SIR JOHN CRAWFORD MEMORIAL ADDRESS

Agriculture: The challenges of the 21st century

John Beddington

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Agriculture: The challenges of the 21st century

Professor Sir John Beddington CMG FRS
Government Chief Scientific Adviser, United Kingdom

Abstract

The Sir John Crawford Memorial Address has been presented since 1985, in honour of the distinguished Australian civil servant, educator and agriculturalist in whose name the Crawford Fund was established. Sir John Crawford was a remarkable Australian who contributed at the highest levels, and was a passionate supporter of international agricultural research for development.

This talk draws attention to four current and interrelated trends that suggest the world will be rather different by 2025, only 13 years away. The four trends are: population growth; rapidly expanding urbanisation especially in Africa and Asia; changes in patterns of demand for food and energy by the increasingly large and prosperous ‘middle class’; and climate change.

Beyond 2025, the prospects are frightening if the momentum of both population growth and greenhouse gas emissions (which, once in the atmosphere, continue to affect climate for 20 years) is not very soon brought under control. A range of solutions are available to improve agricultural production and therefore food security, but they need strong corresponding improvements in storage practices, pest and disease management, and new attitudes to wastage of food. Food supplies and food prices depend on the weather all over the world, and the extra billion people by 2025, living mostly in cities, will need food and energy. Effective action on the factors — including agricultural practices — that are driving climate change is now very urgently needed.

Let me begin by saying that much of the commentary on food and water security and climate change focuses, in my view, too far into the future. Experts talk about 2050. Yet many people will not be too concerned about 2050 because we will be over 100 years old by that time. While that is a personal view, I put it to you that the world must be thinking much more about the immediate trajectory.

It appears to be little recognised that several trends are happening and will continue irrespective of human intervention. The first one is population growth. The world has seven billion people now; by 2025, all projections say there will be a further billion on the planet. That is, in 13 years time, there will be another billion people, roughly divided between Africa and Asia.

That is one of the trends, and really, because of the structure of human demography, there is every chance of that growth continuing inexorably over the next 13 years.
The second trend that is happening in the world and is similarly inexorable is growth in urbanisation. In 2010, for the first time, the world’s urban population exceeded the rural. The rural population of the world is expected to decline and the urban population to increase. To put that into context with the population growth that I spoke of, it implies for example that in Africa in the next 13 years there will be a further thousand cities of 500,000 people each. In Asia, about 500 new cities of about a million people each.

That is a completely breathtaking change over that timescale. Yet these are two fundamental trends and nothing is going to alter them.

Another trend, which is more problematic and may or may not happen, is that people are becoming more prosperous. There is still enormous poverty in the world, but by and large in many parts of the world there is an increase in what might be termed the ‘middle classes’, along with the purchasing power that is associated with that term.

The fourth trend that is really important — and one that I deal with continually in Britain and other parts of the world too — is climate change. Because of the delays that occur naturally in our climate system, the greenhouse gases and other constituents that are in the upper atmosphere at the moment will determine climate for at least another two decades or possibly a little more. Now I know that in all societies there is a degree of climate scepticism, and I confess to being extremely unsympathetic to it. Science grows by criticism; science grows by scepticism; and indeed the odd human being, the odd scientist in human history, has broken the consensus and disagreed and been shown to be right. Galileo was one such person; Copernicus was another; but these are rare.

In terms of thinking about whether in fact climate change is happening, whether in fact the scientific evidence is appropriate, I would like to quote Stephen Chu. Now Stephen Chu, Nobel Prize winner in physics, runs the Department of Energy for President Obama. The Department of Energy has a budget something akin to the budgets of medium-size European states: it is big, and Stephen Chu is a ‘serious player’. He had a marvellous quote that I heard a couple of years back when he was dealing with the governors of the western states, whom you might imagine would not be entirely encouraging about a world of low-carbon economies. He said: ‘People are entitled to their own opinions but not their own facts’.

It is statement that I heartily endorse. We have got to be evidence-based. The evidence, that climate change is happening, is everywhere.

It is very difficult to attribute individual events — weather-related events — to climate change. Although work can be done on them, it is always very difficult. Yet the weight of evidence that climate change is occurring is utterly compelling and by and large it convinces the vast majority of scientists that work in this area. One of the interesting comments that some people make is: ‘Well scientists of course would be saying climate change is happening, because that way they will get more research grants to study climate change!’ — and, to an extent, there may be some natural truth in that.
However, not just scientists but also most of the major corporations in the world believe climate change is happening and are preparing for it. Those who are probably the most cynical and careful people to think about it are insurance companies. Munich Re, the largest insurance company, or re-insurance company, in Europe has analysed natural catastrophes worldwide; these are obviously something that they have to take seriously. In analysing actual catastrophes that occur worldwide they have, as re-insurers, been able to access all the data; and they have used it to look at trends. Of course, natural catastrophes can occur in the geological zone — there was the devastating tragedy that occurred in Japan on the north-east coast, and there are many others. Munich Re has analysed these and other natural catastrophes from geological sources and finds they show no trend at all, absolutely nothing. The incidences increase and decrease a little bit, but the average incidence is pretty much flat.

By contrast, when they analysed the incidence of catastrophes that have occurred in the world that are weather-related, whether it be storm, flood, drought or other weather-related incidents including large wild fires and so on, these come out as trending upwards, trending fast upwards. This means that it is not just the scientific community, but actually a business community saying that climate change is happening.

Agriculture challenges

My talk tonight is about agriculture. Very early on in my tenure when I took over as Chief Scientific Adviser in 2008, in January, we were seeing for the first time an increase in agricultural prices. This was a change from the real decline that had been happening for something like three or four decades. I recall having various conversations with our agricultural economists at the time, who said the supply side would solve it. ‘The price is high; more crops will be planted; this is a one-off event. We will be seeing inevitable decline in real prices. We know what we’re talking about.’

In a sense I wish they had been right but they were manifestly wrong. There was a decline in prices post 2007–08, but also by 2010 there were climate-related increases. The massive drought and wildfire and heatwave that occurred in Russia and the Ukraine, followed by — and indeed driven by exactly the same blocking weather pattern — major floods in Pakistan and a mix of drought and floods in China, pushed cereal prices up to far above even the 2007–08 level.

We are seeing it again this year. The drought in USA is putting corn prices up and I think there is now overall recognition that we have a real problem with agriculture. We must think about issues of food security. It is no use taking the moral high ground and saying that as a developed economy we should be thinking how to help. There is a definite potential for high food prices to destabilise whole countries. There has been an analysis which looked at the index of food prices and related it to civil unrest in cities — and of course the world is increasingly made up of cities, as I said earlier. These are trends that are happening.
When food prices go up, even if we did not worry about that from a ‘humanitarian’ point of view, we should worry about it from a selfish point of view. Think of those thousand cities in Africa of 500,000 people each, in 2025. Think of the potential unrest if they are not getting a reasonable supply of food for reasonable amounts of money, let alone supplies of water and other necessities. City dwellers have political power and they have the potential to draw attention to themselves. Food prices could be a problem.

They are a problem now, because we are not starting equally. We start from a situation where there is fairly dire poverty for around a billion people who have insufficient food intake to even cover their natural energy requirements and certainly not their development. A further billion people are essentially getting insufficient diets, so that they suffer malnutrition and they experience stunting both in mental and in physical growth. This is the starting point, and it is in a context of massive population growth and the growth of the middle class.

We cannot think about agriculture and food security without thinking about water and without thinking about energy. There will be unsatisfied demand, and, as an approximation, by about 2025 or 2030 we will need around 40% more food, 40% more water, and rather more than that in terms of energy, not just to meet the reasonable aspirations of the developing world but also to make improvements.

It is an awkward problem because, as individuals move out of fundamental poverty and become wealthier, their habits change. The demand for livestock and the demand for dairy products rise with gross domestic product, as also do the demand for energy and the demand for access to clean water supplies.

That is the situation that we are faced with now, and I do emphasise the need for speed. You know by 2050 many people will be quite old, so they may not care about it, but for younger people and young children, the world in the year 2025 is going to be a dramatically different world from the one we live in now. So we need to be thinking about that and the challenges leading to 2025.

What are those challenges? In my job, being responsible for science and engineering in the UK, world hunger is an issue. We need to be thinking about reducing the challenge of hunger by thinking about interventions that we can do.

As some of you may know I commissioned and published a report on the future of food and farming1, which came out year or so ago in the UK. It put forward some sensible ideas about how we could improve our science and engineering to help agriculture. A few things are obvious: for example, the arithmetic shows that yields need to increase significantly faster than in the last three or four decades. Unlike the situation in the 20th century, land now cannot be made available for agriculture by cutting down forests and ploughing in grassland. That is not the world we live in now — and properly not.

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How are we going to increase yields? There is a whole mix of things that could be done. The solutions are not just ‘hi tech’. There could be very large benefits in relatively simple changes to the storage of food, for example. Wastage of food is approximately equally a result of pests and diseases pre-harvest in parts of the developing world, and wastage post-consumption in the developed world.

Both types of society waste 40–50% of growing crops. The losses that result from pests and diseases should be solvable by improved storage and infrastructure and credit, and also by simple ways of dealing with stored pests and diseases of crops. In the developed world, however, it is a real problem to reduce the 40–50% of food that is actually bought and then wasted and thrown away. Solving that would be an immense breakthrough. Focusing on waste is going to be really important for food security, and organisations such as CGIAR or IFPRI are doing that and will make some benefit.

An aspect that seems to be almost ignored is the fundamental interrelationship between food production and the food security issue and climate change. We could continue and meet our food security issues using current agricultural practices, but that would be at the expense of enormous increases in greenhouse gases. An international commission that I chaired for the CGIAR climate change system, working with the World Bank, decided that it is essential to be thinking about different agricultural practices. The slogan — which is strangely unpopular — is that we need an agricultural practice which is ‘climate smart’. What that means is it can be intensified, that it is sustainable and is operating in a way that does not produce significant amounts of greenhouse gases or use up scarce resources, water being most important. The commission that I chaired reported just in time for the meeting of the climate change group in Durban in December 2011, and I confess I was disappointed that the discussions on climate change did not recognise that agriculture was central to it. Forestry is recognised, and rightly so, but I believe that the world needs to acknowledge the importance of adapting agriculture so that it will meet the requirements of food security in a rather different way. I really feel that is the potential for our future — and it needs momentum.

There are a few things that can be done — applying new technology for instance. We have the ability to do precision agriculture using less pesticide, less fertiliser. We have a better understanding of plant genomics and the ability to use DNA sequencing, not necessarily for genetic modification but for much better plant breeding and selection using markers.

There is a role for genetic modification, GM, but when speaking about agriculture I find people from some portions of the media and members of non-government organisations object, saying GM crops are terrible. Again, I would remind you of Stephen Chu’s statement that people are entitled to their own opinions but not their own facts. GM is not going to be the silver bullet, as is clearly stated on page 1 of the Foresight Report. That report says GM crops will be part of a whole mass of solutions for solving the food security problem.

An area that is extremely important and closely linked to agriculture, and indeed climate change, is the issue of water scarcity. We are looking at potential
catastrophe in some areas of the world. There is an enormous reliance in particular parts of the world on aquifers. We can now assess the over-exploitation of aquifers, using satellite technology, and it is quite frightening.

A large amount of underground water has been found in Africa. If ways can be worked out to properly harvest that in a sustainable way, there is potential to supply that burgeoning African population increasing by 500 million in a few years — by using groundwater. It will involve investment, but ways to manage the water resources must also be considered. Where is there better expertise for managing water resources than here in Australia?

That is the challenge for the next 13 years, to 2025. What about 2030 and beyond?

**Greenhouse gases challenge**

In the next 13 years or so we must deal with two profound tipping points. First, as we know, energy demand is increasing. Energy demand from the developing world is set to more than double. As we move out to 2030, 2040, 2050 it will get greater still. That is going to put pressure on climate change. If we do not achieve a reduction in greenhouse gases in the next two decades — and a significant reduction — there is very little chance of the world meeting the two-degree target that the world community adopted in Cancun, and later at the Durban meeting. It is just not feasible. It is almost too late already.

For that tipping point, we not only will have to address and adapt to the climate change that is with us now — determined by gases already in the atmosphere — but we must also be thinking about cutting greenhouse gas emissions. ‘Climate smart’ agriculture is one way of dealing with it. We also need fundamentally new attitudes to the way we use energy and our methods of energy production. Otherwise, we will be moving into a different regime. Believe me, the climate projections I see for the world with a three-degree or four-degree temperature rise are profoundly concerning. It is very hard to imagine today’s civilisation operating in anything like the same way in a world that is four degrees warmer.

Yes, there are uncertainties with climate change. The UK Met Office’s Hadley Centre has made around 50 assessments under different scenarios, from the most pessimistic to the most optimistic. In the most pessimistic, we can expect average temperatures to be higher by three-and-a-bit degrees by about 2060 or 2070. In the most optimistic, those averages are expected by around the year 2100.

So, either way, we have to act now, and it is so difficult. The international community may have decided on a two-degree target, but they are not making any decisions about how the greenhouse gases can be reduced. It may happen. It is urgent.

The second stripping point during the next 13 years is not talked about much. It is to do with population. I said above that there will be another billion people on the planet in the next 13 years — but not all projections agree. The demographers’ current best estimate is that at a world population of about
nine or nine-and-a-half billion there may be some level of saturation of human population-growth. It is based on an assumption that there will be a decline in female fertility, similar to the decline seen in the last decade or so.

If female fertility does not drop in some of the countries of the world where there is very rapid population growth, then by the middle of the century and later, the population will be significantly greater.

We know, from research by sociologists and medical people, that the major factors in female fertility are prosperity, the education of women, and the availability of contraception. Unless those factors become more universally available, the world stands again at a tipping point because of the time delays. We need to reduce fertility between now and 2025 or else the population trajectory will lead to significantly more than the forecast nine billion.

These issues are hugely important, but I have a belief that the tremendous resources in human ingenuity and in human moral worth can be harnessed. This conference has recognised that there are vital questions to be asked, and has spoken of actions and solutions that can be achieved. I think there is enough goodwill in the communities around the world to try and make those work. I do hope they do.