

**REHABILITATION OF DEGRADED VOLCANIC SOILS OF CHILE  
AND MEXICO: RESULTS OBTAINED FROM AN  
INTERNATIONAL AND INTERDISCIPLINARY  
PROJECT (REVOLSO);  
(INCO-DEV FRAME PROGRAMME V OF THE EUROPEAN UNION)**

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**Abstract**

The international and interdisciplinary **REVOLSO** Project («Alternative Agriculture for Sustainable Rehabilitation of Deteriorated Volcanic Soils in Mexico and Chile», # ICA4-CT-2001-10052), belonging to the INCO-DEV Programme of the European Union, aimed the rehabilitation of degraded volcanic soils of Chile and Mexico. Five Latin American and four European scientific organizations were included in this Project that started in January 2002 and ended in July 2006. Experimental works were carried out in selected plots located in the States of Michoacán and Tlaxcala (Mexico), and close to the city of Chillán (Chile). The initial hypothesis was based on the fact that much of soil degradation occurring in the studied areas is caused by the excessive pressure on land resources produced by subsistence agriculture, thus increasing poverty. This vicious circle should be broken avoiding the continuous soil degradation through its recovery by applying new knowledge and alternative agronomic management systems. The goal of the REVOLSO Project was to provide and to test a technological package adapted to the socio-economic circumstances of farmers in both countries, adopting organic soil management or balanced fertilization, diminishing soil tillage, maintaining mulching, and to stop the erosive processes and to increase the productive capacity of these lands by including leguminous rotation and agroforestry. Accordingly, the study presents some important final results obtained by the REVOLSO Project.

**Key words:** Soil erosion, Tepetates, Soil fertility, Soil organic C.

### **Introduction**

About 25% of the surfaces of the Andean countries in South America (i. e., Chile, Colombia, Ecuador, Peru), Central America, and Mexico are covered with volcanic soils. These physically fertile soils (poor from the point of view of the some macronutrients) have been cultivated inadequately with culture practices that caused severe erosions, decreasing dramatically the yields during the last decades. Due to erosion of superficial layers, hardened subsoil layers called *tepetates* (Mexico), *talpetates* (Nicaragua), *cangahuas* (Ecuador), *trumaos* or *ñadis* (Chile) appeared at the surface. Small farmers living in these deteriorated regions progressively loose the soils, and migrate toward megacities of Mexico, USA, or Canada.

Taking into account the mentioned problems, the objectives of the REVOLSO Project were listed as following:

- Develop improved technological packages to achieve a sustainable rehabilitation and improvement of deteriorated volcanic soils in Mexico and in Chile, but taking into account the know-how of previous investigations on traditional local practices, principles of organic agriculture, and local experiences in agroforestry.
- Develop a set of measures in order to achieve a sustainable soil management in agriculture and reforestation in order to prevent the erosion of non-deteriorated soils in areas of deteriorated volcanic soils in Mexico and Chile based on results of former research projects, traditional practices, sustainable agriculture, and agroforestry.
- Consolidate and integrate the research results obtained into recommendations for the sustainable rehabilitation of deteriorated volcanic soils and the prevention of the erosion of non-deteriorated volcanic soils.
- Disseminate these recommendations to producers, associations, and governmental institutions of the regions concerned.
- Disseminate the results of the REVOLSO Project internationally by publications in international journals, national and international congresses on agriculture and soil science, and in an International Symposium on Deteriorated Volcanic Soils (ISVO'06) at the end of the lifetime of the project.

### **Materials and methods**

Materials and methods employed were selected by members of the following partners of the REVOLSO-Consortium, according previous experiences:

- a) *Justus-Liebig-Universität, Giessen, Germany (JLU)*
- b) *Institut de Recherche pour le Développement, France (IRD)*

- c) *Colegio de Postgraduados*, Mexico (CPM)
- d) *Universidad Autónoma de Chapingo*, Mexico (UACH)
- e) *Universidad de Concepción*, Campus Chillán, Chile (UDEEC)
- f) *Consejo Superior de Investigaciones Científicas*, Spain (CSIC)
- g) *Universidad Autónoma de Tlaxcala*, Mexico (UAT)
- h) *Instituto Nacional de Investigaciones Forestales y Agropecuarias*, Mexico (INIFAP)
- i) *Università di Pisa*, Centro Interdipartimentale Ricerche Agroambientali, Pisa, Italy (CIRAA)

Organisation of the Tasks of the REVOLSO partners: The tasks of REVOLSO, divided into 5 work packages (WP1-WP5), each one of them co-ordinated by members with experience in former projects on their specific research fields, forming joint working groups. Some Latino-American partners provided support, particularly in the accomplishment of empirical research in the individual countries studied.

Partner (a), Justus-Liebig-University of Giessen, Germany (JLU), has been responsible for overall co-ordination of the work plan, profiting existing strengths in international research related to the rehabilitation of deteriorated volcanic soils and his knowledge of local working conditions.

In line with the objectives mentioned earlier, the 5 work-packages divided REVOLSO into specialised activities over the lifetime of the project (4½ years). The first and second work packages (WP1 and WP2) provided the current local agricultural and agroforestry practices and integrate them to innovative alternative cultivation measures in order to work out a more sustainable agricultural technology package. The third and fourth work packages (WP3 and WP4) analysed the impact of the different cultivation practices respectively on the soil fertility and ecology, and on its erosivity and erodibility. The fifth work package (WP5) analysed the social and economical situation of the rural population involved, implementing the role of women and young rural people in marginal regions with deteriorated volcanic soils, and follow up its dissemination and its acceptance of the technical package among the rural community.

**Table 1. Arrangements for involvement of the REVOLSO consortium partners in the individual work packages (WPs)**

Work Package Nr.	Work Package Title	Cooperation and Name of direct Working Team Partner (Nr.)	Start Month	End Month
1	Cultivation Practices	JLU & UAT	1	55
2	Agroforestry	UDEEC, CENAPROS & IRD	1	55
3	Soil Fertility and Ecology	CPM & CSIC	1	55
4	Soil Erosivity and Erodibility	IRD & CENAPROS ; CIRAA & UDEEC; JLU & UAT	1	55
5	Social and economical aspects	UACH & CPM	1	55

The REVOLSO consortium used basic methods in agricultural and agroforestry research which are standard on farm investigations for all work packages (WPs) to be applied in Chile and Mexico. For WPs 1-3 and 5 the «traditional» standard methods for laboratories have been used as described in the individual reports or the partners.

### **Results, deliveries, and achievements**

Training and Dissemination: Up to the end of 2006 (end of REVOLSO) 22 MSc and 9 PhD degrees have been obtained by 31 graduated students who elaborated their theses or parts of their theses within the REVOLSO Project. Ten scientists stayed more than 3 months with their partners in Latin America or Europe in order to work together with their team colleagues in their labs and/or teaching and learning methods and discussing results. Members of the REVOLSO consortium and their collaborators presented in total 262 papers: 124 papers in scientific meetings, symposia, national and international conferences, 44 publications on CD or in the internet. Forty two articles in journals have been accepted/submitted, 17 books and/or contributions to books were published (some in print), and 35 other publications are registered by the REVOLSO members. Results are listed in chapter 6 (References: Main results).

### **Conclusions**

The REVOLSO consortium hits the main targets of the Project:

- Rehabilitation and management of the renewable resources; rehabilitation of the environment through sustainable agriculture and agroforestry. The following step should be lead by national public officers through the elaboration of public policies preventing further deteriorations of these important soils and lead specifically to
- Improvement of the quality of life of the small holders by
- Achieve of a sustainable development of their communities.
- disseminating results among the rural community and the follow-up of the implementation of the technology package worked out
- Targets to achieve the sustainable social and economical development of the rural community are important to be drawn.

One example of the previous proposition was the result, from a chat between the co-ordinator with the Governor of the State of Tlaxcala, Mexico, the REVOLSO's Tlaxcalan partner *Universidad Autónoma de Tlaxcala* (UAT) convoked the federal and local institutions on July 26, 2006, in order to create a «Permanent Council for the Environmental Protection of the State of Tlaxcala (*Consejo Permanente Para La Protección Ambiental Del Estado*

*De Tlaxcala, COPPAET*)» which will be organised by a Sub-Committee of Ecology and Environmental Protection within the existing governmental «Planning Committee for the Development of the State of Tlaxcala» (*Comité de Planeación para el Desarrollo del Estado de Tlaxcala*).

### References: Main results

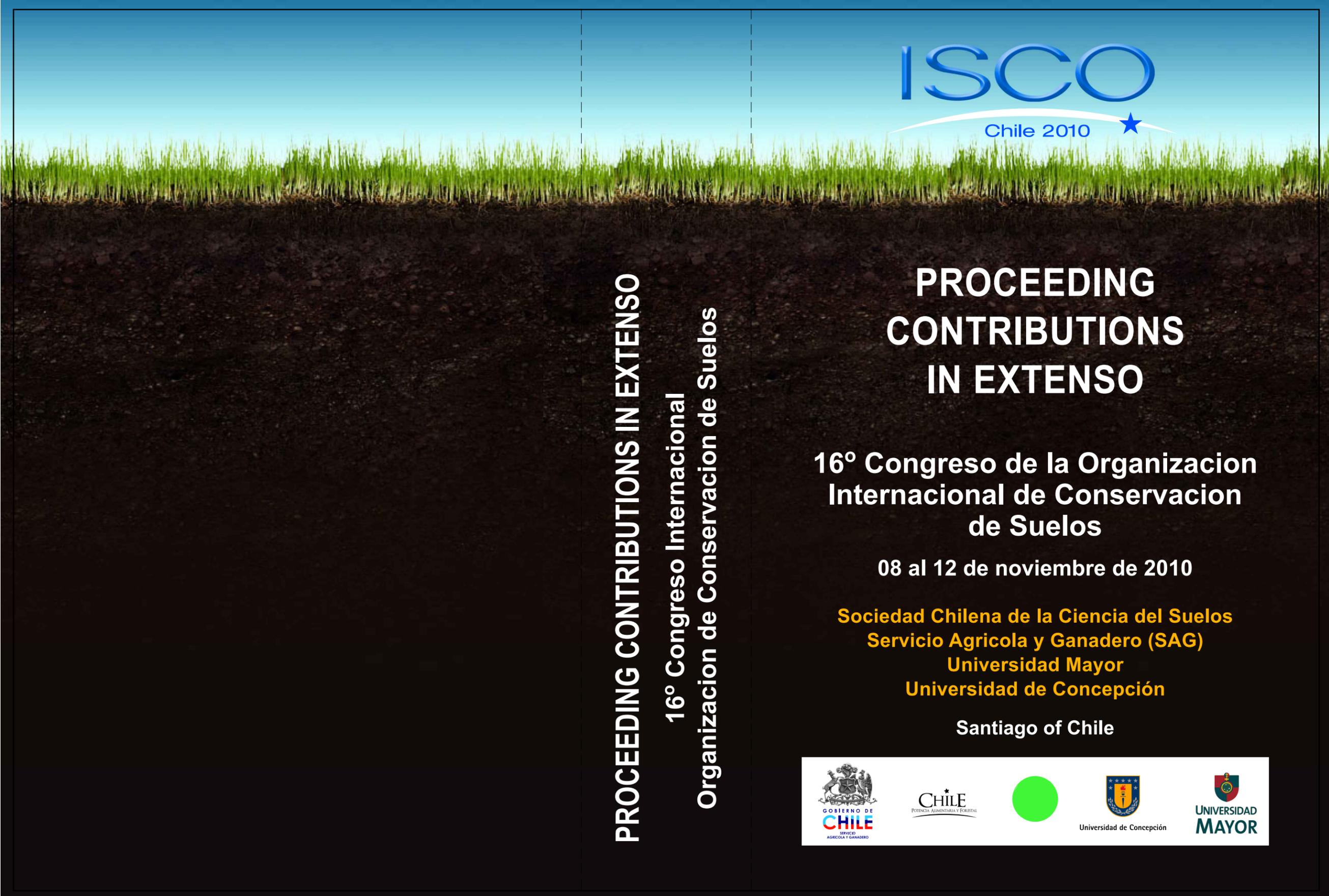
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