research in the pipeline

NEW IIASA RESEARCH AREA

Food & water

Over the next decade, IIASA will study three interlinked global problem areas: Food and Water, Energy and Climate Change, and Poverty and Equity. The Food and Water Research Area will focus on how to improve the management of the world's land, water resources, and ecosystems.

s Earth's population grows from nearly 7 billion to nearly 9 billion by 2050, meeting the global demand for the essential ingredients of life—food and freshwater—will be possible only with dramatic improvements to every link in the human food chain. The scope of the task is daunting, with researchers estimating that agricultural output must improve by 70 percent globally and 100 percent in the least developed countries over the next 40 years.

Achieving that goal will require the use of improved breeding techniques for plants and livestock to foster greater environmental diversity and adaptation to climate change. Better land and water management systems are also needed, for, despite the land and water constraints, farmers will need to grow enough food to feed millions of additional people over the next 40 years.

The demand for freshwater is also increasing, with some experts predicting a gap of 40 percent between demand and supply in as little as 20 years. Agriculture already accounts for more than 70 percent of human water consumption, and several estimates indicate that by 2030 farmers will need 45 percent more water than they use now.

IIASA is pursuing a "systems approach" to the complex web of issues involved in providing sustenance to a burgeoning world population. The researchers approach the food and water problems in the broad context of land, ecosystems, and marine management, taking into account the availability of natural resources and the socioeconomic context in which those resources will be used.

IIASA is developing scientific models (see box) of these complex global problems in order to identify effective policy options. For example, researchers are using global land use models to look at the impacts of developing economies on forests and related ecosystems in Bangladesh, Brazil, China, the Congo Basin, India, the Koreas, and Russia in collaboration with the Food and Agriculture Organization of the UN, the UN Environment Programme, and the World Meteorological Organization, among other international organizations.

Researchers from across the Institute, but particularly from the Ecosystems Services and Management (ESM) and the Evolution and Ecology (EEP) programs, have defined the following food and water policy challenges as being of concern:

- Increasing competition for land and water resources from increasing industrialization and urbanization, particularly in developing countries. This demand for more land and water includes the potential threat to food crops from biofuels. Limited additional sources of freshwater and a decreasing quality of existing water supplies due to pollution. Freshwater resources are unevenly distributed, and the places where water is scarce are often the same places where hunger is worst.
- Forests, wetlands, and lakes play a major role in the subsistence of hundreds of millions of people and are critical in sustaining natural landscapes. These ecosystems are typically not managed in a sustainable way, with integrated management being rare.
- Seafood is the primary source of animal protein for more than one billion people; however, expanding food production from fisheries is hindered by rampant overfishing.

The Institute's areas of concern reflect integrated research that will be carried out over the next decade based on four integrative themes: food security, integrated water resource management, managing multiple ecosystems, and safeguarding sustainable seafood and aquatic ecosystems. Work within these themes will include the following:

FOOD SECURITY In addition to protecting productive land already in use, IIASA's Food and Water research plan shows that better management of marginal and degraded areas would help meet the increasing demand for food. For example, as competition for land and water from the energy sector increases, particularly for growing biofuel crops, IIASA researchers are looking for ways to enhance biofuel production without jeopardizing food crops or increasing deforestation. New databases and systems are being developed to better conceptualize economically viable, socially responsible, and environmentally beneficial uses of marginal land.

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WATER RESOURCES Management of water resources in arid and semi-arid regions in order to avoid groundwater depletion is a particular problem, especially as these regions are expected to suffer disproportionately from climate change. IIASA is developing an approach that will enable these regions to create policies to better adapt to the stresses of climate change.

On the issue of water resources shared by a number of nations, IIASA expects to implement a model-based integrated watershed management analysis involving aspects of land use, agriculture, population, and poverty in a cross-border shared-resource context. This work will be driven by IIASA's new Water Program. Transboundary water issues will also be the focus of IIASA's Policy Forum, with Institute and NMO researchers working in collaboration.

MULTIPLE USES OF ECOSYSTEMS The task of providing sufficient food and water must be accomplished in the broader context of protecting ecosystems and the vital services these provide. Global challenges range from tackling food, water, and energy security to controlling multi-hazard disasters, existing and emerging infectious diseases, and basic nutrient cycles, as well as assessing their economic impacts. IIASA researchers are involved in complex planning, coordination, and international cooperation to deliver insights into managing and maintaining ecosystem services.

SUSTAINABLE SEAFOOD Safeguarding the marine environment as a food source is a critical part of this challenge, essential to feeding many millions of people. Yet overfishing in both the oceans and freshwater systems is already considered severe. IIASA's researchers are focusing on securing and expanding aquatic food resources through better fisheries management, without jeopardizing aquatic ecosystems. IIASA scientists have led international research demonstrating that pressure from overfishing can force fish to evolve rapidly, which may lead to the decline or even collapse of fisheries.

FOOD AND WATER MODELS AT IIASA

Research by IIASA programs working on food and water issues has produced many models that have been used worldwide to develop policy strategies. They include:

BEWHERE Optimizing siting of bioenergy plants

BLS A tool to rationalize the world's food system

EPIC Environment Policy Impact model for soil productivity and management decisions with special emphasis on hydrology

G4M A global biophysical and economic forestry model addressing sustainable forest management

GAEZ Providing comprehensive information for national agricultural decision making

Geo-Wiki The global land cover validation tool

GLOBIOM Assessing competition between agriculture, bioenergy, and forestry for land use

HWSD A vast and growing database of global soil information www.iiasa.ac.at/Research/Models

Such human-induced evolutionary change must be accounted for in monitoring and management of aquatic systems in order to sustain fish populations.

The pressure on Earth's food and water systems comes from many sources, including the burgeoning human population, scarce and over-exploited natural resources resulting from inefficient resource management, and the adverse effects of climate change. Gaining a better understanding of how various ecosystems respond to these multiple stresses, so that they can be managed appropriately, is a key factor in moving toward global sustainability of food and water resources. In its new Food and Water Research Area, IIASA will be extending its systems analysis tools to bring new policy insights to longstanding challenges, many of which have so far proved resistant to traditional development approaches.

Further information IIASA's New Strategic Plan 2011–2020 at www.iiasa.ac.at/docs/strategic_plan.html.

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