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Future of Soil Science

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Soil is fundamental to the needs of man life, because it provides most of our basic needs and plays a central role in determining the quality of our environment, but this is not well appreciated by most of the population. In the future, the role of soils and soil cover in some crucial aspects for man's life like food production, the hydrological cycle, and air composition will further increase. Therefore, more soil information of good quality will be required for adequate decisions about land use and management. The main and final goal of soil science will continue to be the evaluation and prediction of the behaviour of soils in time and space, under a wide range of agricultural and non agricultural land uses, in relation to crop production, water supply and environment quality. At present, most of the major decisions about agriculture and environment, and in general about world development, are usually made without taking into consideration the prominent role of soil science.

Present situation

The rapid increase in population, with higher food and water demands, is causing more human influences on soils, both through the expansion and intensification of agricultural activities and the growth of number and size of populated areas. Frequently, it leads to widespread land and soil degradation, and increased production of farming, domestic and industrial wastes. The main consequences are a decrease in the reserves of arable lands, increasing agricultural developments in new lands with unfavourable climate and relief conditions. There is a decrease in available good quality water for agriculture, urban and industrial needs, and a decrease in biological diversity.

These problems may lead to dramatic environmental, social and economic consequences that in the poorer developing regions are manifested trough decreased crop productivity, increased poverty and migration. There are also increased risks and problems of desertification, flooding, landslides, sedimentation, etc. The shrinkage of water resources of good quality is limiting the development of irrigated agriculture, and is increasing the risks of salinization and contamination of soils. It is also worth to mention the contribution of changes in soil cover and soil degradation to global climate changes. The increased degradation of soils and their consequences may be attributed to the lack of awareness by most of the human society, and of the institutions where decisions of land use and

management planning are taken, about the capital role and functions of soils for man life.

Although contributions of soil science have benefited humankind by increasing agricultural food production and enhancing the environmental quality, at present there is a dangerous general slowdown on those trends. Concurrently, there has been a decrease in resources dedicated to field oriented soil science studies, and much of the present research in soil science is dedicated to isolated aspects, not covering integral problems, due to limitations of time and funds, to the difficulties of interdisciplinary cooperation, and to the compulsion of publishing papers quickly. At the same time, there has been an increased tendency to rely on qualitative data and concepts, based on expert judgements, like indices of soil quality, with a very limited accuracy, insufficient for developing adequate policies for land use and management. Moreover, frequently land use planning is being based on empirical approaches coming from professionals with scarce formation in soil science.

Planning land use and management requires input data which is site specific, but in many cases the kind of required information is not available. One of the difficulties found in the assessment of soil conditions related to the performance of soils under different land use and management, and climate change, based on already existing data, is that most of the previously made soil surveys provided static information, while for soil functions there are necessary more dynamic soil parameters. Modelling is extensively used as a tool to integrate information, and to avoid measurements and field experiments for every soil and condition. Modelling is not a substitute for experimentation and models need input parameters of good quality, obtained not only in laboratory tests, but also under controlled field conditions. These studies are not common because they are time consuming, costly and difficult to finish in a publication fulfilling the requirements of soil science journals. Therefore, they are substituted in many cases by empirical approaches, or the use of data that are already available or easier to obtain, empirically deducing, by the use of pedotransfer functions, of properties and processes required for modelling. Much of the accepted and used methodology and instruments for evaluating parameters of soils in the laboratory do not give data which correspond to real, or even approximate, values under field conditions. In general, the progress in developing models and processing systems of information have been much faster than in the development and use of methodologies and equipment to get the adequate field information to feed them.

Challenges for the future

In general the future developments in soil science research must be directed to a better understanding of the processes and reactions in soils related with

crop production, chemical recycling and water balance, over a range of spatial and temporal scales. Of particular importance will be the improved identification and description of important dynamic processes in soils critical for the supply of water and nutrients for plant growth and for soil degradation, as affected by external temporal factors like climate. This has to be followed by the development of simplified simulation models to find the best combination of management practices, integrating selected critical parameters of soils, crops and climate, for a more efficient and economical use of soil water and energy addressed to increased crop production, overcoming depletion and minimizing risks of soil, water and environmental degradation, including risks of natural disasters like flooding and landslides.

In order to assure the prominence that soil science should have in the future World development there will be necessary to improve the education and awareness of population at all levels about the relevant functions of soils for the life of mankind. There are also required an improvement and a reorientation in the training in soil science addressed to soil scientists and other professionals involved in the design and planning of land use and management, with a more holistic approach, reinforcement of hydrological aspects and a better integration of theory and field work. To guarantee an interdisciplinary approach there would be necessary an increased cooperation among soil scientists and scientists of related disciplines, and among institutions involved in research and application of soil and land use and management.