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## World Food Futures to 2050

Concerns over the long-run future of global food and agriculture have resurfaced in recent years. Spurred by population, income and biofuels growth, many expect agricultural demands to double by the middle of the century. Others foresee looming land shortages, with an attendant increase in environmental problems. Many expect growth in biofuels demand to place a large burden on the land, while crowding out the supply of food.

But how certain are these outcomes? Is the demand growth for agriculture driven by income growth, an increasing but generally aging population, and increasing biofuel demands as much as the pundits predict? Will we require substantial expansion of the agricultural footprint to meet growing demand? How will the future differ from the past?

These are some of the questions tackled in a new report, **A Bounds Analysis of World Food Futures**, published in the *Australian Journal of Agricultural and Resource Economics* that challenges many perceptions about the world's agricultural future. The report is the first in a series that integrates important biological, physical, economic and spatial realities facing the future of global agriculture using the **International Agricultural Prospects (iAP) model**.

The authors find in favor of a future where agricultural consumption (in tonnes) increases more modestly—by around 69 percent (1.3 per cent per year) from 2010 to 2050 with midline population growth projections. If population grows at low-end projections, agricultural consumption increases by just 49 percent, while upper-end projections yield 92 percent consumption growth. Per capita income growth and changing demographics (generally aging population) play significant but secondary roles in spurring growth in agricultural consumption, as does the projected growth in biofuel demand.

Worldwide (but not equally everywhere), crop yield growth has slowed over the past decade or so. Notwithstanding a continuance of this slowdown, prospective improvements in crop productivity are still sufficient to reduce per capita cropland use, such that total cropland needs increase by less than 10 percent. There is sufficient productive cropland to meet demand without plowing-in additional forestlands even in upper-bound (high-consumption) scenarios.

What underpins these new views of global agriculture?

On the consumption side:

- According to the United Nations latest (revised) global population projections, the future does not look like the past, with (midline) 2010 to 2050 growth rates projected to be about half the rate of the previous half century—a game-changing turning point in the historical trajectory of global population.
- World population is aging. By 2050, China's populace is expected to be as grey as Japan's today (with about 30 percent older than 60 years of age). Much of the rest of the world is aging too, but at different rates. *iAP* indicates that countries with younger (under 20 years old) or older (over 60 years) populations tend to consume fewer calories on average.
- In 2010, the world consumed 7,145 trillion kilocalories of agricultural output as food (2,830 daily calories per person). We project growth to 10,908 trillion kilocalories by 2050 (3,129 daily calories per person). Moreover, in 2050, 25 percent of those calories are projected to come from livestock sources (meat, eggs, and dairy) compared with 18 percent in 2010.
- Worldwide, biofuels production is projected to grow, totaling 303 billion liters in 2050 (versus 113 billion in 2011). Technical changes (such as increasing the conversion efficiencies of existing agricultural

feedstocks to biofuel, and moves towards cellulosic feedstocks) further reduce the diversion of agricultural food and feed products to biofuels.

- Much of the food versus fuel debate focusses on corn, soybeans, and canola as feedstocks for biofuels. But in 2011, 62.4 percent of biofuel feedstock was sugarcane (mostly grown in Brazil), which we project to grow to 73.3 percent by 2050.

On the production side:

- Crop yields are projected to continue growing, but at a slower rate. The global average growth rate of corn yields was 1.7 percent per year from 1990-2010. We project it to grow by an average of 1.3 percent per year from 2010-2050.
- About 43 percent of the world's suitable cropland was harvested in 2010. *iAP* projects between 41 and 56 percent of suitable cropland will be required to meet 2050 agricultural consumption, depending on the population scenario.
- In all cases, projected global consumption is met even after setting aside areas presently dominated by forestlands deemed suitable for crop production.
- Notably, while 38 percent of the 2011 U.S. corn crop was diverted to biofuel, the authors estimate that barely 5 percent of the world's cropland area was used to produce biofuels that year and almost no change in that share by 2050, with most of the modest projected growth in global cropland being used for food production.

The report concludes as follows:

“Sustainably feeding the world’s still growing, increasingly richer, more urbanized and overall (but not equally, everywhere) ageing population during the decades ahead will still be a tall order. These projections indicate the task is doable, but by no means is complacency in order.”

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#### STUDY REPORTS

Pardey, P.G., J.M. Beddow, T.M. Hurley, T.K.M. Beatty and V.R. Eidman. “A Bounds Analysis of World Food Futures: Global Agriculture Through to 2050.” *Australian Journal of Agricultural and Resource Economics* 58 (4)(2014): 571-589.

Pardey, P.G., J.M. Beddow, T.M. Hurley, T.K.M. Beatty and V.R. Eidman. “The International Agricultural Prospects Model: Assessing Consumption and Production Futures Through 2050 (version 2.1).” Staff Paper P14-09. St. Paul, University of Minnesota, Department of Applied Economics, August 2014.

**The *iAP* model is part of an on-going program of work conducted by the International Science & Technology Practice & Policy (InSTePP) center at the University of Minnesota on the prospects for global agriculture.**

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