merma de superficie agrícola serían más severos en un futuro ciclo húmedo.

Esta comparación ofrece la oportunidad de diseñar políticas de gestión del territorio que contemplen el contexto hidrológico. Dichas políticas deben tomar en cuenta la fuerte variabilidad en las áreas afectadas por inundaciones en la región. Es necesario contar con un estudio multidisciplinario que evalúe otras pérdidas como daños en la infraestructura o la emigración de los pequeños productores. La identificación de riesgos adicionales resultantes de los cambios en el uso y manejo de la tierra puede poner perspectiva a lo puramente productivo. También habrá que balancear la necesidad de seguir y mejorar la producción de alimento con las necesidades del medio ambiente. El desafío será pensar en políticas que traigan una solución viable para la región en su conjunto a la vez que fomenten el compromiso y la cooperación individual en pos del bien común en los paisajes agrícolas.

** Proyecto "Cambios en el uso de la tierra, biocombustibles y desarrollo rural", financiado por IDRC-Canadá y dirigido por el IAI*

Land use change effects on soil carbon stocks in the La Plata River Basin

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Effective and sustainable management of land use in the LPB depends on the ability of managers and policy makers to predict the impacts of land use changes (LUC) on nature and society. Modeling efforts to predict environmental impacts can benefit from the knowledge acquired from impact assessments of past LUC processes. The soil system is responsible for regulating several ecosystem services. Soil organic matter is directly associated with some of these services, and soil carbon should therefore be assessed and monitored under different land use options. Here, we synthesize research results and analyze LUC impacts on soil carbon stocks from two different collaborative projects: Land Use Change in the Rio de La Plata Basin: Linking Biophysical and Human Factors, led by the University of Buenos Aires, and funded by the NSF-IAI research networks program; and Landuse, Biofuels and Rural Development in the La Plata Basin; led by the IAI and funded by the IDRC, Canada.

Conversion of the native vegetation to agricultural systems has caused reductions in the soil carbon stocks of both the Brazilian Cerrado and the grasslands in Argentina and Uruguay. Such carbon losses may mainly be the result of lower carbon inputs to the soil under crop production, and to a lesser extent to higher carbon respiration losses from the soil. IAI researchers are trying to increase understanding of the dynamics of soil carbon under different land use transitions in the LPB to provide advice on effective and sustainable land use and landscape management.

Similar land use changes in different regions of the basin can have opposite effects. While conversion of non-degraded natural pasture lands in the Pampas to annual crops caused large soil carbon losses, well-managed annual crops might increase soil carbon in degraded Cerrado pastures, particularly if no-tillage and rotations with nitrogen fixing legumes are used. Afforestation of degraded agricultural soils showed positive soil organic matter balance in dry ecosystems, particularly under the presence of beneficial plant root fungi associations (mycorrhiza).

However, in humid environments in the south of the basin and in the Cerrado, afforestation with Eucalyptus or Pinus monocultures has caused carbon losses.

Landuse changes: forest to agriculture // Cambios en el uso de la tierra: de bosques a agricultura

Enhancement of soil fertility has been associated with soil carbon buildup and retention. Pasture areas accumulate more soil carbon when fertilized. Likewise, biological fertilization, such as nitrogen fixation by legumes, increases soil carbon stocks. Therefore, IAI researchers recommended green manuring using nitrogen fixing species in crop rotations under no-tillage systems to enhance both nitrogen and carbon enrichment of agricultural soils, and reduce the system's carbon footprint. Agricultural soils under these conditions can attain high levels of carbon, and may recover, or even surpass, the soil carbon contents found under native vegetation, especially for ecosystems with low primary production. Nutrient management, however, needs to be carefully evaluated to avoid nitrogen losses. When afforestation is used to restore degraded agricultural soils, organic matter in the soil increases and stabilizes. However, the degree to which carbon will be sequestered in the soil is highly dependent on forest species and soil quality. Many of these results were obtained from experimental sites under optimized, not "natural" conditions, so they may not be broadly representative. Full carbon accounting of different agricultural systems in the basin should be carried out, considering indirect impacts such as increased use of fossil-fuel derived fertilizers and other inputs with high carbon footprints.

In the grassland biome (Campos-Pampas), where soil organic matter is the main carbon pool, transformation of pastures and grasslands to annual croplands decreased carbon stocks by as much in 25 years as was lost in over three centuries of grazing use on native grasslands. Soil degradation brought about by agricultural expansion can be very rapid and imply large carbon losses, especially from sandy soils. Soil texture was found to be one of the most important factors that affect the impacts of land use on carbon sequestration or losses.

The global need for a reduction of greenhouse gases in the atmosphere calls for agricultural systems with low carbon footprints, and the effects of soil carbon (organic matter) storage on soil fertility and agricultural production are also an important regional issue. Intensification of agricultural and livestock production systems, using existing technology and innovative solutions, is the most effective way to ensure the sustainable development of rural areas. No-tillage systems are important for soil carbon capture and storage, control of soil erosion, and resilience but may affect hydrologic regulation in negative ways under excess rainfall. New agricultural practices aimed to increase carbon uptake by the vegetation and into the soil may need multi-cropping systems that are more efficient in capturing available water, carbon and nutrients, providing farmers with more options for marketable products, while increasing on farm agrobiodiversity and delivery of ecosystem services.

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