils and Associated Landscapes, 1981
   (Spanish version in preparation)
3. A new Suction Apparatus for Mounting Clay Specimens on Small-Size Porous Plates for X-ray Diffraction, 1979
4. Field Extract of "Soil Taxonomy", 1980, 1982
5. The Flat Wetlands of the World, 1982
6. Labex, the Results of the Pilot Round, 1982
7. Field Extract of "Classification des Sols", in prep.

The ISM Monographs

1. Podzols and Podzolization in temperate regions, 1982

AIMS OF ISM

- to serve as a documentation centre on soils of the world - through its collection of soil monoliths and reports and maps on land resources with emphasis on the developing countries
- to improve methods of soil analysis - through research and international correlation with emphasis on soil characterization and classification
- to transfer specialized information - by lecturing and by publishing on the collected materials and on research data, and by advising on the establishment of national or regional benchmark soil collections
- to stimulate and contribute to new developments in soil genesis and classification, soil mapping and land evaluation - through active participation in international scientific working groups

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ISBN: 90-6672-013-1