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Rational land-use planning

IIASA has developed an integrated modeling cluster built around the Global Biosphere Management Model (GLOBIOM) which integrates the agricultural, bioenergy, and forestry sectors and draws on comprehensive socioeconomic and geospatial data. It is integrated with several other models developed by IIASA and partners.

Cultivable land is under severe pressure, with 10 billion people needing to be fed by 2050. As incomes rise above poverty levels and urbanization continues, people are consuming more animal products, which require more land than crops. Climate change itself is a constraint on land available for cultivation. Moreover, in the next 20 years, an area the size of South Africa will disappear beneath concrete or asphalt, much of it land in developing countries that could grow food and animal feed crops.

The integrated approach

Two principal models are integrated with GLOBIOM. These are i) the G4M model which compares income from growing food, forests, or biofuels on the same land; and ii) the EPIC model, which compares land and forest management systems and their effects on environmental indicators.

GLOBIOM can be linked to macroeconomic or energy models to capture drivers and feedback on, for example, population, GDP, carbon prices, and bioenergy demand. GLOBIOM includes an innovative livestock module and a global renewable energy systems optimization model, BeWhere. It also includes water as a resource, making it a strong tool for analyzing the water-related impacts of different development scenarios.

The model cluster is used to analyze the competition for land use between agriculture, forestry, and bioenergy, which are the main land-based production sectors, and to explore the various trade-offs and synergies around land use and ecosystem services. Its holistic approach helps scientists and policymakers understand and minimize land use and resource competition, avoid serious land use conflicts, and improve production efficiency.

Impacts

- The IIASA cluster is being used to support the development of policies to reduce emissions from forest degradation and deforestation (REDD), enhance forest conservation, sustainably manage forests, and increase carbon stocks. This research follows the UN Framework Convention on Climate Change and the UN Convention on Biodiversity. In 2010 IIASA adapted GLOBIOM to the Congo Basin to provide estimates of future deforestation and support national REDD strategies in the region. Since 2012 the model has been used to study deforestation patterns in the Amazon.

- Analyses with GLOBIOM's new livestock production module show that improving breeding and feed types would help meet the world's future protein demands with considerably fewer livestock resources. This would free up land for other food production like crops, on the other hand, some regions, such as many grasslands in Africa, will not sustain crops, and should be simply left for livestock grazing.

- GLOBIOM scenarios allow researchers to look at future food production from crops and livestock, greenhouse gas emissions, and the trade-offs and co-benefits of different pathways of crop yield improvement. The most efficient way to ensure sustainable crop intensification was found to be reliance on practices and technologies that are not more fertilizer-demanding, such as new varieties, improved rotations, integrated crop-livestock practices, and precision farming.

- One impressive demonstration of the cluster's capacity and functionality is World Wide Fund for Nature's 2011 Living Forest Report, which was entirely based on the cluster's models. The report addressed global forest-related topics such as avoiding deforestation, forest management, biodiversity protection, greenhouse gas emissions, land-use change, bioenergy, fertilization, water demand, food security, agricultural intensification, and global diet patterns. This large-scale effort was the IIASA contribution to the International Year of Forests in 2011 and achieved high visibility among policymakers.

Further information:
www.iiasa.ac.at/impacts/globiom

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