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# BOOK REVIEWS

## Soil Atlas of Europe

*European Soil Bureau Network of the European Commission, principal editors A. Jones, L. Montanarella, and R. Jones, Office for Official Publications of the European Communities, Luxembourg. 2005. 128 p. €25. ISBN 92 894 8120.*

Soil maps from the same area but different periods show how soils and their distribution were perceived and mapped over time. They tell a bit about developments in soil mapping and soil science in general. The first soil maps of Europe started to appear in the mid-1800s but it was not until the 1920s that a map for the whole continent was produced. Since that time several soil maps were published. In this review, I will first discuss the *Soil Atlas of Europe*, and then early generations of soil maps of Europe and how they compare.

This first *Soil Atlas of Europe* is slightly bigger than my *Times World Atlas* but contains less than half of its pages. The primary aim is to provide comprehensive information about the soils of Europe and raising awareness of issues affecting soils; it is part of the European Soil Thematic Strategy that was adopted by the European Union in 2002. Another goal of the *Atlas* is to educate people about the important role of soils in a non-technical manner.

The *Atlas* has 7 sections. In the introduction, some of the main soil properties, processes, and land uses are described. Sections are devoted to the soil profile, horizon classification, soil variation, and soil forming processes. Two pages deal with "the soil in your garden," attempting to explain soils to non-soil specialists. This is a brave attempt and one can read here that people fertilize their garden because of nutrient depletion caused by weeding and tidying. There are also paragraphs on soils and agriculture, forestry, soils as a source of raw material, and soils and cultural heritage.

In the second section, the soil types of Europe are described following the World Reference Base (WRB) for soil resources, which is the successor of the FAO-UNESCO classification system. A brief introduction is given on soil classification and the WRB, followed by descriptions of the major soil types and their distribution across Europe. Seven of the 30 WRB soil types (reference groups) do not occur in Europe, like Ferralsols (Oxisols), Alisols, and Lixisols (Ultisols). The soils with the largest extent are Albeluvisols (Alfisol suborders) that cover 15% of the European land mass; Podzols (Spodosols) cover 14%, and Cambisols (Inceptisols) cover 12%. There are two pages on soil mapping (with the auger, spade, and topographic map) and there is a paragraph on digital soil mapping. Two overview maps show the availability of soil maps at scales of 1:50,000 or 1:250,000 in Europe. It seems that large countries with large economies and populations (France, Germany, UK) do not necessarily have good coverage of detailed soil maps. In fact, smaller and more densely populated countries have more detailed soil maps, or in other words: the smaller the country, the better the availability of detailed soil maps (with the exception of Denmark and Switzerland). There is an array of reasons, but in densely populated places there may have been a historical need to know the land as population pressure was higher. In bigger countries, the need for detailed spatial information about soil resources might have been less pressing as land was amply available.

The third section provides 17 regional maps for the whole of Europe. It starts with an overview map at 1:11.25 million showing the soils in Europe including Turkey and Russia up to the Ural Mountains. The 17 regional maps (Lambert Azimuthal projection) are at scales ranging from 1.175 to 1:6.5 million; most maps are at a scale of 1:2 million. There is a nice text introduction to each regional map but the legend (suborder level) is given only once on pages 40 and 41. Major cities and highways are included, which makes orientation easy.

In the next chapter, the soil types and distribution in Europe are compared to soils in other parts of the world. According to the *Atlas*, Europe covers about 5% of the global soils and an overview is given how soil distribution differs between different parts of the world. For example, Leptosols (shallow stony soils) are the most dominant soils in the world, whereas they cover 9% of the European land mass and are not in the dominant eight soils that occur in North America. Ferralsols (Oxisols) are dominant in South America whereas Arenosols are the most widespread in Africa. The 1:22 million soil map of Europe and Eurasia shows that the Ural Mountains act as a clear divide in soil distribution. Albeluvisols (Alfisol suborders) are dominant on the eastern part, and Histosols, Cryosols, and Podzols (Spodosols) occur at the same latitude east of the Urals. That is nice about maps—if you look longer, you see more. There is a separate section on soils of the Mediterranean regions and soils in the Northern latitudes (with a little bit on global warming).

The next chapter deals with the European soil database and explains what GIS is and how the soil geographical database of Europe is constructed. The database consists of a soil geographical database, soil profile database, hydraulic properties database, and the pedotransfer rule knowledge base. These are linked as the first step in the development of an integrated European soil information system. Using this integrated database, small maps are presented showing, for example, clay content in the topsoil, base saturation, or depth to bedrock. Soil erosion and potential $N_2O$ maps as well as organic matter maps are shown and these are valuable for formulating policy at the EU level. No doubt this section of the *Atlas* shows the potential of soil information systems. And the way ahead!

After that a section is devoted to the seven key threats to soils in Europe: soil sealing, erosion, loss of organic matter, decline in biodiversity, contamination, hydrogeological risks, and salinization. Except for the decline in biodiversity, contamination, and salinization, the other four threats have been fairly well mapped. It would have been of interest to see how these threats are translated into policy and action. Readers of *Journal of Environmental Quality* would probably also like to have seen more on contamination and its spatial distribution in the soils of Europe. The last chapter, "Additional Information," contains maps on rainfall, temperature, land cover, population density, and a tiny section on soil education.

So far, I have given a brief description of the content of the *Soil Atlas of Europe*; now, some general comments. The *Atlas*

is amply illustrated with photographs and most are stunning; a few are poor, false colored, or out of focus. Fewer would have been better. However, more editing would have been better. The *Atlas* would have benefited from careful checking (funny error being the *Crysols* on page 30). The guiding principle of this book was "…that soil should be made as simple as possible, but no simpler." It is a famous quote of Albert Einstein (it should have been: *not* simpler). One wonders whether such guiding principle is functional—I mean, *how* could soil be made simpler; soil maps perhaps, but soil itself? The *Atlas* provides no answers.

The *Atlas* has no index and that in itself is unjustifiable; an atlas without an index is like the Internet without a search engine. There are more peculiarities in the *Atlas*. Throughout the book *Soil* is used, for example, "Soil of Europe," "Key Threats to Soil in Europe," etc.—indeed all single. Why not plural? I guess it is deliberate but we do not have soil in Europe, we have soils. Not one but many, very many, and very different, which the *Atlas* clearly shows. The biggest sin, in this reviewer's opinion, are the regional maps. The 17 maps are scales ranging from 1.175 to 1:6.5 million. That makes comparison between different parts of Europe less easy, and is also disputable in an atlas meant for policymakers and those who are not comfortable with map scales or aware of scale differences.

Somehow, the *Soil Atlas of Europe* could have resembled the beautiful book *Australian Soils and Landscapes—An Illustrated Compendium* (McKenzie et al., 2004), but it does not. It lacks rigor (too many authors perhaps) and image and map quality are not quite comparable. Some subjects in relation to the soils of Europe are lacking or treated very briefly; for example, there is nothing on the manure problem which occurs in some regions or on climate change that will affect the Mediterranean countries and that will also change land use in other parts of Europe. There is also nothing on soils and health or soils and socioeconomics. If the *Atlas* were to live up to its promises (raise awareness, be didactic, etc.), the section on soil education should have been larger.

Despite some points of critique, I enjoyed reading the *Atlas* and learned much about soil distribution in Europe. There is ample information that should be read by policymakers and the general public to increase their understanding of the soils of Europe. The price (about $30) is also very affordable. Buy it, look at the maps, read it.

Of course, the format is different from earlier soil maps but let us see how this first *Soil Atlas of Europe* compares to the earlier soil maps of Europe.

## Soil Maps of Europe, 1928–1985

The first soil maps in Europe started to appear in the 1800s, and such maps were mostly produced for agricultural purposes or the taxation of rural lands and emphasized surface geology and the degree of weathering of the regolith (Stremme, 1997). Mapping approaches varied widely among countries and it took a long time before soil distributions of different countries were produced in one map. K.D. Glinka (1867–1927) produced a schematic soil map of the world in 1908. The International Society of Soil Science (ISSS, but since 1998, the International Union of Soil Sciences, IUSS) was established in Rome in 1924, and one of its first activities was to produce a soil map of Europe. This was deemed necessary to overcome language problems and differences in mapping approaches. Countries in Eastern Europe followed more the Russian (=V.V. Dokuchaev and N.M. Sibirtsev) approach of soils as natural bodies than those in Western Europe where mapping started later and followed a more geologic approach.

The first European soil map was published in 1928 and prepared by H. Stremme (1879–1961) and the soil survey staff from Danzig (Germany). They succeeded G. Murgoci from Romania who died in 1925 (Stremme, 1997). The map at a scale of 1:10 million and legend in German, French, and Polish (later also in English) had 27 map units and included Chernozems, Rendzinas, Podzols, peat, salty soils, brown and red soils. The base map was the geological map at a scale of 1.5 million; geological maps were available since the late 1700s. For this first European soil map, 36 soil scientists from different countries were consulted including J. van Baren, K.D. Glinka, H. Jenny, G.W. Robinson, and G. Wiegner. The map was presented at the first World Congress of Soil Science in Washington, DC (USA) in 1927 where it was agreed to produce a more detailed map at a scale of 1:2.5 million. This map was published in 1937 and also compiled by H. Stremme with the help of W. Hollstein and E. Ostentorff and 87 collaborators from all European countries (Stremme, 1937). The map has 43 map units grouped in seven sets: steppe soils with AC profiles, dry forest soils, forest soils, wet soils, saline soils, rock soils, and mountain soils. There was no explanatory text, and, although there were plans to write such text, it was not realized due to the Second World War (Stremme, 1997).

The next soil map of Europe was produced 30 years later by the Food and Agricultural Organization of the UN and the EEC (FAO, 1965). To this matter, it was decided at a meeting in the early 1950s with the purpose of discussing problems of soil classification and soil terminology. Systems of classification used in the different countries varied in approach but for the 1965 map a uniform legend was presented. The legend consists of soil associations composed of soil units. Various soil classes were later used in the FAO-UNESCO 1:5 million map (1981), like Lithosols, Regosols, Rankers, and Rendzinas but there were also units like Grumusols (≈Vertisols), Rubrozem soils, Brunizems (≈Cambisols), and Sierozems (grey-brown, calcareous) that did not make it into the FAO-UNESCO legend.

Soil associations are composed of soils that are geographically associated in the landscape and have a strong topographic and bedrock composition base. Soils were also grouped based on agricultural use. The map and report were prepared by R. Dudal, R. Tavernier, and D. Osmond but more than 50 soil scientists from 23 countries provided information for this map. Many countries only started systematic soil surveys after the Second World War. This map contains the best soil distribution information available at that time. It is interesting to note that the earlier maps of the 1920s and 1930s were not cited in the 1965 European soil map or in successive efforts.

The next European soil maps were all produced in the framework of the 1:5 million *Soil Map of the World* for which the preparations began in 1961 as a joint project of FAO and UNESCO following a recommendation the ISSS made at the World Congress of Soil Science in Madison, Wisconsin (USA) in 1960. On behalf of the FAO, the coordination of the project was assured by D.L. Bramão (1961–1968), L.D. Swindale (1968–1970), and R. Dudal (from 1970). The complete *Soil Map of the World* was presented at the 10th World Congress of Soil Science in Moscow in 1974, and publication of all 19 map sheets was achieved by 1981. The completion of the *Soil Map of the World* has been one of the main contributions of the ISSS (van Baren et al., 2000) and has since its completion found wide applications, such as assessment of desertification, delineation of major agro-ecological zones, evaluation of

**Table 1. Soil maps of Europe, their scale, number of legend units, and map sheets.**

| Year of publication | Map scale | Number of map units | Number of map sheets | Reference |
|---|---|---|---|---|
| 1928 | 1:10 million | 27 | 1 | Stremme (1928) |
| 1937 | 1:2.5 million | 43 | 12 | Stremme (1937) |
| 1965 | 1:2.5 million | 34 | 6 | FAO (1965) |
| 1981 | 1:5 million | >700 | 2 | FAO-UNESCO (1981) |
| 1985 | 1:1 million | 312 | 7 | Commission of the European Communities (1985) |
| 2005 | 1:1 to 1:6.5 million | 163 | 17 | *Soil Atlas of Europe* |

global land degradation, calculation of population supporting capacity, creation of a World Reference Base for Soil Resources, and the creation of a digital global Soils and Terrain Database (SOTER).

In 1981, the European volume of the 1:5 million *Soil Map of the World* was published (FAO-UNESCO, 1981). By that time, most of the European region was covered by systematic soil surveys. Only Iceland, the northern parts of Finland, and the USSR and Turkey in Asia were mapped at the reconnaissance level. On this map, units are associations of soil units (e.g., Arenosols, Vertisols), which were assigned texture and topography (slope class) of the dominant soil. Phases (e.g., stony, phreatic) are superimposed on the map units.

In 1985, a 1:1 million soil map of Europe was published (Commission of the European Communities, 1985). This map was prepared by R. Tavernier and R. Dudal, who also produced the 1965 soil map of Europe (1:2.5 million) and the European sheet of the FAO-UNESCO soil map (1:5 million). The map has 20 soil orders like Gleysols or Luvisols and more than 60 great groups (e.g., Chromic Cambisols). The legend of the map shows 312 different map units which consist of associations of soil units occurring within the limits of a mappable physiographic entity.

## Three Generations of Soil Maps

Table 1 summarizes the available soil maps for Europe; the first generation maps produced by Stremme have a strong agro-geological base and were based on limited soil survey work. These soil maps stimulated soil survey and research in most European countries of which the fruits were harvested for the second generation of European soil maps (1965–1985). These developed in the heydays of soil survey and were based on hundreds of detailed national and regional maps. The second generation is now being replaced by a third generation of maps—digital soil maps in which full use is made of existing soil information with advancements in GIS, remote sensing, and quick and accurate soil observations using a range of sensors. The *Atlas* has interesting sections on those third generation types of soil maps that should be compulsory reading for those involved in policymaking.

## Concluding Remarks

When comparing the 1965 map to the 1981 and 1985 maps some striking differences are found. Much more detail is reflected in the number of mapping units and scale of the map. All three soil maps summarize soil survey activities in each country, including the types and scale of soil maps, specialized maps, and publications. Soil survey was at its zenith. And then the mapping was more or less over, as most governments withdrew their support for multi-purpose and generic soil surveys. As a result, little traditional soil mapping (auger, spade, stereoscope) has taken place since the early 1990s. And you can tell from this first *Soil Atlas of Europe*. The soils and their distribution are based on early work; few new boundaries are present as compared to the 1985 map. Classification has been adjusted from the FAO-UNESCO system to WRB but other than that, the *Atlas* shows no new insight in the soil distribution of Europe. It appears that the 1965 soil map was used for the first general overview map in the *Atlas* because Zuidelijk Flevoland in the central parts of the Netherlands is shown still as a lake, whereas it already was a polder in 1968. For the regional maps, the 1985 soil map was used.

In the explanatory text of the 1:5 million soil map the following was concluded: "…on balance, it can certainly be said that, all in all, Europe is one of the most privileged regions of the world from the standpoint of the agricultural potential of its soils" (FAO-UNESCO, 1981). This was written in the late 1970s when agriculture was still regarded as very important by most people. But times have changed and more change is on its way. In the coming decade, there will be considerable changes in the European landscape. Such changes will perhaps directly result from global warming, but, more importantly, many farmers will retire or go out of business due to decreasing farm subsidies and increasing farm output in other parts of the world. Future soil maps of Europe will have to focus on changing land use whereby recreation, nature conservation, and urbanization may become more extensive than agricultural land use.

I guess this may be the last time that a printed map of the soils of Europe is produced. Future soil maps will be GIS Web based and, hopefully, continuously updated and expanded. The European Soil Bureau has embraced digital soil mapping in which new soil maps are produced with auxiliary data at a range of scales and resolutions. That is a beautiful development. We can only hope that printing and cartographic features improve as well. The 1965 and 1985 soil maps of Europe are nicely produced in a hard box with eloquent maps and well-written text summaries. They are outdated, of course, but they are a great pleasure to look at—that is not the first aim of a soil map, but helpful if policymakers and the general public are to be made aware of the role of soils in human welfare.

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