

How to feed a hungry world

Producing enough food for the world's population in 2050 will be easy. But doing it at an acceptable cost to the planet will depend on research into everything from high-tech seeds to low-tech farming practices.

With the world's population expected to grow from 6.8 billion today to 9.1 billion by 2050, a certain Malthusian alarmism has set in: how will all these extra mouths be fed? The world's population more than doubled from 3 billion between 1961 and 2007, yet agricultural output kept pace — and current projections (see page 546) suggest it will continue to do so. Admittedly, climate change adds a large degree of uncertainty to projections of agricultural output, but that just underlines the importance of monitoring and research to refine those predictions. That aside, in the words of one official at the Food and Agriculture Organization (FAO) of the United Nations, the task of feeding the world's population in 2050 in itself seems “easily possible”.

Easy, that is, if the world brings into play swathes of extra land, spreads still more fertilizers and pesticides, and further depletes already scarce groundwater supplies. But clearing hundreds of millions of hectares of wildlands — most of the land that would be brought into use is in Latin America and Africa — while increasing today's brand of resource-intensive, environmentally destructive agriculture is a poor option. Therein lies the real challenge in the coming decades: how to expand agricultural output massively without increasing by much the amount of land used.

What is needed is a second green revolution — an approach that Britain's Royal Society aptly describes as the “sustainable intensification of global agriculture”. Such a revolution will require a wholesale realignment of priorities in agricultural research. There is an urgent need for new crop varieties that offer higher yields but use less water, fertilizers or other inputs — created, for example, through long-neglected research on modifying roots (see page 552) — and for crops that are more resistant to drought, heat, submersion and pests. Equally crucial is lower-tech research into basics such as crop rotation, mixed farming of animals and plants on smallholder farms, soil management and curbing waste. (Between one-quarter and one-third of the food produced worldwide is lost or spoiled.)

Developing nations could score substantial gains in productivity by making better use of modern technologies and practices. But that requires money: the FAO estimates that to meet the 2050 challenge, investment throughout the agricultural chain in the developing world

must double to US\$83 billion a year. Most of that money needs to go towards improving agricultural infrastructure, from production to storage and processing. In Africa, the lack of roads also hampers agricultural productivity, making it expensive and difficult for farmers to get synthetic fertilizers. And research agendas need to be focused on the needs of the poorest and most resource-limited countries, where the majority of the world's population lives and where population growth over the next decades will be greatest. Above all, reinventing farming requires a multidisciplinary approach that involves not just biologists, agronomists and farmers, but also ecologists, policy-makers and social scientists.

To their credit, the world's agricultural scientists are embracing such a broad view. In March, for example, they came together at the first Global Conference on Agricultural Research for Development in Montpellier, France, to begin working out how to realign research agendas to help meet the needs of farmers in poorer nations. But these plans will not bear fruit unless they get considerably more support from policy-makers and funders.

The growth in public agricultural-research spending peaked in the 1970s and has been withering ever since. Today it is largely flat in rich nations and is actually decreasing in some countries in sub-Saharan

Africa, where food needs are among the greatest. The big exceptions are China, where spending has been exponential over the past decade, and, to a lesser extent, India and Brazil. These three countries seem set to become the key suppliers of relevant science and technology to poorer countries. But rich countries have a responsibility too, and calls by scientists for large increases in public spending on agricultural research that is more directly relevant to the developing world are more than justified.

The private sector also has an important part to play. In the past, agribiotechnology companies have focused mostly on the lucrative agriculture markets in rich countries, where private-sector research accounts for more than half of all agricultural research. Recently, however, they have begun to engage in public-private partnerships to generate crops that meet the needs of poorer countries. This move mirrors the emergence more than a decade ago of public partnerships with drug companies to tackle a similar market failure: the

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development of drugs and vaccines for neglected diseases. As such, it is welcome, and should be greatly expanded (see page 548).

Genetically modified (GM) crops are an important part of the sustainable agriculture toolkit, alongside traditional breeding techniques. But they are not a panacea for world hunger, despite many assertions to the contrary by their proponents. In practice, the first generation of GM crops has been largely irrelevant to poor countries. Overstating these benefits can only increase public distrust of GM organisms, as it plays to concerns about the perceived privatization and monopolization of agriculture, and a focus on profits.

Nor are science and technology by themselves a panacea for world hunger. Poverty, not lack of food production, is the root cause. The world currently has more than enough food, but some 1 billion people

still go hungry because they cannot afford to pay for it. The 2008 food crisis, which pushed around 100 million people into hunger, was not so much a result of a food shortage as of a market volatility — with causes going far beyond supply and demand — that sent prices through the roof and sparked riots in several countries. Economics can hit food supply in other ways. The countries in the Organisation for Economic Co-operation and Development pay subsidies to their farmers that total some US\$1 billion a day. This makes it very difficult for farmers in developing nations to gain a foothold in world markets.

Nonetheless, research can have a decisive impact by enabling sustainable and productive agriculture — a proven recipe (as is treating neglected diseases) for creating a virtuous circle that lifts communities out of poverty. ■

Save the census

The Canadian government should rethink its decision to change the way census data are collected.

It is hard enough to get people excited about statistics at any time, let alone at the height of the summer holiday season. But in Canada this month, people have become passionate about the subject. A quiet political decision to scrap the compulsory long-form part of the Canadian census has inspired fuming in the national press, vitriolic protest from numerous academic bodies, the resignation of the head of Statistics Canada, and even a YouTube broadcast of a song espousing the importance of census data for public policy (go.nature.com/O9TWcf). Critics have accused Canada's ruling conservative party of being anti-science — and, worse, anti-information. To gut one of the world's most respected statistical organizations, they argue, will prevent future policy decisions on everything from health care to public transport from being based on either data or logic.

The incident comes amid a growing sense of unease about the right-leaning Canadian federal government's apparent disregard for science-based policy. The country continues to support the mining of asbestos and its export to the developing world, despite repeated calls to ban the toxic substance and cries of protest from the medical community. Canada has been one of the most obstructive countries at climate-change talks, and continues to be protective of its development of the tar sands — one of the world's dirtiest sources of oil. The federal government has fought against maintaining the supervised injection facility for drug addicts in Vancouver, despite staunch protest from the medical community and studies showing that such programmes are helpful. Now the government is threatening to undermine the system that collects the data needed for a multitude of other evidence-based decisions.

Every five years for almost four decades, the Canadian census has involved both a head count and a longer questionnaire asking about details such as ethnicity, education and housing. The long form was sent to 20% of the population, and replying was compulsory by law. At the end of June, citing concerns about privacy, industry minister Tony Clement announced that the long form would be made voluntary; an additional Can\$30 million (US\$29 million) a year will be spent

to send the form to 30% of the population, in an attempt to make up the numbers.

This, as any statistician can testify, is not the same thing. Inevitably, vulnerable populations of the poor and downtrodden will be less likely to reply, skewing the resulting data. Although statisticians are adept at correcting for such factors in surveys, they can do so only if they have a gold-standard set of data to refer to — namely, the census data. Even if the voluntary data are sufficiently robust to allow for good public policy-making, it will still cause a problem for researchers looking for long-term trends, because comparing the compulsory data with the subsequent voluntary set will be nearly impossible.

In a country defined by a mosaic of immigrant groups and indigenous populations, precision data on their lives are crucial to good public policy. Statistics Canada has been widely regarded as a world leader in handling everything from the intricacies of question wording to protecting individual privacy. Although the government claims that it is responding to public concerns about privacy and 'big brother' government, this, ironically, does not seem to be based on evidence — the privacy commissioner's office has received only three complaints about the intrusiveness of the census long form over the past decade.

The United States investigated the option of switching to a voluntary long form in 2003, but concluded that it would be too expensive to bring the data up to par. Instead, this year it replaced its long form with a mandatory ongoing survey — a change that required nearly a decade of research to confirm that it would maintain the quality of the data. Academics, economists and public policy-makers find themselves open-jawed at Canada's snap decision — made without consulting the data's users — which will effectively allow the government to do less while spending more money. Letters of protest and editorials have been penned by the *Canadian Medical Association Journal*, the Canadian Federation for the Humanities and Social Sciences, and many others.

Canadian academics are not letting this pass quietly; the rest of the world should join their voice of protest (go.nature.com/dq6rZ3). It is too late to save the form for 2011, but this could, and should, be reinstated for 2016. ■

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