

Land reclamation by agave forestry with native species in the mountains of Michoacán state

Alejandro Martínez Palacios, Christian Prat and Eduardo Ríos Patrón

In Mexico, 45 percent of the country suffers from land degradation, 12 percent of which, or some 23 million ha, are degraded due to water erosion. In Michoacán, a state in west-central Mexico, the figure rises to 27 percent. A study of the soil in Michoacán determined that overgrazing was a cause of degradation and a strategy was drawn up to promote cropping of agave, which is used in production of a high-value alcoholic drink as well as in medicines and cosmetics. The agave's high value would mean farmers would need fewer cattle. While waiting for the agave to mature, the farmers intercrop trees, plants and grasses that produce marketable products and women earn income in greenhouses by selling small agaves from the seeds they have collected. This project, which started in 2011, is still ongoing.

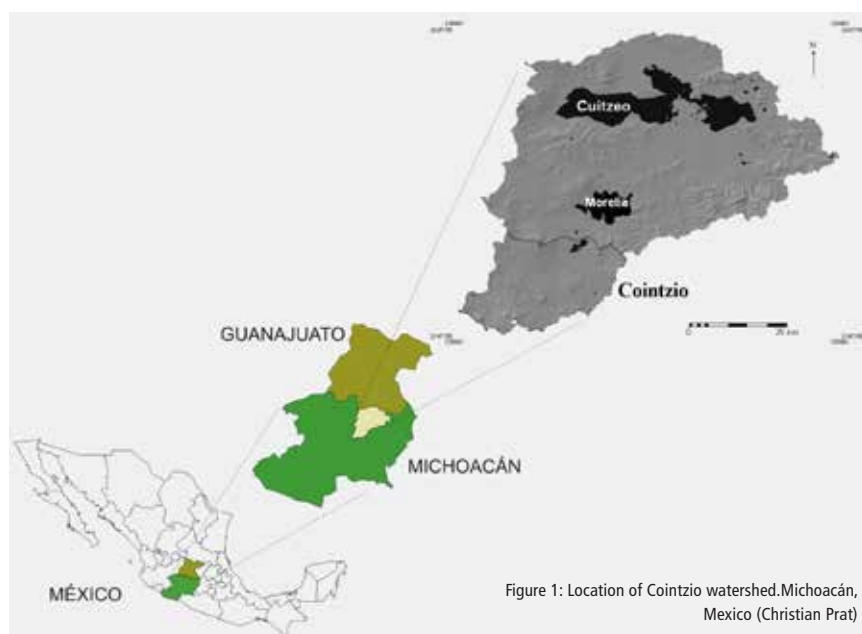
Agave (*Agave cupreata*) plantations of seven years growth for mezcal production. Titzio, Michoacán, Mexico (Christian Prat)

The Cointzio catchment located in the transverse volcanic belt of central Mexico covers 630 km² (Figure 1). The catchment bedrock consists of igneous rocks generated by Quaternary volcanic activities and, according to the World Reference Base (WRB) for soil resources, its soils are mainly Andosols in the headwater areas and on the hillsides up to 3 000 masl, Acrisols on the foothills, and Luvisols on the plains at 2 000 masl. An area river network is dominated by the Rio Grande de Morelia with a dam located at the outlet of the catchment, 13 km upstream of Morelia, the state capital, which has more than 1 million inhabitants. This dam was built in 1940 to create a reservoir to supply water for domestic consumption as well as for agricultural irrigation. However, the reservoir (4 km² – 65 × 10⁶ m³) has undergone significant sedimentation, which has led to severe deterioration of environmental conditions in the lake and to a 20 percent loss of its water holding capacity.

Fingerprinting methods to study soil erosion in this watershed provided very similar results regarding the origin of sediment in the subcatchment, which is dominated by Acrisols and the bulk of sediment is supplied by gullies. In contrast, in the subcatchment dominated by Andosols, the bulk of sediment was supplied by cropland.

The combination of the fingerprinting and the sediment export data measurements yielded information on the erosion dynamic as well the origin of the eroded soil particles. The studies showed that soil erosion in the Cointzio catchment is due to overgrazing, mainly on the upper part and the mountainsides – information used to prioritize the implementation of erosion control measures to mitigate sediment supply to the Cointzio reservoir.





The main suggestions called for improving the agronomical system by improving cattle production, reducing free grazing and the number of animals. However, due to the fact that this proposal would call for more work, more funds and more time, and as the level of poverty in the area is medium to high, and the income from agriculture accounts for only 10 to 20 percent of the total family budget, few farmers were able to follow this recommendation. Thus, building from this information and from workshops in some farming communities with national institutions and local authorities, another strategy was developed based on plantation of native agave (*Agave inaequidens*), trees or fruit trees, shrubs and grasses plants to create at mid-term (7–12 years) a sustainable production of a traditional Mexican alcoholic liquor (*mezcal*) or cosmetic and medicinal products, fibres or fodder for cattle or wood.

One part of the agave is planted in continuous lines to create a green wall to control soil and water runoff and the other part is planted in staggered. In addition, other native plants are planted between the lines of agave, to be used as food, fodder and/or medicinal products.

Unlike most agave, *Agave inaequidens* reproduces from seed, which requires harvesting seeds from native plants found growing wild in the fields. One plant generates 80 000 seeds with a 90 percent success rate of germination, which is enough to cover 25 ha of agave forestry plantations to control soil erosion. The harvested agave, tree and shrub seeds are maintained in a greenhouse managed by the owners or tenants of the land. At the beginning of the rainy season, plants are transferred to the plots, where cattle are not allowed for at least the first two years of planting.

While the trees, shrubs and grasses are harvested annually, agaves are only harvested after 7 to 12 years depending on the soil degradation level. Harvesting requires removing the heart of the agave (*piña*) which weighs around 50 kg. The actual *mezcal* production requires an average of three weeks with at least two men to process 25 agave plants (1.5 tons) and produce 300 litres of *mezcal*. The proximity of the site to the Michoacán state capital and recognition by the



authorities of the designation of origin for this *mezcal* creates high value for their future production.

The main purpose is to reach sustainable land rehabilitation while generating high incomes for the farmers. This allows them to reduce the amount of livestock and overgrazing, which is the main cause of soil erosion in this region. The production of *mezcal* will give local farmers high incomes. While waiting the 7-12 years for the agaves to produce, farmers are growing small agaves from seeds that they collected. This activity gives jobs to a dozen women in each community who receive income from selling part of this plant production. Trees, shrubs and grasses for medicinal uses, food and fodder are complements of agave production and are processed mainly by women, while agave harvesting is a male activity.

As it is very financially convenient, farmers will remain in the communities instead of migrating to cities or abroad. Biodiversity is preserved with the increased use of native agaves, trees, shrubs and grasses. Turning eroded soil into productive soil also sequesters carbon and increases water availability as a result of the new soil cover.

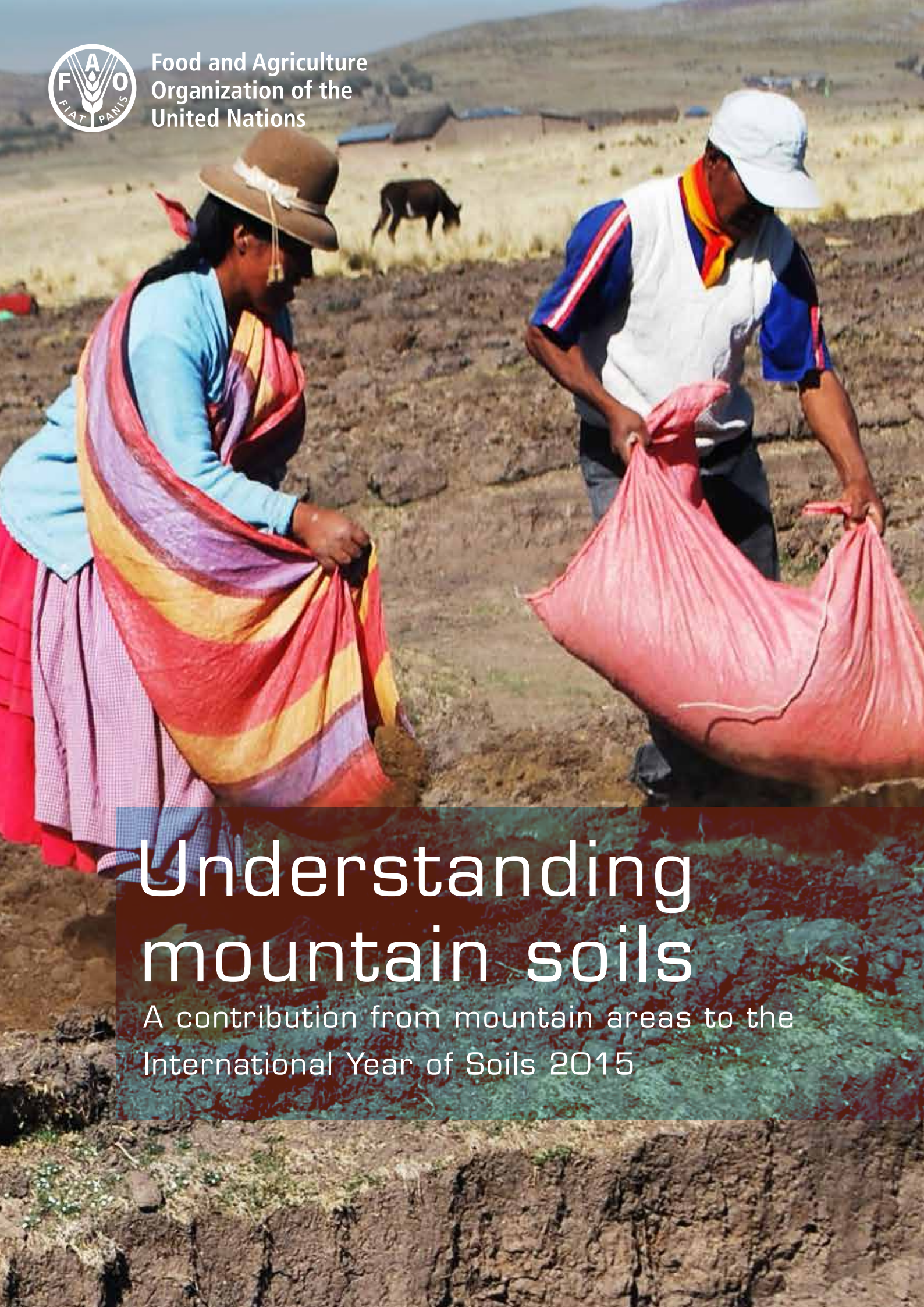
The agave project was initially implemented for five years (2007-2012) through Mexican (Secretaría de Medio Ambiente y Recursos Naturales – SEMARNAT, Secretaría de Educación Superior Ciencia, Tecnología e Innovación – SENESCYT, Michoacán State, Ministerio de Agricultura, Ganadería, Acuacultura y Pesca – MAGAP, Universidad Nacional Autónoma de México – UNAM, Universidad Michoacana de San Nicolás de Hidalgo – UMSNH), French (Institute de recherche pour le développement – IRD) and the European Desertification mitigation and remediation of land (DESIRE) project funds. Since 2013, SEMARNAT, municipality of Morelia and UMSNH have continued to follow the project and share the results with other communities. They also have supported the local population with introduction of efficient woodstoves and a drinking-water network.



3 months old agaves (*Agave inaequidens*) San Andrés Coapa, Michoacán, Mexico (Christian Prat)



Food and Agriculture
Organization of the
United Nations



Understanding mountain soils

A contribution from mountain areas to the
International Year of Soils 2015

Understanding Mountain Soils

A contribution from mountain areas to the
International Year of Soils 2015

In collaboration with the Mountain Partnership Secretariat,
the Global Soil Partnership and
the University of Turin

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2015

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO in preference to others of a similar nature that are not mentioned.

The views expressed in this information product are those of the author(s) and do not necessarily reflect the views or policies of FAO.

ISBN 978-92-5-108804-3

© FAO, 2015

FAO encourages the use, reproduction and dissemination of material in this information product. Except where otherwise indicated, material may be copied, downloaded and printed for private study, research and teaching purposes, or for use in non-commercial products or services, provided that appropriate acknowledgement of FAO as the source and copyright holder is given and that FAO's endorsement of users' views, products or services is not implied in any way.

All requests for translation and adaptation rights, and for resale and other commercial use rights should be made via www.fao.org/contact-us/licence-request or addressed to copyright@fao.org.

FAO information products are available on the FAO website (www.fao.org/publications) and can be purchased through publications-sales@fao.org

Authors of case studies and introductory texts: international group of experts (for the names see list of authors)

Concept: FAO Mountain Partnership Secretariat, University of Turin

Layout: Roberto Cenciarelli

Editing: Nancy Hart

Proofreading: Caroline Lawrence

Recommended citation:

FAO. 2015. *Understanding Mountain Soils: A contribution from mountain areas to the International Year of Soils 2015*, by Romeo, R., Vita, A., Manuelli, S., Zanini, E., Freppaz, M. & Stanchi, S. Rome, Italy.

This publication is available from:

FAO information products are available on the FAO website (www.fao.org/publications) and can be purchased through publications-sales@fao.org.

Electronic version can be downloaded from:

www.fao.org

and

www.mountainpartnership.org

Cover photo: Community partners of Caritamaya, Pruno, Peru planting and composting potato in rehabilitated Sukaqollos (@FAO/Alipio Canahua)