THE CRAWFORD FUND

For a Food Secure World

ETHICS, EFFICIENCY AND FOOD SECURITY

FEEDING THE 9 BILLION, WELL

The Crawford Fund
2014 Annual Parliamentary Conference

Parliament House
Canberra ACT, Australia
26–28 August 2014

Editor: A. Milligan

THE CRAWFORD FUND

For a Food Secure World

ETHICS, EFFICIENCY AND FOOD SECURITY

Feeding the 9 billion, well

The Crawford Fund

2014 Annual Parliamentary Conference

Parliament House, Canberra ACT, Australia

26–28 August 2014

Editor: A. Milligan

The Crawford Fund

The Australian Academy of Technological Sciences and Engineering established the Crawford Fund in June 1987. Named in honour of the late Sir John Crawford, the Fund commemorates his outstanding services to international agricultural research. The Crawford Fund is a non-profit, non-government organisation, dedicated to raising awareness of the benefits to developing countries and to Australia of international agricultural research. The Fund depends on grants and donations from governments, private companies, corporations, charitable trusts and individual Australians. It also welcomes partnerships with agencies and organisations in Australia and overseas.

The Fund promotes and supports international R&D activities in which Australian research organisations and companies are active participants. It supports the work of the Australian Government's aid program, particularly with the Australian Centre for International Agricultural Research (ACIAR), the CGIAR Consortium and other international research centres.

The annual Parliamentary conference is a key part of the Fund's public awareness campaign, which increases understanding of the importance and potential of international agricultural research, its achievements and needs.

The Fund also runs training programs that fill a niche by offering practical, highly focused non-degree instruction to women and men engaged in agricultural research and management in developing countries.

The Crawford Fund
Level 3, 10 National Circuit
Barton ACT 2600, Australia
Phone: +61 (0)2 6188 4370
Email: crawford@crawfordfund.org
Web: http://www.crawfordfund.org
Twitter: @CrawfordFund
YouTube: https://www.youtube.com/user/Crawford Fund

ISBN 978 1 921388 29 3

Cite this work as:
Crawford Fund (2015). *Ethics, efficiency and food security: Feeding the 9 billion, well.* (Ed. A. Milligan.) Proceedings of the Crawford Fund 2014 Annual Parliamentary Conference, 26–28 August 2014, Canberra ACT, Australia.

Transcriptions	TranscriberOnline, www.transcriberonline.com
Cover	Wendy Bortolazzo, Crawford Fund
Photographs	Kate Langford, Joanna Kane-Potaka, ACIAR and conference speakers
Editing, Production	ENRiT: Environment & Natural Resources in Text
Printing	Bytes 'n Colours, ACT

Contents

Page no.

ii The Crawford Fund

iv Acknowledgements

v **Foreword**
The Hon John Kerin AM

The Sir John Crawford Memorial Address

1 **Effective, efficient, ethical solutions to feeding 9 billion people: Invest in women**
Professor Catherine Bertini

Opening Address

9 **Australia's leadership role: Using aid to tackle intractable problems and catalyse long-term solutions**
The Hon Julie Bishop MP

Keynote Session 1

15 **Achieving global food security: Building a new food system where nutrition, climate change and sustainability collide**
Ms Rachel Kyte

23 **Economics of food insecurity and malnutrition**
Dr Shenggen Fan

32 **Australian agriculture's role in meeting increased Asian demand**
Mr Luke Chandler

Panel: Ethics and efficiency in the face of competition for food

42 **Population and food security: Key trends and changing dynamics**
Dr Laurent Zessler

52 **Food vs feed: The livestock equation in food security**
Mr Yudi Guntara Noor

58 **Food vs energy: Crops for energy**
Dr William D. Dar

Panel: Ethics and efficiency in food security challenges

66 **Is modern farm technology a saviour or a threat?**
Dr Elizabeth Finkel

72 **Food vs nutrition security: Feed the people, well. Nutritional challenges of a developing nation**
Dr Norah Omot

78 **Watch your waste: Lose less, consume sustainably, feed more**
Dr Helen Szoke

Keynote Session 2

85 **Long-term food demand in Asia and implications for Australian agriculture**
Dr Jammie Penm

93 **Agriculture restructuring: Towards higher global competitiveness and food security**
Dr Nguyen Van Bo

Conference overviews

101 **Conference synthesis and summary**
Dr Denis Blight AO

Page no.

109 **Q&A sessions**
Morning 27 August; Afternoon 27 August

129 Delegates and Crawford Fund Scholars 2014

135 Media coverage 2014

Acknowledgements

The Crawford Fund wishes to thank the Chairs of the conference sessions, and the supporters and sponsors of the 2014 Annual Conference:

The Hon Margaret Reid AO, Board of Directors, Crawford Fund
Dr Nick Austin, CEO, ACIAR
Associate Professor Robyn Alders AO, 2014 Crawford Medal
Dr Jim Woodhill, Department of Foreign Affairs and Trade

Australian Academy of Technological Sciences and Engineering (ATSE)
Australian Agricultural and Resource Economics Society (AARES)
ACIAR (Australian Centre for International Agricultural Research)
Australian International Food Security Research Centre in ACIAR
CBH Ltd
CGIAR
Coffey International
Commonwealth Scientific and Industrial Research Organisation (CSIRO)
Cosmos Media
Department of Agriculture
Department of Foreign Affairs and Trade (DFAT)
Gardiner Foundation
Global Food Studies, The University of Adelaide
Grains Research and Development Corporation (GRDC)
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
International Food Policy Research Institute (IFPRI)
La Trobe University, Securing Food, Water and the Environment
Murdoch University
Office of the Gene Technology Regulator (OGTR)
Plant Biosecurity Cooperative Research Centre (PBCRC)
Queensland University of Technology, Institute for Future Environments
Rabobank
Rural Industries Research and Development Corporation (RIRDC)
Tasmanian Institute of Agriculture (TIA)
United Nations Population Fund (UNFPA)
University of New England, School of Environmental & Rural Science
The University of Queensland
The University of Western Australia, Faculty of Science
The World Vegetable Centre (AVRDC)
University of Western Sydney

Foreword

The Crawford Fund's 2014 Parliamentary Conference again brings together a group of outstanding international and Australian practitioners of the art of policy making and the science of agricultural research and development. By doing so, the Crawford Fund promotes policies that are evidence-based and, we hope, help ensure that public and political support for investment in international agricultural research will be sustained.

In spite of ever tightening fiscal circumstances, that message has got through to successive governments in Australia and abroad. As a former Cabinet Minister, I know that policy making is indeed an art, especially when you are faced with a clutter and diversity of views, not all of them based on science. With the best advice available from a highly professional public service, a first rate scientific community and with quality independent counsel from others, it is possible to cut through to formulate sensible policy reforms that will eventually attract bipartisan and broad community support.

This year we added two criteria to our selection of topics: ethics and efficiency. The conference had a better than usual gender balance, in addition to an international leading light to address the issue of women in agriculture. We also successfully encouraged more young people to join in, through our own scholarships, through the newly formed Researchers in International Agricultural Development, and through personal approaches to a range of universities. A Young Agricultural Scientists Forum followed the conference.

The quintessential message that we hope has emerged from the conference is the need to increase global food production in ways that are ethical and efficient; that are profitable for farmers and consumers, and that protect the environment. Research and training are essential to the delivery of these outcomes and we need more young people, and especially women, engaged in the effort in rewarding ways.

It is important to stress that in investing in agricultural research and training for development we are not necessarily even in a competitive world confronting a zero-sum game. Australia can both do well and do good, a thesis which we have backed up with our report 'Doing well by doing good: International agricultural research – how it benefits Australia as well as the developing countries'[1] and a series of forums and media outreach on this topic around the country.

As well as encouraging support for international agricultural research, the Crawford Fund has another role: the conduct of Master Classes in key topics such as agribusiness, communication and biosecurity to name a few, and delivery, by our State and Territory Programs, of specialist individual and group training activities. Our training efforts have reached over 10,000 scientists in the

[1] Available at <http://www.crawfordfund.org/focus/doing-well-by-doing-good>.

developing world. These programs are delivered at very low cost by Australian institutions and coordinated by our largely voluntary workforce and committees, and they yield very high returns.

Finally I wish to thank the record number of sponsors who generously supported this conference. The simple listing of their names on page iv seems an inadequate expression of our gratitude, but their support reflects the passion that we all have for international agricultural research and training.

The Hon John Kerin AM
Chairman, The Crawford Fund

SIR JOHN CRAWFORD MEMORIAL LECTURE

Effective, efficient, ethical solutions to feeding 9 billion people: Invest in women

Professor Catherine Bertini
Global Agricultural Development Initiative,
The Chicago Council on Global Affairs

Abstract

Most of the world's expected population increase will be in South Asia and sub-Saharan Africa. Growing more food in these regions is imperative, and smallholder farmers are critical to this effort. Women are the core of the agriculture workforce, and their improved productivity is key to this increase. Women are also responsible for feeding their families; feeding growing populations is impossible without significant emphasis on and support for the roles of women and girls.

Sir John Crawford was one of the founding fathers of modern international engagement, especially in agricultural research and development. He made, and the Crawford Fund continues to make, critical contributions to a peaceful and prosperous world.

This is my fourth visit to Australia but the last one was too long ago, during my World Food Programme (WFP) tenure. When people ask: 'Catherine, you have been to probably 100 countries: which do you like the best?', I say 'Well the food is best in Italy, the colours people wear are most striking in West Africa and Guatemala, and the friendliest people are Australians ... and Cubans'.

I have had many wonderful Australian colleagues, including John Powell, Alan Wilkinson, John Bailey, Anthea Webb and Mike Sackett at WFP, and Catherine Walker at AusAID[1]. I worked extensively with then Minister Alexander Downer and at the United Nations with Ambassador John Dauth, but the Australian to whom I owe my biggest debt and gratitude is my predecessor at the WFP, James Ingram.

After a distinguished career in the Australian foreign service, Jim served ten years as executive director of WFP. Not only did he have to run that large development and humanitarian organisation, but he did so while leading an important effort to institutionally divorce WFP from the FAO (Food and Agriculture Organization of the United Nations). This was much like changing the engine on a train while it is running fast down the tracks. He succeeded,

[1] Australian Agency for International Development

effective 1 January 1992, and passed the CEO reins to me three months later. Given that the USSR[2] fell in December 1991 and the world was beginning to be enveloped with massive new humanitarian needs, Jim's achievements were critical to the WFP's future succcess in having the flexibility to quickly feed tens of millions of people. Jim has written a book about this, *Bread and Stones* (Ingram 2007), still available on Amazon. I highly recommend it to you; in fact, I assign it to graduate students in the classes I teach on the United Nations at Syracuse University. Jim Ingram put into action principles that Sir John Crawford established. Thank you Sir John; thank you Jim.

Solutions to feeding 9 billion people

Many times during the conference we will hear about the 9 billion people who will inhabit the earth, God willing, in 2050. Our mission is to discuss how to ensure that they have food security, which can be expressed as 'reliable access to sufficient quantities of affordable nutritious food to maintain healthy active lives'. I want to share five points with you, including:

- where these people will live, and the projected growth;
- how many are hungry;
- the nature of future food needs;
- highlights of related challenges.

Most importantly, I will address the role of women and girls as crucial contributors, and how important it is for us to address gender roles in agriculture if we are to support a workforce to feed 9 billion people.

Where 9 billion will live, and the growth patterns

Today, worldwide, approximately 4.2 billion of the 7 billion humans are Asian, or more than half. By 2050, there are expected to be 1 billion more people in Asia, and 1 billion more Africans – double that continent's current population.

How many are hungry

There is good news: the numbers of desperately hungry, food insecure and chronically hungry people are not keeping up with population growth (percentage-wise). The numbers FAO states are that 870 million people suffer from acute and generational hunger. Though there was a spike in this number during the food price crises in 2008 and in 2011, the current numbers are roughly the same as they were in 1970. The world population in this timeframe (1970–2010) has doubled.

The primary cause of this decrease is economic development. The clearest examples are here in the Indo-Pacific neighbourhood. Indonesia, for instance, now the fourth largest economy in Asia, has had an increase of per capita income from US$890 in 1994 to US$3580 in 2013. Though hunger exists, it is far less extensive than it has been. Incomes in Bangladesh have tripled in the same timeframe, though from a very low base, but poverty has dramatically decreased,

[2] Union of Soviet Socialist Republics, also called the Soviet Union

life expectancy has increased, and statistics for improvements in maternal and child mortality rates are now better than those from India.

How is this related to agriculture? Think of every economically growing or successful country you can, and name one (well perhaps Singapore) where the economy did not start with agriculture: Australia's, America's, the Republic of Korea's, Switzerland's ... . Now this is occurring in developing countries, with agricultural growth rates in many countries now greater than the growth rates in OECD[3] countries. This, in turn, helps alleviate poverty and hunger. The World Bank writes that 'agricultural production is two to four times more effective at alleviating poverty' than any other activity.

The nature of food needs

If the population is rising by 30% then we need that much more food, right? No. The lowest estimates are that we need at least 60% more food.

Why is double – or more than double – food required? There are many reasons, but a primary reason is that, as people become less poor, they change their eating habits. They move from inexpensive, minimal calorie foods to a more diverse diet. More meat, more fish, more vegetables. It takes more grain to raise beef, chicken and fish, and more investments and infrastructure to grow, store and ship more fruits and vegetables.

Highlights of related challenges

Even after this conference we will not have a complete list of all the challenges facing farmers and producers. I will highlight just a few.

Climate / nutrition / research / smallholder farmers / education

This discussion is impossible without raising the issue of the world's changing weather patterns, sometimes called climate change. Any farmer anywhere in the world can tell us about her or his new challenges because of more rain or less rain, or hotter temperatures or cooler ones, or more weather disruptions. Farmers, in Australia and worldwide, must be even more adaptable to change than they have been in the past.

Nutritional challenges are becoming a priority, as they should be, in development programming. For instance, the most important time in a person's life is his or her first 1000 days – from conception to age 2. If a baby does not have adequate nutrition during this period of life, he can never make up for it. He will be stunted, physically and intellectually. She will give birth to a baby whose chances of being born healthy are minimal at best.

Are we growing, and producing, the correct type of baby friendly foods in every community around the world, and making sure pregnant and breastfeeding mothers and their infants have access to it? Far from it yet, but it is possible.

Adults need more diversity in their diets as well, which argues for more fruits and vegetables especially, as well as a wider variety of food available and affordable.

[3] The Organisation for Economic Co-operation and Development

Children need food to be able to learn. Study after study shows that if children are able to eat in school, for instance, they are less absent and tardy, they progress faster, and they perform better on tests.

Adequate crops and food do not all happen by themselves. Research and development (R&D) as well as infrastructural development are key contributors to progress. Kanayo Nwanze, the current president of IFAD, the International Fund for Agricultural Development, said: 'It is no coincidence that in countries where agriculture has taken off, there have been large investments in research and infrastructure'. China and Brazil, for instance, have increased R&D significantly since 2000, and have productivity increases to prove it. This is one of Australia's strengths, and an extremely impactful way to use your country's expertise to help build local capacity in your geographic space and in Africa as well.

Globally, we should think beyond national programs and to what the international network could look like in the future. In August 2014, Brian Keating of CSIRO in Australia was the keynote speaker at the Food Science Congress in Montreal. Paraphrased, he said:

> During the doubling of population growth from 1960 to 2000 we had the benefits of the 'green revolution' – advances in science, technology, innovation, policy changes, business investment – but not without some controversy. Now we face a range of issues: environmental, nutritional, scientific, waste, over-consumption, etc. As a result we should think in terms of a 'rainbow revolution'.

A recent study by IFPRI, the International Food Policy Research Institute, co-authored by Shenggen Fan who is IFPRI's President and a distinguished speaker at this conference (see Fan 2014), discusses smallholder farmers in the developing world, and the need for specific and differing policies to optimise support for those for whom farming continues to make sense (Fan *et al.* 2013). It is well worth a read. While it reminds us that all smallholder farmers are different and should not be treated as a homogenous group, the role of productive farmers of this type is critical throughout the world. The world is counting on smallholder farmers to help meet those huge increases in food production.

Separately, IFPRI writes of education: that educated farmers are more productive than uneducated farmers. Of course. They also write that women farmers are more likely to follow the lead of other women farmers than of men farmers.

The role of women

All of this brings me to my major argument: to increase productivity and food security, invest in women.

Where did we see women in this story so far? Nowhere except as mothers, but they are everywhere. They are the mothers; the cooks; the water and firewood fetchers; the child-caregivers; the housekeepers; many of the marketers; at least half of the farmers, many operating their own smallholder farms. Women produce 60–80% of food in the developing world, according to FAO.

What they are often *not* are the landowners; the inheritors of land; the family bankers; the ones who went to school; the ones who have paid jobs; the people who show up at meetings and training sessions; the people sought out by agricultural extension workers.

In virtually every community and culture, in agriculture there are gender roles as in life. Some are ignored; some overcome; most live on for generations. It might be the case in a certain community that men plant and harvest crops; women weed and water. In another community, that make-up might be different. It is often the case that women are responsible for growing vegetables; often women are responsible for raising small animals, men large animals. Women are almost always working in fields by hand. The more mechanical the inputs get, the more male the workforce becomes.

Women are less educated than men because more boys attend and finish school than girls; yet educated farmers are more productive than uneducated farmers. Women are more likely to follow the lead of other more successful women farmers than of men, according to IFPRI. Yet when given the same inputs, according to FAO, women's farms are 20–30% more productive.

Extension work is an almost exclusively male domain: FAO estimates 85% of extension workers are men. These are the formal government assistance programs to support farming, but often it is culturally unacceptable for strange men to have conversations with women.

What is wrong with this picture?

The world has a goal: double food production. Developing countries, already with agriculture bases, offer prime opportunities for much of that growth. Smallholder farmers in the developing world are an important part of the solution. Many are women. Therefore, half the farmers cannot own their own land, many cannot count or read, have no agricultural experts to talk to them, and no time to invest in new ideas because they are holding down what we would define as at least two full-time jobs – in the fields and in their homes. If one cannot read, one cannot tell what the package of seed or fertiliser says. If one cannot count, one does not know how many rows are planted. If one owns no land, one has less incentive to produce on it. If one is working two jobs, she is not going to drop one to go to training. If extension workers are mostly men, they are not going to easily find and guide women farmers.

Therefore, my major point: to increase productivity, invest time and effort in those labouring in the fields. Be sure they have a basic education, access to resources, financing and land, and time to invest in their own productivity.

To do this, policy makers, aid workers, private sector partners and others must always take into account gender when working in agriculture. Here are some examples.

Years ago, I visited an area of rural Angola that had just been de-mined after the country's war. The community was ready to plant, but they needed hoes. There

were perhaps 100 long-handled hoes leaning against a fence. 'What is wrong with those?' I asked. 'They are male hoes, from an NGO,' was the answer. 'Is there a female hoe?' 'Yes.' They produced a shorter-handled hoe with more of a pointed shovel-type metal spade. Did you know there is a gender differentiation in hoes in rural Angola? Why? Because women spent most of the day in the fields with babies on their backs, and the short hoes, which required them to squat, were less back-breaking than the stand-up hoes.

In Ada, Ghana, I visited a local radio station which was soon going to air a program once a week training people on how to grow tomatoes, a new crop being introduced in the area. Local residents all had radios. Farm Radio International, a Canadian non-government organisation (NGO) funded by the Bill & Melinda Gates Foundation, had created the programming as well as developed a survey of families who would be planting tomatoes. They had to speak to each husband and wife to find out: When do you listen to the radio? If you both listen at the same time, who controls the knob? If those information sessions were put on at a time when women could not listen, all the resources would have been wasted.

The progress on human development indicators in Bangladesh has gone hand-in-hand with women's empowerment, with especially strong NGO work by the Bangladeshi organisations BRAC[4] and the Grameen Bank, among others.

Think about the daily role of girls and women in collecting water and firewood. Did you ever think that they are the people who best know the status of those available resources in any community? Environmental stewards, they are. How can their knowledge be used?

Sometimes, you may hear about 'gender neutral' policies: 'We don't discriminate. Our policies are all gender neutral'. This is hogwash. Do not trust anyone who tells you their policies are gender neutral. That means that they pay no attention whatsoever to the roles of women and men. Yet in agricultural development, in human development, in life, there are many gender-specific roles. If we do not pay attention to them, if we do not build policies around them, we are wasting our time and the taxpayers' money – or someone's money and time.

Australia is, as always, in a key position to influence the rest of the world on agriculture. You have huge credibility based on your own history, your current trading levels, and the in-depth expertise you have in R&D, university skill sets, strong NGOs, and governmental experience. The rest of the world always listens when Australia talks about agriculture. On top of that, in 2014 you lead the G20. You are perfectly positioned to lead on a range of policy programming designed to take advantage of your skill sets and reputation in a mission to lead on building the capacity of the people on whom the world is counting to produce more in the developing world: women.

[4] BRAC stands for Building Resources Across Communities

Here is a basic plan:

- Ensure that every girl has a primary school education.
- Convince governments to create universal secondary school education systems.
- Improve adult literacy programs for women; train girls how to teach their mothers.
- Use the Internet, use cell phones, use the radio, to reach women farmers with information and training.
- Support technical training in agriculture and related programming at basic levels and university education options for women and girls.
- Encourage development of out-of-the-box extension systems.
- Support innovative programming for girls at and outside of school to cut down on their time spent on chores and allow more time for school – like placing wells at schools.
- Encourage national policies that make owning and inheriting land be reasonable opportunities for women.
- Double-down on programs to grow vegetables and fruits – important for nutritional needs – and indigenous crops that women are most likely to tend and from which they can earn income.
- Create systems where the voices of women can be heard – about nutrition, about new crop development, about implements needed to be productive.
- Encourage banks to lend to women and men smallholder farmers.
- Be sure that women and men, girls and boys, are counted – in birth statistics and in any of our own research. Gender and age disaggregation still is not widespread and those data help dramatically when working on policy.
- Hold governments accountable for basic safety of their citizenry and for having real consequences for those who physically abuse the ability of girls and women to participate in work and education.

For years, those of us who have cared about international agriculture have been preaching only to ourselves. Aid levels decreased, interest decreased, support for developing country agriculture decreased. But since the 2008 food price crisis, the world has woken up to the food needs of the current and future inhabitants of this earth.

Australia is extremely well placed to lead these efforts further and will be most effective in doing so if it promotes policies that reflect the relative work and experience of women and of men in agriculture. To have the greatest impact, we could borrow and follow the words of one of America's founding mothers. Abigail Adams was the wife of John Adams – one of those who signed the colonies' Declaration of Independence, and later a United States President. When he was working on that declaration she wrote to him: 'Don't forget the ladies'.

If we ignore the roles of women in agriculture, we can guarantee reduced effectiveness of our efforts.

If we highlight and support the role of women, the world can reach much higher levels of development, productivity and success.

References

Fan S. (2014). Economics of food insecurity and malnutrition. *Ethics, efficiency and food security: Feeding the 9 billion, well*. Proceedings of the Crawford Fund 2014 Annual Parliamentary Conference, August 2014, pp. 23–31.

Fan S., Brzeska J., Keyzer M. and Halsema A. (2013). *From subsistence to profit: Transforming smallholder farms*. International Food Policy Research Institute (IFPRI), Washington, DC. <http://www.ifpri.org/sites/default/files/publications/pr26.pdf>

Ingram J.C. (2007). *Bread and Stones: Leadership and the struggle to reform the United Nations World Food Programme*. South Carolina, USA: BookSurge.

Professor Bertini is Distinguished Fellow at the Chicago Council of Global Affairs where she co-chairs the Global Agricultural Development Initiative. She serves as a board member of the Stuart Family Foundation, as a juror of the Hilton Foundation Humanitarian Prize, and on the Board of Directors of the Tupperware Brands Corporation. For two years, she was the Senior Fellow of Agricultural Development at the Bill & Melinda Gates Foundation. She is on the Board of International Food and Agricultural Development, which advises USAID, having been appointed by President George W. Bush and reappointed by President Barack Obama. Previously, she served as the Assistant Secretary of Food and Consumer Services at the United States Department of Agriculture where she drove nationwide implementation of electronic benefit transfer programs, created a food package for breastfeeding mothers, and oversaw the design of the Food Guide Pyramid. In 2012, she served as a member of the Accountability Review Board on Benghazi, appointed by Secretary Hillary Clinton. Professor Bertini's leadership of the UN World Food Programme (WFP) transformed WFP into the world's largest humanitarian organisation. As WFP's Executive Director, first proposed by President George H.W. Bush in 1992 and re-endorsed by President Bill Clinton in 1997, Professor Bertini led the efforts to end famine in North Korea, avert starvation in Afghanistan, ensure food was delivered effectively during crises in Bosnia and Kosovo, and prevent mass starvation in the Horn of Africa. Because of her reforms, WFP was held as the model for UN efficiency, effectiveness, and accountability. Professor Bertini was named the 2003 World Food Prize Laureate for her leadership at WFP in ending famine and decreasing hunger. Later, she served as the Under Secretary General for Management and as UN Security Coordinator. Secretary General Kofi Annan also appointed her as his Humanitarian Envoy to the Horn of Africa and to Gaza and the West Bank. Professor Bertini earned a Bachelor of Arts degree from the State University of New York at Albany and has been accorded numerous awards, commendations, and honorary degrees.

Email: cbertini@maxwell.syr.edu

Australia's leadership role: Using aid to tackle intractable problems and catalyse long-term solutions

The Hon Julie Bishop MP
Minister for Foreign Affairs, Australia

Parliamentary colleagues past and present – I believe Cathy McGowan is here, Margaret Reid, Neil Andrew, John Anderson and of course John Kerin, panellists, distinguished guests, ladies and gentlemen.

Sir John Crawford was a remarkable man. He was an adviser on agricultural and trade policy to Ben Chifley, to Bob Hawke but is said to have had a special spot in his heart for John "Black Jack" McEwen who, as a member of the Country Party, actually served as Prime Minister.

Crawford started the Bureau of Agricultural Economics in 1944 he was chairman of the Australian Wool Industry. He established the Centre for Resource and Environmental Studies at the ANU and he drove the establishment of the Australian Centre for International Agricultural Research (ACIAR) which is an agency for which I am responsible and I believe that it is one of the most treasured and valuable assets of our international engagement. Sir John co-authored the 1975 'Crawford Report' into the effectiveness of Australia's development assistance in science and technology.

So here we are nearly 30 years on and reflecting on the Crawford Fund's long and distinguished association with government, particularly through its partnership with the much treasured ACIAR.

Together your institutions have helped build a huge global agricultural research reputation for our country, setting Australia up to play a leading role on the world stage in areas that are so important to the world's future and its security.

Since coming to office almost 12 months ago, I've made a number of what I believe are significant public policy changes in the portfolio of Foreign Affairs and Trade.

Significantly we launched the New Colombo Plan, a flagship foreign policy initiative of the Coalition to support thousands of young Australian undergraduates to have the opportunity to live and study and work in our region. We want to encourage our future leaders to be more Asia-literate,

---

This is the Minister's speech as supplied.

to learn new skills, hopefully a second language, to come home after their experience with new perspectives and ideas and insights and to form friendships and connections that will last a lifetime. Just as the original Colombo Plan did all those years ago, bringing tens of thousands of young Asian students to our region, we now hope to send tens of thousands in return.

Relevantly for today, the first tranche of the New Colombo Plan included students from the School of Animal and Veterinary Science at Charles Sturt University undertaking studies at Bandung and Bogor Agricultural University in Indonesia. And we hope to see more of these kinds of opportunities for Agricultural Science students because next year the New Colombo Plan will be rolled out beyond the four pilot locations of Singapore, Indonesia, Hong Kong and Japan to over 35 countries in our region. What a rich experience our young people will have and bring back to our country.

Secondly, we've refocused our international engagement in a platform that I call 'economic diplomacy'. Economic diplomacy is our overarching principle that puts strong economic outcomes at the centre of our foreign, trade, investment, tourism and development assistance policies. Just as traditional diplomacy aims for peace, economic diplomacy aims for peace and prosperity.

I see economic diplomacy as changing the approach of government, to more closely engage with the private sector, the business community and non-government organisations in all of our work – both in our country and in our partner countries, particularly focussing on the Indian Ocean, Asia-Pacific region.

Third we've realigned our overseas development efforts to more clearly focus on driving economic growth in our region, enhancing the private sector. And we have merged the separate aid agency AusAID with the Department of Foreign Affairs and Trade so all of our efforts, all of our engagement with our regional, and more broadly partners beyond, are more effectively and efficiently aligned.

I believe that a more prosperous region is in Australia's national interest, and it is economic growth that lifts people out of poverty. Aid in itself is not a panacea for poverty.

In June of this year I launched our new aid policy for Australia, what I call the new aid paradigm. We have a much more rigorous set of performance targets for the aid program. We want to make sure that we are spending Australia's $5 billion per year aid program in smarter, more effective ways that are more result and outcome driven.

To many in this room it might seem obvious why we have ensured that our new aid program is focussed on agricultural issues, fisheries and water. The global task of feeding the nine billion well is a massive one and we want to play our part. Agricultural production will need to increase by 60 per cent to meet anticipated demand in 2050 in a world where already 842 million people worldwide are food insecure due to low incomes and other circumstances – two thirds of whom live in the Asia Pacific region. This is our neighbourhood, this is where we can make the biggest difference.

There are seemingly intractable problems but they can be solved through innovative and creative thinking, through partnerships and a long term commitment, indeed the very thinking that this conference is promoting.

Agriculture is a priority for our aid program because evidence shows that investment in agriculture works. Agriculture drives meaningful and lasting poverty alleviation. It is essentially a private sector enterprise. It is a simple and effective way to engage and economically empower women and it's a strength Australia possesses. And these are all pillars for our new aid policy – private sector involvement, the empowerment of women, effective outcomes and doing what Australia does best.

About 75 per cent of the world's poor live in rural areas and rely upon agriculture for their livelihoods. So an investment in agriculture is a targeted investment in their future. And it does represent value for money – GDP growth originating in agriculture is two to four times more effective in reducing poverty as GDP growth originating outside the sector.

And Australia is well placed to invest. We have world-leading agricultural scientists who are sharing their knowledge and expertise with the world. Australia's Chief Scientist, Professor Ian Chubb, has said that Australia feeds about 60 million people with our food products yet the knowledge we generate in partnership with developing countries contributes to the diets of over 400 million people. This is a remarkable contribution that is being made and it does have that ripple effect across the region and the globe.

Investments in the agricultural sectors of developing countries are investments in the private sector of those countries. According to the United Nation's Food and Agriculture Organisation private investment by farmers is the largest and most important source of investment in agriculture in developing countries, averaging around US$170 billion.

We are working with the private sector to leverage our investments in developing countries. Local private sectors are often well placed to provide the services farmers need.

Let me take Cambodia as an example, 80 per cent of Cambodian households are involved in agriculture and rice is their crop, but rice yields are far lower than they should be. Farmers have limited access to information about modern farming techniques, about fertiliser use, modern seed varieties, and planting techniques. We support the Cambodian Agricultural Value Chain program that works with seed producers, fertiliser and pesticide producers and retailers, rice millers, traders, exporters, media, research institutions, farmers' associations and government agencies.

And they provide farmers with information to help them increase yields more efficiently, improve their livelihoods and build their economic independence. With a dozen fertiliser companies partnering in this program we have the capacity to reach around half the farmers in Cambodia.

As always, women make a difference. The third reason why we've put agriculture front and centre is that investing in agricultural development in

developing countries is an investment in their women. One example clear in my mind is a project that I visited during my time in Vietnam in February. I met some wonderful people and I think some of them are here today – Dr Nguyen Van Bo and the President of the Vietnamese Women's Union, Nguyen Thanh Hoa.

I announced Australian Government support of over $4 million, for two projects to be delivered in partnership with the Vietnam's Women's Union and one of these partnerships is with ACIAR.

The project is aimed at improving women's lives, lifting household incomes by linking farmers and traders with more lucrative markets in urban centres. More than 2000 women from ethnic minority and smallholder farming families are benefiting from training and improved market access which will deliver financial and health benefits to many farming families.

Women comprise about 43 per cent of the agricultural labour force globally and women could increase yields on their farms by between 20 and 30 per cent if they had the same access to productive resources as men. With improved incomes, evidence suggests, they spend the majority of their incomes on the health and education of their families.

The fourth reason why I have made agriculture a priority of our aid program is we're good at it. This is one of our strengths. For more than a century, this country has been defined, in large part, by our success in agricultural production.

But we're also world leaders in agricultural science, research and innovation. In particular, as argued in the Crawford Fund's recent report Doing Well by Doing Good, international agricultural research generates a huge return on investment for Australia and some of our most important partner countries.

It is estimated that the $2.5 billion investment in research partnerships made by ACIAR since 1982 has delivered more than five times that in benefits to developing economies and of course to Australia. We – you – have the knowledge that underpins sustainable agriculture and food systems and we want to share and work together with our neighbours and to see a higher return on that investment.

So to deliver our agricultural development programs we are for a start improving market linkages. A central element of our approach – and this is, of course, critical if we are to build greater food security – is to ensure food moves freely from where it is produced to where it is needed. This is what 'aid for trade' is about – another pillar of our new aid program.

Sometimes, there are barriers that prevent farmers accessing markets – barriers we intend to overcome with our 'aid for trade' programs. My colleague, the Minister for Trade and Investment Andrew Robb recently announced a $60 million global trade integration facility over four years which will help developing countries remove some of the barriers and make trade easier

We're working to create an enabling environment, in developing countries, where agriculture and food businesses can prosper and this is critical to attracting much needed private sector investment. We're working on

governance and reform, that helps build investor confidence and makes it easier to attract finance. And – as we've done for many years – we'll advocate globally for an open and transparent system for global agricultural trade.

Third we'll invest in lifting agricultural productivity and sustainability. Again ACIAR is absolutely critical here. Developing new technologies that help farmers increase their yields and reduce their losses. Promoting sustainable use of natural resources, as water, land and other inputs come under ever-increasing pressure.

Our approach works best where our agricultural research endeavours are coupled with efforts to improve market opportunities. In post-conflict Timor Leste, for example, farmers struggle to find markets for their crops. Australia invested in research to increase yields of major staple crops such as maize – through the Seeds of Life program. Yields have gone up, and many farmers are now keen to sell their surpluses.

Maize is used in Timor Leste to produce fortified food products – important for tackling the chronic malnutrition that affects a quarter of lactating mothers, and over half the children in that country.

To be able to use local maize for local food fortification, they needed a local facility to test maize for toxins. And now support from Australia's Market Development Facility has resulted in a local testing facility being set up that will allow around 500 farmers to sell their maize for fortified food production.

Over time, having access to local testing facilities will open up many more opportunities for the marketing and processing of local maize. In Tonga, Australia's development assistance has helped watermelon growers increase their exports from 100 tonnes in 2011 to 280 tonnes just two years later.

Working with the Tonga Ministry of Agriculture, Food, Fisheries and Forestry – business systems and administrative and compliance activities have been improved and streamlined to meet the market and compliance demands set by New Zealand. An Export Pathway Manager has been appointed, auditing improved, training in export specifications and rules was initiated. Shipping schedules were adjusted and improved. All simple adjustments, but all adjustments that enabled Tongan farmers to cater to the export market more effectively.

So ladies and gentlemen, as far as Australian agriculture, research, aid and trade go – Sir John Crawford set a golden standard. For me, one of his great contributions was seeing the link between agriculture, poverty reduction, feeding the world, and Australia's remarkable strength in agricultural research and innovation.

And I'm confident in saying that Sir John would have been pleased with the prominence we've given agriculture, fisheries and water as one of our priority investment areas in our aid program. It is smart, cost-effective development. It's about building enduring people-to-people ties, sharing our knowledge, sharing our creative thinking. It's highly effective and agriculture is one of our major national strengths.

I wish you all the very best for your conference and the important effort that you make to solve the great challenges of our time, including global food security. All the very best.

Julie Bishop is the Minister for Foreign Affairs in Australia's Federal Coalition Government. She is also the Deputy Leader of the Liberal Party and has served as the Member for Curtin in the House of Representatives since 1998. Julie was sworn in as Australia's first female Foreign Minister on 18 September 2013 following four years in the role of Shadow Minister for Foreign Affairs and Trade. She previously served as a Cabinet Minister in the Howard Government as Minister for Education, Science and Training and as the Minister Assisting the Prime Minister for Women's Issues. Prior to this, Julie was Minister for Ageing. Julie has also served on a number of parliamentary and policy committees including as Chair of the Joint Standing Committee on Treaties. Born and educated in South Australia, Julie graduated with a Bachelor of Laws from the University of Adelaide in 1978, before practising law at an Adelaide law firm and becoming a partner at the age of 26. In 1983, Julie moved to Perth and practised as a commercial litigation lawyer at Clayton Utz, becoming a partner in 1985 and managing partner in 1994. She attended Harvard Business School in Boston in 1996, completing the Advanced Management Program for Senior Managers. In 1998, Julie was endorsed as the Liberal candidate for the seat of Curtin and won the seat in the general election held in October 1998. Prior to entering Parliament, Julie held a number of positions including: Chair of the Western Australia Town Planning Appeals Tribunal; a member of the Murdoch University Senate, the board of the Anglican Schools Commission, a director of SBS (TV and Radio) and a board member of the Committee for Economic Development Australia (CEDA WA). Julie was also Ambassador of the Muscular Dystrophy Association in WA, on the Council of Governors of the Lions Ear and Hearing Institute, a patron of CanTeen, and vice patron of Westcare Incorporated. She was inducted into the inaugural WA Women's Hall of Fame in 2011. Julie remains a patron and member of many business, cultural and sporting organisations in her electorate.

Achieving global food security: Building a new food system where nutrition, climate change and sustainability collide

Rachel Kyte
CGIAR Fund Council Chair, World Bank Group Vice President and Special Envoy for Climate Change

Abstract

We stand at the confluence of three of the greatest challenges that humanity faces in the 21st century: achieving global food and nutrition security; climate change; and agriculture's environmental footprint. A business-as-usual approach to agriculture will not effectively address these challenges and feed and nourish the world's growing population while protecting the planet. Only an integrated holistic approach that preserves vital natural resources such as water, land, forests and fisheries will enable us to achieve our development goals. At the heart of this solution is 'climate-smart agriculture', which seeks to address challenges head-on by pursuing a triple win: sustainably increasing productivity; enhancing resilience and farmers' capacity to adapt; and reducing greenhouse gas emissions and increasing carbon storage. Climate-smart agriculture is at the heart of a paradigm shift in the food system and how we manage the fragile ecosystems that sustain rural livelihoods. It combines sustainable intensification – producing good quality food with fewer inputs – with a landscapes approach, so that progress on farms does not come at the expense of forests, streams, and biodiversity, the loss of which will have impacts on farmers' productivity and resilience down the line. Diverse farming systems also provide more diverse and nutritious diets. This will have to be accompanied by a reduction in food waste and significant changes in the nitrogen cycle. Capitalising on the potential of climate-smart agriculture requires broad, strategic partnerships and significant investment in research – particularly the global public goods that CGIAR and its partners may uniquely provide – to generate the scientific, political, financial and technological innovations needed to transform agriculture for the benefit of poor people and the planet.

This paper focuses on a fundamental and daunting challenge: how to nutritiously feed the world's growing population in uncertain times. To feed and nourish the 9 billion people who will be living on the planet by 2050, farmers will need to produce as much food as they have over the past 8000 years, and do so without destroying or taking a hefty toll on the environment.

Yet we are already failing to feed today's population. One in eight people suffers from chronic hunger, and more than a billion people – the majority women and

children – are undernourished. Most of these people live in Africa and South Asia, two regions of the world that are particularly vulnerable to the impacts of climate change, and urbanising at an unprecedented rate.

Hunger exacts a terrible toll. When a child is hungry or malnourished, their physical and mental development are stunted. Their ability to learn is compromised, and those who survive face a life of diminished earnings and productivity. This creates the vicious cycle of poverty that extends from generation to generation, preventing not only people but countries from realising their true potential.

Increasingly, all forms of malnutrition, from stunting to obesity, demand our attention.

We tend to think of obesity as a rich-country problem, but according to the Food and Agriculture Organization of the United Nations (FAO) the number of overweight and obese people in developing countries – 904 million – has more than tripled since 1980 and has now overtaken the number of malnourished – 842 million (Stevens *et al*. 2012). A study published in *The Lancet* in August 2014 found that one-third of the world's population is now overweight or obese, and 62% of these individuals live in developing countries (Ng *et al.* 2014).

Meanwhile our cities are growing at breakneck speed. Each year, 70 million people move into urban areas in developing countries. In the space of 30 years, 2 billion people will move to urban areas in emerging economies, doubling the global urban population. Built-up urban areas will increase by 1.2 million square kilometres, which is nearly triple the global urban land area in 2000.

As urban people become increasingly affluent, their food preferences change rapidly. When incomes rise, people tend to eat more meat. In low and middle-income countries, meat consumption is projected to grow 75% from 2005 to 2050, reaching 30 kilograms per person per year.

This growing demand has major environmental consequences. For every 1 kilogram of change in demand for meat, up to 10 kilograms of additional feed is required, intensifying pressure on crop lands and forests, and increasing emissions. A CGIAR-funded study found that beef and dairy cattle account for 77% of all global greenhouse gas emissions from livestock, but animals in the developing world require more food to produce 1 kilogram of protein than do livestock in wealthy countries. And ruminants, such as sheep and goats, require up to five times more feed to produce 1 kilogram of protein as meat than as milk (Herrero *et al*. 2013). In Africa, where most livestock graze on marginal land and crop residues, feed efficiency is low and emission intensity is high. CGIAR research found that cattle foraging in arid areas can release the equivalent of 1000 kilograms of carbon for every kilogram of protein they produce, or 100 times the emission intensity recorded in parts of the developed world (Herrero *et al*. 2013).

This raises questions about how to balance food wants and needs with those of the environment, and how to balance individual choice with costs to the community.

At the same time as we must understand the shifts in demand for food, we must grapple with challenges in supply, namely the extraordinary levels of food waste in our broken food system.

As the World Bank Group's *Food Price Watch* pointed out in February 2014, the world loses or wastes one-quarter to one-third of all food produced for people (World Bank 2014). In North America and Europe, roughly 95–115 kilograms of food per person are wasted annually, compared with 6–11 kilograms per capita in Africa and in South and South East Asia (FAO 2011). In Africa, an information tracking system shows that 10–20% of grain is lost prior to processing, amounting to billions of dollars in terms of production value. If these losses and waste were avoided, 48 million people could consume more than enough calories to sustain them each day for a year (World Bank 2011).

There are many different reasons for the waste, but behind them all is a broken food system. A lack of roads, refrigeration and storage means a lot of food never makes it from the farm to the market. Perversities in business models, regulations and consumer appetites result in more waste between market and home. Prices, a culture of excess, and attitudes that reflect the fragility of our food system mean more waste at our family dinner table or favourite restaurant.

And last but not least, our food system must adapt to climate change – the threat intensifier – as well as reduce its own contributions to that threat. Climate change and its impacts, such as more frequent and severe heat, drought and floods, are expected to intensify, diminishing crop yields even more significantly than we are seeing today.

The latest science predicts that if we continue down the 'business as usual' path we will be living in a 2°C warmer world by the 2030s, and that agricultural productivity will drop even further as weather patterns become more extreme. Globally, cereal yields could decrease by one-fifth. In Africa, the most food-insecure region of the world, farmers' yields could decrease by up to 50%. In a 4°C warmer world, currently predicted by the end of the century, over 10% of South Asia's agricultural land is projected to be flooded, with a 10% intensification of storm surges and a 1-metre rise in sea level (World Bank 2013a).

Warming and acidification threaten our ocean resources and fish stocks and livelihoods, especially in the developing world where more than 1 billion people depend on fish for most of their animal protein (World Bank 2013b). Over 700 million people rely on aquatic agricultural systems for their income (CGIAR n.d.). Many of these poor farmers, fishers and herders live in coastal zones and along river floodplains, making them vulnerable to sea level rise and extreme weather events. In South East Asia alone, about 138 million people live on coasts and within 30 kilometres of a coral reef.

The challenges – from waste to warming – spurred on by a growing population with a rising middle-class hungry for meat, are leading us down a dangerous path. Unless we chart a new course, we will find ourselves staring volatility and disruption in the food system in the face, not in 2050, not in 2040, but potentially within the next decade. A business-as-usual approach to agriculture

is no longer an option. It will not enable us to feed and nourish the world's growing population, nor to protect the planet.

To chart a new course we first need to face the fact that agriculture and land-use change are responsible for 30% of greenhouse gas emissions. They have to move from being a part of the problem to the core of the solution.

That does not mean that mitigation should come at the expense of production. In fact, I am suggesting the opposite. I am talking about increased efficiency leading to lower emissions per calorie or kilogram of food.

It is time for a shift in our approach to agriculture. We need to move to an integrated holistic approach that enables us to build a new food system where nutrition, climate change and sustainability come together and feed an increasingly urbanised population.

At the heart of this solution is what we term 'climate-smart agriculture' – an approach that refutes the idea that preserving vital natural resources, reducing carbon emissions and nourishing people is a zero-sum game. It offers farmers a future, a path through uncertainty. Climate-smart agriculture offers a triple win: increased productivity, improved resilience and greater climate change mitigation.

What does a triple win mean in practice?

- First, sustainably increasing productivity means increasing food and nutrition security by producing more food in ways that do not come at the expense of the environment.
- Second, enhancing resilience means reducing farmers' exposure to short-term risks and shocks, such as drought, pests and disease; improving the capacity of smallholder farmers to adapt in the face of longer term stresses such as shortened seasons and erratic weather; and building healthy ecosystems.
- Third, lowering agriculture's footprint means reducing greenhouse gas emissions for each calorie or kilogram produced; avoiding deforestation from agriculture; and increasing carbon storage.

Climate-smart agriculture combines sustainable intensification – producing more and better food with fewer resources – with a landscape approach, so that progress on farms does not come at the expense of forests, streams, and biodiversity, the loss of which will have impacts on farmers' productivity and resilience down the line.

The reality is, if we continue to fund crop expansion on the one hand, and natural resources conservation on the other, outside of a landscape approach, we will cancel ourselves out.

In Uganda, farmers are practising climate-smart agriculture by intercropping two key cash crops: banana and coffee. Banana captures atmospheric carbon dioxide, enriching soil carbon stocks while mitigating climate change; and its permanent canopy, roots and mulch prevent soil erosion and degradation. Research by CGIAR's International Institute for Tropical Agriculture (IITA) shows that shade

from the taller banana trees could cool coffee plants by at least 2°C – a huge plus in a warmer world. And by intercropping, farmers can earn significantly more income (IITA 2009, 2012).

This poses major challenges to the research community: in how we conduct research, what we research, who carries out the research, and the levels of committed funding. After falling behind the curve, siloed in crop-based research, we now see partnerships asking different questions and clearly focused on the cross-cutting challenges posed by population demands, nutrition needs, climate challenges, environmental limits and urbanisation.

A case in point is rice, which feeds almost half the world's population. Some 65% of the world's rice is produced in the great deltas of Asia, where one hectare currently provides food for 27 people. By 2050, one hectare, which will be massively affected if sea levels rise as the planet heats up, will need to support at least 43 people (Wilson 2014). It is an impossible task with existing rice varieties. It is an impossible context outside an effort to manage whole water basins differently, and aggressively move to reduce emissions.

That is why some of the best scientific minds in the world, including scientists from the Australian National University, CSIRO and CGIAR's International Rice Research Institute, are trying to convert the 3-carbon (C3) metabolic pathway of photosynthesis in rice into a 4-carbon or C4 pathway, so the plant can absorb sunlight faster. The C4 pathway, incidentally, was first discovered here in Australia by a CSIRO scientist. If researchers succeed in turbocharging the plant's engine, the new rice variety would need less water and fertiliser but yield 50% more grain than the best current varieties (Sheehy and Mitchell 2013).

Climate-smart agriculture is also about resilience, helping poor and vulnerable people cope with the negative effects of climate change and weather-related stress.

In Bangladesh, where over 20 million people suffer from malnutrition and nearly one-third of the population is living in poverty, CGIAR's WorldFish Center is helping women produce their own food by transforming unused ponds into fish farms (WorldFish n.d.). This dramatically increases food security, nutrition, and incomes.

This initiative highlights the importance of providing women with equal access to critical resources, technology and knowledge. Women make up 43% of the world's agricultural workforce (World Bank 2012). Yet women farmers tend to have smaller plots with poorer soils, insecure rights to land, and significantly less access to fertiliser, improved seed, credit, and other tools to gain more from the land. They are more vulnerable to climate change and natural hazards, and are less able to adapt.

It is estimated that giving ALL farmers equal access to productive resources could increase agricultural output in developing countries by as much as 2.5–4% (World Bank 2012).

In 'climate-smart villages' – sites in Africa and Asia where researchers, development partners, and farmers come together to test agricultural

innovations – CGIAR and its partners are empowering women to adopt climate-smart technologies and practices. And they are succeeding (CCAFS 2013, 2014).

We have seen the partnership yield important impacts. CGIAR and ACIAR, for example, have collaborated with developing country scientists to reduce poverty and hunger (Page 2009), including by:

- developing and disseminating improved crop varieties in East Timor and Iraq,
- boosting fishing productivity in the Pacific, and
- improving agricultural practices in southern Africa.

Last year, Australia and other dedicated investors helped CGIAR reach a major milestone: doubling annual funding to US$1 billion. It is money that has helped millions of farmers and consumers avoid hunger and poverty.

We need to capitalise on the vast potential of agricultural research, so CGIAR has set another ambitious goal: doubling our funding again, this time to US$2 billion by 2020.

I would like to leave you today with an invitation to join us in pursuit of this goal. It is vital. The stakes are high.

As Lloyd's of London, the insurance giant, makes clear in its report 'Feast or Famine', food insecurity will be one of the greatest risks to global society over the next 10 years (Lloyd's 2013). Whether big business, small farmer, or government policy maker, we all need to take responsibility for creating a food system that is climate-smart, people-focused and planet friendly. The world's future security is at stake.

References

CCAFS (2013). Empowering women farmers in Haryana to combat climate change. *Advancing climate-smart agriculture: The 2013 Annual Report*. <http://ccafs.cgiar.org/research/annual-report/2013/empowering-women-farmers-haryana-combat-climate-change>

CCAFS (2014). Gender, power and climate information in Nyando, Kenya. News blog, August 2014, by Devereux T. and McKune S. <http://ccafs.cgiar.org/blog/gender-power-and-climate-information-nyando-kenya>

CGIAR (n.d.). CGIAR Research Program on Aquatic Agricultural Systems, webpage. <http://www.cgiar.org/our-research/cgiar-research-programs/cgiar-research-program-on-aquatic-agricultural-systems>

FAO (2011). Cutting food waste to feed the world. 11 May 2011, FAO Rome. <http://www.fao.org/news/story/en/item/74192/icode>

Herrero M., Havlik P., Valin H. *et al*. (2013). Biomass use, production, feed efficiencies and greenhouse gas emissions from global livestock systems. *Proceedings of the National Academy of Sciences* 110(52), 20888–20893. Published ahead of print December 16, 2013, doi:10.1073/pnas.1308149110
Summarised at <http://www.ilri.org/ ilrinews/index.php/archives/12353>.

IITA (2009). Banana–coffee mix boosts farmers' incomes by 50 percent. International Institute for Tropical Agriculture, Press releases – 2009 archive. <http://www.iita.org/2009-press-releases/-/asset_publisher/hB8z/content/banana-coffee-mix-boosts-farmers-incomes-by-50-percent;jsessionid=0AF498244C792BFC0763DDF6C7F21AA0?redirect=%2F2009-press-releases#.VLWLESvF-P8>

IITA (2012). Banana can protect coffee from the effects of climate change. International Institute for Tropical Agriculture, Press releases – 2012 archive. <http://www.iita.org/2012-press-releases/-/asset_publisher/CxA7/content/banana-can-protect-coffee-from-the-effects-of-climate-change?redirect=%2F2012-press-releases#.VLWJpivF-P8>

Lloyd's (2013). *Feast or famine: Business and insurance implications of food safety and food security*. <http://www.lloyds.com/~/media/lloyds/reports/emerging%20risk%20reports/food%20report.pdf>

Ng M., Fleming T., Robinson M. *et al.* (2014). Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: A systematic analysis for the Global Burden of Disease Study 2013. *The Lancet* 384(9945), 766–781. <http://dx.doi.org/10.1016/S0140-6736(14)60460-8>

Page W. (2009). Working with the CGIAR. *Partners in Research for Development*, July–October 2009, pp. 12–13; magazine of the Australian Centre for International Agricultural Research, <www.aciar.gov.au>.

Sheehy J.E. and Mitchell P.L. (2013). *Designing rice for the 21st century: The three laws of maximum yield*. Discussion paper series 48. Los Baños (Philippines): International Rice Research Institute. 19 p. <http://books.irri.org/DPS48_content.pdf>

Stevens G.A., Singh G.M., Lu Y. *et al.* (2012). National, regional and global trends in adult overweight and obesity prevalences. *Population Health Metrics* 10:22. <http://www.pophealthmetrics.com/content/10/1/22>.

Wilson K. (2014). In search of a new strain of super rice. *China Daily Asia Weekly*, 6 June 2014. <http://www.chinadailyasia.com/asiaweekly/2014-06/06/content_15138936.html>

World Bank (2011). *Missing food: The case of postharvest grain losses in sub-Saharan Africa*. Washington, DC: World Bank. <https://openknowledge.worldbank.org/handle/10986/2824>

World Bank (2012). *World development report 2012: Gender equality and development*. World Bank. <https://openknowledge.worldbank.org/handle/10986/4391>

World Bank (2013a). *Turn down the heat: Climate extremes, regional impacts, and the case for resilience*. A report for the World Bank by the Potsdam Institute for Climate Impact Research and Climate Analytics. Washington, DC: World Bank <http://documents.worldbank.org/curated/en/2013/06/17862361/turn-down-heat-climate-extremes-regional-impacts-case-resilience-full-report>

World Bank (2013b). *Fish to 2030: Prospects for fisheries and aquaculture*. World Bank Report 83177-GLB. Washington, DC: The World Bank. Summaries and link to report: <http://dialogues.cgiar.org/blog/the-challenges-of-the-global-fish-food-system>; <http://www.ifpri.org/blog/fishing-answers>.

World Bank Group (2014). *Food Price Watch*. Year 4. Issue 16. February 2014. Poverty Reduction and Equity Department, World Bank Group, Washington, DC. <http://www.worldbank.org/content/dam/Worldbank/document/Poverty%20documents/FPW%20Feb%202014%20final.pdf>

WorldFish (n.d.). Participating in research equips Bangladeshi women with valuable knowledge and skills. Web article on 'Women-Led Participatory Action Research on Homestead Challenged Pond Aquaculture' project. <http:// www.worldfishcenter.org/featured/participating-research-equips-bangladeshi-women-valuable-knowledge-and-skills>

Rachel Kyte is World Bank Group Vice President and Special Envoy for Climate Change. She oversees work on climate change adaptation, mitigation, climate finance, and disaster risk and resilience across the institutions of the World Bank Group, including IBRD, IDA, IFC and MIGA. The climate group is focused on ensuring that all Bank Group operations integrate climate change and take into account the opportunities that inclusive green growth presents. The group is also an advocate for global climate action. Ms Kyte previously served as World Bank Vice President for Sustainable Development and was the International Finance Corporation Vice President for Business Advisory Services and a member of IFC's management team. She is Professor of Practice in Sustainable Development at The Fletcher School of Law and Diplomacy. She holds a Master's degree in international relations from Tufts University, and a Bachelor's degree in history and politics from the University of London.

Email: jknapp1@worldbank.org

Economics of food insecurity and malnutrition

Dr Shenggen Fan
International Food Policy Research Institute

Abstract

Despite significant progress achieved in the last two decades, global hunger and malnutrition remain big challenges. About 805 million people in the world continue to suffer from chronic hunger and more than 2 billion people suffer from micronutrient deficiencies. Moreover, overweight and obesity are on the rise in low- and middle-income countries. Hunger and malnutrition impose huge economic and social costs which can be felt at individual, household, and societal levels. For example, hunger and undernutrition cost the global economy US$1.4–2.1 trillion per year, or 2–3% of global gross domestic product, according to the FAO. The economic returns to eliminating hunger and malnutrition can also be very high. Evidence from IFPRI-led research demonstrates that there are substantial, lifetime economic benefits from reducing child undernutrition. In India, for example, every dollar spent on interventions to reduce stunting is estimated to generate about US$34 in economic returns. This paper makes the economic case for investing in the elimination of global hunger and malnutrition. It also focuses on the inefficiencies of policies and practices that add to the burden of hunger and malnutrition: such as under-investment in food security and nutrition; lack of social safety nets to protect the poorest; unsustainable natural resource use in food production; trade restrictions; and gender inequality in agriculture.

This paper focuses on one of the dimensions of food security and nutrition: that is, the economics of hunger and malnutrition. Ending hunger and malnutrition is not only a moral obligation, it also makes economic sense. One of the key messages here is that hunger, malnutrition and poverty remain big challenges. Eliminating hunger and malnutrition must be top priority in the development of the Sustainable Development Goals – the anchor of the post-2015 development agenda. Hunger and malnutrition should be eliminated for ethical and economic reasons. Efficient policies and prioritised investments will be critical in achieving the goal.

As papers by Ms Kyte and Ms Bishop mention (see Kyte 2014; Bishop 2014), there has been tremendous progress in reducing hunger, malnutrition and poverty in many regions in Asia, particularly East Asia and South-East Asia (Figure 1). In fact, the prevalence of hunger has been cut in half or more than half in these regions. While progress has been made in these regions, in other parts of the world, particularly Africa and South Asia, the prevalence of hunger and undernutrition remains very high.

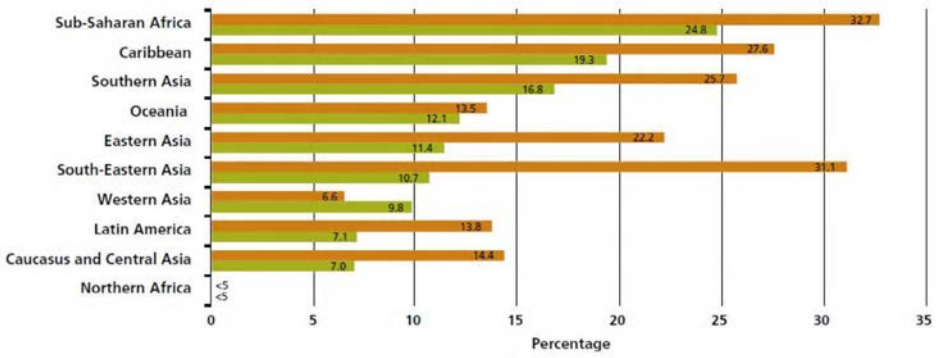


Figure 1. Prevalence of undernourishment by region. Source: FAO, IFAD & WFP 2013. For each country, orange (top bar) =1990–92; green (lower) = 2011–13.

In Africa, 25% of the population still suffer from chronic hunger or undernourishment. Progress in reducing hunger and undernutrition in the region has been very slow. In fact, as a whole, Africa has not been on track to achieve the Millennium Development Goal of reducing hunger by half between 1990 and 2015. The picture is similar in South Asia, where the prevalence of hunger is still around 17% and the region is also not on track to cut the percentage of undernourished population by half.

Globally, 805 million people are suffering from chronic hunger – lack of calories and lack of energy in their diet. There is another dimension of hunger that is not seen, which is 'hidden hunger' – lack of essential minerals and vitamins or micronutrients. Hidden hunger is prominent and most severe in some of the poorest regions and the poorest countries, including Australia's neighbouring countries in the Pacific region. Overall, more than 2 billion people are suffering from micronutrient deficiencies (Figure 2).

There exist three burdens of malnutrition – the triple burden of malnutrition. The first burden is undernourishment, which is the traditional definition of hunger according to the FAO[1] – a lack in calorie intake. The second is the lack in micronutrient absorption, or hidden hunger. The third burden of malnutrition is over-nutrition – overweight and obesity.

Currently, 2.1 billion individuals in the world are either overweight or obese, and 62% of that population is in developing countries, showing that over-nutrition is no longer a rich-country phenomenon. Over 40% of men and 50% of women are overweight and obese in Oceania (Ng *et al.* 2013). The most striking feature, and probably the most alarming, is the increase in overweight and obese children. From 1990 to 2010 the percentage of overweight and obese children has doubled (Figure 3).

Hence, with the triple burden of malnutrition affecting almost every country, ending hunger and malnutrition should be of high priority in the post-2015

[1] Food and Agriculture Organization of the United Nations

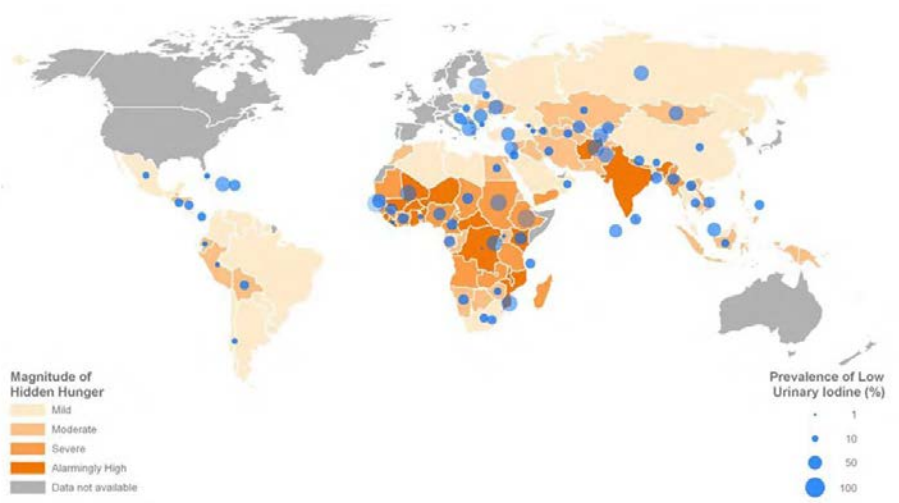


Figure 2. The Hidden Hunger Index of micronutrient deficiencies. More than 2 billion people are deficient in micronutrients. From Muthayya *et al.* 2013.

agenda. The global community is currently in the process of structuring the Sustainable Development Goals. The proposed 17 goals and 169 targets are mixed – many of them are instruments, some of them are measurable, and some are only aspirational – and place high priority on poverty eradication.

While the elimination of extreme poverty is important, ending hunger and malnutrition should be equally central, if not more critical. Why? Because hunger and malnutrition affect the capability of individuals to overcome poverty and must, therefore, be addressed first. Hunger, malnutrition and poverty are linked in a vicious cycle. For example, if a woman and her baby are undernourished, it is highly likely that her baby could experience cognitive and physical impairment, thus affecting their income-earning capacity. This, then, cycles back through further hunger and malnutrition for that family (Eggersdorfer *et al.* 2013).

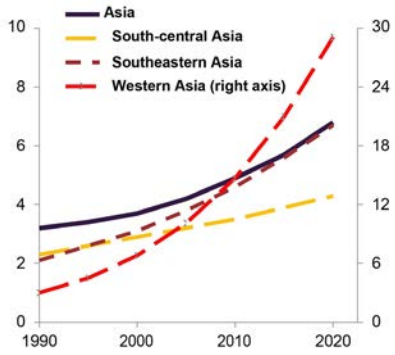


Figure 3. Prevalence of overweight and obese children under 5 years old, as percentage of population, by year (not including Japan), 1990–2020. From de Onis *et al.* 2010.

Hunger and malnutrition are costly. It is estimated that 2–3% of global gross domestic product (GDP), equivalent to US$1.4–2.1 trillion per year, is lost because of undernutrition. Another 2–3% of annual GDP is lost because of over-nutrition. Together, 5% of global GDP (US$3.5 trillion per year) is lost because of malnutrition (FAO 2013).

Strong economic returns to investment

The returns to investment in addressing hunger and malnutrition are very high. The cost-to-benefit ratio for nutrition is as much as 1:30 (Eggersdorfer *et al*. 2013; Hoddinott *et al*. 2013). This means that for every dollar invested in addressing nutrition – whether through reshaping agriculture for better nutritional outcomes, or whether as direct nutrition interventions – will reap $30 in return. In comparison, investments in rural infrastructure, education, R&D and irrigation have not shown such high returns.

While this is true, inefficient policies and practices add to the burden of hunger and malnutrition, and prevent such high returns. Therefore we must fix these weak policies, which include:

- underinvestment in food security and nutrition;
- disconnection between agriculture and nutrition policies: many ministries of agriculture aim for self-sufficiency in food, such as grain self-sufficiency, and not for nutrition;
- unsustainable natural resource use in food production: food waste and, more importantly, post-harvest loss, subsidised fertilisers and water and, in some places, free electricity.
- trade restrictions: while the 2007–08 food crisis was partly triggered by drought in Australia, it was exacerbated by trade restrictions. In the case of rice, a major staple crop in the region, many countries began to impose trade bans that increased rice prices by 100–200%, leading to panic behaviour, panic purchasing, and panic border restrictions.
- lack of social safety nets to protect the poorest: remember that one dimension of food security is accessibility, so availability through production is critical but it is equally important to make sure that the poor have the means and the income to access food.
- gender inequality in agriculture: reflect on Professor Bertini's very powerful Sir John Crawford Memorial Address on gender in agriculture, gender in rural development, and gender's role in reducing poverty (Bertini 2014). The papers of Ms Kyte and Ms Bishop also emphasise the role of gender (Bishop 2014; Kyte 2014).

Efficient policies and prioritised investments are key, so how can we fix the failed policies or misguided priorities of our investments? Here are some ways:

- accelerate investments in nutrition and reshape agriculture for improved nutrition and health;
- promote sustainable intensification and resilient food systems;
- transform smallholders;
- scale-up well-targeted, productive and cross-sectoral social safety nets;

- facilitate trade that is open, transparent and fair;
- support gender equality in agriculture.

Accelerate investments in nutrition and reshape agriculture for improved nutrition and health

Reshaping agriculture for improved nutrition is a fundamental shift that we must look into. It requires two different but linked approaches (Figure 4). Nutrition-specific interventions help to address immediate causes of undernutrition, which include micronutrient supplementation, breastfeeding and complementary feeding practices and dietary diversification.

More important are nutrition-sensitive programs, policies and approaches that address the underlying causes of undernutrition. Such interventions offer ways to reshape agriculture for better nutrition and health outcomes instead of, for example, maximised grain production or self-sufficiency. Nutrition outcomes, instead of self-sufficiency goals, for example, should be used to evaluate the performance of Ministers of Agriculture. Along with this, nutrition-sensitive programs should include, for example, social safety nets because they are very important to ensure universal access to food. Additionally, women's empowerment is a nutrition-sensitive approach that must be considered.

IFPRI, together with University of Oxford and USAID (United States Agency for International Development), has developed a Women's Empowerment in Agriculture Index (WEAI) that includes indicators such as:

- income-earning opportunities,
- a woman's role in associations, and
- a woman's ownership of assets.

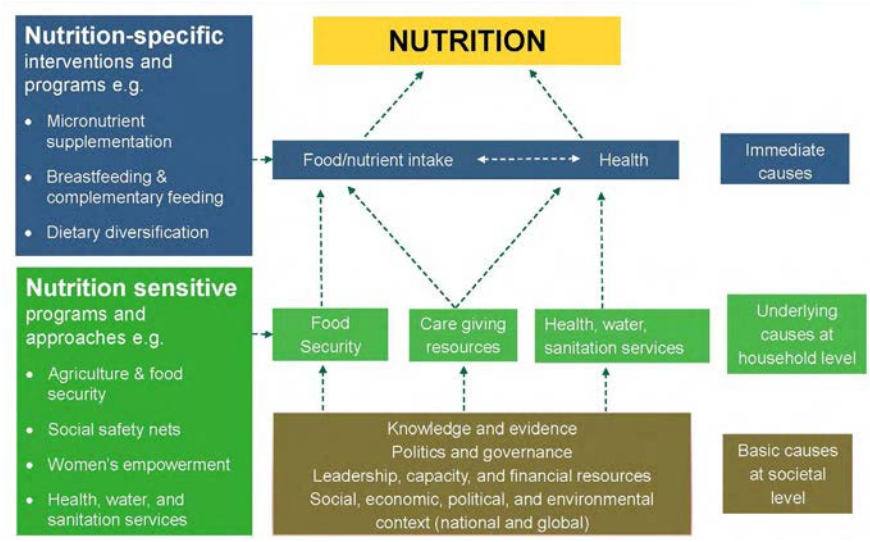


Figure 4. Interactions between nutrition-specific and nutrition-sensitive interventions. Adapted from von Grebmer *et al*. 2010, Black *et al*. 2013.

We have found that ownership of assets is the most critical factor in empowering women, whether through control of land, water, or other assets. With this index we can evaluate performance of countries and encourage government accountability in women's empowerment. We at IFPRI hope that global institutions, whether the FAO, the World Bank or CGIAR, will construct that index for every country, over time, and make policy-makers accountable for improved gender equality.

Promote sustainable intensification and a resilient food system

Promoting sustainable intensification and resilient food systems is a matter for the entire CGIAR system. Sustainable intensification research involves cross-cutting analysis on how to produce more – 'more' here means more nutrition, or more nutritious food – with less inputs, such as water and energy. Water, for example, can be used for other purposes, such as for clean drinking water. Additionally, with less reliance on energy and less carbon emission, we can adapt the whole food system to help to mitigate climate change. In sum, sustainable intensification involves more outputs, particularly more nutrition, with more efficient use of all inputs on a durable basis while:

- reducing environmental impacts and greenhouse gases,
- building resilience, and
- increasing natural capital and the flow of environmental services.

At IFPRI we use a global model to analyse how different technologies can help in achieving these different goals by producing more with less. There are a number of appropriate agricultural technologies (Figure 5), all with different costs, which must be adapted based on context and country specificity. For instance, no-till, nitrogen-use efficiency and drought-tolerant varieties (such as Green Super Rice); and conservation agriculture in wheat and maize production can achieve much better nutrition outcomes using less water and less land and producing smaller carbon emissions.

Transforming smallholders

Not all smallholders are the same; in fact, they are all very different. They account for the majority of the poor and undernourished population of the world and that is why we need to work to help them. Smallholders are not homogenous – some smallholders have large holdings, some small; some farm in

Figure 5. Eleven agricultural technologies and techniques that promote sustainable intensification. From Nelson *et al*. 2009; Rosegrant *et al*. 2014.

areas dominated by traditional agriculture, some are in emerging economies, and others are in more urbanised areas. We need a range of policies and instruments to help this diverse group transform their businesses.

Depending on their situations, smallholders should be encouraged to move up or move out of farming. Smallholders should be encouraged to move up when commerialisation is feasible and when they have the means to improve links to global and urban markets. Where non-farm sectors are expanding, such as in urbanised economies, smallholders could increase their incomes by engaging in non-farm activities by moving out of agriculture. Pathways to enhance the profitability of smallholder farms must include institutional reform – land ownership or leasehold, and access to rental markets. Scaling-up innovation in smallholder-friendly financial services and access to finance is key, and so is investment in new technologies and innovative risk-management tools, so that smallholders can adapt to climate-smart agricultural practices. Smallholders should also be linked to agrifood value chains. Finally, promoting market-based price stabilisation mechanisms is key, as smallholders are vulnerable to price fluctuations or volatility.

Productive social safety nets

Scaling-up productive social safety nets is important. Better-targeted and more productive social protection policies can give smallholders:

- short-term cushions for coping with livelihood shocks; and
- long-term productivity-enhancing or exit opportunities.

Many smallholders lack access to nutritious foods. Either they do not produce enough or they do not have income to buy from markets. Productive social safety nets should guarantee smallholders have access to nutritious foods while at the same time supporting smallholders' own growth and development.

Cross-sectoral social protection can reach the poor more effectively. The Productive Social Safety Net Programme in Ethiopia is a good example. When the 2012 drought occurred in the Horn of Africa, in Somalia for example, 16 million people suffered from hunger and 3 million children suffered from malnutrition. In Ethiopia, however, 7 million of the poor avoided being hungry because of the social safety net set up by the Ethiopian Government, with the support of research institutions like IFPRI (Gilligan *et al.* 2008). Aother example is the Bangladesh Vulnerable Group Development Programme. It includes food security and nutrition interventions with income-generating activities that target women (Ahmed *et al*. 2009).

Facilitate open, transparent and fair trade

In relation to trade, the World Trade Organization has emphasised import tariffs and restrictions, but we need to work on export bans and restrictions as well. Export bans hinder the efficiency of agricultural markets and prevent fair trade from neighbouring countries. Furthermore, export bans and restrictions can lead to and exacerbate high food price spikes and volatility which hurt both poor consumers and producers. Trade should be transparent and fair.

The elimination of distortionary trade policies will not only improve access to food but also promote efficient allocation of resources. We need to create global and regional grain reserves in poor countries, such as those in the Horn of Africa that import food. We must also remove the competition between food and fuel – minimise grain-based biofuel production.

In addition, the OECD[2] countries need to cut down their subsidies. Emerging economies such as China and India should not repeat the mistakes of the OECD countries. Protection policies of emerging economies like these should be monitored.

Support gender equality

We must make governments accountable for their performance on gender equality. Gender inequality leads to inefficient allocation of resources. By contrast, gender equality in agriculture leads to:

- higher agricultural output and gains in productivity;
- reduced hunger and malnutrition, especially for the next generation; and
- improved rural livelihoods.

To support gender equality in agriculture, governments can strengthen land rights for women, improve women's access to inputs and credit, and provide them with agricultural training and up-to-date agricultural information.

Conclusion

Concerted action for efficient policies and prioritised investments is critical in eliminating hunger and malnutrition by 2025, and we must work together to achieve it. This is both good economics and the right thing to do. Nutrition is a basic human right.

References

Ahmed A.U., Quisumbing A.R., Nasreen M. *et al.* (2009). *Comparing food and cash transfers to the ultra poor in Bangladesh*. International Food and Policy Research Institute (IFPRI) Research Monograph 163. <DOI: 10.2499/9780896291737RR163>

Bertini C. (2014). Effective, efficient, ethical solutions to feeding 9 billion people: Invest in women. *Ethics, efficiency and food security: Feeding the 9 billion, well.* Proceedings of the Crawford Fund 2014 Annual Parliamentary Conference, August 2014, pp. 1–8.

Bishop J. (2014). Australia's leadership role: Using aid to tackle intractable problems and catalyse long-term solutions. *Ethics, efficiency and food security: Feeding the 9 billion, well.* Proceedings of the Crawford Fund 2014 Annual Parliamentary Conference, August 2014, pp. 9–14.

Black R.E., Victoria C.G., Walker S.P. *et al.* (2013). Maternal and child undernutrition and overweight in low-income and middle-income countries. *The Lancet* 382(9890), 427–451. August 2013. <http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(13)60937-X/fulltext#cesec20>

de Onis M., Blössner M. and Borghi E. (2010). Global prevalence and trends of overweight and obesity among preschool children. *American Journal of Clinical Nutrition* 92, 1257–1264. <http://ajcn.nutrition.org/content/92/5/1257.full>

[2] Organisation for Economic Co-operation and Development

Eggersdorfer M., Kramer K., Ruel M. *et al.* (2013). *The road to good nutrition: A global perspective*. Basel: Karger.

FAO (2013). *The state of food and agriculture*. Food and Agriculture Organization of the United Nations, Rome. <http://www.fao.org/docrep/018/i3300e/i3300e00.pdf>

FAO, IFAD and WFP (2013). *The state of food insecurity in the world 2013: The multiple dimensions of food insecurity*. Food and Agriculture Organization of the United Nations, Rome. <http://www.fao.org/docrep/018/i3434e/i3434e.pdf>

Gilligan D.O., Hoddinott J. and Taffesse A.S. (2008). *The impact of Ethiopia's Productive Safety Net Programme and its linkages*. International Food Policy Research Institute (IFPRI) Discussion Paper 00839, December 2008. <ifpridp00839.pdf>

Hoddinott J., Alderman H., Behrman J.R. *et al.* (2013). The economic rationale for investing in stunting reduction. *Maternal and Child Nutrition* 9(S2), 69–82.

Kyte R. (2014). Achieving global food security: Building a new food system where nutrition, climate change and sustainability collide. *Ethics, efficiency and food security: Feeding the 9 billion, well.* Proceedings of the Crawford Fund 2014 Annual Parliamentary Conference, August 2014, pp. 15–22.

Muthayya S., Rah J.H., Sugimoto J.D. *et al.* (2013). The Global Hidden Hunger Indices and maps: An advocacy tool for action. *PLoS ONE* 8(6), e67860. <doi:10.1371/journal.pone.0067860>

Nelson E., Mendoza G., Regetz J. *et al.* (2009). Modeling multiple ecosystem services, biodiversity conservation, commodity production, and tradeoffs at landscape scales. *Frontiers in Ecology and the Environment* 7(1), 4–11. DOI: 10.2307/25595032 <http://www.jstor.org/stable/25595032>

Ng M., Fleming T., Robinson M. *et al.* (2014). Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013. *The Lancet* 384(9945), 766–781. <http://dx.doi.org/10.1016/S0140-6736(14)60460-8>

Rosegrant M.W., Koo J., Cenacchi N. *et al.* (2014). *Food security in a world of natural resource scarcity: The role of agricultural technologies*. International Food Policy Research Institute, Washington, DC. <DOI: http://dx.doi.org/10.2499/9780896298477>

von Grebmer K., Ruel M.T., Menon P. *et al.* (2010). *2010 Global Hunger Index. The challenge of hunger: Focus on the crisis of child undernutrition*. International Food Policy Research Institute; Concern Worldwide; Welthungerhilfe: Washington DC, Dublin, Bonn. <http://www.ifpri.org/sites/default/files/publications/ghi10.pdf>

Dr Shenggen Fan has been Director General of the International Food Policy Research Institute (IFPRI) since 2009. Dr Fan joined IFPRI in 1995 as a research fellow, conducting extensive research on pro-poor development strategies in Africa, Asia, and the Middle East. He led IFPRI's program on public investment before becoming the Director of the Institute's Development Strategy and Governance Division in 2005. He has served as the Chairman of the World Economic Forum's Global Agenda Council on Food and Nutrition Security since 2012. In 2014 Dr Fan received the Hunger Hero Award from the World Food Programme in recognition of his commitment to and leadership in fighting hunger worldwide. Dr Fan received a PhD in applied economics from the University of Minnesota and Bachelor's and Master's degrees from Nanjing Agricultural University in China.

Email: s.fan@cgiar.org

Australian agriculture's role in meeting increased Asian demand

Luke Chandler
Food & Agribusiness Research and Advisory,
Rabobank Australia & New Zealand

Abstract

Food and agricultural producers across Australia and New Zealand are increasingly turning their attention to their close neighbours on the Asian continent. The proximity of almost a third of the world's population has always been impossible to ignore; however, the region has taken on a new level of significance in recent times as developing countries across Asia have embarked upon their journeys of economic transformation. Rising incomes across Asia and the changing dietary habits of households have already had a significant influence on many global agricultural markets and trade flows. This influence is expected to strengthen in coming years as the region increases its share of the global economy, while remaining somewhat limited in its ability to satisfy its own growing needs and wants for food and fibre products. Indeed, the dawning of the so-called 'Asian Century' holds great promise, but it also presents a great challenge to Australian and New Zealand (ANZ) food and agricultural producers. Understanding the business risks of supplying a diverse economic, cultural and political region is critical for ANZ farmers and agribusinesses to maximise the value of their expansion into Asia. Improving their understanding of these factors will also allow ANZ agribusinesses to better respond to the opportunities emerging in Asia at the right scale. Developing strong partnerships along the supply chain and across borders will be critical to the success of Australia and New Zealand in capturing value in the growing Asian markets. Increasingly, consumers across Asia are demanding high levels of food safety and traceability, with many willing and able to pay a premium for the clean and green food we produce. Australia and New Zealand together supply less than 10% of Asia's total food and agricultural imports: our focus needs to be on leveraging the many attributes of agricultural sectors at the high-value end of the market.

Rabobank is a global food and agribusiness bank: the world's largest food and agribusiness bank. We started in the Netherlands 110 years ago as a co-operative, and we still are a co-operative. We do not have shareholders, and almost everything we do outside of the Netherlands is focused on food and agribusiness. In Australia and New Zealand we now have about 100 branches. We are located in about 48 countries around the world, and increasingly in Africa as the Rabo Development Bank where we invest significantly.

I manage the Rabobank Food and Agribusiness Research team in Australia and New Zealand. The team has over 80 members in 20 offices around the world, and covers the entire food and agriculture value chain, from inputs and production to processors and consumers. It focuses on animal protein, seafood, beverages, dairy, farm inputs, food retail & consumer behaviour, fruit & vegetables, grains, oilseeds, sugar & sweeteners. Our job is to try and capture information and knowledge and help support our clients, be they farmers or other participants throughout the supply chain.

This paper is about Australia's role in feeding Asia.We are currently developing policies and new financial products to facilitate that role, and I will discuss the importance of supply chains, which are going to be critical if Australia is to play a bigger part. There are also challenges for Australian agriculture which need to be addressed if we are to improve our importance in feeding Asia.

First, let me ask: Are we on the brink of a second 'GFC' (a global *food* crisis)? The following words[1] summarise the challenge we have as a community over the next 10–30 years.

> The world is on the verge of a global food crisis. Rising food prices can plunge millions more into poverty and destabilise the world as we know it today. Close to 870 million people are chronically hungry, 2.5 million children die of hunger every year. To make things even more challenging the world population is forecast to grow from 7 billion today to over 9 billion in 2050. Every minute, the world population grows with another 158 mouths to feed. The majority, 154 of these mouths, are expanding populations in emerging and developing regions. Not only is the world's population getting bigger, it's also getting older and wealthier, and diets are changing as well.
>
> If we continue consuming as we are today we will need the equivalent of two planets Earth before 2040. If everyone lives like an average resident in the western world a total of up to four planets Earth would be needed to regenerate humanity's annual demand on nature. One third to half of globally produced food is wasted, an amount big enough to feed 2 billion people. While in developed regions a significant share of this usually gets wasted on the end-consumer side, in developing regions food waste occurs through poor infrastructure, before it even reaches the consumer. Higher food demand will have to be realised with less available arable land, less water, fertilisers, chemicals, etcetera, and fewer emissions.
>
> Productivity gain of major commodities has slowed down to 1.4% per year. To meet rising demand it should be at least 1.75%. The last 20 years' productivity growth for wheat decreased to 0.5% per annum. A similar trend holds true for rice. So the two most important staple crops in the world have had almost flat yield increases due to a lack of sufficient investments. We have entered an era of scarcity, with higher and more volatile prices, and the battle for agri-commodities will only intensify. The economics of farming are not sound. Although prices are rising, farmers' margins have improved much less than prices of agri-commodities would suggest. Farmers get

[1] From 'Future of farming – global food security', a video uploaded by Rabobank, online at <https://www.youtube.com/watch?v=ArvQtSmjgcg>.

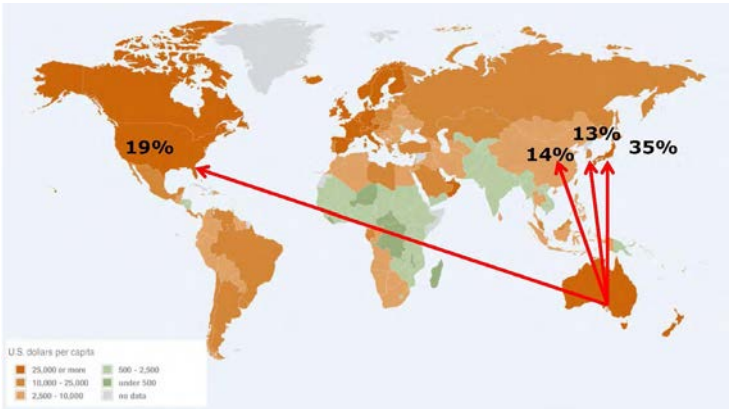
squeezed between highly consolidated upstream farm-input suppliers seeking to maximise their returns, and downstream customers seeking to capitalise on strong demand.

Australia's role in feeding Asia

Look at how the world has changed over the last 30 years in relation to Australia's beef trade. The maps (Figure 1) show the areas where per capita income is high, in brown. In 1980, trade was dominated by North America; 20 years later the brown areas were starting to spread and Australia's beef trade was moving more towards Asia. By 2013 much of Asia is coloured brown, and most of Australia's beef exports are going into that market.

Much can change in 30 years, and in 30 years' time it may be 100% of our protein exports going into those markets. Other things that affect agriculture and how we do business are changing rapidly as well, such as communication

Figure 1. (a) In 1980 the US and Europe dominated the world. (b) By 2000 Asia had begun to emerge. Colours show per capita income: darkest brown = US$25,000 or more; palest brown = US$2500–10,000; darkest green < US$500.



(c)

Figure 1(c). By 2013 per capita income has grown throughout Asia. Darkest brown = US$25,000 or more; palest brown = US$2500–10,000; darkest green < US$500.

and computing technologies which have advanced greatly in the last 30 years. Obviously, farming technology has changed with that.

Agriculture is also affected by other factors, including politics and geopolitics. For example, agriculture and agricultural markets can suffer significantly when geopolitical risks impede market trade.

Among Australian exports of agriculture and food, only exports to Asia have grown in recent years (Figure 2). North Asia and South Asia represent by far the most significant market share for our agricultural exports these days, reflecting what has happened in beef.

However, compared to our agricultural competitors around the world, Australian exports are growing much more slowly than those of some other countries. Brazil, for example, is very rapidly increasing soy bean exports into

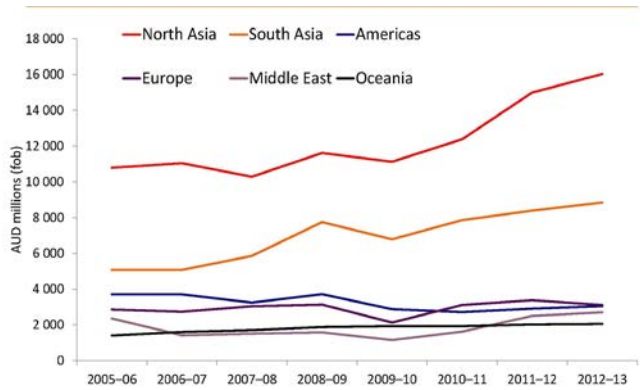


Figure 2. Asia already dominates Australia's export returns. From: ABARES, Rabobank 2014.

markets such as China. New Zealand's growth in dairy exports into China and Asia has been significant. Australia is actually lagging behind other exporters around the world in terms of that growth in capturing market share.

We continue to oversell our role as a food basket to Asia … because we really are not. We export around 6% of Asia's agricultural imports, which means they are really not very reliant on Australia (Figure 3). On the other hand, Australia is very reliant on Asia, given the fact that those countries are the most significant market for our goods.

Importance of quality and demand

What should Australia do? Agriculture Minister Barnaby Joyce is completely right in telling us Australia needs to be chasing value, chasing quality markets, chasing markets that can pay a premium for our goods.

Australia is a high-cost producer of agriculture compared to others in the world. Our role in feeding Asia is not to supply low-cost calories. It is to supply high-quality goods that consumers in the increasingly affluent middle classes are able to afford. That is where Australia should focus, and New Zealand is in a very similar situation. We share many attributes, such as our clean and green image, which allow us to charge a premium, and we need to ensure that premium flows all the way back to the farm gate. Farmer incomes are not improving, and although we talk about research and development and lifting production and tackling sustainability challenges, none of that will happen unless farmers are profitable.

Australia's trade flows of agricultural goods are also being affected by changes in demand from Asia and particularly from China. Almost all agricultural markets in all parts of the world are influenced and being changed by China's demand. China is now one of the largest importers of corn from the United States, and China is the largest pork importer in the world.

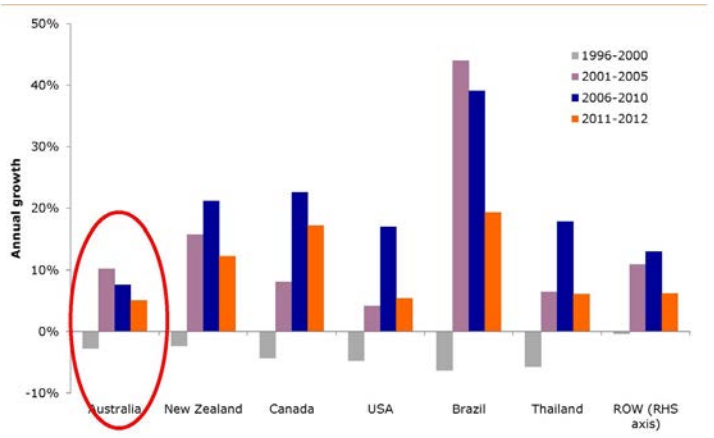


Figure 3. Australia's agricultural export growth rates are lagging competitors into the region. Sources: Comtrade, Rabobank.

China imports around 65% of world trade of soy beans, and their imports continue to grow. By comparison, 15 years ago China imported zero soy beans. China is the largest importer of dairy produce around the world, and New Zealand is the largest exporter. Just last year Australia exported record amounts of wheat and beef into the Chinese market, and we are sending increasing amounts of other animal protein – not necessarily beef – which is also meeting this food demand in China.

Look at any market. Look at wine and Penfolds 'Grange': last year they had to limit the amount of Grange that was allowed to be subscribed in Shanghai so that other markets around the world could get that product. These kinds of changes are transforming how agricultural trade flows operate, and also how agricultural supply chains work.

Supply chains

Rabobank has undertaken a significant amount of research on food and agricultural supply chains over the last couple of years. Big agricultural companies such as Coca-Cola and McDonald's and Unilever are really focused on how their supply chains are working, for a number of reasons. One reason is the commodity price dynamics. Over the last 10 years there have been a number of instances of record-high grain prices and shortfalls in supply. Companies with branded products want to ensure that they have sufficient commodity and sufficient supply to be able to meet their end needs. Chocolate processers are a clear example: they are investing significantly in cocoa producers in West Africa to ensure they can obtain the commodity on a sustainable basis. Security of supply is really critical for many of these companies.

Four main factors are pressuring supply chains (Figure 4). Shifting market power and margins are aspects we are very aware of in Australia, with the power that the retailers have. We have seen that power particularly in sectors such as dairy, influencing farmer margins significantly. The world needs to feed 9 billion people, and these situations add to the challenge of doubling food production.

On top of that there is the 'great cross-over' (see Figure 4) – a term to express the way agriculture is increasingly being influenced by other markets and also is influencing other markets. Consider the energy market: at the moment, for example, 40% of US corn produced goes into the ethanol market, as does a significant amount of Brazilian sugarcane. The interlinkages between agriculture and other markets are increasing, but so also are the interlinkages between agriculture and society.

Increasingly, consumers are demanding to know where their food comes from. They are putting pressure on supply chains through concerns about animal welfare and similar issues. This means supply chains across sectors need to be able to work together to ensure that they are viable. Figure 4 (boxes at right-hand side) shows several dimensions to this. Brand and reputation are critical and are increasingly the reasons for companies wanting to change their supply chains and ensure that they have partners along the supply chain who have the same values they aspire to.

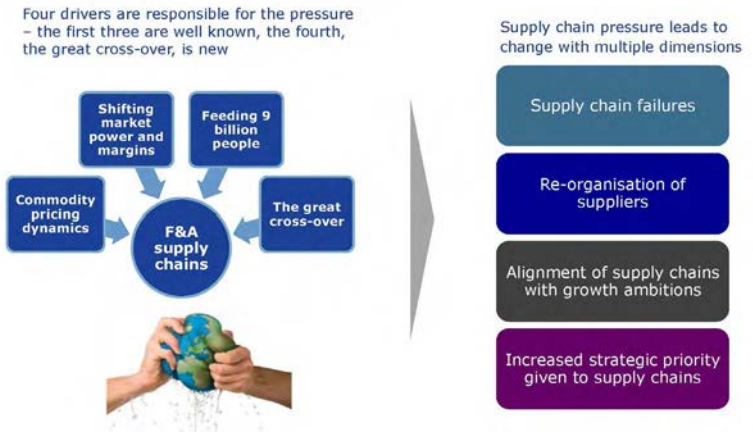


Figure 4. Food and agriculture supply chains are under more pressure and becoming more complex. Three of the four driving factors responsible for the pressure are well-known; the fourth, the great cross-over, is new.

Remember the breakdown in supply chains that followed the European horse meat scandal. This is a clear example where the supply chain broke down because people were chasing price, not value, across the supply chain: they did not have the incentive to be trustworthy. Consumers in China voted with their feet in KFC stores in 2012–13 (Figure 5). Year-on-year sales fell dramatically (far right of figure) after chemical residue was found on some of the chicken.

Australia is well placed in terms of food traceability (Figure 6) and we need to ensure that we are monetising that situation in our key Asian markets.

We need to think broadly in our planning. For example, social media means that information is flowing very rapidly now, and the big brands are very much

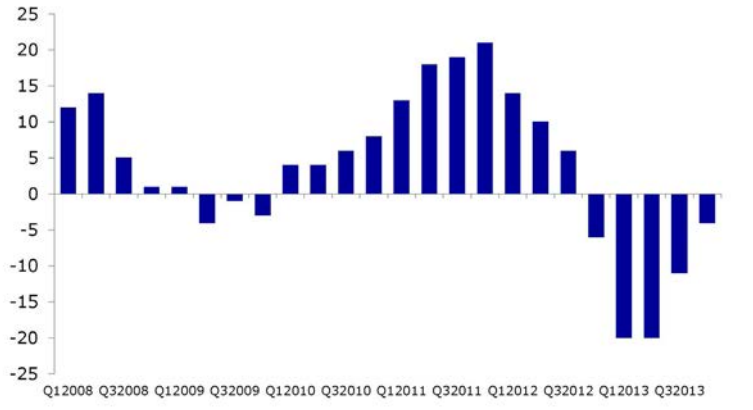


Figure 5. Sales percentages show consumer reaction to contamination found in food in China during the 3rd financial quarter of 2012. Source: YUM China Same-store Sales, YoY per cent.

Figure 6. Through its emphasis on quality, functionality, traceability and absence of disease in agricultural production, Australia has the opportunity to supply high-quality food at export.

focused on that. By 2017, two-thirds of all mobile data traffic will be video. It is said that almost 10% of all photos in existence were taken in the last 45 days. Farmers are engaged: for instance, there is now a website[2] where a farmer can post a selfie of themself with their livestock – called a 'felfie'.

What about the nature of our competition? We need to think ahead, up to and beyond the 30-year horizon: will competition then be from other countries exporting beef, or will it be from man-made beef?

To conclude, farmers are fed up hearing about all the wonderful opportunities offered by Asian demand, because they are not seeing the returns at the farm gate. Farmer terms of trade in Australia (Figure 7) show that prices they pay (e.g. Figure 7b) have been increasing at a greater rate than prices they receive, and terms of trade for farmers in Australia have been declining for a long time.

Unless there is some sort of step-change in farmer incomes it will be very hard to give farmers incentives to boost their production and to invest in technologies and in new research and development, in order to lift productivity and lift their exports (Figure 7c). I think this is typical all around the world. All Australia's confident talk about how we need to lift production to meet the increasing demand is useless unless farmers are seeing that return, because they are not going to have the incentive to invest in lifting their production.

Summary

In summary, Australia can have a big role in helping meet Asian food demand, but it needs to be at the right level, We should not overstate this role, nor try to be all things to all consumers. We should focus on quality markets where people are prepared to pay a premium for our goods. Supply-chain partnerships

[2] www.felfies.com

will be very important. We need to ensure our farmers have *incentive*. We need to address some of the challenges farmers face from costs of inputs, red tape, difficulties of market access and supply-chain efficiency – these are really restricting Australia's agricultural sector.

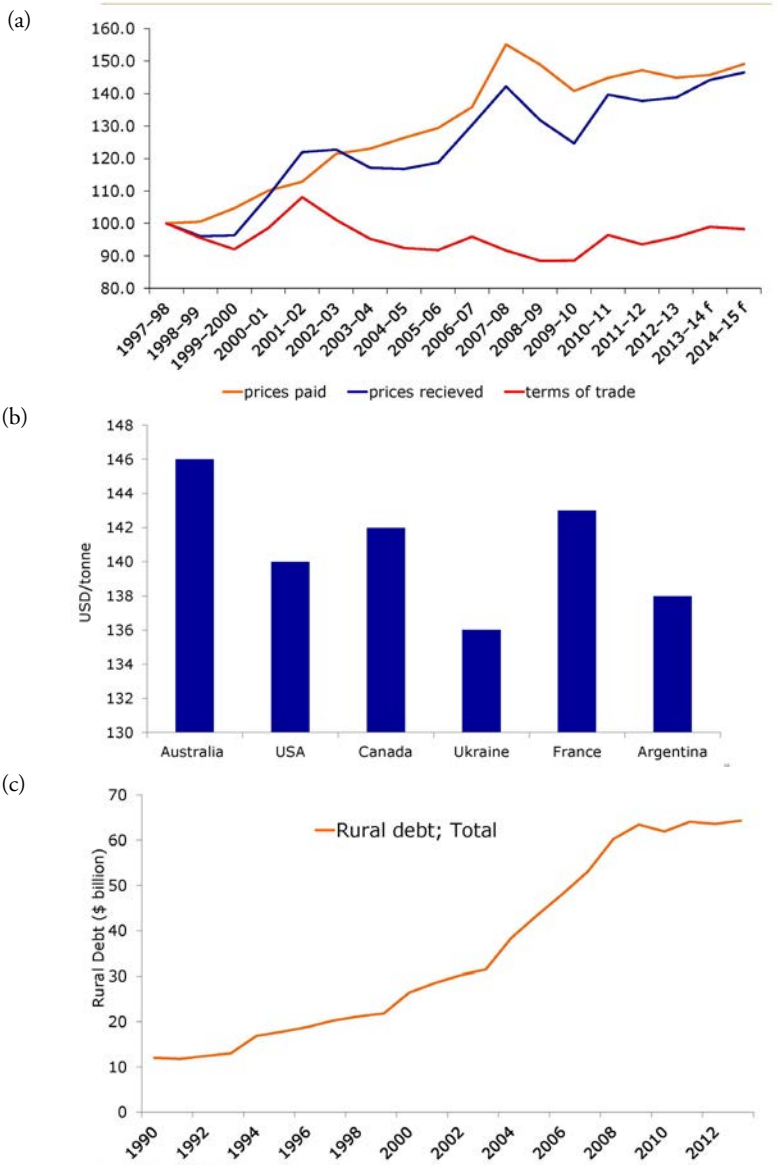


Figure 7. (a) Australian farmers' terms of trade, i.e. ratio of index of prices received by farmers and index of prices paid by farmers (ABARES, Rabobank 2014). (b) Cost of wheat production: it is high for Australian growers relative to other major wheat producers. (c) Australian farmers face capital constraints, restricting their capacity to finance the future. Sources: Reserve Bank of Australia, Rabobank 2014.

Postscript

The weekend before this conference in August 2014, some of my team from Rabobank and I set out to try the Oxfam 100 km Trailwalker Challenge in Sydney. The event, which raises money to go towards fighting poverty, challenges teams of four to journey through 100 km of bush trail within 48 hours. As the Oxfam website says, it is not a relay; the team has to start together, stick together and finish together; it is tough. The photos and caption below tell the story for our Rabobank team.

There had just been month's-worth of rain in a day and a half, so we had a muddy track. After 35 hours of no sleep, and lots of rain and mud, all four of us crossed the finish line. We were pretty pleased with that, because I think fewer than 35% of the teams finished with all of their team in one piece. We raised $6000 to go towards fighting poverty, and the event itself raised around $3 million. A great thing to be involved in!

Luke Chandler is General Manager, Food & Agribusiness Research and Advisory, Rabobank Australia & New Zealand. Luke is responsible for managing Rabobank's analysis and outlook for the world's major agri-commodities markets, including price forecasts for the key grains and oilseeds, softs and livestock commodity markets. In addition, his team of analysts works closely with Rabobank's commodity division servicing client price-risk management needs, and is part of the bank's Food & Agribusiness Research and Advisory (FAR) division. Rabobank's FAR division is staffed by an international team of research specialists focused on producing comprehensive, world class research on global food and agribusiness markets, including the latest market trends, future industry developments, sector and environmental issues. Luke has extensive experience working in commodities having worked in some of Australia's major agribusiness companies. Luke holds a Bachelor of Agricultural and Resource Economics and a Master of Economics, both from the University of New England.

Email: Luke.Chandler@rabobank.com

Population and food security: Key trends and changing dynamics

Dr Laurent Zessler
United Nations Population Fund (UNFPA)
Pacific Sub-Regional Office

Abstract

One of the turning points in the development world occurred during the 1994 International Conference on Development and Population (ICPD) in Egypt which marked the fundamental shift away from the numerical aspects of considering population and development dynamics to a human-rights approach. A consensus in its Programme of Action provided that: 'The relationship of population to development is so intertwined with issues of poverty, patterns of production and consumption, and inequality, that none can be fruitfully addressed in isolation'. Twenty years on, a lot has been achieved, emphasising, however, a lot more needs to be done. Developing countries' population bases are projected to rise from 5.9 billion in 2013 to 8.2 billion in 2050 and 9.6 billion in 2100. Growth is expected to be particularly dramatic in the least developed countries of the world: from 898 million in 2013 to 1.8 billion by 2050 and 2.9 billion in 2100. Youth and children populations now in least developed countries are at an all-time high: 1.7 billion children and 1.1 billion young people. Globally, the population aged 60 or over is the fastest growing cohort. In developed regions it is increasing at 1.0% annually (before 2050) while the 60 or over-60 cohorts in less developed regions are increasing at the fastest pace ever. Respecting fundamental human rights in framing policy interventions that understand the role of sexual and reproductive health and rights in policy and programming will be critical to responding to shifts in population dynamics. People must be in the centre of our collective response to the changing dynamics and key trends presently experienced globally, in particular countries with urgent food security issues.

Last year in June the population on the planet reached 7.2 billion persons. These numbers come from the counts made by the UNFPA (United Nations Population Fund), which is the group within the United Nations system responsible for correct population numbers. In 2025, 'just around the corner', we will have 1 billion more people on the planet; that means 8.1 billion people.

If we continue like that, Figure 1 shows the future. The blue line represents the projection if fertility should decrease, which we call the low-variant population. Following the solid blue line you can see that by 2050 we will reach 9.6 billion persons, and 10.9 billion by 2100. If on the other hand fertility stays the same

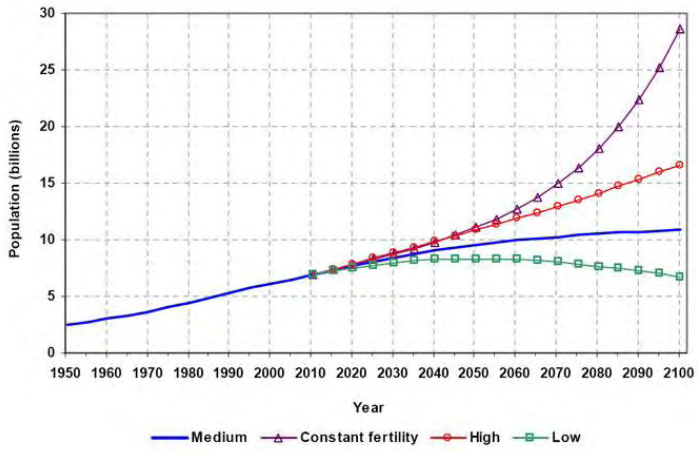


Figure 1. Population of the world 1950–2100, according to different projections and variants. Source: United Nations Department of Economic and Social Affairs, Population Division (2013). [Note: 'constant fertility' in the graph means 'if fertility were to remain constant at the levels estimated for 2005-2010' (ibid. p. 3).]

as now, we will have 10.9 billion on the planet in 2050, and 16.6 billion in 2100. Fertility greatly influences the total population.

I should emphasise that the bulk of this population growth will be in countries that are less developed and least developed (Figure 2). In 2013 the population of less-developed countries was 5.9 billion people, and there were 898 million people living in the least-developed countries, according to the United Nations classification of countries as low income, middle income and higher income.

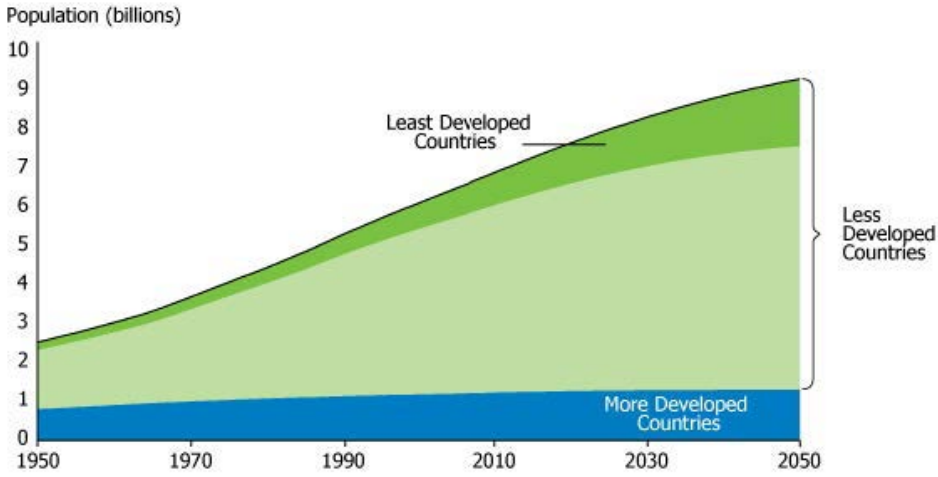


Figure 2. Proportional population growth expected in least and less developed countries compared to more developed countries, 1950–2050. Source: Population Reference Bureau.

Figure 3. Youth and ageing are two important fast-growing cohorts, especially in less-developed regions.

The international community will be facing the problem of feeding a lot of people in the developing world. They need the right tools to do that. In the projected population for the year 2100 we estimate those extra 3.7 billion people will include 1.6 billion between 15 and 59 years of age, and 1.9 billion of 60 years and above. The number of children under 15 will remain more or less the same.

Youth and children in less-developed countries are two very important groups that need to be considered in relation to international aid and trade. I know the Australian Government and Australian international partners are very aware of this cohort, which will comprise 1.7 billion children and 1.1 billion young people. The less-developed countries will have to secure adequate education and decent jobs for these two cohorts.

The ageing population is another critical cohort. It is surprising to us within the United Nations system that there has been little discussion about this group. In looking for countries with experience in ageing matters we have turned to Japan, which has the largest ageing population in the world. They have some approaches to offer the international community in terms of social protection and longevity for the older generations. The ageing population is growing at a very fast rate in the developed world: 1% annually. This is also a fast-increasing cohort in the less-developed world. Images on international television can be misleading because they tend to show only young children that are deprived – but the ageing populations are facing very difficult situations as well.

These changing population dynamics affect food security (Figure 4). The Food and Agriculture Organization of the United Nations (FAO) has suggested that by 2050 we will face a doubled demand for food, which means that the world will have to produce double the amount of food by then. You, at this conference, will be involved in this task for the future and its increased pressure on natural resources. Consider the challenge in Kiribati, for example. Imagine the pressure on the land in the small atoll Tarawa, only a few tens of metres wide in some places. That is a big challenge.

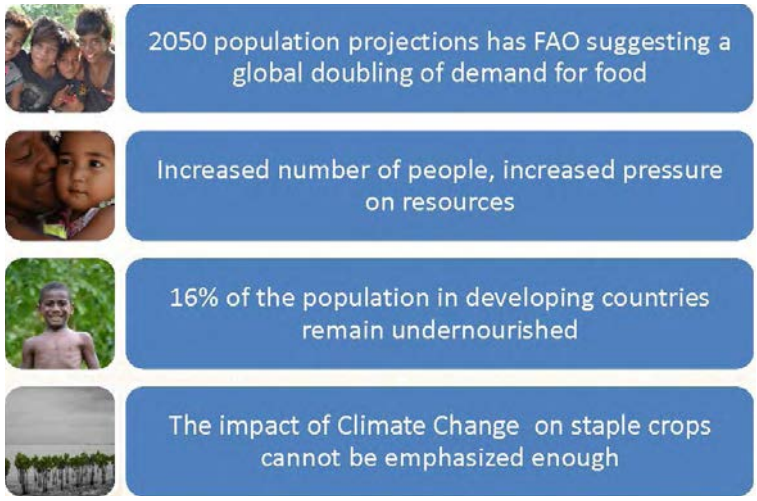


Figure 4. Changing population dynamics affect food security.

Governments of these countries are very worried about climate change. The President of Kiribati, one of our best champions, goes all over the world, including to our meeting in New York, to say: 'For us it's too late; the water level has risen already; we are under water in some areas of our land'. Kiribati is buying land in Fiji which has islands with mountains. This is a new phenomenon, these climate-change refugees, people that will have to resettle because of climate change. Who is responsible for relocating them? The state? The private owners of the land? This is a big challenge that they are already facing.

The contradiction in this picture is that 16% of the population in the developing world remains undernourished. We see pictures of children not able to grow normally, and of mothers not able to feed their children. The impacts of climate change cannot be emphasised enough, and in the Pacific this is a very urgent issue.

At the Small Island Developing States Conference in 2014 the main topic for discussion is climate change. Kiribati, Tuvalu and other countries are facing rapidly increasing sea water level, and so they are looking at climate change very carefully. This conference is a United Nations meeting with 2500 delegates, primarily to discuss climate change.

Turning now to the Pacific Region (where I am based, in Fiji), there are two extreme situations which are very relevant for Australia's international aid and trade. First there is a very high adolescent fertility rate in most Pacific Island countries, and there is a high rate of teenage pregnancy. In addition we have a depopulation phenomenon: people in Niue prefer to go to New Zealand; workers from Tonga and Samoa go to work in New Zealand; Fijian workers go to Australia to be migrant workers; and so on. From the northern Pacific Island countries the workers prefer to go to Guam or Hawaii.

Another issue is the interaction of life expectancy and land rights. It is sometimes overlooked that in Pacific Island countries women outlive men but they do not inherit the land. When the husband or partner dies the woman that stays behind will have to provide for the family, but she does not inherit the land. That is a big issue.

Life expectancy in France is 79 years for men and 85 for women; in Australia it is 80 years of age for men and 84 for women; and at the bottom of the rankings is Papua New Guinea with life expectancies of 54 years for men and 55 for women. There is a range of life expectancies across the Pacific (Figure 5).

Another striking set of numbers in the Pacific is the contraception prevalence rate. In Australia, 71% of women aged 15–49 use contraceptives, and 79% in the USA, but on average in the Pacific the rate is 20–50%. This is much too low.

Are we to blame? Maybe the international community is not investing enough to ensure wide use of contraceptives in the Pacific. There are success stories elsewhere. In Bangladesh, for example, there has been an amazing change: women there now are working in many areas of government – and there is very wide use of contraceptives. Yet while there are plenty of success stories, there are still countries not addressing this issue.

What should be done? What should the international community do about this? In 1994, the United Nations held the International Conference on Population Development (ICPD) in Cairo. At this very important conference they developed a plan of action and recommendations. The first thing that became evident was that 'the relationship of population to development is so intertwined with issues of poverty, patterns of production and consumption, and inequality, that none can be fruitfully addressed in isolation' (ICPD Programme of Action 1994).

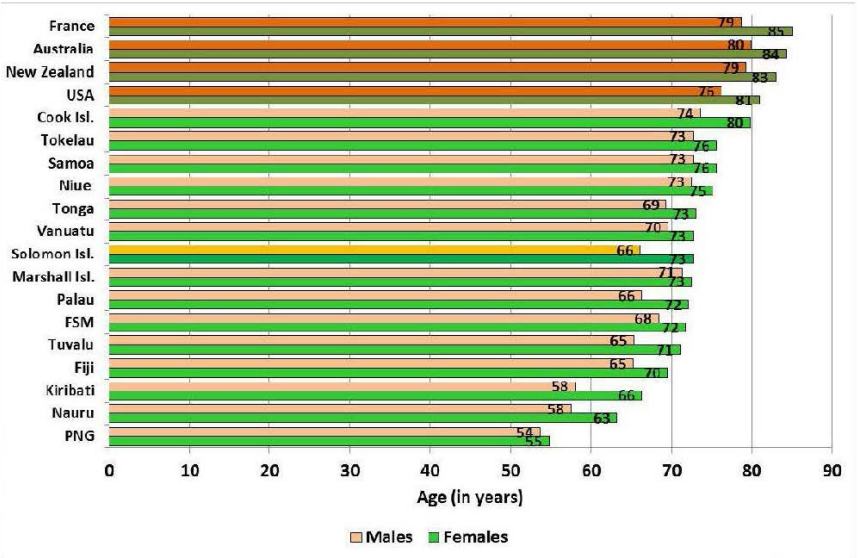


Figure 5. Life expectancy at birth in Pacific Island countries and four developed nations.

At this conference 20 years ago we decided that 'population-related goals and policies are integral parts of cultural, economic and social development, the principal aim of which is to improve the quality of life of all people' (Principle 5, ICPD Plan of Action). The agenda was set, a plan of action was developed, and the UNFPA was asked to monitor what happened.

The focus was very much a new focus, looking not only at numbers but at the human rights discourse – which means that to tackle these issues you have to do so in terms of human rights. To elaborate, when a young woman decides she wants to be pregnant, that choice is a right she has; it is the right of the couple to decide when they want to have children. For many years people told young women that if they have too many children they will face difficulties in raising, educating and providing for them. Now, instead, the discourse acknowledges that it is a young woman's right to decide, to be pregnant by choice and not by chance, and this has produced positive results.

In Cairo we decided we have to look at the individual and how to secure people's futures in this context of population and development. The principle of action that was developed there acknowledged population and development and food security as integrated issues that should be tackled together.

The UNFPA has been asked, 20 years later, to review what came out of those decisions. We have sent questionnaires to many countries – to people, ministers, non-government organisations, civil society organisations, and so on – and we have asked them: 'Have you made progress on the population and development agenda?' (Figure 6). We have been pleasantly surprised. Many things have progressed, although many things remain to be addressed.

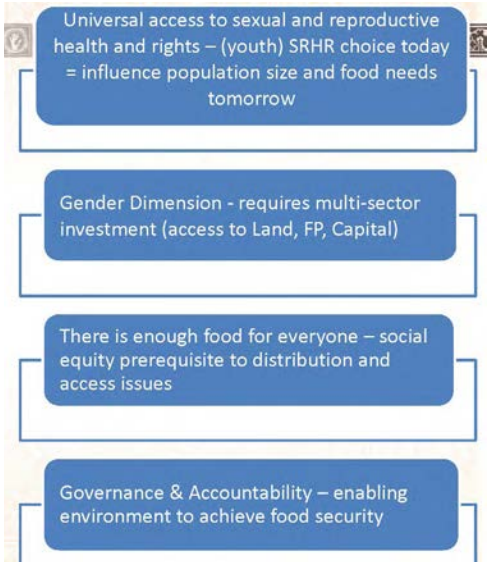


Figure 6. Aims arising from the International Conference on Population Development (ICPD) which are being reviewed by the UNFPA.

In 1994 the ICPD Consensus stated: 'Increasing social, economic and political equality, including sexual and reproductive health and rights, are the basis for individual wellbeing, lower population growth, and sustainable development'.

Access to sexual and reproductive health and rights

Now, 20 years later, we still see that access to sexual and reproductive health and rights is not universal in many countries – it has not happened yet. We think that the international community has to do better in that aspect. Influencing the population side of the equation will have a direct impact on the food that will be needed tomorrow. We are puzzled by some of the results, good and not so good, and have discussed them thoroughly. The findings from our review of the ICPD are being presented to members of the UN in September 2014.

Gender equity

The ICPD recognised that gender would require multi-sector investment. When we talk about gender we are talking specifically about access to land. That is the key point, and it is essential in relation to food security. We are looking at capital investment opportunities: small grants that can enable women to be smallholder farmers. Although this is happening, it is not happening enough: the gender dimension is not being fully addressed.

Access to food

Thanks to the work of many at this conference there is a lot of food available around the world, and sometimes wasted. A key issue is access to and distribution of this food. In some countries in a fragile state, such as Somalia and Eritrea, we see that conditions prevent there being a distribution system that will allow the people to have access to food. So we have a big challenge in terms of access and distribution of this food.

Governance and accountability

It is clear to us that governance and accountability can provide an enabling environment in which to achieve food security. As part of the UN mandate to look at governance issues, the impacts of corruption and crime are being examined, and also the number of women in parliaments. In France, 225 years since the French Revolution of 1789, only 26% of members of parliament are women. For the people involved in the French Revolution, especially the women, to have foreseen such a low involvement of women in parliament, it would have been a disappointment.

As I travel around the Pacific I always ask the chair of the parliament, 'How many women do you have in your parliament?', and they say, or sometimes they say, 'We are looking at it'. I respond, 'Well that's a good first step'. In one country they said, 'We have enacted a law that says we will have 10% of parliament members as women in 2016'. That is a good start, but it is only 10%. This governance issue has an important bearing on, for example, the distribution of land. Who will enact a law that will defend acquisition of land, in the parliament, if countries do not have women parliamentarians?

For us, accountability is important because we are using taxpayers' money from around the world, and we want to make sure that this international aid money

is used the proper way and gives the necessary results. We are very encouraged by the point the Australian Foreign Minister, the Hon Julie Bishop, makes in her paper (Bishop 2014) – about a strong focus on results and accountability to guide Australia's aid and trade investment abroad.

Role of the UNFPA

The staff of the UNFPA are working on several fronts to help ease the pressures of large populations in relation to development and people's needs. The first thing we do is to talk about comprehensive sexuality education at schools. Some countries do not like the term 'comprehensive sexuality education' so we call it 'family life education'. It means giving teenagers information on reproduction and biology so that once they reach the age of 16 they can make informed decisions about their future sexual behaviour. We have had good success in the Pacific where family life education is taught to children. Sometimes there is opposition, but most of the Education Ministers are fully 'on-board'.

We also count people via careful census. You need these data, desegregated, so you can plan food supplies. We help countries to do their census, and sometimes that is complicated. In my last posting we were counting people in Kabul in Afghanistan, which was a challenge because we had to be safe to count people and we needed to be in places where people could be counted. We also examine data, such as data related to violence against women to help police respond appropriately to cases of domestic violence, and to make sure that healthcare workers deal adequately with gender-based violence. We also make sure that judicial systems punish the perpetrators of violence against women.

A third thing that we do is develop activities to promote sexual and reproductive health and rights. These are mainly youth-focused services, giving them access to ask for contraception without being stigmatised. In a small island country, that can be awkward for people, because everybody knows everyone.

The UNFPA also provides contraceptives around the world. We buy them from funds provided us by various countries, including generous support from the Australian Government Department of Foreign Affairs and Trade. We buy on the international market, and we make sure that they are distributed. In the Pacific, UNFPA is providing contraceptives to all the Pacific Island countries.

The fifth thing that we do is to try to communicate with the people in an integrated way. We cannot go door to door to talk with people. In Fiji, for example, there is a very interesting system. The women gather in the village regularly, and they may talk about (most likely) how poorly men behave, but they also talk about what can be done about it. When, for example, they talk about how to distribute the income of the village, or how they plan to deal with other issues, we can take the opportunity to talk with them about health issues. These might include non-communicable disease, which is a big issue in the Pacific where there are a large number of obese persons, and we can also talk about reproductive and sexual health and rights. This is very effective. We call it this system 'household resource management'.

Innovation, partnerships and human development

There is need for innovation and partnerships, and the UNFPA is very pleased that the Crawford Fund has addressed this matter and sees the linkages between gender equality initiatives and food security. In the UNFPA we say repeatedly that gender equality is related to access and distribution; and by carefully and methodically reviewing the aid and trade investment data you can see if gender equality issues are being addressed.

There is a need to direct investment to boost women's agricultural capacity. When women have credit, land, appropriation of land, and access to food production, they can make incredible gains in food security for themselves and their families. We should not see population growth only as a threat to food security, but instead we should look at how we can better manage population growth – how we can be smarter and more innovative.

Looking to the future

In conclusion I would like to look to the future. Nowadays in New York and around the world many experts are discussing how we should shape the post-2015 agenda. We have the Millennium Development Goals (MDGs), and some countries have achieved great advances in terms of MDGs. Other countries are not achieving in the same way. We know there are costs involved, but in some countries the lack of achievement is because of very bad political leadership which has prevented the MDGs being tackled, presenting obstacles. Young people know what to do about the MDGs, but they may not have even been consulted. We have to look at the post-2015 agenda in a way that involves many more players.

This is a challenge for us in the United Nations because we are a multi-governmental organisation. Our main counterpart is government. Therefore we are taking the initiative and involving a wider range of experts, academics, young people and civil society organisations, to define the post-2015 agenda. We are counting strongly on Australia to drive the agenda forward, as well as our New Zealand colleagues, because we know that you are strong advocates for dealing with the population issues outlined in this paper. You can help shape the post-2015 agenda around the world, and your focus on agricultural research and development will be essential in this post-2015 agenda.

Some countries' governments say: 'Well you are the United Nations; you have experts. You take care of it. Just report to us once a year'. We find that kind of attitude puzzling, because we are using taxpayer money every day, and we need a result. But in the case of Australia, we know that you carefully observe what we do, that we will be accountable to you for failure and sometimes recognised for success. After all, the success of the United Nations is the success of the member states.

The United Nations is counting on you, as members of the Australian Government as well as the Crawford Fund, to shape the post-2015 agenda so it answers all those basic needs for food security and other matters for the people around the world.

References

Bishop J. (2014). Australia's leadership role: Using aid to tackle intractable problems and catalyse long term solutions. *Ethics, efficiency and food security: Feeding the 9 billion, well.* Proceedings of the Crawford Fund 2014 Annual Parliamentary Conference, August 2014, pp. 9–14.

United Nations, Department of Economic and Social Affairs, Population Division (2013). *World Population Prospects: The 2012 Revision, Key Findings and Advance Tables*. Working Paper No. ESA/P/WP.227. <http://esa.un.org/wpp/documentation/pdf/WPP2012_%20KEY%20FINDINGS.pdf>

Dr Laurent Zessler, UNFPA's Director and Representative for UNFPA's Pacific Sub-Regional Office, based in Fiji, was appointed to this role in November 2013. Previously he was in Afghanistan for some three years as UNFPA's Country Representative. Dr Zessler, a national of France, joined UNFPA in 2011 from UNAIDS, the Joint United Nations Programme on HIV/AIDS, where he had served as Senior Regional Adviser for West and Central Africa. He also was country director for Brazil, Argentina, Chile, Paraguay, Uruguay, Vietnam, Pakistan and Ecuador between 1996 and 2011. In 1995, Dr Zessler served as the AIDS/STI (sexually transmitted infections) Intercountry Adviser for the World Health Organization (WHO) in Pakistan; until then he had served as the AIDS/STI Intercountry Adviser for PAHO (Pan American Health Organization)/WHO from 1989 in Ecuador, Venezuela, Uruguay, Argentina, Chile, Paraguay and in Washington DC. Dr Zessler has also worked as an Associate with the Pasteur Institute in France and as a medical officer for the Ministry of Foreign Affairs in Sudan. He holds a Doctorate in Medicine from the Paris School of Medicine, Université René Descartes, a Masters in Public Health from the Bloomberg School of Public Health at Johns Hopkins University and a Fellowship in Infectious Diseases at the School of Medicine at Johns Hopkins University.

Email: zessler@unfpa.org

Food vs feed: The livestock equation in food security

Yudi Guntara Noor

Asian–Australasian Association of Animal Production Societies

Abstract

The world's population of 7.2 billion is projected to increase and reach 9.6 billion by 2050. FAO-predicted demand for food, fuel and fibre will thus increase 60% by the year 2050. Demand for beef and milk will increase significantly, and create global concern over the level of feed required to meet the projected levels of demand. Indonesia is the fourth largest populated country in the world with almost 240 million people in 2010 and a predicted population of about 320 million in 2050. The high population, together with economic growth and increased public demand for high quality protein sources such as beef and milk will result in a significant increase in demand for these food products. Increasing livestock and dairy production to secure food availability to feed the population is a high national priority. Need for food, feed and fuel, along with factors including climate change and massive land clearance for housing and industries, have encouraged Indonesia to improve the competitiveness and efficiency of its livestock and dairy production systems. Recent public awareness of ethical and environmental issues in animal production means these matters require greater attention to avoid public distrust in these industries. As feed and feeding contribute to more than 70% of the cost of livestock or dairy production, utilising alternative cheaper feeds which do not compete with food is a commercial necessity. Fortunately, there are by-products of agro-industries in Indonesia that can be used as alternative feeds: for example, cassava meal, rice straw, copra meal and palm oil by-products such as palm kernel cake and palm fronds. The nutritive value of these by-products can be improved by physical or biological treatment. Among these, palm oil by-products have the highest potential as feed alternatives because Indonesia is one of the largest palm oil producing countries in the world. Consequently, integrating livestock, dairy and palm oil plantation systems is seen as a preferable way forward to deliver better efficiency and zero-waste agricultural systems and add more value for the local communities. Also grazing management under palm oil plantations may improve the cost-efficiency of cattle breeding systems.

The focal point of this conference is the year 2050 and the approximately 9 billion people in 2050, and that we have to increase food production by about 70%. As well, there is the problem that even if population increases only 35%, we still need to increase food supplies by 70% because people are moving from poverty to middle class. About 3 billion people are moving to middle class

incomes now, and that number will grow to 4.8 million people in 2050. An impact of this middle class income group will be a huge demand for animal food sources. There will be a big demand for meat. Everybody will be asking for meat, for more milk, for more eggs. This is, I think, the challenge for all of us. That will create other issues. Will there be enough land or water or biological diversity to meet the demands?

Another issue is food versus feed. When the energy prices increase we talk about using grain instead of fossil fuel, but another issue is that people go hungry because so much arable land is needed to grow grain to feed animals rather than humans. Half of the world's population today lives in only six countries. About 3.6 billion people live in China, India, USA, Indonesia, Pakistan and Brazil. This paper is not about global issues but instead about how Indonesia and Australia have important roles in food security, and about alternatives for feeding livestock.

Indonesia is the fourth most populated country in the world. About 250 million people now live in Indonesia, the closest neighbour to Australia. Also, according to recent data from the McKinsey Global Institute (2012), Indonesia in 2012 was the 16th largest economy in the world. It had 45 million people of 'consuming class'[1] incomes generating US$0.5 trillion worth of market opportunities in consumer services, agriculture and fisheries, resources and education. McKinsey projected that in 2030 Indonesia will be the seventh largest economy in the world, with a consuming class of about 135 million people and US$1.8 trillion in market opportunities in consumer services, agriculture and fisheries, resources and education. This is a big market, and it is Australia's closest neighbour.

Beef demand in Indonesia

The Indonesian market needs to import live cattle more than beef, because the Indonesian culture requires fresh beef prepared in the local market. It is well known that Indonesia imports a large number of live cattle from Australia and feeds them in Indonesia. There are around 14.5 million head of cattle in Indonesia.

The industry depends on two groups of smallholders (Figure 1). All the cattle belong to smallholders. One group comprises the very intensive smallholder farmers in Java and Bali. This group is relatively small in number, with relatively few cattle, and the feed base is from the rice fields and native grasses. In the second group are the extensive farmers in eastern Indonesia, in East and West Nusa Tenggara.

The high population and economic growth are increasing the already large demand for beef in Indonesia. In the 1980s Indonesia formed a strategic policy about beef availability, beef accessibility, supplying Indonesian countrymen with high quality beef, and sustainable production for cattle locally, because we understand that Indonesian demand for beef will grow faster than Indonesian

[1] McKinsey Global Institute (2012) defines consuming class as 'those individuals with an annual income of more than $3600 or $10 per day at purchasing power parity (PPP), using constant 2005 PPP dollars'.

Figure 1. Cattle production systems in Indonesia: (left) intensive farming in Java, using native grass, rice straw, etc., as feedstuffs; (right) extensive farming in West and East Nusa Tenggara where the cattle graze pastures.

cattle production. Between 1980 and 1990 Indonesia started introducing cattle fattening systems into the production chain. We want to increase the liveweight of cattle before slaughter so we can produce more beef from fewer cattle – more beef with fewer cattle slaughtered.

We start feeding cattle on feed grain, as we have learnt from the United States and from Australia. We have to import this grain for animal feed. At the same time our poultry industry has grown, and we import a large amount of grain also for the poultry. The result has been very high beef prices in Indonesia; the digestive systems of ruminants such as cattle are less efficient in using grain than the digestive systems of monogastric animals such as pigs or poultry.

Food demand and feed competition and demand for land for housing and industry have encouraged Indonesia to improve the competitiveness and efficiency of livestock production systems. Having done a great deal of research into agricultural by-products, we encourage the cattle industry to implement innovations from the research and to feed cattle using these by-products. In the early 1990s a range of agricultural by-products were available in Indonesia, such as cassava chips, copra meal, palm kernel cake, rice bran, cassava onggok (a source of energy and protein) and rice straw (Figure 2).

We started importing feeder cattle from Australia in the early 1990s because we needed a large supply to meet the growing demand from Indonesian consumers. In the early 1990s Indonesia was not the biggest market for Australian live cattle exports: Asia and the Philippines were larger. But Indonesia has built

Figure 2. The Indonesian feedlot industry uses agricultural by-products as feed for the cattle.

and developed one of the best livestock industries; it is very efficient. We fed the cattle with the cheapest feed using agricultural by-products so they were not competing with humans for food. It was very competitive, efficient and sustainable. Indonesia became the biggest market for Australian live cattle exports after the economy crashed in 1998 when other Asian markets shrank.

In 2009 and 2010 Indonesia imported more than 750,000 head of feeder cattle, and the Indonesian fattening feedlots produced about 30% of the total Indonesian beef production. But in 2011 the Australian supply to Indonesia was stopped because of concerns over animal welfare. Indonesia worked very hard, hand in hand with Australian sectors, and through a great deal of research, innovation, changes to cattle handling in land transport, field management, watering and feeding systems and the slaughtering process, Indonesia became the first Australian live cattle export destination to fully implement, discuss and comply with Australian animal welfare requirements by the end of 2011.

In 2012 and 2013 the Government of Indonesia put a quota on the live cattle trade, interrupting it and reducing our imports from Australia to fewer than 300,000 head per year. This affects Indonesian consumers. In Indonesia beef is very expensive and that situation is worsened by inflation. On top of that there are 2.5 million fewer head of cattle now. If each farmer has about three head of cattle on average, 600,000 farmers lost their livestock through trade stoppages.

This shows that food security also relies on trade policy between countries, and how freely food flows from one country to another. When the trade is interrupted it creates problems with food availability, accessibility and sustainability.

In 2014, it is projected we can import about 750,000 head of cattle; the capacity of our industry is about a million head per year. There is a cooperative spirit between Indonesia and Australia: Australia breeds, Indonesia feeds – that is the tag line.

At this moment, there are about 250,000 head of Australian feeder cattle feeding in Indonesia without competing with Indonesian food supply and welfare, and also supplying beef for 250 million Indonesian people. Under current conditions I think we could take a million head in the next few years, but recent discussions have suggested that there are limits on the Australian supply. We know that Australia is also open to marketing to other countries. Live cattle exports to Vietnam have improved significantly in the last two years, and China will be 'joining the club'. When China joins the club everything will be more expensive!

Integrating cattle breeding with palm plantations

Now Indonesia is facing a new challenge. We have to start breeding cattle on Indonesian land. Yes, that will be more expensive than importing from Australia but, as I said, when China joins the market everything will cost more. We have to make a start. Indonesia has the biggest palm plantation in the world: more than 10 million hectares of palm plantations. We have enough rainfall and sunlight, and among the palm trees we can grow a great deal of grass and cover-crops or weeds. At the moment the plantation companies use large amounts of herbicide and labour to control weeds, but by integrating palm plantations with the cattle we can reduce the costs of weed control. This will be a very good outcome and potentially very efficient.

However, we still have to do a lot of research and innovation, and have the technology adopted by the industry. We have to support research and development – and encourage the cattle industry to start breeding in the

Figure 3. Palm plantations require periodic applications of fertiliser and herbicides and labour to control the cover-crops or weeds that flourish in the equatorial sunlight and rainfall (left), but cattle grazing the plantations can control the weeds, saving costs and labour and contributing manure and urine as fertiliser (right).

palm plantations. This will be similar to the way it was 25 years ago when we encouraged feedlotting in Indonesia using agricultural by-products as feed. I think this is what we have to do.

Indonesia and Australia can work together on this very important research and development, to improve production efficiency and create opportunities for using agricultural by-products as feed for cattle, and in ways of growing and supplying beef, and other meat, for the consumer.

Reference

McKinsey Global Institute (2012). *Urban world: Cities and the rise of the consuming class.* June 2012, McKinsey & Company. <http://www.mckinsey.com/insights/urbanization/urban_world_cities_and_the_rise_of_the_consuming_class>

Yudi Guntara Noor comes from Bandung, West Java, Indonesia. After graduating from the Animal Husbandry Faculty at the Padjadjaran University he worked in the feedlot industry for two years as a cattle selector before starting his own business 19 years ago. He now runs PT Agro Investama which owns the PT Citra Agro Buana Semesta (CABS) feedlot in Garut West Java, which has a capacity of approximately 12,000 head. Yudi Guntara Noor is a former Chairman of Indonesian Cattle Feedlot and Beef Producers (APFINDO) and Vice Chairman of Indonesian Cattle and Buffalo Farmers Association (PPSKI). He also holds the following positions: President, Asian–Australasian Association of Animal Production Societies; President, Indonesian Society of Animal Science; Head, Permanent Committee for Dairy and Beef Cattle, Indonesian Chamber of Commerce; Chairman, West Java Sheep and Goat Farmers Association; Member, Trustees Committee in Padjadjaran University.

Email: noor_yudi@yahoo.com

Food versus energy: Crops for energy

Dr William D. Dar
International Crops Research Institute for the Semi-Arid Tropics

Abstract

The global production and use of biofuels have increased dramatically in the past few years due to volatile and increasing oil prices, and environmental concerns. The main feedstocks for ethanol are sugarcane, maize and, to a lesser extent, wheat, sugarbeet and cassava. Biodiesel oil-producing crops include rapeseed and oil palm. All divert land away from food production to energy production. This has in turn triggered the food versus energy debate, with several studies attributing the rising food prices to the feedstock diversion to biofuels, hurting poor consumers and net food-importing countries. To overcome the food–fuel trade-off several countries are promoting feedstocks that can grow on marginal lands and hence do not compete with food production. At ICRISAT we launched a global pro-poor 'BioPower Initiative' focusing on biomass sources and approaches that do not compete with, but rather enhance food and nutritional security. Sweet sorghum is one such 'smart' multipurpose crop that does not compromise on food security while producing energy. The grain is used for food and the stalk is used for juice extraction for bioethanol. It is encouraging that the Western Australian Government in partnership with Kimberley Agricultural Investments has plans to grow sweet sorghum on 13,400 hectares of land for processing into bioethanol. Further, the use of sweet sorghum in existing sugar mills as biofuel feedstock provides a win–win situation for both farmers and industry. Data from India, the Philippines, China and Brazil indicate that sweet sorghum is an economically viable, socially equitable, environmentally sustainable and resilient smart crop.

This paper is about food versus energy, highlighting potential crops for energy without compromising food security. The context is the challenge of providing for almost 9 billion people by the year 2050, and producing 60% more food, 50% more energy and 50% more water than today.

ICRISAT and its work

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is one of the 15 centres of CGIAR. The centres' work is supported by funds from development investors brought together by the CGIAR Fund Council. ICRISAT focuses its work in dryland tropics of Asia and sub-Saharan Africa, and our vision is for the dryland tropics to be prosperous, food secure and resilient.

ICRISAT and the Crawford Fund have shared goals and responsibility to feed the world. We started an Ambassador program in ICRISAT last year, and we

are very pleased to have Hon John Kerin AM, Chair of the Crawford Fund, as an ICRISAT Ambassador of Goodwill. John Kerin will be highlighting the work of ICRISAT that focuses on the poor and the smallholder farmers of developing countries.

The headquarters of ICRISAT are in India, and we have eight locations in sub-Saharan Africa, including two regional hubs. We work to improve sorghum, pearl millet, chickpea, pigeon pea and groundnut or peanut, and as several of these crops are also important to Australia we are collaborating with a number of universities in this country. ICRISAT has benefited from the strong support of the Australian Centre for International Agricultural Research (ACIAR) for many years. They have championed our work on crops research, particularly on dryland cereals and grain legumes production.

These crops are grown not just for food security but also because they are highly nutritious. ICRISAT has begun a Smart Foods campaign to highlight the nutritional value of the crops we are mandated to improve. One example that we are promoting around the world including in Australia is 'Smart Brkfast', a single serve ready-to-eat breakfast cereal made from sorghum and pearl millet flakes. We are developing crops that are not only drought tolerant but also environmentally sustainable and highly nutritious. We are aiming for a food system that provides carbohydrates and also a balanced diet of proteins, minerals, vitamins and essential fats, wherever possible.

Our major responsibility is strategic research, and we have developed a new strategic research framework that we call 'Inclusive Market-Oriented Development' or IMOD (Figure 1). It has three components. The most important is the harnessing of markets. You may know that most smallholder farmers in the dryland tropics are trapped in poverty: 60% or 70% of them are at subsistence level. In the long term we want them to have better access to markets, such as through links to existing markets or new markets, or by helping these farmers become entrepreneurs.

The second aspect of smallholder agriculture in the dryland tropics is risk management (see Figure 1). Smallholders face risks from factors such as droughts, poor soils and weak institutional arrangements, so it is necessary to set up 'safety nets' for them. Over time we help smallholder farmers build resilience so they are able to cope with these challenges.

The third component is the engine of growth, the technologies or innovations that fuel development (see Figure 1). As subsistence farmers become self-sufficient, and then move from self-sufficiency to dealing with a market economy, they need this engine of growth through innovation so that they can reinvest gains from farming.

Biofuels

Turning to biofuels and why they matter, we need to promote biofuels to reduce greenhouse gas emissions, mitigate climate change, improve energy security, and reduce dependence on oil imports. At present, fossil fuels provide

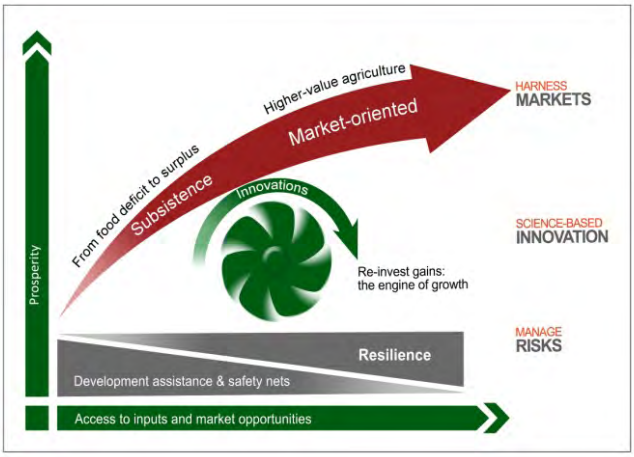


Figure 1. ICRISAT's Inclusive Market-Oriented Development (IMOD) framework.

95% of the energy used in the transport sector globally, but price volatility in fossil fuels has jeopardised the economies of many developing nations in the recent past. In contrast, a biofuel industry offers immense employment opportunities and can enhance the livelihoods of poor and small farmers in developing countries.

The major biofuel feedstocks include corn, sugarcane, sugar beet, cassava (Figure 2) and newly emerging crops such as sweet sorghum which ICRISAT started to develop and promote as early as six years ago.

Compare the use of United States corn and Brazilian sugarcane as feedstocks, in relation to food prices (Figure 3). In less than one decade world biofuel production has increased by a factor of five, from less than 20 billion litres per year in 2001, to over 100 billion litres per year in 2011 (Bastianin *et al.* 2013). The biofuel and food price debate is long standing and controversial, with wide ranging views. The relative strengths of these positive and negative impacts differ

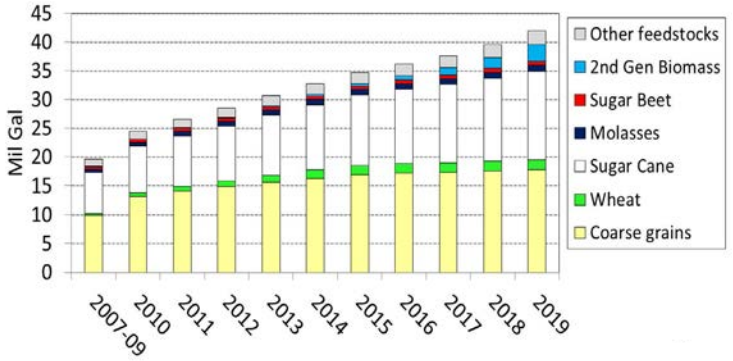


Figure 2. Major biofuel feedstocks for ethanol production. Source: OECD/FAO.

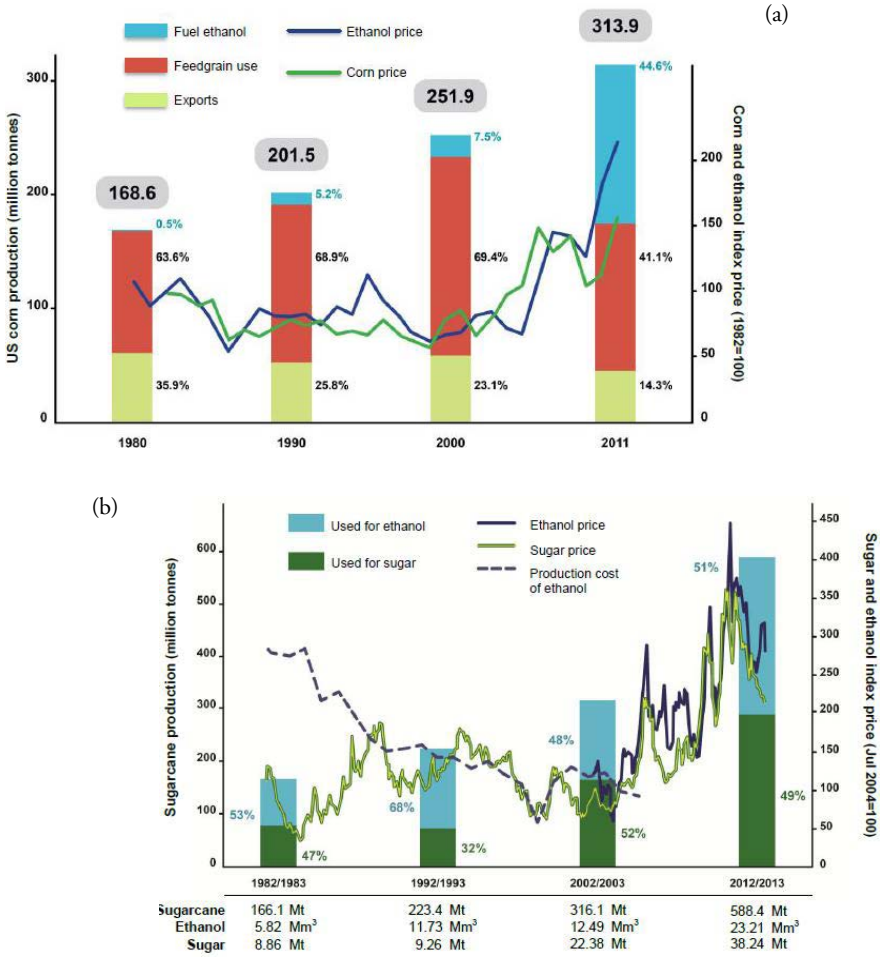


Figure 3. US corn and Brazilian sugarcane vs food prices. Source: Bastianin *et al.* 2013.
(a) Biofuel demand affects food commodity prices: blue line = fuel ethanol price; blue bar = corn (megatonnes) used in fuel ethanol; green line = corn price; brown bar = corn (megatonnes) used as feed grain.
(b) Biofuel demand has a moderate effect on sugar prices: blue line = ethanol price; blue bar = sugarcane (megatonnes) used for ethanol; green line = sugar price; green bar = sugarcane used for sugar.

between the short term and the long term. Diversion of corn to ethanol in the United States, which produces 4% ethanol, has played a significant role in the price rise.

By comparison, sugarcane use in Brazil has a moderate effect on the sugar price. Similarly palm oil used for biodiesel production is a concern for vegetable oil importing nations, such as India, China and the European Union.

Biofuel production competes for land with other agricultural activities, hence both direct and indirect land use change have significant impact on the food

system. It is estimated that with the current technology 2–3% of global arable land is required to produce 100 billion litres of biofuel, but the land needed for dedicated biofuel production varies widely from region to region. For example, 3% of cropland is required in Brazil, while 72% of cropland is required in the European Union to implement a 10% biofuel-blending program. We need to pursue complementary land use arrangements to meet food and energy security.

Ethical principles of biofuel development

The ethical framework for biofuel development must consider the following principles:

- should be environmentally sustainable;
- should contribute to a net reduction of greenhouse gas emissions and mitigate global climate change;
- development should not be at the expense of people's essential rights;
- the biofuel value chain should invariably involve women farmers and smallholder farmers, who form the majority in many developing countries; and
- biofuel development should be in accordance with trade principles that are fair and just, including labour rights concerns.

Australia is the world's 9th largest energy producer but the 17th largest consumer of renewable energy. The Australian energy portfolio comprises 96% fossil fuels and 4% renewables – a biofuel : gas ratio of 0.4% (Figure 4). The bioethanol production capacity is 440 million litres using feedstocks such as wheat flour, red sorghum and sugarcane, and 350 million litres of biodiesel were produced in the last year from used cooking oil; that is, used canola, poppy and vegetable oil.

Australia's biofuel production facilities are concentrated in New South Wales, Queensland and Tasmania, with isolated facilities in Western Australia. The Australian Government's Clean Energy Future Plan has committed $17 billion

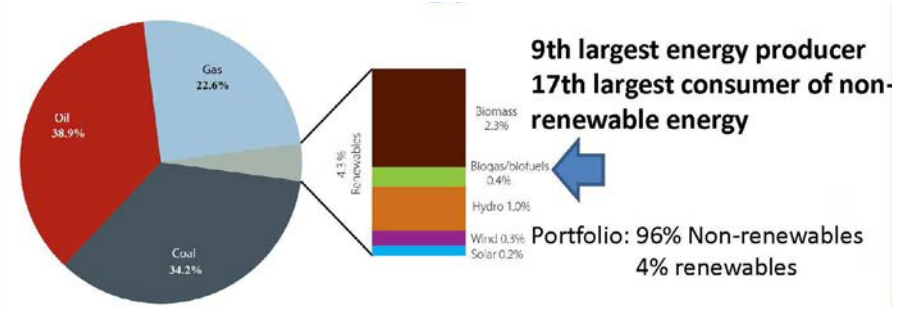


Figure 4. Only 4.3% (pale grey sector in pie) of Australia's energy use comes from renewable sources: 2.3% biomass, 1.0% hydro, 0.3% wind, 0.2% solar and 0.4% biogas and biofuels. Source: 2013 Australian Energy Statistics.

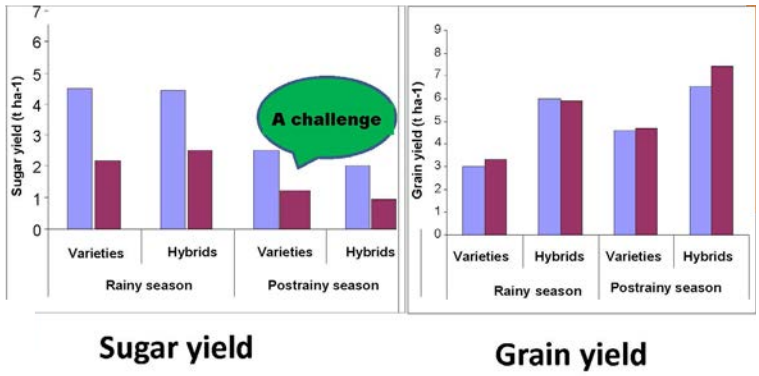


Figure 5. Results of ICRISAT sweet sorghum trials, 2011–13. Blue bars = sweet sorghum; purple bars = grain sorghum. Source: Rao and Kumar 2013.

over the next 10 years to research for development of clean technology, including $20 million for advanced biofuels. The New South Wales State Government has increased its mandate for ethanol inclusion to 6%. The Queensland Alliance for Agriculture and Food Innovation is working on sugarcane, eucalyptus, pongamia and sorghum, and in Western Australia more than 13,000 hectares of land in the Ord River area has been identified to commercially grow sorghum for biofuel production.

ICRISAT has a pro-poor BioPower Initiative, focusing on yields of biomass, juice and grain. It enables the dryland poor to benefit from emerging bioenergy opportunities, with larger smallholder incomes. Also, for the last six or seven years we have been developing and promoting the potential of sweet sorghum for use in bioethanol. Areas where water is availabile can produce three crops per year because sweet sorghum matures in 120 days. Sweet sorghum as feedstock has the potential to provide food–feed–energy security in the world's semi-arid tropics. Researchers at ICRISAT compared the grain and sugar yields of improved grain sorghum and sweet sorghum varieties in the rainy and post-rainy seasons during 2011–13. In general, sweet sorghum out-yielded grain sorghum in sugar content in both seasons without compromise on grain production (Figure 5).

In developing nations, ICRISAT has found that biofuel production is profitable when subsidies on fossil fuels are low to medium. Low feedstock prices are important in the overall cost of biofuels. Studies in India, China and Brazil show that using the whole sweet sorghum plant as well as the by-products of processing leads to positive economic and environmental results.

Several cases provide proof of concept for sweet sorghum and opportunities for partnerships for the poor. For example, ICRISAT's Agri-Business Incubation program has helped Mr Palaniswamy in India to set up a sweet-sorghum-based ethanol production centre, Rusni Distilleries Pty Ltd. Chinese industry has successfully experimented with sweet sorghum, and Bapamin Enterprises in the Philippines are pioneering by-product utilisation. Demonstrations conducted

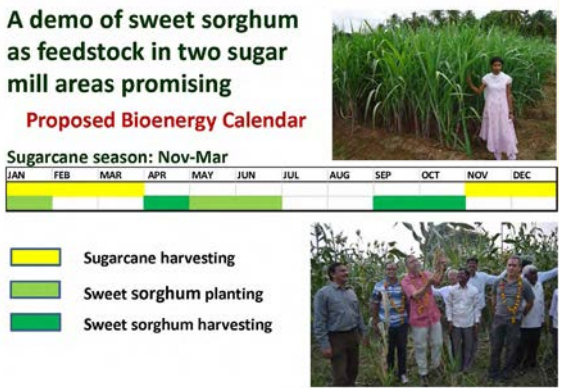


Figure 6. In India a practical approach has been developed, integrating sweet sorghum and sugarcane cropping.

by ICRISAT in partnership with sugarmills in southern India suggest that sweet sorghum may be grown in rotation with sugarcane crops (Figure 6). These collaborations are developing the science and technology needed to produce both feedstock and biofuel products from sweet sorghum, and promote its potential.

Summary

In summary, ICRISAT, in pursuing various forms of biofuel production, takes the view that food security is paramount. We need to balance food security and energy security to mitigate food price volatility. We know that biofuel development offers both opportunities and risks, which we must take advantage of and manage well. We believe sweet sorghum is an emerging and competitive feedstock for bioethanol production that does not compromise food security and feed security. We believe that the right policy environment and support, with significant investments in research for development, are critical in biofuel development. And in pursuit of energy security that does not compromise food security it is essential to ensure the participation and engagement of smallholder farmers, including women and youth.

References

Bastianin A., Galeotti M. and Manera M. (2013). *Biofuels and food prices: Searching for the causal link* (March 1, 2013). University of Milan Bicocca Department of Economics, Management and Statistics Working Paper No. 239. Available at SSRN: <http://ssrn.com/abstract=2295119> or <http://dx.doi.org/10.2139/ssrn.2295119>

Rao P.S. and Kumar C.G. (Eds) (2013). Characterization of tropical sweet sorghum cultivars. Springer brief. 132 pages.

William Dollente Dar PhD was the Director General of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), from 2000 to December 2014. ICRISAT is a non-profit, non-political and pro-poor institute and a member of the CGIAR Consortium. Dr Dar was Chair of the Committee on Science and Technology of the United Nations Convention to Combat Desertification from 2007 to 2009. He was also a Member of the UN Millennium Task Force on Hunger. Prior to joining ICRISAT he served as Presidential Adviser for Rural Development, and Secretary of Agriculture in the Philippines (equivalent to Minister of Agriculture). Before this, he was Executive Director of the Philippine Council for Agriculture, Forestry, and Natural Resources Research and Development and Director of the Bureau of Agricultural Research of the Philippine Department of Agriculture. Dr Dar served on the governing boards of the Australian Centre for International Agricultural Research and the CGIAR International Maize and Wheat Improvement Center as well as of ICRISAT. He was Chair of the Asia–Pacific Association of Agricultural Research Institutions and the Coarse Grains, Pulses Research and Training Center based in Indonesia. Dr Dar received a PhD in Horticulture from the University of the Philippines Los Baños and an MS (Agronomy) and BS in Agricultural Education from Benguet State University (BSU) in La Trinidad, Benguet, Philippines. He taught at BSU for 11 years, becoming a Professor and the Vice President for Research and Extension.

Is modern farm technology a saviour or a threat?

Dr Elizabeth Finkel

Cosmos Science Magazine

Abstract

Journalistic ethics require objectivity and balance. Although that may sound straightforward, reporting on genetically modified (GM) crops and biotechnology is anything but. The terrain is full of paradoxes. Notional 'good guys' such as non-government organisations (NGOs) – would-be guardians of the environment and human well-being – have no qualms about distorting information about GM organisms even when they lead to benefits for the environment and people. Witness the campaigns against vitamin A rice and Bt cotton. 'Card-carrying' scientists champion research that is poorly designed and where the conclusions bear no statistical significance. Witness the 'circus' around the publication, retraction and republication of Gilles Séralini's paper. One might think that people approach the issue on the basis of evidence. That seems not to be the case. Rather, pre-existing world views seem to dominate. Politicians and NGOs appear to exploit these attitudes, fanning the flames for their own ends. As with climate science, it seems dismayingly easy to distort logic and evidence. Staggeringly, the attack on GM crops seems to know no bounds. Recently European NGOs including Greenpeace called for the abolition of the position of the European Commission's Chief Scientific Officer. Accusations of conflict of interest and undue corporate influence resonate and stick like mud. There is a view that providing information barely helps: it is only filtered to fortify pre-existing positions. It is disheartening, but that is the nature of public discourse. Journalists can only continue to explain the issues and the science as objectively and clearly as possible. The battle is not just about GM crops but for science itself.

Is modern farm technology a saviour or a threat? *Cosmos* magazine explored that question in March 2014 on the occasion of the 100th birthday of Norman Borlaug, the man whose Green Revolution set Asia on the path to food security and development. Most people have never heard of Borlaug and his Green Revolution. Of those who have, many see the Green Revolution as the beginning of modern agriculture's woes. In our special issue we set ourselves the task of unpacking that paradox.

Journalism behoves us to be a proxy for the public. We are the ones privileged to tour through the knowledge-jungle guided by experts. We need to think up the incisive questions and drill down to the bottom of the issues. That role then behoves us to produce some sort of sum-up – like a judge summing up for the jury after the courtroom's cross-examination of the evidence.

What are the most important questions to ask about modern agriculture in general and genetic modification (GM) specifically? To me they are:

- Is it safe for humans?
- Is it safe for the environment?
- Does it benefit farmers? Especially does it benefit farmers in poor countries; perhaps an illiterate African woman living at the end of a dirt track? These are the farmers who really need the help both to rise out of poverty and to feed their countries as populations continue to soar in Africa and India.

It is often said that the world already produces enough food. That may be true but it is hard to see how excess corn grown in the United States will solve the problems of food security and poverty alleviation in Africa.

It is also important to explore the opposition, which in certain quarters grows ever more virulent. Europeans are generally hostile to GM, particularly in France. This attitude is also at odds with Europe's own scientific advice, chiefly that from the European Food Safety Authority (EFSA) and its Chief Scientific Adviser Ann Glover. In March, green groups invaded the offices of EFSA. In July, nine non-government organisations (NGOs) took the extraordinary step of requesting that the European Commission do away with the position 'chief scientific adviser' altogether.

Before I take you through cross-examination of the evidence, let me do things in reverse and give you my sum-up. It is my considered opinon that the attack on modern agriculture does not at all serve the public or the planet or farmers. Though the various opponents 'fly the kites' of sustainability, protecting the environment, and helping poor farmers, their stance seems to put them at odds with those causes.

Farmers are smart and will pick the solutions that suit them. No-one is trying to block them from using organic methods if they so choose. Indeed, they work very well for Sulawesi cocoa farmers, as La Trobe University's Dr Philip Keane finds; and insects can be used to control pests in China's rice paddies, as Professor Geoff Gurr from Charles Sturt University has found. Different methods work better for large-scale crops. So why are activists or NGOs or governments trying to dictate to famers just how they should farm?

Now let me back-track and take you through the journalistic cross-examination.

Are modern agriculture and genetic modification safe?

The question is: compared to what? Nothing is 100% safe when it comes to food. The worst toxins are to be found in moulds like those that grow on corn, or the bacteria that can contaminate bean sprouts. Mycotoxins cause acute illness, cancer and sometimes death. In 2004 in Kenya, 125 people died and nearly 200 others were treated after eating homegrown contaminated maize. In 2011 in Germany, there were 45 deaths and 3785 illnesses from eating sprouts.

Is modern agriculture good or bad for our health? One statistic speaks very loudly: take a look at studies on the human lifespan – for instance, Professor James Vaupel's paper in *Nature* (Vaupel 2010). He is Director of the Max Planck Institute for Demographic Research. One telling graph charts lifespan in the

United States, Sweden and Japan since 1860. There is a small rise from 1860 to 1950; then the slope 'takes off'. Between 1950 and 2000 lifespan went up from 70 to 80 years. Vaupel says it shows no signs of slowing down – its rate of increase is now 2.5 years per decade. It is not that people are filling up the nursing homes: they are reaching old age in better health. As Vaupel put it, 'senescence has been delayed by a decade' – 50 is the new 40.

The real hike in the longevity curve began after 1950, as modern agriculture was coming online. Of course lots of things contribute to longevity, but clearly those railing against the woes of modern agriculture should take a look at this. If it is so bad for us, please explain.

Is GM safe? If you are guided by what the world's major food safety agencies have to say after 25 years of testing then you would have to say 'Yes' – as safe as anything produced by agriculture, and arguably much much safer because it has to run the gauntlet of safety testing. Most of the 2000 or so studies are indeed done by industry (just as with pharmaceuticals) but some 50% of studies are independent – and the majority concur.

Occasionally a paper comes along raising alarm, over GM maize for instance, and often by the same authors – most recently from Gilles-Eric Séralini and colleagues from the University of Caen, France. Their original paper published in *Food and Chemical Toxicology* (Séralini *et al*. 2012) was widely ridiculed by statisticians and retracted in November 2013. Last June it was republished, largely unchanged, by *Environmental Sciences Europe*.

If this was a courtroom analysis you would have to think the jury would weigh the evidence and decide that the world's regulators and scientists had won the day. Staggeringly, the French Government seems to be most swayed by the Séralini line.

Is modern farm technology good or bad for the environment?

You would have to say 'Good'. Green Revolution wheat and rice, plus fertiliser, chemicals and irrigation, produce a greater yield on the same footprint, and that spares land. Since 1960 the world population has doubled, but food production has tripled while using only 12% more land.

The Rockefeller University's Jesse Ausubel (Director, Program for the Human Environment) estimates that without modern farming the world would have needed to grab the equivalent of two South Americas for farming. Some of that spared land has been given over to conservation. India's forest cover has actually increased since 2005.

Overall when it comes to the overuse of chemicals seen in the 1970s – the trigger that prompted Rachel Carson to ring the alarm bell in her book *Silent Spring* – we are seeing a big trend in the right direction. Much of that is due to clever technologies that allow the farmer to be much more frugal, using so-called 'precision farming'. United States farmers, for instance, reduced their pesticide use by 6% each decade between 1980 and 2007, and the energy used to make each bushel of corn declined by 43% according to calculations by Professor Robert Paarlberg (of Harvard Kennedy School and Wellesley College, Massachusetts).

Gains from GM crops

The 'poster child' for gains from GM crops is *Bt* cotton. I think it is fine to use a poster child as a representative if you are putting an entire technology on trial, because if you can show a great benefit from one case then surely this argues that condemnation of the entire technology is unwarranted. It is not a *carte blanche* for every case, but genetic modification is not asking for that. It is painstakingly regulated on a case by case basis.

The cotton industry is the biggest consumer of pesticide, using 16% of the world's pesticides. That includes the use of the highly toxic organochlorine endolsulfan, which is banned in 80 countries including Australia, the United States, the European Union countries and Canada. It has not yet been banned in India where cotton is grown by small-scale farmers. *Bt* cotton was introduced in India in 2002 and 'took off' – some 93% of farmers grow it. As a result, the use of chemical pesticides dropped by 50% in India. In particular, the use of the most toxic types of chemical, such as endosulfan, was reduced by 70%. That has had a huge health benefit. A 2011 study found some 2.4 million farmers are not getting poisoned each year. *Bt* cotton has also cut pesticide use by 50% in China, and by 80% in Australia.

Does modern farm technology help farmers?

Clearly GM and modern agriculture help farmers, particularly small farmers. The great thing about seeds is that they are 'scale neutral' as United States political scientist Robert Paarlberg put it: that is, the advantage accrues equally regardless of the size of the farm. It is estimated that 90% of the 17 million farmers growing GM crops are small-scale and poor.

In India, cotton farmers are spending less on pesticides so they make a bigger net profit (and 2.3 million of them are not getting poisoned each year). Some *Bt* cotton farmers' incomes have increased nearly four-fold, according to a 2012 study in India. Across all of India, the cultivation of hybrid *Bt* cotton seeds has enabled the average incomes of farmers to more than double! Here is an extract from *The Hindu*, dated 29 August 2013:

> Union Agriculture Minister Sharad Pawar ... said that the Indian farmer was more-wise than him. They understood what crops should be taken. 'When 93 per cent of cotton growers are using this seed [*Bt* cotton], ... they are the sensible people.'
>
> Because of the use of *Bt* cotton seed, cotton production had gone up from 137 lakh bales to 352 lakh bales. The use of pesticides had dropped from 46 per cent to 21 per cent as the seed was disease-resistant. ... On farmers' income, Mr. Pawar said prior to *Bt*, in 2001, the total income per hectare was Rs.7,558 in the rain-fed area. After the introduction of *Bt*, the income had gone up ... Rs.16,000 and in the irrigated area, it touched Rs.25,000 per hectare. 'So, *Bt* has established all the benefits and advantages to the farmers and to the nation,' he claimed.
>
> Meanwhile, Neha Saigal of Greenpeace India, has charged that Mr. Pawar's 'continued flawed pitch for promoting GM crops and denial of scientific evidence on the adverse impact of this technology is a huge threat to farming livelihoods and food security.'

Opposition to modern agriculture and particularly to GM

What is it all about? What is Greenpeace, that champion of all good things, alluding to?

Scan through the literature and it seems to come down to the following:

1. Lack of safety and bad effects on environment. On the weight of evidence, I think the courtroom can dismiss this one.
2. They do not work. Dismiss: if they do not work why do 93% of farmers use *Bt* cotton?
3. They harm farmers economically because they have to keep buying seed. Dismiss: farmers are doubling their profits with GM cotton.
4. Corporate takeover, especially Monsanto.

This last objection has been dubbed 'Monsanto derangement syndrome'. I cannot really say that it makes any sense to me. All big companies merit suspicion.

The bottom line is that GM has been tarred by association; yet many not-for-profit organisations are developing GM. Examples include the International Rice Research Institute (IRRI) and the International Maize and Wheat Improvement Center (CIMMYT), and CSIRO in Australia. I think the courtroom just has to say: 'We reject the argument of "guilty by association" '.

Most people in this 'courtroom' (this Crawford Fund Conference) probably agree with my ruling. That was not the case with the correspondence we received at *Cosmos* after the *Cosmos* 'Food Wars' issue. We were accused of being corporate mouthpieces and told that our tone was insulting. Our evidence, based on rigorous science and the views of expert agencies, was rejected in preference to other views.

As the 'judge', we had tried to advise readers how to weigh different kinds of evidence: for instance, evidence coming from a French scientist whose paper had been rejected should not be given more weight than the views of the worlds' expert bodies. Clearly, for many readers, that distinction made no difference.

What is to be done?

You might say: 'It is not really my job to worry: I have done my journalistic cross-examination and sum-up. Maybe trying to change people's opinions is futile. There are plenty of studies showing that evidence is not all that important when it comes to people's views.'

Dan Kahan (Elizabeth K. Dollard Professor of Law and Professor of Psychology at Yale Law School) calls this 'cultural cognition'. People are most influenced by the view of the group they identify with – their tribe. Kahan has found that when it comes to people's attitudes to climate science, the degree of scientific education is almost irrelevant. Instead, attitudes correlate with whether they see themselves as liberal Democrats or conservative Republicans. Kahan also saw a link (albeit much smaller) with attitudes to GM; liberal Democrats rate GM as riskier than do conservative Republicans. In Australia, a 2012 government study also found people's values predict their position, though 30–80% thought

GM acceptable at some level. In general, public opinion seems to be softening. Another 2012 survey suggested 50% of respondents accept GM, compared to zero a decade ago.

As a journalist, should I care? I do – very much. My job is to chaperone scientific evidence as it makes its way into the public arena. I am still appalled by the wanton attempts to mutilate it.

When I see Greenpeace spread the story of farmer suicide in India as a result of GM crops[1], I wonder what is going on. It is a big organisation with clever people. Can they really believe that? Suicide is an endemic and longstanding problem that can be precipitated by going into debt. You can go into debt by borrowing money for chemicals, fertiliser, hybrid seed, your daughter's wedding, or GM seed. Your crops can fail for lack of rain, or floods. Yet Greenpeace and others pin the blame on *Bt* cotton, whereas the evidence of its benefits to farmers speaks for itself.

Journalists must keep putting out the evidence – calmly, without hyperbole, lest they trigger tribal responses. Evidence may not always win but without it we are back in the dark ages.

References

Kahan D.M. (forthcoming). Climate science communication and the measurement problem. (June 25, 2014). *Advances in Political Psychology*. Available at <http://ssrn.com/abstract=2459057>.

Séralini G-E., Clair E., Mesnage R. *et al.* (2012). RETRACTED: Long term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize. *Food and Chemical Toxicology* 50(11), 4221–4231.

Vaupel J.W. (2010). Biodemography of human ageing. *Nature* 464, 536–542. doi:10.1038/nature08984

Dr Elizabeth Finkel received a PhD in Biochemistry from the University of Melbourne. She spent five years at the University of California, San Francisco, studying the genes that transform a mushy egg into a shapely embryo. For the last 20 years she has been a science writer for scientific and lay audiences including serving as a correspondent for the American magazine *Science* and an associate editor for *Cosmos* magazine, a popular science magazine that she co-founded. In June 2013 she was appointed the next *Cosmos* Editor in Chief. In 2005, Elizabeth's book *Stem Cells: Controversy at the Frontiers of Science* was published by ABC books. The book won the Queensland Premier's literary award and was short-listed for the Victorian Premier's award and the Australian Government Eureka Award for promoting the public understanding of science. Her second book *The Genome Generation* was published in January 2012 by Melbourne University Publishing.

Email: ella@cosmosmagazine.com

---

[1] <http://www.tonu.org/2013/04/20/a-talk-with-rajesh-krishnan-of-greenpeace-india/>

Food vs nutrition security: feed the people, well. Nutritional challenges of a developing nation

Dr Norah Omot[1]
Enabling Environment Programme
Papua New Guinea National Agricultural Research Institute

Abstract

Nutritional security is often not adequately considered and addressed in agricultural research and development (R&D) projects, despite the widespread occurrence of malnutrition. In many countries malnutrition constitutes a 'double burden', with under-nutrition and increasing obesity happening at the same time. Nutritional insecurity occurs either as a result of choice, of not knowing the nutritive values of food and their importance in diet, and/or as a result of 'force' through deficiencies in food supply systems. An assessment of the smallholder farming environment in Papua New Guinea revealed environments that are vulnerable to food and nutrition insecurity. While attempts had been made to increase productivity of commodities in demand in these areas, less attention had been given to nutrition. This disconnect can be addressed by considering nutrition in initial stages of R&D planning; and by developing projects that focus on both productivity and nutrition. It may be possible to boost use of traditional vegetables through building nutrition indicators into projects' monitoring and evaluation systems, and by working with women groups and community organisations to create awareness, with training in schools and health clinics (targeting women) in areas where research projects are implemented.

This paper covers three points on nutritional challenges in Papua New Guinea (PNG). First, the major staple food crops in PNG, their variable nutritional quality and effects on nutrition. Second, the social relationships, culture, beliefs and attitudes to food in rural or local communities and their effects on nutrition. Third, the environmental challenges, especially where food is grown, and access to markets and income.

Staple food crops

PNG is rich with diversity in crops such as sweet potato, banana, taro and yam. These crops have become staple food for the majority of the people in the country; however, their nutritional qualities are variable (Table 1). All of these staples have low concentrations of protein, iron, vitamin A and other minerals,

[1] This paper was written by Norah Omot and Birte Komolong and presented by Dr Norah Omot.

Table 1. Some food crops and their nutritional composition (Dignan *et al.* 2004).

Name	Protein (g/100g edible portion)	Iron (g/100g edible portion)	Vit A (ug/100g edible portion)
Sweet potato *(Ipomea batatas)*	1.1	0.9	185.5
Banana (*Musa cultivar*)	0.9	0.6	15
Taro (*Colocasia esculenta*)	2.2	1.2	2
Yam (*Disocorea rotundata)*	1.4	0.6	40
Karakap, (Solanum nigrum)	5.0	19.0	NA
Tulip (*Gnetum gnemon*)	5.3	3.7	296

except for sweet potato which is rich in Vitamin A. For many families in rural areas, these crops would often be easy to access, and daily would constitute a large portion of any meal eaten, larger than vegetables, protein and fruit. Meals would often be unbalanced resulting in under-nutrition. In contrast, some food in PNG such as the traditional vegetables have high nutritional qualities, as shown in the bottom two rows in Table 1, but they are often eaten in smaller amounts in meals. Evidence from research throughout PNG shows undernutrition.

Beliefs, lifestyle and culture

People's beliefs, attitudes to food, social relationships, lifestyles and culture also influence nutrition. Here are some examples.

The orange sweet potato, which is now promoted in some African countries, is also grown in PNG. This variety is nutritionally of better quality than the other varieties, but in PNG we find that a lot of people want to eat the other varieties and not the orange varieties. The reason is that the orange varieties are soft when they are cooked, and people find they quickly get hungry again after eating them. As is the nature in villages and rural areas, families often have only two meals a day. In between breakfast and dinner they have 'snack food' of fruit and nuts if available. Hence they would prefer to feel full for a longer time if they have a meal of sweet potato in the morning.

As another example, some people express dislike for nutritious foods such as the traditional vegetables in Table 1. Although they are high in nutritional quality, some people see them as of low status: they consider vegetables like these to be 'village' food, and do not want to eat them. Also, some of these vegetables have a distinct taste that people do not like.

In other words, people have access to good quality foodstuffs but they choose not to eat them because of their negative attitudes towards those foods.

Another aspect of people's attitudes is the preference for processed food. Lifestyles in PNG are increasingly changing because of urbanisation and

modernisation, and this tends to change food preferences and to shift demand away from local fresh food towards manufactured food. As a result we are also seeing increasing rates of non-communicable diseases such as those related to the heart and high blood pressure.

There is also ignorance about food value. In rural areas many people are not educated and they do not understand the value of food. In one study (Muntwiler and Shelton 2001) in a rural village in the highlands of PNG a researcher asked villagers and people who were working in the health clinics what they thought of noodles: whether noodles are an energy food or a protein food or a protective food. Thirty-seven people were interviewed and 76% of them said noodles were a protein food, and that was because the packet showed pictures of prawns and beef and chicken.

Finally on this second point, in many cultures in PNG men are given the best food and are served first. This means that in general women, and largely those in rural areas, miss out on good food and they are greatly affected nutritionally. Any good food that remains after the men have had their share is either divided between the children and women or given to the children, and the women eat whatever is left over.

Environment challenges, markets and income

Turning now to environment challenges, especially where food is grown, and access to markets and income, three aspects are discussed here: (i) the smallholder farming environment and food security status; (ii) the interventions that have been identified to address some of the problems of productivity in these farming environments; and (iii) the gaps found in addressing productivity and nutrition and some suggestions to bridge them.

Seven years ago my organisation ran a project, with funding support from AusAID (Australian Agency for International Development), to try to define the smallholder farming environment. We used geographic information systems to define areas of land that had similar social and geographical characteristics. We called these areas Agricultural Development Domains, or ADDs. We identified 22 ADDs which were grouped into eight clusters. Each ADD was defined based on its agricultural potential, the access to markets and services, and the population density there. Therefore each ADD represents areas where there are or could be similar problems or opportunities in agricultural development, and where similar strategic and investment opportunities or viable sets of opportunities can be worked out.

The map (Figure 1) shows the eight ADD clusters in eight different colours. Areas coloured deep green on the map are the cluster HHH: they are places where agricultural potential is high, access to markets and services is high, and population density is also high. In these areas, because of the potential for agricultural production, a lot of the commodity crops such as coffee, cocoa, coconut and oil palm are grown, and also a lot of high value crops. Market systems are well established in these areas. In contrast, the areas shown as brown or yellow on the map are farming environments that are high in

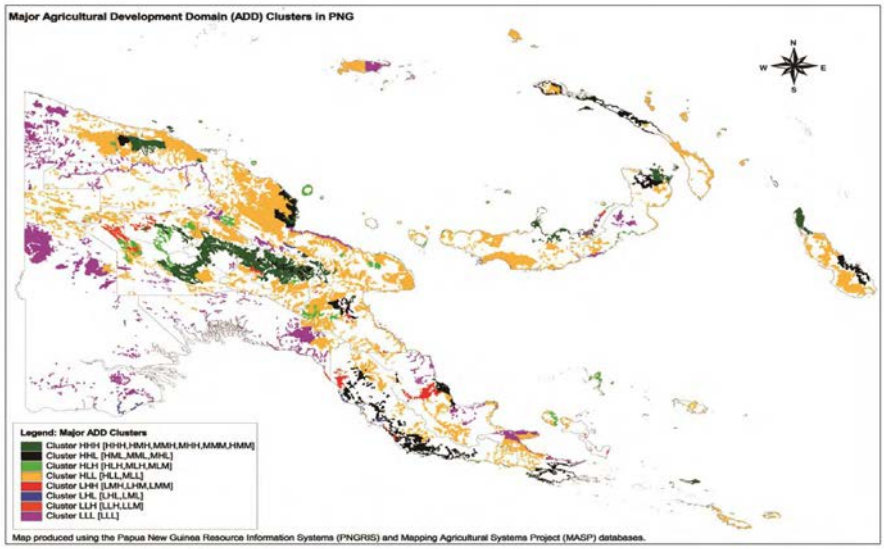


Figure 1. The smallholder farming environment in PNG, based on databases of the PNG Resource Information Systems and Mapping Agricultural Systems Project.
Areas in purple or red (southern): low agricultural potential and low market access. Areas in brown or red (northern): low agricultural potential but some access or even good access to markets, or high agricultural potential but poor access to markets. Areas in black or dark green: good market access and high agricultural potential.

agricultural potential but have poor market access and small population density.

We used this map to identify the food and nutrition security status of the smallholder farming environments, and we found that there were three levels of vulnerability within all these different clusters. The most vulnerable areas are those that have low agricultural potential and low access, and they are the areas coloured purple and the red areas towards the southern part of the country on the map.

The next most vulnerable areas are those that have low agricultural potential but have some access or even good access to markets, or they have high agricultural potential but poor access to markets. These are mostly areas in brown and light green, and the red areas towards the northern part of the country. As mentioned above, the least vulnerable areas are those where there is good market access and high agricultural potential, and they are coloured black and dark green on the map.

This mapping showed places with production constraints, and we tried to identify interventions to address them. Most effort would be directed towards R&D, addressing productivity and efficiency, with some interventions focusing on:

- seed systems, crop improvement, marketing systems;
- value adding, abiotic threats, climate change;

- land and soil fertility management, biotic threats;
- pests and diseases, farm mechanisation, market opportunities.

These are broad areas and so there were a number of projects and research topics within them. However, we found that we had not adequately considered nutrition security when we were doing that planning – not on purpose; rather it was an oversight. At that time we had not realised the importance of impacts on nutritional security.

In future this disconnect between productivity and nutrition can be addressed in a number of ways, including by considering nutrition in the initial stages of planning, and by developing projects that focus on both productivity and nutrition. In existing projects we can emphasise the need to focus on nutrition in the implementation plans. Instead of only working within agricultural research we can also link up with other relevant sectors, such as the Health sector.

Another possibility is to work with traditional vegetables: we can improve productivity with new varieties, and we can promote the use of traditional varieties of vegetables to enhance people's nutrition. This could be through building nutrition indicators into projects' monitoring and evaluation systems, and by working with women groups and community organisations to create awareness, with training in schools and health clinits (targeting women) in areas where research projects are implemented.

Summary

In summary, PNG has nutritional challenges of various types, including those related to food consumption, habits, culture and access to food. Assessment of the smallholder farming environment has revealed areas that are vulnerable in terms of food security and nutrition security. While attempts have been made to increase productivity, less attention has been given to nutrition, and we have identified a series of possible ways of remedying that gap.

References

Dignan C., Burlingame B., Kumar S. and Aalbersberg W. (2004). *The Pacific islands food composition tables*, 2nd edition. Food and Agriculture Organization of the United Nations, Rome.

Muntwiler M. and Shelton R.M. (2001). Survey of nutrition and protein intake in rural families in Eastern Highlands province. In Bourke R.M,, Allen M.G. and Salisbury J.G. (eds). *Food Security for Papua New Guinea*. Proceedings of the Papua New Guinea Food and Nutrition 2000 Conference, PNG University of Technology, Lae, 26–30 June 2000. ACIAR Proceedings No. 99, p. 432.

Dr Omot is the Director of the Enabling Environment Programme with the Papua New Guinea (PNG) National Agricultural Research Institute (NARI). She is an agricultural economist with research interest in policies, market systems and value chains, social cultural

studies and innovation systems. Dr Omot has been involved in two ACIAR projects through the PNG NARI. One project, 'Improving the marketing systems for fresh produce in the highlands of PNG', focused on developing supply-chains for the exportation of produce through improved postharvest management and buyer–seller relationships. The second project targeted constraints to women's participation in market-systems, aiming to improve their livelihoods by developing their business acumen. Work on these projects led to Dr Omot being awarded a John Allwright Fellowship, sponsored by ACIAR. Subsequently she received a PhD from University of Canberra. Her studies identified weaknesses in the process of bringing the vegetables from production to market in PNG. Dr Omot is now running the NARI program 'Enabling environment', which is identifying the socio-economic barriers to sustainable agricultural development in PNG. Dr Omot also works closely with the National Office of the PNG Women in Agriculture.

Email: norah.omot@nari.org.pg

Watch your waste: Lose less, consume sustainably, feed more

Dr Helen Szoke
Oxfam Australia

Abstract

The world already produces enough food to feed the world, yet over 800 million people are hungry. Further to this paradox, increasingly we are aware of the potential negative impacts that expanding agriculture can have. Valuable ecosystems and carbon sinks may be lost or threatened, while vulnerable people – particularly women, children and Indigenous peoples – can be forced off their land as we see increasing levels of competition for arable land. Curbing waste in the food system is critical to more sustainable natural resource use and reducing agriculture's contribution to climate change. Addressing food waste can also bring social benefits at the family level, supporting smallholder farmers to retain more of their crop, and household consumers to spend less on food purchases. The dynamics of food waste also differ between communities. In smallholder agriculture, up to 40% of food produced can spoil, rot or be diseased before it reaches the plate. Reasons for such losses can include a lack of post-harvest storage facilities or locally appropriate options for pest management. This can have dire impacts for communities with limited access to water or land, and for those facing the stress of adapting to a rapidly changing climate. Yet in long-chain agriculture, food is similarly wasted – up to 20% of Australian household food purchases may be being discarded – contributing heavily to Australia's already weighty carbon footprint. This paper explores some of the ways in which Oxfam Australia approaches curbing waste in the food system, drawing on our analysis of trends in global agriculture, as well as our work on the ground in smallholder agriculture and public education.

Today we grow enough food to feed the world, yet over 800 million people face hunger. Tackling food waste is key to building a more sustainable food system.

Children who face hunger, even for a short period of time, can suffer lifelong effects on their mental and physical development, negatively affecting their future livelihoods and their quality of life. Hunger can force families into heartbreaking situations and decisions, and women and girls are particularly vulnerable – as mentioned, for example, in the paper by Omot & Komolong (2014). From my perspective as a parent I cannot imagine what it must be like to be unable to feed my children. This is ultimately what is at stake when we talk about the food system.

As we contemplate the future of our current food systems we also know that world agriculture is rapidly changing. For many farmers, it may seem that

agriculture is constantly under attack. Every day, precious fertile soils are lost to urban development, to erosion and pollution, to coal and gas extraction, to roads, to light industry, to tourism, to mining and even landfill.

Yet agriculture itself is part of a new wave of intensive resource competition. The boom in agricultural commodity prices over the past decade has fuelled rapid domestic and international demand for agricultural land, and this can also create a cruel paradox where agricultural expansion actually threatens the right to food. Increased competition for land now frequently leads to human rights violations, as we see reported in the growing literature about illegal or unethical land acquisitions. Like many other global voices, Oxfam and its partners see communities displaced and denied access to their sacred sites and food crops when land is turned over to agriculture in which community considerations play little part. Hunger disproportionately impacts the landless and communities that rely on agriculture for their income or subsistence (WFP 2014). This is a cruel irony that should not be lost on us.

Agriculture is also a key contributor to global carbon emissions, and it drives 80% of global deforestation (UNEP 2014). Forests are the heartbeat of our climate systems, holding 289 gigatonnes of carbon in biomass alone (FAO 2010 p. 4). By the year 2050 an additional 20–25 million children under 5 could face malnutrition as a result of changing climate (Nelson *et al.* 2009).

Also today, we see that limits to agricultural consumption have been burst open in a globalised industrialised food system. Over the past four decades the livestock revolution has dramatically transformed grain use, with around 670 million tonnes of cereal now fed to livestock, using a cropped area of 211 million hectares (FAO 2006 p. 38; Weis 2013). Activities related to livestock production contribute to an estimated 37% of global methane emissions and 9% of all carbon emissions (FAO 2006). In the 21st century biofuel production has increased 500% so that consumption is no longer constrained by the size of our stomachs because crops like sugar, palm oil, soy and corn are increasingly used for non-food purposes (Naylor 2012 p. 2).

Facing a seemingly limitless appetite for agriculture, yet increasingly aware of the natural constraints of our local ecologies and our shared planet, turning to a more efficient and ethical approach to agriculture is actually key to managing and reducing waste. It is estimated, for example, that at least one-third of food produced is lost in the food system. In a world where over 800 million people face hunger, this statistic is truly alarming.

In many places throughout the developing world, waste occurs because farmers lack access to resources or appropriate information to enable them to store or transport food better. This challenge will increase, as climate change requires farmers to adapt their production and storage practices.

In contrast, in high income countries, most food waste arises not from spoilage but from perfectly good food not being eaten. Food is rejected by retailers for purely aesthetic reasons, or wasted because people buy more than they need.

Our work in Oxfam looking at food waste focuses on the household, the individual and community and ways to improve food security and economic benefits for families. For example, we support work in Timor Leste, north of Australia. This half-island nation achieved independence at the turn of this century, but still faces profound challenges including high levels of illiteracy, the impacts of climate change, and heartbreaking rates of child malnutrition (WHO 2014). Food security is a major national issue which has impacts on people's quality of life.

Oxfam supports local partner organisations that share information and provide training to rural women and men about low cost and low risk agricultural practices appropriate for remote places. This includes efforts to reduce losses that occur shortly before or shortly after harvest. For example, farmers may build new facilities for seed storage, or use affordable plastic drums so that seeds will not be eaten by pests or spoilt (Figure 1), and we experiment with simple food processing to turn excess crops into additional income. For instance, turning bananas into banana chips not only means the fruit is not wasted but also preserves it for longer use and for sale.

Farmers learn how to protect their crops from losses, for example by raising garden beds so that food plants are not destroyed by flooding or by heavy rains just as they are ready to be harvested. People learn more about the benefits of living fences that protect food gardens from farm animals, and they discuss planting several species together to reduce risk of crop losses to pests that attack a single species – a practice which is commonly part of traditional agriculture in many places across the island. Diversity in planting also helps to spread risk from post-harvest losses, which are highest in maize and rice and lower for other staples such as cassava and sweet potato (WFP 2006).

By experimenting with these techniques farmers see what works well, and the benefits or disadvantages that they may bring. These easy to implement, low-cost techniques can then be easily transferred to family and friends, contributing to a long-term change to the food system. Farmers provide feedback, and it is understood that the community is pivotal in creating and adapting locally

Figure 1. Farmers in Timor Leste are beginning to store seed in plastic drums to prevent pest attack and spoilage.

appropriate techniques. These are techniques that are 'owned' by that community, not imposed on them.

Oxfam Australia's work relies on the generosity of Australian people, and I say this to illustrate that the notion of ethics at the heart of today's conference is a powerful one. It reminds us of the choices that we make in our everyday life to decrease the burdens that others face across the world (see for example Chandler 2014 postscript).

This ability to affect the lives of others by our choices takes on new dimensions as Australians learn more about our role in the global food system.

Each year Australian households waste $8 billion worth of food (Foodwise 2014). We waste 4 million tonnes of food, and much of that goes to landfill; 20–40% of fresh fruit and vegetables are wasted before they reach the shops because they do not meet supermarket or consumer aesthetic requirements (Foodwise 2014). That squanders the precious water and soil nutrients used to actually grow the food.

Once this waste enters landfill it emits methane and carbon dioxide. To grow, transport and market this excess food which goes to landfill, we first use non-renewable fossil fuels, adding to the global climate burden, and contributing to the land competition mentioned above. The average household in Australia wastes at least $1000-worth of food per year, enough to feed a household for over a month, and up to 40% of the average household bin can often be food waste (Foodwise 2014).

Oxfam has a long tradition of public information campaigns for consumers. We were pioneers of the fair trade movement, and to build this movement we needed to make situations visible that have often been invisible in the production chain. We showed that many people in developing countries who produce much of the food that we eat and drink do not get a fair share of the wealth created by trade, because the rules of international trade favour rich countries over the poor ones.

Through our global food justice campaign called GROW, launched four years ago, we are supporting people in Australia to think about how to take action on this issue of food waste. We build awareness of waste in the food system via social media campaigns (e.g. Figure 2) and face to face community campaigns.

The extent of waste in our food system can be shocking; it was for me. Many Australians want to support farmers at home and overseas by reducing the carbon footprint of our own food consumption.

Our GROW campaign urges people to take simple steps to address food waste, such as: use yesterday's leftovers; check the fridge before going shopping so you do not buy more than you need; choose perishable food that is in season because it is likely to use fewer resources; eat a bit less meat and dairy; compost food scraps. These are small changes, simple ones. But it is because they are small that they are powerful.

Figure 2. Oxfam runs campaigns in Australia and across the world to raise awareness of waste and how people can take action to avoid it.

We also know that these messages succeed. In August 2013 we urged Oxfam supporters taking part in our six-month GROW challenge to 'Watch your Waste' for one month (Figure 2). The GROW challenge inspired people to take action to help create a more sustainable food system by completing a monthly challenge. Of the participants we surveyed at the end of 2013, 76% reported that they had cut down their food waste. Our Food Justice Community Engagement Co-ordinator told me:

> The issue of food waste has really resonated with Oxfam Australian supporters, and particularly young people. Reducing food waste is one tangible way to engage with the complex issues of food justice. Disparity and injustice cannot be better demonstrated than with the case of one-third of the world's food going to waste, while one in eight people go hungry.

Of those one in eight people who go hungry, 80% of them are involved in food production of one sort or another. Creating an efficient and ethical food system is central to meeting the challenges that we face, and by reducing the agricultural burden of waste we can reduce pressure on our natural resources and slow agriculture's contribution to climate change.

This is an important step in addressing the inequalities that exist in our global food system, and these are inequalities that contribute to existing hunger and that will exacerbate problems into the future. Reducing food waste can bring direct benefits to farmers by increasing their household food security through lowering the risk of crop losses before they reach the plate. We can also bring economic benefit for consumers in industrial countries by helping them to become more mindful of managing waste, and reduce their disproportionate

contribution to greenhouse gas emissions and the squandering of our natural resources.

Looking towards the future of agriculture it is easy to be overwhelmed by the challenges we face in building a more sustainable food system. Yet I am reminded, in looking at our own work in Australia and in Timor Leste, about the power of little decisions: of a farmer building a fence, of someone taking leftovers for lunch. Just as we built the fair trade movement one cup of coffee at a time, little decisions are key to transforming an inequitable and wasteful food system into a more ethical and efficient one where we lose less, consume sustainably, and help relieve more people of the heartbreaking burden and indignity of hunger.

References

Chandler L. (2014). Australian agriculture's role in meeting increased Asian demand. *Ethics, efficiency and food security: Feeding the 9 billion, well.* Proceedings of the Crawford Fund 2014 Annual Parliamentary Conference, August 2014, pp. 32–41.

FAO (2006). *Livestock's long shadow: Environmental issues and options*. Food and Agriculture Organization of the United Nations, Rome.

FAO (2010). *Global forest resources assessment* 2010 – *Key findings*. Food and Agriculture Organization of the United Nations, Rome. <http://foris.fao.org/static/data/fra2010/keyfindings-en.pdf>

Foodwise (2014). Food Waste Fast Facts (webpage). <http://www.foodwise.com.au/foodwaste/food-waste-fast-facts/>

Naylor R.L. (2012). *Biofuels, rural development, and the changing nature of agricultural demand*. Stanford Symposium Series on Global Food Policy and Food Security in the 21st Century. Center on Food Security and the Environment. April 2012.

Nelson G.C., Rosegrant M.W., Koo J. *et al.* (2009). *Climate change: Impact on agriculture and costs of adaptation*. Food Policy Report. International Food Policy Research Institute. Washington DC. Updated October 2009.

Omot N. & Komolong B. (2014). Food vs nutrition security: Feed the people, well. Nutritional challenges of a developing nation. *Ethics, efficiency and food security: Feeding the 9 billion, well.* Proceedings of the Crawford Fund 2014 Annual Parliamentary Conference, August 2014, pp. 72–77.

UNEP (2014). Agriculture and Food (webpage). United Nations Environment Programme. <www.unep.org/resourceefficiency/Home/Business/SectoralActivities/AgricultureFood/tabid/78943/Default.aspx>

Weis T. (2013). *The ecological hoofprint: The global burden of industrial livestock*. Zed Books. New York.

WFP (2006). *Timor Leste district-level emergency food security assessment (EFSA)*. August–September. <http://documents.wfp.org/stellent/groups/public/documents/ena/wfp175175.pdf>

WFP (2014). Who Are the Hungry? (webpage). <www.wfp.org/hunger/who-are>

WHO (2014). Global Database on Child Growth and Malnutrition: Timor-Leste (webpage). World Heath Organization. <www.who.int/nutgrowthdb/database/countries/tls/en/>

Dr Helen Szoke commenced as Chief Executive of Oxfam Australia in January 2013. Prior to this appointment Helen served as Australia's Federal Race Discrimination Commissioner, following seven years as

the Victorian Equal Opportunity and Human Rights Commissioner. She is currently Co-Chair of Make Poverty History, an ExCom member of the Australian Council for International Development (ACFID), a member of the Deakin University Master of International and Community Development Advisory Board, a member of the Advisory Committee for the Centre for International Mental Health and a member of the Mining for Development Advisory Committee. In 2011, Helen was awarded the Law Institute of Victoria Paul Baker Award for contribution to Human Rights. Helen has extensive experience in management, community development, organisational development, consumer advocacy and regulation in the education and health sectors. She is a Graduate of the Australian Institute of Company Directors and a Fellow of the Institute of Public Administration.

Email: helens@oxfam.org.au

Long-term food demand in Asia and implications for Australian agriculture

Dr Jammie Penm

Agricultural Commodities and Trade Branch, Australian Bureau of Agricultural and Resource Economics and Sciences

Abstract

Food consumption in Asia is projected to increase significantly toward 2050, with consumption patterns shifting from traditional diets oriented around starchy staples to more varied diets with larger quantities of higher-value and higher-protein foods. Although food production in Asia is also expected to increase, it will not be able to meet the growth in Asian consumption of many food products. In Japan and the Republic of Korea, growth in food consumption is projected to be limited through to 2050 because of projected declining populations and modest future income growth. The most significant rise in food demand is expected to occur in China toward 2050. The rise in food consumption in China will be characterised by significantly higher demand by urban consumers for high-value foods such as dairy products, beef, sheep and goat meat, fruit and vegetables. For rural consumers in China, growth in consumption of high-value commodities is also projected, but the increases on average are expected to be smaller than from urban households. India is one of the largest consumers and producers of grain in Asia and has a self-sufficiency policy. By 2050, India is projected to become a significant net importer of fruit, vegetables and dairy products. For the ASEAN (Association of SE Asian Nations) member states as a whole, imports of wheat, beef and dairy products are projected to rise toward 2050. Vegetable and fruit consumption in the ASEAN region is projected to nearly double by 2050. Australia needs to remain competitive to meet the opportunities provided by greater Asian demand for food. Apart from the role governments will play in reducing market barriers, contributions from the private sector will also be important. Strong working relationships with supermarkets and hypermarkets in Asia will facilitate food exports.

This paper is about modelling long-term demand for food, carried out by the Australian Bureau of Agricultural and Resource Economics (ABARES). It gives modelling results for individual countries in the Asian regions to the year 2050, discusses the export potential for Australian agriculture; and outlines the challenges and opportunities ABARES sees for Australian agriculture.

It is expected that world income growth will continue, with especially strong growth in Asia, and that global population will also increase significantly toward 2050 (Figure 1). Therefore there will be very strong demand for food toward

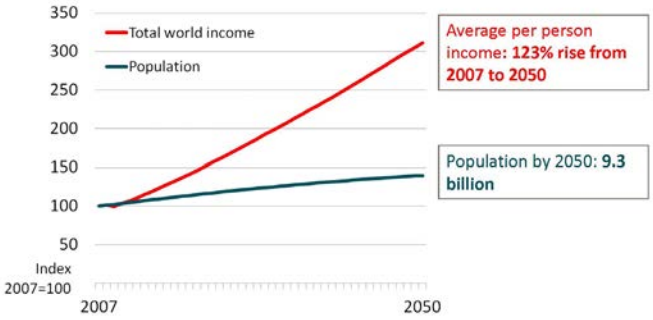


Figure 1. Average per person income and population are expected to rise to 2050.

2050, and we expect that the strongest growth will come from the Asian regions, especially in China.

Our modelling also assumes that agricultural production in Asia will increase significantly and will meet quite a large proportion of the expected growth in food demand in the region. If Asian agricultural producers can adopt the modern technologies used in Australia, the European Union or the United States to suit their own conditions, there will be significant scope for agricultural production to increase in Asia. However, our modelling results indicate that it will be difficult for domestic food production in Asia to satisfy all the food demand in Asia (Figure 2), so we project that food imports will also rise toward 2050. That will provide opportunities for Australian agriculture to increase its exports to the region.

Turning to individual countries, first we look at Japan and the Republic of Korea. It may not be surprising that we do not expect food consumption to grow very much in Japan and the Republic of Korea toward 2050 compared with actual consumption in 2007 (Figure 3). This is because per-person incomes in those countries have reached very high levels, so there is limited scope for switching from staple foods to more protein-based foods there. Secondly, populations in those countries are not expected to increase significantly, and could even decline toward 2050.

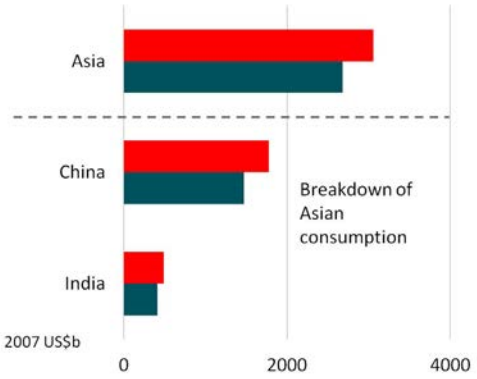


Figure 2. Value of food consumption and production in Asia by the year 2050 in billion 2007 US$. (Red/top bar in each pair = consumption. Blue/lower bar in each pair = production.)

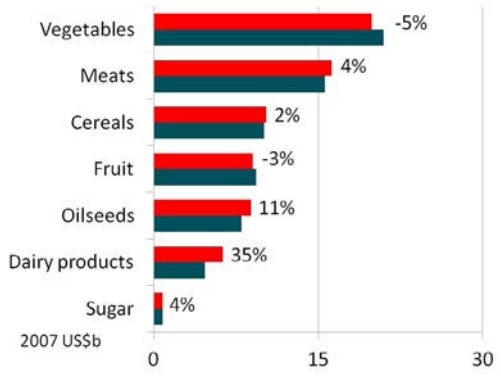


Figure 3. The value of food consumption in Japan and Korea in the year 2050 (red/top bar) is expected to remain relatively stable compared with 2007 (blue/lower bar) (in billion 2007 US$).

However, even though we do not expect food consumption in Japan and the Republic of Korea to rise, we nevertheless expect there will be strong competition for those markets toward 2050. This is because we consider those two markets are high-value markets; that is, if Australia exports to those markets we usually can get higher returns for our agricultural exports relative to other export markets. Therefore, competition in those two markets can be expected to be strong toward 2050 because other producers in the world will also want to increase their exports into those countries to get higher returns.

Next, we look at India. India has a food self-sufficiency policy, especially with respect to rice and wheat. We expect that most of the increased demand for food in India can be met by India's own domestic food production. But there is an interesting aspect here in terms of Indians' dietary habits. A big proportion of the Indian population is vegetarian, so we can expect demand for fruit and vegetables to increase significantly as income levels continue to rise there. Also vegetarians in India use dairy products to supplement their protein intake, so we expect that there will also be significant opportunities for dairy exports to India, given income growth toward 2050 (Figure 4).

We have modelled the expected consumption of dairy products in several Asian countries that will have to be met by imports (Figure 5). As mentioned already,

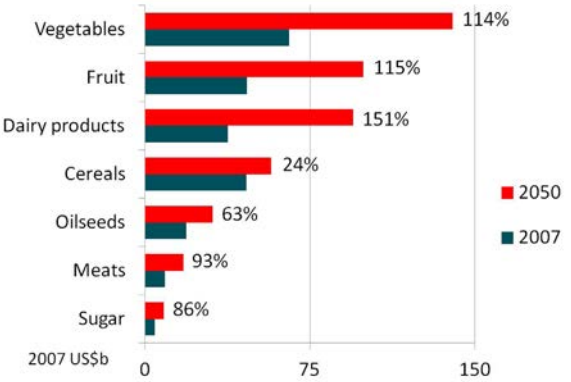


Figure 4. In India, the value of food consumption in 2050 (red/top bar) is expected to be generally or considerably greater than in 2007 (blue/lower bar) in billion 2007 US$.

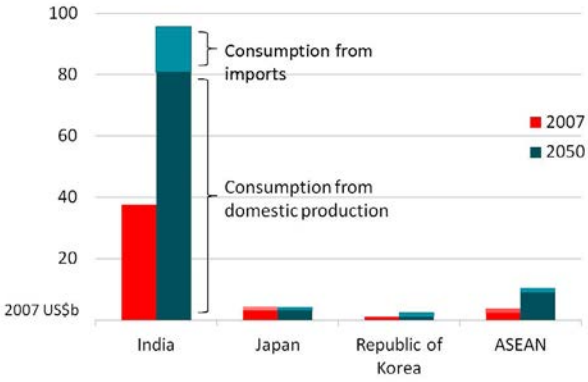


Figure 5. Prospects for dairy consumption and the value of imports in selected Asian countries in 2050 (right/blue bar) compared with 2007 (left/red bar) (billion 2007 US$).

there are considerable prospects for India, and some potential in ASEAN (Association of SE Asian Nations) countries, but opportunities for growth in import demand from Japan and the Republic of Korea are expected to be small for dairy products.

ASEAN countries are expected to increase their demand for meat products – beef, sheep meat and so on – and there should be potential there for Australian exports (Figure 6). There will be opportunities for higher wheat or cereals exports to the region because there is very little wheat production in the ASEAN region. There may also be opportunities for exporters of vegetables and fruit. The catch is that the ASEAN countries produce large amounts of vegetables and fruit themselves, with significant regional trade and some exports. If Australian producers are to increase exports of fruit and vegetables to the region they will need to be high-quality high-value products, aiming for the niche market of the high-end consumers.

It is from China that we expect the largest increase in food demand, and one of the reasons for that is continuing urbanisation. We have modelled changes in the urban population in China toward 2050 (Figure 7a). Urbanisation is helping to change people's dietary habits: they will be eating more protein-based products such as meat and dairy products, and will reduce their consumption of grains

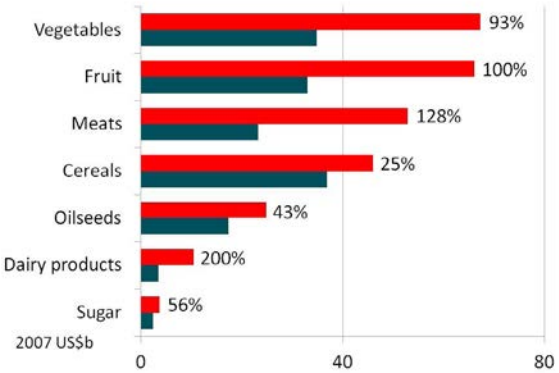


Figure 6. Prospects for growth in the value of food consumption in ASEAN nations (billion 2007 US$) comparing 2050 (red/top bar) and 2007 (blue/lower bar).

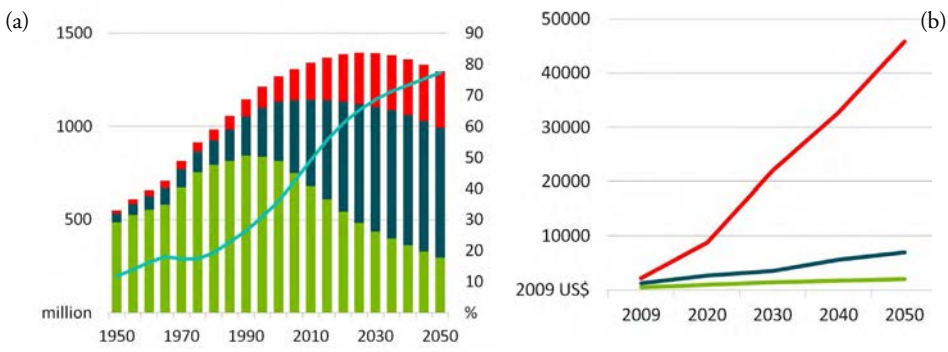


Figure 7. (a) Urban populations in China are expected to grow strongly (in millions or %), changing the proportions of the population in urban high-income (red/top), urban middle-income (blue/middle) and rural sectors (green/lower).
(b) Urban and rural incomes per person in China, 2009–2050, in 2009 US$: urban high-income group (red/top), urban middle-income group (blue/middle) and rural income (green/lower).

such as rice, and perhaps also other staple foods such as sweet potatoes and some other low-value foods.

ABARES has also projected income changes in the three population groups: that is, the urban high-income and middle-income groups and the rural population in China. Based on our modelling, we expect the urban high-income group will have a very significant income growth toward 2050 (Figure 7b). That should be the target group for Australian high-value products exported to China.

We expect both urban income groups in China to be consuming more in 2050 than in 2009 (Figure 8a) in real value terms. The modelling suggests significant increases in beef consumption, dairy consumption, sheep meat, and maybe sugar, among urban consumers, which certainly presents openings for Australian agricultural exports. When we include the rural population's consumption we find that it is still roughly the same picture for beef, dairy products, sheep meat and goat meat: the percentage increases will be large (Figure 8b).

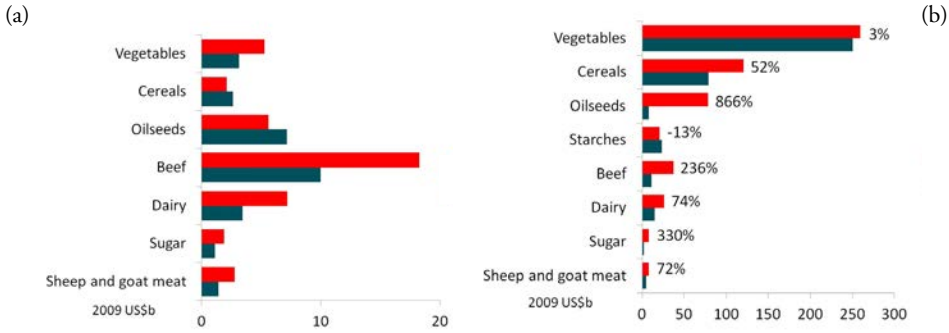


Figure 8. (a) Projected rises in the value of China's food consumption (in billion 2009 US$) between 2009 and 2050 in the urban high-income (red/top bar) and middle-income (blue/lower bar) populations; and (b) increases in the value of China's total food consumption (in billion 2009 US$), in 2050 (red/top bar) and in 2009 (blue/lower bar).

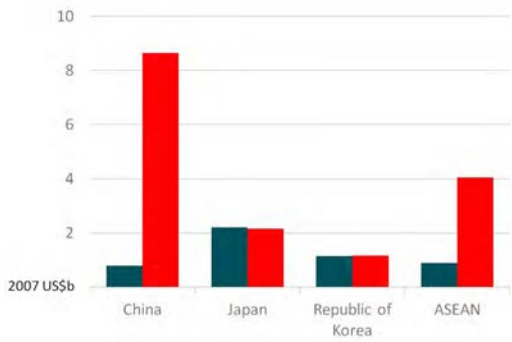


Figure 9. The value of Asian imports of beef is expected to rise by the year 2050 (red/right bar) compared with 2007 (blue/left bar) (billion 2007 US$).

For vegetables and fruit there will be relatively limited increases in consumption because there has always been high intake of those food groups in China. But the increase in demand for protein-based products will spill over into demand for feed grains and oilseed products for feed (Figure 8).

Using beef as an example, we can compare China with some other Asian countries, and again we find that especially for beef we can expect significant market opportunities (Figure 9).

Opportunities and challenges

Based on the modelling results we can examine the opportunities and challenges for Australia. They can be summarised in three points.

First, there will be market opportunities in Asia, but there will also be competition. It is very simple: if Asia is the place where agricultural exporters can make a dollar, then our competitors in the United States, the European Union and Latin America will all want to sell their products there. So it will be very important for Australian primary producers and exporters to maintain their competitiveness. In 2011, the value of Australia's agricultural exports was not ranked very high (Figure 10). There are many other producers exporting significant amounts of agricultural products into other parts of the world.

The second point is that it will be important to remove trade barriers to help food to flow to where it is needed. That has been happening: for example, there

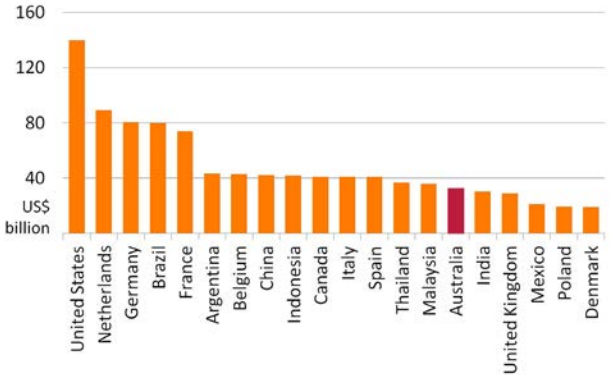


Figure 10. Values of agricultural exports in 2011 by major exporting countries, including Australia (darker bar), in billion US$.

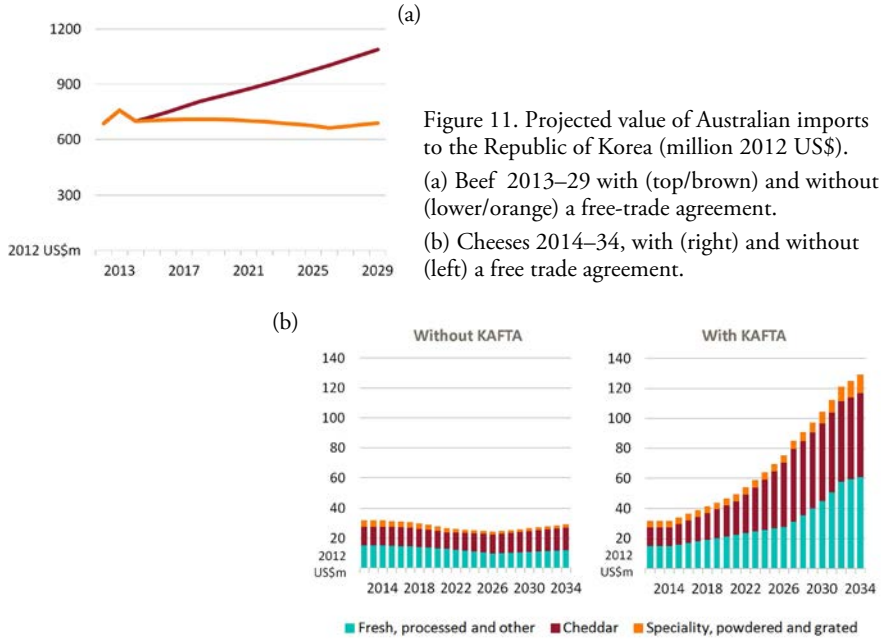


Figure 11. Projected value of Australian imports to the Republic of Korea (million 2012 US$).
(a) Beef 2013–29 with (top/brown) and without (lower/orange) a free-trade agreement.
(b) Cheeses 2014–34, with (right) and without (left) a free trade agreement.

are free trade agreement deals with the Republic of Korea and Japan, and the government is negotiating with China for another free trade agreement.

ABARES has done some studies to examine the likely impact for our beef exports under the newly negotiated free trade agreement with the Republic of Korea (Figure 11a). We expect that with the free trade agreement our beef exports will be significantly higher to the Republic of Korea toward 2030, compared with no such free trade agreement. The United States had already achieved a free trade agreement with Korea with consequent tariff reduction, and Australia is matching that now. Without a free trade agreement our exporters will be disadvantaged because we will have to pay a higher tariff.

The free trade agreement with the Republic of Korea applies also to Australia's dairy products. We expect there will be significant increases in our dairy exports, specifically of cheese, under the free trade agreement (Figure 11b). The European Union and the United States have also achieved free trade agreements with the Republic of Korea.

It is very important for Australia to be able to strike good free trade agreements with major trading partners in Asia so that our producers and exporters can take advantage of the expected increases in food demand from those regions.

The third opportunity and challenge relates to business communities. They will have to be able to incorporate the changing Asian food consumption into their planning. As one example, we can expect supermarkets in Asia to become more dominant and important for getting food directly to the consumer. We need to build good working relationships with the supermarket chains in Asia. It will be very important for Australian producers and exporters to ship our food products into Asia – to locations where they are needed.

Dr Jammie Penm is Chief Commodity Analyst and Assistant Secretary, Agricultural Commodities and Trade Branch at the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES). His professional expertise and achievements revolve around commodity analysis and economic research important to Australia's primary industries. Jammie has a PhD in econometrics from the Australian National University and a Masters degree in economics from the State University of New York at Stony Brook. Before joining ABARES, Jammie worked at the Australian National University, the former Industries Assistance Commission and the State University of New York at Stony Brook in the United States.

Email: jammie.penm@agriculture.gov.au

Agriculture restructuring: Towards higher global competitiveness and food security

Dr Nguyen Van Bo
Vietnamese Academy of Agricultural Sciences

Abstract

Ensuring food security is not merely an economic or humanitarian activity: it also actively contributes to national and global socio-political stability. During the last 25 years of implementing its Renovation Policy, Vietnam has achieved national food security, actively contributing to the goals of eliminating hunger, alleviating poverty, and ensuring regional and global food security. Vietnam is changing from a net food importer to an exporter of many agricultural commodities. However, Vietnam is an agriculture-based economy with more than 70% of its population engaged in agriculture. A very high proportion of many of the commodities it produces are exported: 25% of its rice production, 90% of coffee, rubber, cashew nut and cassava, and 95% of black pepper. Any fluctuation on the international market can adversely affect its agricultural industries. Difficulties and challenges will face the country in the years to come: rapid population growth; decreasing farm areas and water resources; natural disasters, floods, droughts; decreasing levels of investment in agricultural production; barriers to agricultural international trade; low incomes of the poor, reducing their access to food; food demand increasing for other purposes, including the production of bio-energy; and climate change. Vietnam's agriculture restructuring policy aims at higher competitiveness and ensuring food security in the context of climate change. Efforts are focused on policies to stabilise the area of land devoted to rice cultivation; increasing investment in water management infrastructure; and promotion of mechanisation in rice production and processing. It will apply scientific and technological advances to varietal improvement; natural resource management; pest and disease control; and post-harvest technologies. It will also re-organise the institutional set up for agricultural production, linking production with processing and marketing. This will raise the incomes of rice growers, modernise rural life and enhance farmers' livelihoods. At the same time, it will actively seek to mitigate the impacts of climate change, especially of rising sea levels. With sound policies to guarantee its national food security, Vietnam is ready to cooperate with its neighbours, share its experiences in agricultural development with the international community; and actively contribute to ensuring food security globally. Halving the proportion of people suffering from hunger by 2015 is one of the eight Millennium Development Goals agreed to by many nations more than a decade ago. With many difficulties and challenges still facing food security, achieving this goal will require the effort of every nation, and especially active support from developed countries and international organisations. This demands coordinated action at regional levels as well as on a global scale.

Vietnam has an agriculture-based economy, though agriculture accounts for only 22% of Vietnam's total gross domestic product (GDP). More than 70% of the population is engaged in this sector, and most of the country is devoted to growing food crops, with rice accounting for more than 7.8 million hectares of harvested area (Figure 1).

Agriculture in our country is a very open sector, so a big share of many products is produced for export (Table 1). For rice, about 23% of the total production is for export, and for coffee, rubber, cashews and black pepper that percentage is 92–99%. Table 1 shows rubber and pepper at over 100% for export because some stock has been held back waiting for better prices than were received in previous years. In the case of cashew nuts, we import quantities from India and other countries to do their processing, so we export more than we produce.

Agriculture is the only industry sector in Vietnam to provide a surplus in the import–export balance, so it supports the national economy. As Figure 2 shows, the agriculture trade balance is positive, and below it the national trade balance is negative. According to records, Vietnam has been exporting rice since 1861, though there was an interruption of about 50 years for a range of reasons. Rice export ensured not only poverty alleviation but also food security.

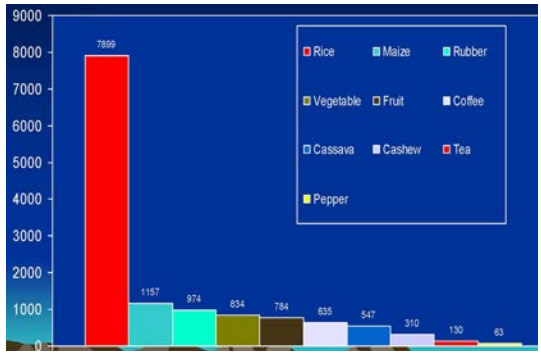


Figure 1. Planted areas of main crops in Vietnam, in '000 hectares. Left–right: rice, maize, rubber, vegetables, fruit, coffee, cassava, cashews, tea, pepper. Source: Ministry of Agriculture and Rural Development (MARD) 2014.

Table 1. Crop production and export in Vietnam in 2013. Source: MARD 2014.

Crops	Production 1000 tons	Export, 1000 tons	% Export
Milled Rice	28,649	6,653	23.2
Coffee	1,322	1,308	98.9
Rubber	935	1,090	116.6
Tea	187	142	75.9
Cashew	285	264	92.6
Pepper	123	134	108.9
Cassava	9,740	3,142	32.2

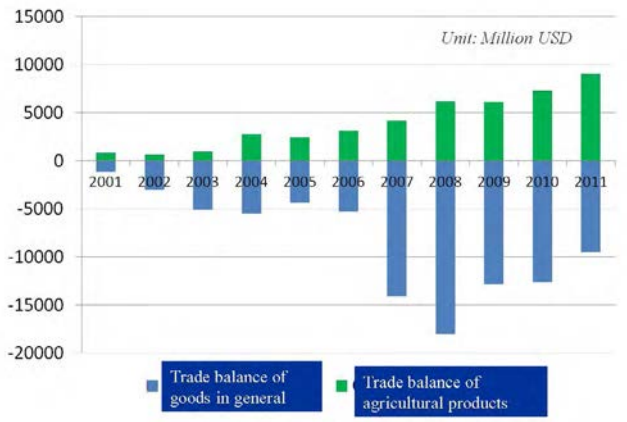


Figure 2. Vietnam's estimated trade balance, 2001–2011, in million US$. Goods in general = blue, below 0. Agricultural products = green, above 0. Source: Institute of Policy & Strategy for Agriculture & Rural Development (IPSARD) 2013, based on data from the General Statistics Office of Vietnam (GSO) and MARD.

Our national food security indicators have improved since 1990. The proportion of the population that is undernourished has been reduced from 31% in the early 1990s down to 9% now. However, dietary energy supply has also improved very quickly, from 2090 kilocalories per person per day in 1990–92 to now around 2700 kilocalories per person per day, which is too high for good health. In Vietnam 70% of people's calories come from rice, and a big number of people are overweight. In other countries, especially developed ones, the percentage of energy (calories) derived from carbohydrate should be less than 40–50%; that would be a good balance.

Success in agriculture

What defines success in agriculture? We think the most important indicator of success for Vietnam is its change from net food importer to top exporter of many commodities – rice, coffee, rubber, pepper, cashew nuts, tea, cassava (Table 1) and also catfish, shrimps and wooden products.

Of the many possible reasons for this success we consider three to be key. The first is policy renovation. In Vietnam, land is allocated to a farmer and the farmer's household as a key production unit. This system has functioned very well for the last 25–30 years, though now it is becoming a limiting factor – a barrier to large-scale commodity production.

The second reason is increased investment, mainly in improving irrigation and drainage systems. Over the last 20 years in the Mekong River delta (the biggest rice bowl) we have doubled the area of paddy land – from 2 million to 4 million hectares.

The third reason is the strengthening of science and technology. We have focused strongly on crop improvement, developing new varieties and breeds.

Challenges and shortcomings

There are many challenges and shortcomings for agriculture. One major factor restricting Vietnam is the limited agricultural land. The world average is 1.2 hectares per person but our country has only 0.104 hectares per person. Having land allocated in such small areas limits large-scale production.

A second challenge is population pressure: we had 90 million people in 2013. Vietnam ranks 14th in the world in population but only 65th in natural area.

Another challenge is our quantity-oriented production. In the past we have worked hard to overcome the food deficit, so most of our agricultural policy supports quantitative production. Table 2 shows some key crops for which production has increased very fast over the last 25 years. Rice production has nearly tripled, corn production has increased by close to ten times and coffee and rubber by more than ten times. Most crops have increased in productivity. There was a rush towards intensification, and a lot of fertilisers were applied to improve productivity. At the same time we had to use a lot of pesticide.

Fourthly, we have food security at national level but not at household level. Even though Vietnam exports rice we still have a large population of undernourished people. There is some interesting research on the food security indexes of ASEAN countries. Table 3 shows that countries importing grain and not producing any rice, such as Singapore, Brunei and Malaysia, have very high food security indexes. Rice producing countries such as Thailand and Vietnam are

Table 2. Quantitative production in Vietnam, 1986–2012. (US Dept of Agriculture Statistics)

Crops	Area increased by	Prod. increased by
Rice	1.35 times	2.73 times
Corn	2.8	8.4
Coffee	8.7	12.7
Rubber	2.5	17.0
Tea	2.0	6.8
Cassava	1.7	3.4
Sugarcane	1.6	3.8

Table 3. ASEAN security index scores (1–5). Source: Silberglitt (2013).

Country	Food	Water	Energy
Singapore	4.0	3.4	4.5
Brunei	3.5	3.0	4.0
Malaysia	3.2	3.4	4.0
Thailand	3.0	2.2	4.0
Vietnam	2.4	1.8	1.5
Indonesia	2.3	2.6	2.5
Phillipines	2.3	2.2	1.5
Myanmar	2.0	2.2	3.0
Laos	1.8	2.6	2.0
Cambodia	1.6	1.6	3.0

exporting grain but in a poor situation in terms of food security because many people still do not have access to food. This shows that food security does not depend on quantity of food produced but instead on food accessibility.

Fifth, the reductions in export prices in recent years are a problem. Most of our products are for export and their success depends on international markets; fluctuations in international prices have negative impacts on our agriculture (see Tables 4a,b). High post-harvest losses and high production costs are also big challenges.

Sixth, we have relatively low investment in agriculture. Even though agriculture provides 22% of national GDP, the total investment in this sector is reducing. It is now less than 6%.

The last challenge in this list is climate-change impact. According to the World Bank, Vietnam is among the five countries most likely to be affected by climate change, and we have the worst scenario in relation to sea level rise (Figure 3). Vietnam ranks 2nd in the world in terms of land area that could have impacts from flooding, and 1st in the world in terms of the proportion of our population likely to be affected by flooding because of sea level rise.

Restructuring

How should restructuring of agriculture be directed so as to meet future food security needs? Common goals are:

- every decade ensuring that production grows by 20% to ensure food security at household and national levels, gradually shifting from food security to nutrition security;
- poverty is reduced by 20%; and
- greenhouse gas emissions are reduced by 20%.

Table 4. (a) Declines in export prices for rice, rubber and coffee between 2011 and 2013 (from MARD reports 2014) contribute to (b) the falling growth of agricultural GDP since 1995 (data from GSO and MARD).

(a)

	2011	2012	2013
Rice	514	461 (- 10.3% vs 2011)	410 (- 11.1% vs 2012)
Rubber	3,954	2,792 (- 29.4% vs 2011)	2,356 (- 15.6% vs 2012)
Coffee	2,047	2,122 (+ 3.7% vs 2011)	1,500 (- 29.3% vs 2012)

(b)

Periods	%
1995-2000	4.01
2001-2005	3.83
2006-2010	3.30
2013	2.80

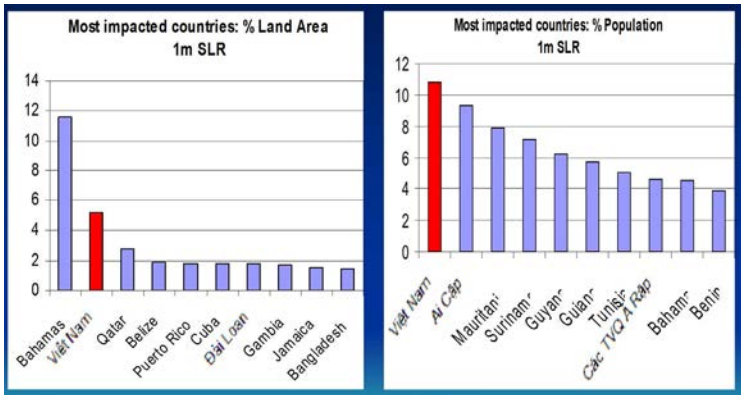


Figure 3. Likely impacts of climate change and 1-metre sea level rise in Vietnam (red bar) and other countries, according to the World Bank.

A higher profit from farming and higher income for farmers should be among the top priorities, shifting from an export-driven to a farmer-income-driven approach because we tend to forget about farmers' incomes. Harmonising agriculture–industry rural–urban development also needs attention.

To achieve these goals, Vietnam can adopt several strategies. First, sector restructuring with emphasis on high-value-added products and deep processing. It is not fair that one cup of coffee in a five-star hotel costs the same as about 2 kilograms of coffee beans – which can produce 140 cups of coffee. This return does not come to the coffee growers unless we do the deep processing with appropriate technology, and have our own brand names. Most of our coffee is commercialised under international brand names. So, instead of exports being worth US$3 billion we could have exports worth up to US$50 billion or US$60 billion if we invest more in processing.

Other effective strategies would include a focus on science and technology, narrowing the gaps between achieved yields and potential yields (e.g. Figure 4), reducing post-harvest losses, and improving infrastructure. Enterprise-oriented development, instead of small-scale household-oriented development, can improve the effectiveness of agricultural production, through investment, land accumulation, contract farming, marketing, and international integration.

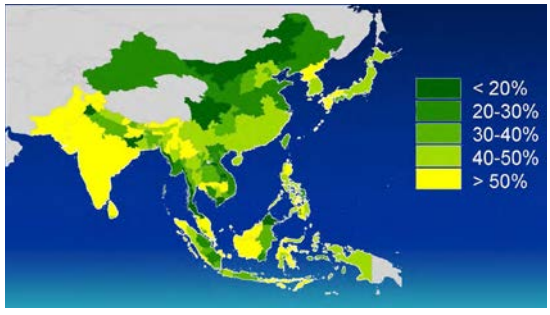


Figure 4. Rice yield-gaps in Asia. Map by A. Nelson, IRRI. Source: Dobermann (2012).

Research contributes to greater productivity. Assessment of ACIAR's returns on investment[1] found that 130 ACIAR-funded projects returned a benefit–cost ratio of approximately 84 : 1 in 2010 and 2011. That means, every dollar spent on research delivered $84 in return, a very impressive figure. In China, science and technology's contribution to agricultural development was 51% in 2009, through improvements in fertilisers, varieties, plant protection and mechanisation.

Finally, analysis by CCAFS, the Research Program on Climate Change, Agriculture and Food Security, of which I am a member, has defined a safe space for food security (Figure 5). We can enlarge it by minimising the negative impact of climate change, by changing the pattern of the food consumption, including reducing food waste, and by maximising climate-smart production of food.

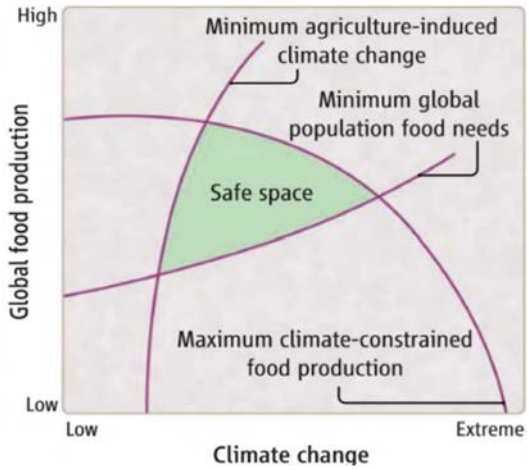


Figure 5. Result of analysis of global food production when constrained by climate change (CCAFS 2011).

Summary

To summarise, agriculture should be considered as a socio-economic sector, not purely as an economic one, because agriculture ensures not only food security, improving farmers' income, but also sustains social and in some cases political sustainability. Thus, higher investment in agriculture will bring worthy rewards.

We should shift from quantitative production to qualitative, from food security to nutrient security and farmer-income-oriented policy.

We need to pay as much attention to agricultural and rural sectors as to urban and other sectors, because otherwise the rural and agricultural sectors are overlooked.

We need to seek higher investment and expertise from the private sector, especially from international research and development organisations in developed countries, such as ACIAR and CGIAR's Centers. Along with the

[1] as reported at <http://aciar.gov.au/content/returns-aciar-investment>

policy and technical measures already mentioned, capacity building is vital; for example through training young agricultural scientists. In developing countries most agricultural scientists come from farming families, but fewer and fewer young people want to work in agriculture and that is an unfortunate trend.

We also need stronger voices in some sensitive issues such as cross-border use of natural resources, environment pollution, food safety, genetically modified crops, and unfair trade.

References

CCAFS (2011). Achieving food security in the face of climate change: Summary for policy makers from the Commission on Sustainable Agriculture and Climate Change. <http://ccafs.cgiar.org/publications/achieving-food-security-face-climate-change-summary-policy-makers-commission#.VLINqSvF-P8>

Dobermann A. (2012). Future directions in rice breeding. Trends in Rice Research to Overcome Stresses in a Context of Climate Change. Hanoi, 6 September 2012. <http://atin-vietnam.com/Library/Download/Dobermann%20future%20directions%20rice%20breeding.pdf>

Silberglitt R. (2013). The ASEAN energy–food–water nexus. Symposium on Integrated Foresight for Sustainable Economic Development and Eco-Resilience in ASEAN Countries. Thailand, 1–2 October 2013. Via <www.apecforesight.org/index.php?>

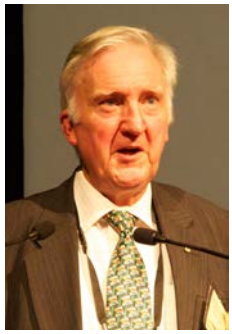
Dr Nguyen Van Bo is President of the Vietnam Academy of Agricultural Science (VAAS) and a member of the Policy Advisory Council of ACIAR (Australian Centre for International Agricultural Research). He began his career in 1978 as a soil and plant nutrition scientist and subsequently worked in soil fertility, fertiliser efficiency, farming systems, land use policy and environmental monitoring. His current work focuses on food security, biofuels and climate change mitigation and adaptation. Dr Bo worked as Director General of the National Institute for Soils and Fertilizers (1994–1999) and Director General of the Department of Science and Technology and Environment, Ministry of Agriculture and Rural Development (1999–2005) before becoming President of VAAS in 2006. Dr Bo holds a PhD in Biology from the Moscow State University, Russia, and was awarded the Crawford Fund Medal in 2011 in recognition of his contributions to international agricultural research.

Email: nguyenvanbo2@gmail.com

Ambassador Allaster Cox presenting the Crawford Fund Medal to Dr Nguyen Van Bo in March 2011.

Conference synthesis and summary

Dr Denis Blight AO
The Crawford Fund



The Crawford Fund 2014 Parliamentary Conference on global food security asked how the world might be fed, well, in an efficient and ethical way, with a growing population demanding more nutritious food, in the face of a declining resource base, slowing productivity growth in the main food crops, and neglect of many traditional foods and indigenous vegetables.

Conference discussions highlighted:

- the pivotal role of women: inequitable treatment of women is both unethical and inefficient;
- the importance of nutritional security: more than 2 billion people suffer from micronutrient deficiencies, yet the incidence of overweight and obesity has doubled in the last decade;
- intertwining of the issues of population, development and food security; the sure prospect of a global population of 9.6 billion by 2050 if fertility rates continue to decline, or 10.9 billion or higher if they do not, and that a population increase of 30% will double the world's food needs;
- that a balance is needed between national self-sufficiency – still a deeply held policy conviction for some countries – and global self-sufficiency which emphasises the importance of free trade;
- trade and investment as key in global development, and the legitimate role of 'aid for trade' in encouraging a more open global trading system;
- the re-emergence of agriculture as a key tenant of a broader Australian aid strategy and the priorities of other international aid programs.

Policy change, research and training should be at the centre of responses in each of these areas. Australian Foreign Minister Julie Bishop, in formally opening the conference, confirmed that Australia is prepared to play its role with renewed priority for agriculture in its aid program, support for an open trade and investment environment (reflected in an emphasis on 'aid for trade' and 'economic diplomacy'), and continued support for the high impact research investments of ACIAR and the CGIAR.

John Kerin[1] and Tim Fischer[2] when in government had confirmed a bipartisan base for the view that Australia cannot be research isolationists and should not ignore the vast store of knowledge held globally. It is in Australia's interests to be a good neighbour, supporting research for the global public good and for the well-being of the human race, which depends on agriculture for stable civil societies. Echoing support for the priority of international investment in

agricultural research, Rachel Kyte noted that the CGIAR milestone of doubling funding to US$1 billion had been achieved, and she announced another target to double funding again by 2020.

Women and girls: 'Don't forget the ladies'

No one should have left this conference with any doubt about the pivotal role of women in agriculture, especially after the Sir John Crawford Memorial Lecture delivered on the eve of the conference by Professor Catherine Bertini. Women are at the core of the workforce even if, as conveyed in one dramatic image in her presentation, they are carrying children on their backs and therefore need short-handled hoes so they can crouch to weed the fields. In Profesor Bertini's presentation, and those of others, it was argued that:

- feeding a growing population is impossible without significant education and training of women and girls;
- inequitable treatment of women is economically inefficient;
- empowered and educated women will have lower fertility rates;
- women's groups and community organisations can create awareness of the need for training in schools;
- health clinics should target women's reproductive health concerns; and
- policy makers should be made accountable for gender equity.

Women's rights are a crucial component of fertility decline. Whilst a solution might lie in bringing fertility rates down in food-insecure countries, the concept of universality – that is, thinking in terms of global responsibilities – is important. In this view, rather than setting development goals in terms of education, fertility rates and so on for the developing countries only, as was the case in the first set of Millennium Development Goals, we should now be trying to negotiate *universal* goals for *all* countries.

Women are not valued in some societies, being placed below men and children in the priority list, such as at meal times. Women are under-represented in the corridors of power and in senior levels of the CGIAR.

Inequitable treatment of women is inefficient. Women make up 43% of the farm labour force yet they have smaller farm plots, poorer access to credit and other inputs, and they are more vulnerable to change. Evidence shows that given the opportunity they can be powerful contributors to productivity as well, with education improving the quality of care for their children. Rachel Kyte illustrated the potential gains if women are granted equal access to finance, land and other inputs, by drawing on an example of women farmers in Bangladesh.

---

[1] Hon John Kerin AM was (Labor) Minister responsible for Primary Industries, or Primary Industries and Energy (1983–91), and Trade & Overseas Development (1991–93), and Treasurer (1991). He is now Chair of the Crawford Fund — and one of ICRISAT's Ambassadors of Goodwill.

[2] Hon Tim Fischer AC was (National Party) Minister for Trade, and Deputy Prime Minister (1996–99).

Under a new interpretation of the term 'G20', the organisation G(IRLS)20 'brings together one young woman delegate from each G20 country plus a representative from the European Union and African Union ...[in] a year-long program and global Summit that generates ideas that are presented to G20 Leaders'.[3]

Population and food and nutrition security

Declining human fertility should mean that the human population will peak at around 9–10 billion after 2050 although the numbers are clouded by complexity, cultural variance and unreliable data. The numbers could be bigger. Much depends on whether women are empowered with the right to choose the number and spacing of childbirth or whether the pattern is left to chance. An improving trend depends, in turn, on a set of factors: most importantly the education of girls and women in sexual health and reproduction, their ability to participate happily and productively in the economy and workforce, and food security – food insecurity is at the highest levels in countries with the highest fertility rates. Cultural and religious factors can make outcomes better or worse. Education is surely the answer here, too.

The number of chronically hungry people in the world, over 800 million, is still too high. However, apart from spikes in the number during food price crises in 2008 and 2011, this absolute number has not increased since 1970, even though the human population doubled to over 7 billion in the period. As an example of the gains made, national food indicators in Vietnam are said to have improved, with the proportion of the population undernourished reducing from 31% in 1990 to 9% currently. The global population will almost certainly grow to over 8 billion by 2025. Already, every minute there are 150 more people to feed.

At the same time, malnutrition is an increasingly serious issue: more than 2 billion people suffer from micronutrient deficiencies; and overweight and obesity, which have doubled in incidence in the last decade, have serious consequences for people's health, happiness and their ability to contribute to society. An estimated 5% of global gross domestic product is lost through under-nutrition and over-nutrition. Obesity is not just a rich country problem; the number of obese or overweight people in developing countries – over 900 million – now exceeds the number of people in the developing world who are chronically hungry.

As Rachel Kyte pointed out, hunger exacts a terrible toll, with impacts compounding through stunted growth, diminished learning ability, and prospects of only relatively low earnings and productivity.

Nutritional security is often not addressed in agricultural research and development programs, although it is now a priority consideration in agencies such as the Australian Centre for International Agricultural Research (ACIAR) and the United Nations' International Food Policy Research Institute (IFPRI). Plant breeding might pay more attention to nutritional traits. Social attitudes

[3] see <www.girls20.org>

can affect consumption patterns and therefore nutritional intake. For example, as explained by Dr Norah Omot, the 'orange sweet potato' introduced into Papua New Guinea has good nutritional value but is not popular because it is 'soft' when cooked and people feel hungry again too soon after eating it; and some traditional vegetables have a low status. Poorly educated people may not be able to read nutritional information on food packaging and might be guided, or misguided, by colourful package illustrations. Changes in lifestyle may lead to more processed, and less nutritious, food consumption. As we heard in the Q&A, there is scope for practical measures such as promotion of recipes for tastier ways to prepare traditional food, to illustrate eating options through attractive pamphlets through schools, community groups and at community health clinics. Closer liaison between agriculture and health ministries, and accountability for nutritional as well as production outcomes, might help.

One questioner noted, in respect of the targeted increase of funding from US$1 billion to US$2 billion, that 90% of investment was directed at increased production. Might it not be more balanced to include investment in, for example, biosecurity? Rachel Kyte responded that the shift in the CGIAR (and CGIAR Research Programs) is to research that cuts across disciplines and systems to focus, for example, on nutrition and on landscapes. She agreed that the globe is vulnerable to continued outbreak of zoonotic diseases where more research and capability are needed.

Dr Shenggen Fan added that some $150 million had been invested over a number of years in nutrition research and food safety. IFPRI has a large concentration of nutritionists (25–30) and a number of health and food safety people. He added that cross-boundary diseases, bio-terrorism and diseases such as Ebola could shut down the movement of people, which means that food cannot move.

Traditional and modern breeding approaches also afford the opportunity for bio-fortification of foodstuffs such as has been achieved with 'Golden Rice'. Although there is debate around the impact of genetic modification (GM) on nutritional quality of grains, it remains true, according to a comment from the floor, that some 90% of corn produced in the United States is from GM crops, delivering yields of 10.6 tons per hectare. Another comment from the floor referred to studies from Argentina showing effects by Roundup® through chelating, which reportedly diminished the availability of micronutrients to crops and hence had an adverse impact on human nutrition; this speaker was asked to cite the publications to which he referred.

Food security and free trade

A change in mindset from an aspiration for national self-sufficiency in food production to global self-sufficiency is needed. As Shenggen Fan noted, we need to avoid repeating past mistakes such as large subsidies and export bans. Whilst an ambition for self-sufficiency in the main food grains is deeply embedded in the national psyche of many developing countries, there are encouraging signs of change as policy capability increases, and reliance on subsidy and trade restrictions decreases.

More efficient food production makes sense not only because of the principle of comparative advantage and free trade but also because it will result in a net lower impact on the globe's scarce natural resources – which was the focus of the Crawford Fund's 2012 Parliamentary Conference, on 'The scramble for natural resources'.

Change in policy and practice will be critical: small farmers have to 'move up or move out of farming', as Dr Fan explained: possibly moving up when there are opportunities for commercialisation or better market links, or moving out when non-farm work is available. Land title, smallholder-friendly (and women-friendly) financial services, some form of market-based price stability, and social protection such as Ethiopia's social safety net program – which meant that they were able to deal relatively effectively with food shortages in 2013–14 – are all policy options that could be explored. Lifting of export bans is good economics and 'the right thing to do.'

Presentations on the demand for food from Asia noted that demand from Korea and Japan is already high-value, and that urbanisation in China and an associated growth in incomes will lead to changes in consumption patterns and to greater demand for beef, sheep and goat meat. Fruit and vegetable consumption is already high and national production increasing, so prospects for export growth into North Asia in these food types on such a high base may be modest; India has a self-sufficiency policy in rice and wheat but the vegetarian sector of its society may be increasingly looking to dairy.

Demand for dairy and meat is on an upward trend in Asia and especially in countries such as Indonesia and China. Some countries will seek to enhance their own livestock production through pasture improvement and animal breeding but also continue to rely on imports, including of live cattle. Increasingly, consumers are demanding higher levels of food safety and food traceability, with many willing to pay a premium price for clean and green food.

Australia, as an efficient agricultural producer, has a high stake in free trade and is also in a position to contribute through its research skills and experience to global food security whether through aid or trade channels. Directly, Australia contributes to the diets of some 60 million people and through the delivery of research, technical and education services can contribute to the diets of around 400 million. It has a strong tradition of free trade and open investment policies; it has negotiated free trade agreements, most recently with Korea and Japan; and is a middle order contributor to the CGIAR. The removal of trade barriers in Korea will have a favourable impact on beef exports from Australia and similarly for cheese. Asia already dominates Australia's agricultural exports but, to place the ratios in a converse perspective, Australia delivers only 6% of the region's food imports, and the rate of growth is slower than for competitors such as Brazil and New Zealand from which Australia faces tough competition.

Nevertheless, there are measurable trade opportunities in the Asian food market, including for Australia, and the absolute size of prospective export volumes is still significant. In Australia's case, strong partnerships will be needed across the supply chain and across national borders, including strong working relationships between its private sector and supermarkets and hypermarkets in

Asia as power in the supply chain shifts to the retailers. Traceability and the use of digital media (including through the use of 'felfies' showing the human face of clean green farming in Australia) will be important, we heard.

According to presentations and the Q&A, Australia can grow its exports, particularly into Asia, as a quality niche provider albeit for a relatively small share of the higher-price and high-quality end of the market, and it faces tough competition from North America and Brazil. Whether competition comes from low cost or subsidised production – or countries with access to cheap energy – the squeeze on Australian farmers will become tighter. The biggest challenge in building farmer profitability, according to Rabobank, is that we have relatively high production costs for commodities such as wheat. As well as higher quality produce we have a significant advantage in the cost of freight for exports to our near north, but the cost base of labour and energy has been rising. Australia needs to find higher value markets because we cannot compete at the lower end against, say, the Ukraine and Russia. Also we need to shift our export focus to Asia and away from North America and the Middle East where we cannot compete.

Ironically, perhaps, the 'squeeze' on farmers (as the impact of increased input costs and downward pressure on food prices was characterised) will continue. Australian farmers are 'fed up' with hearing about wonderful opportunities in Asia while their terms of trade have been worsening. Unless farmers are seeing a return from markets prepared to pay the price for our goods, they are not going to have the incentive to invest in the production of high quality foodstuffs. One questioner said that the appreciation of Australian currency has increased costs significantly and that the Dutch had solved their problem, in part, through investment in R&D.

Competition for resources: Feed for livestock and energy

Competition for resources was also illustrated at the conference through case studies of food for people, feed for animals and feedstocks for energy. For every one kilogram of meat consumed, demand for feed grows by 10 kilograms, intensifying pressure on crop and forestry lands and adding to greenhouse gas emissions.

It was suggested that some 40% of American corn is converted into biofuels. Does it make sense for countries in Asia to devote arable land to animal production and to biomass for energy generation from biofuels? Would it not be better to focus on food-crop production, including through intensified systems? Reforms appear to be tending in this direction, while it is hoped that research and development will enable utilisation of poorer land to deliver multiple purpose crops such as sweet sorghum, with by-products providing for energy and animal feed.

Competition for resources: Food waste – making the invisible visible

Wasted food in 'our broken food system' is wasted energy and lost natural resources. Food is lost and wasted to varying degrees in the developed and developing countries: in North America and Europe, 95–115 kilograms of food

per person annually compared to 6–11 kilograms per capita in Africa, South and South East Asia. In Australia, average household waste, often discarded to landfill, is estimated at $1000 per household per year.

Losses in developing countries are mostly due to pests and diseases and infrastructure weaknesses in the supply chain. In Africa, losses reach 10–20% prior to processing. Training in seed storage, better post-harvest facilities, the raising of village gardens, and diversity in plantings can help. If that loss was eliminated and waste avoided, 48 million people could be fed.

There is a need through public awareness to 'make situations visible that have often been invisible', recalling the fair trade movement and the overall impact of scarce natural resources, and even greenhouse gases. Oxfam urges simple steps to reduce food waste: eat a little less, and watch your waste. Ethical behaviour may be a powerful factor in encouraging change amongst Australian households.

Dealing with climate change

Rachel Kyte characterised climate change as a 'threat intensifier' and said we will soon be living in a 2°C degree warmer world with consequential drops in yield. In a 4°C degree warmer world it would be even worse.

Agriculture and land use patterns must change from being part of the problem to being part of the solution through an integrated holistic approach to climate change adaptation and mitigation. We must produce more food with fewer resources: in the case of rice, 65% of which is grown in Asia where currently one hectare provides enough rice for 27 people, by 2050 that hectare will need to feed 43. This holistic approach must include increasing resilience of farmers, and reducing greenhouse gas emissions for each kilogram of food produced.

Climate smart agriculture offers a 'triple win', through increased productivity, improved resilience and greater climate change mitigation. Examples of progress or potential breakthroughs include: intercropping of bananas and coffee – taller shading banana plants can lower air temperatures for coffee trees; converting a C3 metabolic pathway to a C4 pathway (first discovered in Australia) for faster photosynthesis converting carbon dioxide and water to plant growth; and new rice varieties that increase yield but reduce water and fertiliser use.

In the Q&A session, a fibre and grain producer from southern Queensland, recalling that cost of production is a major issue and agreeing that climate smart agriculture was 'a noble initiative', asked whether it can it be done in a sustainable way.

A questioner from the University of Queensland and WorldFish agreed that nutrition is gaining traction amongst research priorities, but doubted impact at the grass-roots and program roll-out levels. There are successes in homestead gardens promoted by Helen Keller International working with women to create home gardens to produce vegetables: in Bangladesh 3.5 million people had been helped to produce vegetable gardens where women are well fed and generate incomes. The question was, however, how can we can scale up? Perhaps by making ministers responsible for nutrition.

Governance

Responding to a question on global governance, Shenggen Fan noted that the current global governance system was set up in the 1940s or 1950s. Now the world has changed and the G20 countries therefore need to ensure that voices of the emerging economies and the private sector can be heard, to drive and lead on improved trade policies, better sharing of research and information on production, and more effective investment (where emerging economies have invested most). Governments need to facilitate this, with the right policies across aid and other portfolios.

One reason for some optimism is that there is so much more awareness now of the broader issues and inter-relationship.

The answer also involves young people and the conference acknowledged with applause the presence of some 50 people under the age of 35 at the conference.

Urban agriculture

Participants showed some interest in talk about urban agriculture: Rachel Kyte responded that it is understood that urban issues will become a bigger part of the puzzle. Currently many policy makers work in separate 'silos' of urban and rural divisions. She felt that we will see a lot of work and redefinition of urban and rural landscapes.

While intensifying food production is part of the food production/resource scarcity equation globally, Luke Chandler suggested that the trend is moving the other way in Australia because, due to the fad of superfoods, intensive protein sectors are pushing away from intensive production.

The way ahead for the Crawford Fund

The Fund will be using the key messages around these issues from the conference to inform its policy, public awareness and training activities. Its 2015 conference will, for example, focus on the role of the private sector in natural resource management, sustainability and profitability.

Dr Denis Blight AO, the Chief Executive of the Crawford Fund, has had a career including positions as an Australian diplomat, public servant and chief executive. His association with international agricultural research began in earnest some 25 years ago. Prior to working for the Crawford Fund, he was Director-General of CAB International, an intergovernmental body in research, training and publishing in the life sciences, and had 15 years with IDP Education Australia, the international development program of Australian universities and colleges, including the position of Chief Executive.

Email: denis.blight@crawfordfund.org

Q&A: morning session

Panel: Rachel Kyte, Luke Chandler, Dr Shenggen Fan, Dr Willie Dar, Dr Laurent Zessler, Yudi Guntara Noor

Facilitator: Dr Jim Woodhill

Principal Sector Specialist, Food Security & Rural Development, DFAT

Facilitator *(Jim Woodlhill)*: Our morning speakers have given an extremely insightful and challenging set of presentations, highlighting the diversity of issues and the complexity of those issues that need to be considered in tackling food and nutrition security. Looking across all the presentations so far, some radical changes are going to have to happen if, using Rachel Kyte's words, we are going to fix a broken food system. These changes are going to have to happen very quickly, at a large scale.
How do we get the political and business leadership to drive that sort of change?

A. *(Rachel Kyte)*: I think a number of countries are already in the middle of decisions that need to be taken now, that will not lock them into the wrong pathway going forward. I was in Vietnam in recent days, where huge decisions about the management of the Mekong Delta need to be made, in terms of future livelihoods, the future stability of that part of the country, and the economic viability of food production systems which are important to the economy. Some of the units of account for decision-making are local, regional and national and then, of course, there is a unit of account for all of the countries of the Mekong. The question is whether the international community can keep a focus on the long-term objectives, and I think it is also important for the international community to be able to break down the 'silos'. There is extraordinary work going on in agriculture; there is extraordinary work going on in nutrition; there is extraordinary work going on in livelihood development and economic development. Are we, as the international community, reinforcing the silos that exist at a national level or are we able to help them to be broken down? Also, we should listen to 'the client': in our case, the need for revolutionary changes in the way that agriculture delivers stability. The voices are coming from African heads of state, from South Asian and Asian heads of state. The developed world has a duty of care to listen to what people are asking for.

A. *(Luke Chandler)*: From an Australian agricultural point of view, I think it is very important that government gets involved in facilitating new trade flows and new partnerships between Australia and our Asian neighbours as we shift our exports more into that part of the world. The supply chains are critical, as was discussed earlier. We need strong government-to-government relationships there, and strong business-to-business relationships. Many of those are still in

---

This record of the Q&A sessions is derived from a transcript of the discussions and may contain inaccuracies.

the development stage, and there have been examples where those relationships have broken down, trade flows have suffered, industries have suffered, and profitability and even livelihoods suffer. The current government has taken some great steps in terms of market access over recent months. This time last year we had no free trade agreements in place with any of the six nations that are Australia's six major agricultural trade destinations – which represent around 60% of our exports. Now we have two and we are working on a trade agreement with China as well. The more we can do to break down those barriers and facilitate trade into our Asian neighbours the better.

A. *(Shenggen Fan)*: Two points. First, we need evidence; facts on what has worked, what has not worked. Second, we need to communicate to general citizens, so the general citizens will push the political process to make the right decisions and the right commitments. Some countries have become more democratic than before, responding to citizens' demands. How can we communicate? What can we discuss with our citizens, everybody, political constituents, to push that political process?

Facilitator *(Jim Woodhill)*: Your message is that we need to be preaching beyond the converted in this room.

A. *(Willie Dar)*: Related to biofuels development, our experience is that you need governments' interventions in terms of the right policy environment, the right taxes that have to be paid so that you can promote biofuels development strongly, and you need also to harmonise existing policies that are contradictory to each other. We cannot succeed in a big way without policy support initiated and institutionalised in governments, and incentives that can be offered to those engaged in biofuels development.

Facilitator *(Jim Woodhill)*: You are saying that harmonisation of policy across different governments is a really critical issue. Now to questions from the floor.

Q. (*Jenny Goldie, National President of Sustainable Population Australia)*: My question is directed to Rachel Kyte who is admirable for her recognition of the way in which climate change is going to affect agriculture. I am concerned that there does not seem to be a sense of urgency about the problems of population growth. Everyone mentions it, but clearly it is going to be better if we have fewer people rather than more people in 2050 and 2100. Is the World Bank looking at development projects, population health environment projects – PHE – which combine family planning with development projects of coastal management, and that sort of thing?

A. *(Rachel Kyte)*: It was at the Cairo conference 20 years ago that there was one of those very rare paradigm shifts in world understanding: that it is the status of women – not just that a woman graduates from her elementary school or primary school education, but that for every year of secondary education you start to get economic benefits. That empowerment, those economic benefits, that voice, these lead to lower fertility levels. On its own that will not help … will not solve everything. Violence against women, which of course is a huge issue in the Pacific, affects the outcome from all of that investment. Yes, we

are fully involved in that economic development that results in women being able to make choices about what happens to their own bodies, and that results, with everything else, in reduced fertility levels. In 20 years the world has made huge progress. The problem is that there are a few places in the world where the population rates and the fertility rates are still extraordinarily high. The momentum that is building up there, together with the greying of the global population and the very young populations in urban settings, is going to create pockets of potential instability if not managed very well.

Is the solution fewer people? I think the solution, in some places, is to really bring fertility levels down and that is done through investing in women and economic development and the things that we all know that work. The solution is also to look at how the people on the planet actually live. One of the big issues for the development goals that are being negotiated currently is this concept of universality. When we negotiated the last development goals, the last goal, Goal 8, was for all of us that live in the developed world – and that is the goal where we really fell down. We were supposed to act in solidarity with those who had to achieve Goals 1–7. This time when negotiating development goals we are trying to negotiate universal goals. It is not enough for a developed country to say, 'OK, you over there in the developing world, fix your agriculture systems, etc., etc.'. It is how are we living, how are we eating, how are we wasting, and the footprint of everybody we put onto the planet. This concept of universality has to be embraced.

We have seen fertility levels come down. We have seen progress in some places. In other places it has not gone quite fast enough. Do I think there's enough gender-focused development going on? Do I think that we have solved the issue of the empowerment of women, 20 years after Cairo? Not at all. We have a lot to do and it is an intractable problem, but we can see what has worked in some places in the world.

A. *(Laurent Zessler)*: I would like to re-emphasise those points. For many years after the Cairo conference we were looking at how to reduce fertility. We have made progress in some countries and failed in other countries. Before my posting in the Pacific I was posted in Afghanistan where on average a woman has six children. What has progressed, and what has been a key factor for us, is when we talk about rights: women's access to contraceptives is a right. It is as much a right as is proper education, proper healthcare and so on. It is a right. When we empower women and make them understand that this is their right and they have this right to control when they want to be pregnant and what type of family they want to have, then we have some success. We need to continue to invest in these matters; into access to family planning. I would like to re-emphasise that the population will decrease and stabilise if we have this right fulfilled in many countries, and many governments addressing it. I think that Australia, as an important international player, has a very important role to play as an advocate on these issues by intervening on the global scene and also at country level on these aspects. I think countries are receptive, but we would like some countries to react more strongly and invest more in their own family planning methods and their own infrastructure related to that.

Q. *(Shashi Sharma, from Murdoch University)*: My question is to Rachel Kyte. You mentioned the billion dollar investment in CGIAR research for food. In a report I read recently, 90% of international investment in research goes into producing more food, whereas there is significant merit in investing in not losing what we grow and produce. Is the CGIAR looking at investing in those areas? A related question is about globalisation and its importance for production. With globalisation there are many benefits, but at the same time we are disseminating pests and diseases across the world, and the majority of the developing countries do not have very biosecure systems to safeguard their production regions and their food value chains. Are there going to be risks to the investment, with this situation?

A. *(Rachel Kyte)*: I will answer very briefly because there are two Director Generals of CG Centres on this panel with me. The CGIAR has been increasingly moving to fund research programs that cut across the traditional crop-by-crop research: research on nutrition, research on climate change, for example. They are taking the deep understanding of the dimensions of different crops and trying to bring that together, focusing on landscape approaches, for example. I think there needs to be much more progress, but I think we have shifted direction in the last few years. On your second point, following disease outbreaks a few years ago there was an injection of funds into zoonotic diseases and the relationships between public health and the agricultural sector, including at the global coordination level. I still remain quite concerned that that is a weak point, and that for many countries, even though there was investment in their bio-safety protocols and the way in which they dealt with this issue at the national level, I think we are vulnerable, as a global community, to continued outbreaks of zoonotic diseases. It is of concern to us, both from a health perspective and also from an agricultural perspective.

A. *(Willie Dar)*: One billion dollars – is that enough? It is not enough. We need more. There are big issues before us, global contemporary issues: climate change, nutrition, land degradation, desertification, loss of biodiversity, ... As Rachel said, the CGIAR research programs today are strengthening the synergies between and among the 15 Centres. I believe that is very significant progress, although we can further improve this relationship and work together more.

A. *(Shenggen Fan)*: I want to bring in the IFPRI perspective here. We have about US$158 million investment in policy and nutrition research. A very small share of that amount is related to technology to expand production. We have really changed the priorities to also include nutrition and food safety. IFPRI has the largest concentration of nutritionists of all the CGIAR Centres; probably a sizable number compared to any university. We have about 25 to 30 nutritionists and also a couple of health specialists. We pay serious attention to nutrition. From my rough calculation, probably 25–30% of our spending is related to nutrition and food safety. We are leading one of the largest CGIAR research programs called 'Agriculture for Nutrition and Health': this is big shift. Another program is about poverty issues, to make sure that poor people will have access to food through their income, through markets, with globalisation, and how globalisation affects everybody in the world. I think there is no doubt

we have benefited from globalisation, but there are some challenges: for example, cross-boundary diseases, and bio-terrorism. All this will affect our global food system, and that is the area we need to work on. So we treat the global food system as one integrated system. We look at where it is weakest and lowest, and we aim to address these low and weak points, because I am afraid if we do not address these then something may happen which will really lead to the collapse of the global food system, and trade will not work. The Ebola in Sierra Leone, in Guinea, is shutting down the regional movements of people, which means that food cannot move around. If that situation is not solved we will see malnourishment problems in these regions probably in the next two or three months.

Q. *(Risti Permani, Research Fellow and Lecturer in Global Food Studies at the University of Adelaide)*: Dr Shenggen Fan mentioned governance. Global governance in particular is a topic that we have not discussed much. We know the issues, we might have the solutions, we have the science and the facts, but how do we deliver those? I think that is one of the biggest challenges. When we talk about poverty, we have Millennium Development Goals (MDGs) ensuring that all countries have the same goals which we monitor over time and then we evaluate. But when we talk about food security… when I attended a regional dialogue last year that was parallel to the APEC[1] meetings in Indonesia, we invited countries in the Asia–Pacific to submit a country report about how they actually defined food security. All of them use a self-sufficiency ratio as the indicator. We all agree food security is not only about availability but is also about access and nutrition and equality. But when we talk to governments, it is always self-sufficiency that concerns them. Therefore my question, to the people in this conference who have decision-making potential, is: Do we actually have a plan? Is there any progress in terms of redefining this global governance of food security? Is it part of the post-2015 agenda, because 2015 is only a few months away? Is it going to be discussed soon? I am a bit worried.

A. *(Shenggen Fan)*: I can offer some of my perspectives. I think the current global governance system related to food and agriculture was set up in, probably, the late '40s or early '50s, but now the world has changed. The private sector, the charity organisations and the emerging economies, G20 countries, all these account for the largest shares of global food production, global food consumption. We need to hear the voices of the emerging economies – India, China, Brazil – and the private sector, on the global governance structure. That is critical. I think the G20 can play a very important role with Australia leading the G20 this year. All G20 countries account for probably 80% or even more of the world's food consumption and production. How can we use G20 as a mechanism to ensure that the member countries work together; for example, in terms of trade issues, food export, prices, sharing information on stocks, on production, prices, investment in R&D? Look at the investment picture. It is the emerging economies who have increased their R&D investment substantially, and with a new world order coming we need to be more open, more inclusive to this. Global governance is on the post-2015 agenda. I am worried that the

[1] Asia–Pacific Economic Co-operation

current process has been dominated by the UN agencies. Particularly, we need food and nutrition goals. I really hope that emerging countries can drive, lead and own the post-2015 agenda. Unless they own, drive, lead the agenda, we will not achieve an end to hunger and malnutrition by 2025 or 2030.

A. *(Yudi Guntara Noor)*: I think when the world becomes global, there is no war between countries. I agree that probably at the moment it is government that is the dominant sector. I think the private sector will begin playing more important roles and then governments will have to facilitate and put policies in place, so that in the end the food can flow from the producer to the consumer. I think other countries may look at Indonesia as an example after the food crisis in 2008. Much of our agenda then was about self-sufficiency, but also this can lead to protectionism. For the future I think the most important thing is to facilitate how the producer can send food to the consumer.

A. *(Laurent Zessler)*: Global governance is currently being defined by many world leaders and experts as we near post-2015. We [UNFPA] have noticed that most governments know why they succeeded on some MDGs and why they failed on others. They have made their report. They know what parts of the structure are wrong. Basically what emerges is that if countries cannot rely on their own governments, then many countries will have to rely on the private sector, on the NGO community, because they are the counter power that can bring about change. We see also that there is more and more emphasis on greater accountability and also greater accountability for foreign aid, which is now being reviewed and carefully monitored. Being optimistic, I think there is much more awareness about how issues such as food security, population growth and even security should be addressed. But we still have challenges. We hope for the participation of young persons, youth. We are now trying to define goals related to youth participation and youth involvement because this is where they have the power to say something and to be involved in the decision-making process.

A. *(Willie Dar)*: [At ICRISAT] we anchor our research for development activities on overarching development goals. I believe you in your observation that most Ministers of Agriculture in developing countries would only equate food security to self-sufficiency. In our research for development there are five overarching goals, development goals. One is food sufficiency; the second is economic income security; the third is nutrition security; the fourth is environment sustainability and resilience; and the fifth is women and youth empowerment. Those are the five development goals that we research.

A. *(Luke Chandler)*: A quick comment, in the context of the G20 which was mentioned. Rabobank is holding a conference in the week leading up to the G20, called the F20 Summit (F for food), for around 500 of our farmer clients from around the world. We shall get some of these issues on the table for the G20, and particularly look at issues challenging farmers around the world, such as succession and sustainability and similar issues.

Q. *(Tara Mackenzie, a Crawford Fund scholar from University of the Sunshine Coast)*: I have a question for Luke Chandler. Talking about the Australian farmers becoming increasingly disempowered, what do you consider are the key factors in building farmer profitability and resilience?

A. *(Luke Chandler)*: The biggest challenge that farmers in Australia have at the moment, if you look over the last five or ten years, is that increasingly we have become less competitive in terms of our costs of production. Australia is one of the largest wheat exporters in the world. We are now the most expensive producer of wheat of any of those major exporters onto the world market. We do produce a higher quality of wheat, but the only way that we can be really competitive into markets such as Indonesia where 25% of our exports go now is because we have a significant freight advantage over other exporters such as Ukraine or Russia or Canada or the United States. In beef the situation is similar. It costs almost four times as much to process a beast in Australia as it does in Brazil, and about twice as much as it does in the United States, so our costs are really prohibitive. Our labour costs are significantly more expensive than for other producers in the world. Electricity costs have been skyrocketing. So the biggest issue in terms of profitability is that the cost base has just been rising far more than the commodity price and, as I highlighted in my paper, terms of trade for farmers have been declining. It is a real challenge for farmers to decide how to invest, how to facilitate succession. Debt levels have been rising in Australian agriculture. To boost incomes, we need to be trying to find higher value markets where we can effectively lift the top line.

Facilitator *(Jim Woodhill)*: The main way forward is higher value markets?

A. *(Luke Chandler)*: Well, we cannot compete at the lower end of the commodity spectrum. Take wheat, for example. In places like Ukraine and Russia, even with the fighting they have there at the moment, there has not been any sort of indication that exports have slowed at all, and they can produce wheat a lot more cheaply than we can. In traditional markets for Australia, which were the Middle East, North Africa and Europe, we cannot compete any more. Our exports have shifted more towards Asia. Effectively we need to be looking at markets where we can compete and that means leveraging all of the attributes that are special to Australian agriculture – and New Zealand is in a very similar boat – using those 'clean and green' images and trying to extract premiums for the products that we are trying to sell on the world market.

Q. *(Justin Borevitz, from the Australian National University):* We have heard a lot about the production side, and also that we need to balance the poverty and health issues. But we have not talked about urban agriculture. Maybe from an Australian point of view the population is a little low, but for much of the world where the labour pool is available what does the panel collectively think about the contribution of urban agriculture in the next several decades?

A. *(Rachel Kyte)*: We understand that this is going to become an ever bigger part of the puzzle. Estimates are 10% of all agricultural productivity. So it is something that we have started to look at. I think that we might be in the situation that applied in many other development agencies in the past. That is, that the agricultural work was very rural-focused, and people working on urbanisation practices and the urban planners were in a completely different part of the building. One of the tasks on the 'to do' list at the moment is to gain much better understanding of the dynamic between pathways of urbanisation,

the already very exciting moves towards urban agriculture which are happening in Latin America, North America, Europe and elsewhere, and how to support that as a viable part of the whole food system and also as a viable part of urban livelihoods. Where I think you will see a lot of information coming from us in the next few years is in redefinition of the relationship between rural productive landscapes and cities, and where those lines fall, because that is a vastly changing – and fast changing – point of landscape development.

A. *(Luke Chandler)*: In terms of how urban agriculture might affect Australia, I think, interestingly, we are seeing that trend move the other way. I do not see urban agriculture playing a major role here. In fact we are seeing pressures on intensive protein sectors, say poultry and pork, where the shift is away from intensive agriculture and more towards free range. Consumer demands are playing a large part. Australia has a whole fad around superfoods and these kinds of things, and pasture-fed proteins is a part of that. It is one of the attributes of Australian agriculture. So I think urban agriculture is probably not going to have as big an impact here as it might in other parts of the world where population is much more heavily concentrated.

Q. *(Jessica Bogard, a Crawford Fund Scholar from the University of Queensland and WorldFish, one of the CG Centres)*: The importance of nutrition as a driver and as an output of agricultural systems is clearly gaining a lot of traction at a higher level. But my experience on the ground, or more at a grass-roots level, is that it is really hard to break through the culture of productivity and income generation as the sole way to alleviate poverty and food insecurity. What can we do at that 'program rollout' level to emphasise the importance of nutrition, to get some truly collaborative nutrition and agricultural programs?

A. *(Shenggen Fan)*: There are some successes in using the home garden or homestead food production, promoted by Helen Keller International. That program was implemented in Bangladesh, and now in West Africa. The home garden idea is to work with the women, particularly housewives, to create a garden to produce vegetables and fruit and to educate women about the nutritional values of different vegetables. As a result of that program, something like 3.5 million poor people, hungry people, have been helped through vegetable gardens, and the majority of them are women. Children are better fed, and the women also control more income and more employment. The question is how can we expand these sorts of initiatives – not just producing more rice, rice self-sufficiency? As I said, can we make the Ministers of Agriculture accountable for nutrition outcomes instead of rice self-sufficiency?

Facilitator *(Jim Woodhill)*: Your main solution there, Shenggen, is to make ministers accountable for nutrition targets?

A. *(Shenggen Fan)*: Let's do that!

A. *(Willie Dar)*: Let me add to this. For 40 or 50 years, the policy has been to support the big cereals, and I have no problem with that. Now we need to correct that policy distortion and bring in a higher level of support for a balanced-diet framework. It is as simple as that. I would like to make it clear

that we need rice, yes, and we need wheat, we need corn. However, we also need sources of protein, vitamins, minerals, essential oils, so we need fruit and vegetables, legumes: everything is needed. We need to correct that policy distortion. Second, in relation to policies, what are governments supporting in terms of minimum support prices? Again, the big cereals: rice, wheat and corn. There is no minimum support price for the other foodstuffs that we want to promote, such as grain legumes, so again it is a policy issue that has to be corrected.

A. *(Rachel Kyte)*: Yes, I think that the fastest progress is where there is leadership at the country level. That comes either from a Minister of Agriculture who understands what the outcome indicators need to be, or it comes from interaction between a Minister of Health and a Minister of Agriculture which really works. Look at Nigeria or Rwanda or Tanzania. This year there has been a big focus on Africa because the Africans themselves – because 2014 is the 'International Year of Family Farming' – have tried very hard to get themselves organised so that they can say to the rest of the world 'This is what we need', rather than being on the receiving end of lots of policy ideas not all of which are well coordinated. You can see a Rwandan Minister of Agriculture saying 'OK, this is the support I need and these are the landscapes in which we are going to work'. And then you start to see the nutrition levels improve in the villages in that landscape because they are aiming for a balanced outcome, not just for a productivity outcome. The point is, as my colleagues have said, how do you move from this example and that example and my ability to quote eight anecdotes, to something which is systematically being rolled out? That is where these development goals become important, because they will certainly direct where the United Nations puts its money, and where organisations like ours and other regional development banks will put their money. It depends on what you are measuring. If, let us say, stunting is going to become one of the indicators that everybody will use under the new development goals, then that is a proxy for nutrition and for micronutrient nutrition as Shenggen Fan was saying in his paper. It is a proxy for sanitation because even if you are putting nutritious food inside the baby for the first 24 months, if their body is fighting disease for 24 months it is not going to grow. You manage what you measure and you succeed in what you are managing and measuring. Let us hope that the Member State-driven process which starts in a few weeks' time will allow us to come out with goals that will get us the outcomes we really want.

Q. *(Dan Etherington, from the private sector, working particularly on coconuts)*: When we are talking about nutritious products, coconut is probably one of the most nutritious elements and it has a lot to do with the South Pacific. But my question is very small, not big like a coconut. Nobody has mentioned the potential of insects – not as enemies but as food; and not necessarily 'yuk' or 'I can't eat insects', but as a by-product of other foods. We can breed insects that can feed on food that we do not understand or want. For example, from the residue from producing virgin coconut oil in the villages, we have the meal. The meal is a very good source of food for pigs, for chickens and so on, but also for insects, and those insects can feed the chickens. We get the eggs that Dr Dar has asked

for and we get the nutrition. Why no mention of insects?

A. *(Rachel Kyte)*: I like them deep fried with chocolate and chilli myself.

A. *(Laurent Zessler)*: Lots of French people eat snails, imported from Australia.

A. *(Willie Dar)*: I also eat insects, and also from the literature this is one of the potential sources of food in the future.

A. *(Yudi Guntara Noor)*: Insects are most productive for producing animal protein, so that is the challenge for the future.

Q. *(Peter Corish, a fibre and grain producer from southern Queensland)*: We heard Luke's comments earlier, which I fully agreed with, that cost of production is the major issue that Australian farmers face, and that our friends in New Zealand face the same issue; and my exposure to farmers all round the world tells me those farmers are facing this same issue. My question is to Rachel. Climate smart agriculture, I think, is a noble initiative and something that we do really have to focus on, but can it be done in an economically sustainable way?

A. *(Rachel Kyte)*: We think yes, but we are going to have to move our agricultural systems into a place where they are producing the nutritious food that we need, and they are resilient to the changes in the climate which we have already baked into the system, and they are reducing the emissions that come from the technologies we use, from the methods of farming that we use, etc. We should not be pointing our fingers at the agricultural community and saying 'You are part of the problem'. But if the energy sector of the economy is locked into an appropriately difficult and controversial debate about how to reduce their emissions, and if the transport community around the world is locked into a suitably difficult and at times controversial debate about how we are going to move people around with lower emissions, then the agricultural community had better get enjoined in this conversation in a serious way as well. Because if we make huge progress in energy and huge progress in the way we live in cities and huge progress in transport, but the way we manage the landscape still contributes 30% or 40% and therefore a greater percentage of the emissions problem, we will not have solved the problem. Do I think we can do it? Yes. That means that when the European Union (EU) sets its targets for emissions in the next few weeks, part of that has to be an understanding of what EU agriculture's contributions to those emissions will be, and then how the agricultural footprint of the EU is going to be managed along with the renewable energy targets of the EU, etc. I think it is time for us to have that debate. It is time for us to look at what the technological choices are, at scale, over large pieces of land. Choices already exist. If Brazil can reduce emissions by double digit percentages while it has increased its productivity over the last few years, we know it can be done at scale. That is a conversation that has to be had. There is a debate going on here in Australia around the agricultural part of your own carbon dialogue. That conversation is going on in other countries as well. We are going to have to find solutions for farming and forests within one landscape because otherwise we will be leaving out one big part of the problem as well as a very big part of the solution.

Facilitator *(Jim Woodhill)*: A very quick last comment, please, Shenggen.

A. *(Shenggen Fan)*: I think part of the reason why Australia's agricultural competiveness has come down is because of appreciation of your currency, which means your cost of production has increased by 40 or 50% or even more in the last 10 years. What can you do about it? You might remember 'Dutch Disease' which occurred because the discovery of oil in the North Sea drove the wages in the Netherlands very high. That really reduced the competitiveness of many industries in the Netherlands. But they got rid of the Dutch Disease by investing in science and technology to shift their industry to higher value, particularly agricultural industry. Perhaps we should rename it 'Australian Disease' in the future if you don't invest in R&D.

Facilitator *(Jim Woodhill)*: That is another call for really investing in value-added products at the high end of the market.

A. *(Shenggen Fan)*: Sure.

The Crawford Fund sponsored 26 agricultural science students to attend this 2014 annual conference as its Crawford Fund Scholars. They are photographed here with the Fund's state & territory Coordinators and the members of the Crawford Fund Board.

Q&A: afternoon session

Panel: Dr Helen Szoke, Dr Norah Omot, Dr Elizabeth Finkel, Dr Nguyen Van Bo, Dr Jammie Penm

Facilitator: Dr Jim Woodhill

Facilitator *(Jim Woodhill)*: I would like to invite you all to come up with some controversial questions, particularly related to a core theme of this conference, the ethics of food security.

Q. Thank you for a really interesting session. My question is to Dr Jammie Penm. I am from Charles Sturt University, Wagga, and from India. You were talking about the food demand and consumption traits in India and the Asian perspective. Can you reflect on the food pulses, their production and consumption traits? They may be a solution towards reducing meat consumption in the future, as an alternative.

A. *(Jammie Penm)*: You are quite right, pulses demand has been increasing very significantly in India. You probably noticed that I did not really say anything about meat demand in India. There is a very simple reason. India is the largest world exporter for buffalo meat, so it actually has significant surpluses that it can supply to Asian countries. That is the reason I keep on emphasising that the market opportunities for Australia for the rest of the world will be fruit, vegetables and dairy products. Currently, very little of any of those products is imported into India because of its self-sufficiency policies. Many countries in Asia have self-sufficiency policies, but we do not believe that, towards 2050, they can keep that policy for every single agricultural commodiy. Choices will have to be made about where they want to concentrate their so-called self-sufficiency policies. In China, we do not think that they are going to keep their self-sufficiency policy on beef, because production costs are just too high. In India, we think that the policy will be focused on rice and maybe wheat, those staple foods, because of a large population on the poverty line, so we think that vegetables, fruit and dairy products will present market opportunities.

Q. My question is addressed to Dr Nguyen Van Bo. I was wondering if you could comment on the ethics of other countries mining the Mekong River? China is putting in dams; Cambodia, Lao and Vietnam are going to be severely affected, I would imagine, in your agricultural production because of the reduction in water from upstream. As you said in your paper, in Vietnam the problems are being compounded by sea level rise, which is going to bring a lot of sea water up the Delta, which will also affect the Red River Delta as well. I am wondering if you would like to give your opinions about your upstream neighbours?

This record of the Q&A sessions is derived from a transcript of the discussions and may contain inaccuracies.

A. *(Nguyen Van Bo)*: The question is easy but the answer is very difficult, because it is very sensitive. Maybe some of our Chinese colleagues here can add some of their opinions? Vietnam ranks at the bottom of the ASEAN countries in terms of the Water Security Index [see page 96, Table 3], because 70% of the water for our country originates outside Vietnam. We have the biggest river running from China, through Thailand, Lao, Cambodia and Vietnam. We have support from many international organisations and countries, including Australia. We have the Mekong River Commission. I think we would like to invite China to be a member, because China is not a member of this group, and they are upstream. As I indicated in my paper, international organisations give us a stronger voice on sensitive issues regarding natural resources.

A. *(Helen Szoke)*: I would like to add a comment. Oxfam does a lot of work around water governance. Impacts happen downstream, and also, as you would know, when dams are put in. I visited a site where a new dam is proposed to be built in Lao on the Cambodian border. The net effect in terms of displacement of families is only 11 households, but the total effect is enormous because of the actual construction of the dam and the building of concrete walls along the river to contain the water, which means that hundreds of households that are living quite well from fishing and small-scale crops will lose their primary source of food from fishing, because they will not be able to fish off the concrete embankments. So I think I am in a position, perhaps, to be a little bit direct and to say that issues around water governance are absolutely critical for many of those communities along the Mekong. It is not just the effects of countries upstream that can grab the water ahead of time. It is within those countries as well. The issue is that many problems can potentially be exacerbated, and communities that are doing quite well can be put into a state where they are experiencing hunger and poverty as a result.

Q. *(Colin Chartres, Crawford Fund and formerly Director-General of the International Water Management Institute (IWMI))*: My question is to Jammie Penm, about the India data you showed. Data that IWMI produced, and the Indian Government agreed with a couple of years ago, showed that India is already using, basically, all of its available water resources. The Water Resources 2030 Group associated with the World Bank demonstrated they are going to have quite a deficit by 2030. I would like some clarification from you about your figures. Are all those increases in India going to be water limited, or are they assuming that there is a very big increase in productivity and efficiency of agriculture? How did you factor those issues in, in terms of water availability, because a lot of production there is irrigated?

A. *(Jammie Penm)*: You are quite right. First, let me brief you on the type of evidence we collected before this modelling, which is still ongoing. I consulted widely in India, in China and some other countries. Now, it depends on which scholar or representative you talk to. Both in China and in India, the Government officials that I talked to cited that significant investment into agriculture will improve productivities and that it will be Government policy to protect water resources and so on. I do not mean to come here and tell you that this is what will happen by 2050. The modelling is based on the productivity assumptions that India will achieve towards 2050. If we believe that Delhi

cannot achieve that kind of productivity growth then obviously imports will have to increase a lot more; and for the world, if we cannot achieve significant productivity growth for the world as a whole, then food prices will skyrocket and there will be a lot of unhappy people living in developing countries. My paper merely showed you our modelling results, and an underlying assumption is that, yes, agricultural productivity growth will slow. For the world as a whole, it has been slowing from about 3% per year to around 2% per year. It will continue to slow, in our view, towards 1% per year by 2050, but there are countries that cannot generate significant productivity growth. If those assumptions turn out to be wrong by 2050, if I am still in Canberra I will be happy for anybody to come and see me.

Facilitator *(Jim Woodhill)*: If I understand you correctly you are saying that those assumptions about dramatic increases in water use efficiency are fairly optimistic assumptions?

A. *(Jammie Penm)*: I would not say they are optimistic assumptions; let me make that very clear. There are a lot of other organisations, such as FAO and others, which are using similar types of assumptions. We complement the assumptions with sensitivity analyses because the science evidence related to some of those issues is not really clear-cut. At this stage, based on the current information, it is very difficult to say that I am right and somebody else is wrong.

Q. *(Rowan Alden, a Crawford Fund Scholar from Charles Sturt University)*: I am interested in the panel's thoughts on the ethics around biofuels, and food for consumption versus food for fuel.

A. *(Helen Szoke)*: In my paper I talked about the fact that crops have been used to produce other forms of food, and that that is problematic. It did not comment on the biofuels area particularly. My response to this question is that we have to look at the total picture and if at the end of the day we still have people who are hungry then there is a problem in diverting food products into other enterprises, and that problem is exacerbated if there are consequences of those other enterprises in terms of impact on the environment. That then takes us into the full cycle of what that means in terms of sustainability and what it means in terms of the impact on communities, and then what it means in terms of people being in hunger. I do not think grain used for biofuels can be looked at in isolation.

Q. *(John Rivers, from the Australian National University)*: This is a general question to the panel. There has been a bit of a vibe today, and it is perhaps more pronounced in the mainstream media, that self-sufficiency is a bit of a dirty word. But for a lot of developing countries, to focus on exporting crops onto the global market makes them far less food secure because they are diverting resources away from providing for the local market and into cash crops — and of course the idea of a globalised food market is predicated on the idea of seamless infrastructure that can move the food efficiently between markets. Is there room in our policy in Australia, and indeed around the world, for self-sufficiency? Is there scope for some form of self-sufficiency?

Dr Nguyen Van Bo, Dr Helen Szoke and Dr Elizabeth Finkel on the afternoon Q&A panel.

A. *(Panel member)*: For the world as a whole, we tried self-sufficiency, maybe a thousand years ago, or five hundred years ago, and it turned out to have not a very good outcome. I personally think that trade will have to be part of the solution, because if you want to achieve maximum efficiencies the best way is through trade. Food security does not necessarily mean self-sufficiency. When you want to achieve self-sufficiency, you lose economic efficiencies. A thousand years ago everybody was doing backyard production for their own consumption. It did not turn out to work very well.

A. *(Panel member)*: I would like to add to this. The lessons learned from the hundred years of agricultural commercialisation show that every economy should be based on the relative advantages of production. Every country has some advantages in some commodities. So, I think that for the world, it should be based on maximising economic profit.

A. *(Helen Szoke)*: I want to comment from the perspective of the global food market. We have done some work as part of a campaign called 'Behind the Brands', in which we researched the top 10 food producers and did a desktop policy analysis of their sourcing behaviour: asking if they pay living wages to small-scale producers and farm workers; and what policies they had in place in relation to women. What about the sustainability of their behaviour? If you go to any of the Oxfam websites and look at the 'Behind the Brands' campaign and see the web of the top 10 food producers and all the labels and all the brand names that we know so well, you can see that they have a really critical role in terms of the future in relation to people's access to food and the people who are producing food that are living in poverty. So, if there is an inevitability to having a global food system where there is less emphasis on self-sufficiency, there will also have to be checks and balances. The private sector, the multinational companies, have a really critical role to play in that, because they can lead with ethical sourcing. To the credit of some of these top 10 food producers, they have led the way in terms of sourcing cocoa from the west coast of Africa, and Coca Cola and Pepsi have adopted a zero tolerance to land grabs. All the bits

of the jigsaw have to be looked at — not just one part of it — in terms of the issues around agricultural development.

Facilitator *(Jim Woodhill)*: Helen, what is Oxfam's overall view on more open trade versus self-sufficiency?

A. *(Helen Szoke)*: I don't know that we have a view on that *per se*. Our focus is on poverty and the people who are in poverty, and the systems that keep them there. We certainly support small-scale producers having a critical role to play. We do not support the corporatisation of agriculture because of what we see as the impacts of that in displacing people. How that then elevates to national trade and international trade policies is a different area that I do not think I am equipped to comment on.

Q. *(a student from the University of Western Sydney)*: My question is for Dr Elizabeth Finkel. In your paper you said that there were organisations like Greenpeace that were against genetically modified organisms (GMOs), on almost an ideological level. What strategies would you use to try and convince people like that, that GMOs are a good idea?

A. *(Elizabeth Finkel)*: I have been looking at this issue for quite a few years now. When I would have conversations with my friends, maybe five or six years ago, they were astounded how naïve I was, because I assumed that organisations like that would operate on the basis of evidence. Somebody pointed out to me, 'No, their opinion comes first, not evidence. You know, evidence is only collected in favour of their particular stances.' I do not really understand the basis of the Greenpeace position. I am guessing that it helps to keep the rage alive, and... and GM is a great lightning rod which helps to fill their coffers. Certainly, lots of political groups around world make use of that rage. I do not really know what to say. I did confront the Australian representative at a science communicators conference in Brisbane earlier this year, where he was part of a very cosy panel. Everybody was talking about science communication and he was talking about science communication and I thought, 'No, this is wrong'. I said, 'No, no, I do not consider your institution to be at all aligned with science, because any member of this group will change their opinion based on evidence, and what will it take for Greenpeace to change their opinion, based on overwhelming evidence?' And his answer was really just to say: 'Well, we are a huge organisation'. I do not know what that meant.

Q. *(from the floor)*: We need to get an alternative response to that.

A. *(Helen Szoke)*: I will comment. Oxfam is a global organisation that campaigns. I do not know enough about Greenpeace and their particular position on GM, but I would have to say that just because an organisation is an activist organisation, it does not mean that it responds to evidence. It depends on what arguments are put together. Now, some of the arguments are around science, but in your paper you said some of the arguments are also around issues to do with corporatisation and what the other impacts of corporatisation might be, and they are the sorts of things that I have alluded to. For instance, do corporations acquire land through prime form consent? Do they appropriately resettle people in a way where they can sustain their livelihoods? Do they take into account

environmental impacts? I am not going to speak on behalf of Greenpeace, but I am speaking on behalf of a global organisation that is an activist organisation, as well as an organisation that is involved in international development, to say that often we will not come at things just on the basis of scientific evidence, because there is a range of other evidence that also comes into play, which includes issues around global corporate interests, which includes the impact on little people, small communities across the world. Now, whether that is part of the Greenpeace argument or not I do not know, but from my perspective that is certainly how we [Oxfam] operate.

A. *(Jammie Penm)*: In some countries they do not call it GM corn or GM soy bean; they call it biotech crops, to avoid this trouble.

Q. *(Scarlett Crawford, a student from the University of Sydney)*: My question is about food waste. What has been done in developed countries to reduce food waste, and what has been done specifically from a top-down approach? I feel that grass-roots movements can only go so far, because the food waste in developed countries generally stems from entrenched consumer attitudes and behaviours.

A. *(Panel member)*: I have two responses that do not answer your question directly. First, in [less] developed countries, I do not think waste comes from entrenched behaviours. I think that systems of dealing with the supply chain around food and processing food are, perhaps, not as well developed as they are in developed countries, to prevent the waste of food. Basic things, like transport, refrigeration, packaging, those sorts of things. I think waste there is partly a systemic issue. On the other hand, given the consumption patterns of the developed world, I think it is incumbent on the developed world to fundamentally change some of its practices, because that is where the wealth is, that is where we see the changing food patterns, the changing use of food, the changing acquisition of food. I think there is a job to be done there as well. Also, I think multinational companies that are actually involved in food production could help with some of that wastage, preventing some of it, and that is a much more challenging issue, I think, for them, because of issues around markets and aesthetics and changing consumption patterns.

A. *(Panel member)*: I would also like to comment on food waste. One of the things I encounter, when there are arguments for biotechnology — not by me particularly but in the literature — one of the new ripostes is, 'The world produces plenty of food. We don't need biotechnology.' I think that is an interesting statement to unpack. Of course we should reduce food waste, but most food waste does take place in countries that are not having food shortages and issues feeding their people. It is hard for me to understand how Australia reducing its food waste is going to help poor women farmers at the end of a dirt road in Africa to increase their productivity. I would like to see a bit of segregation in that popular argument.

A. *(Jammie Penm)*: I would like comment on changing this situation: how to change attitude and behaviour. The most important meal is breakfast, but most young people forget to have breakfast, and they eat very late in the night; it is not good. It is also one of the ways of wasting food. In the morning, we need

but we don't have; in afternoon and the late night, we do not need but we have food. Is there a way to change this habit?

Q. *(a private pharmacist and economist)*: One main issue for food waste in our western world is the use-by-date. I think the use-by-date is now used in a stupid way, and that we have to train consumers again about when you can eat things and when you cannot eat things, rather than going by the use-by-date. People look at that and then just throw the item away. Helen or other panel members might like to comment on that?

My main question is to Elizabeth Finkel about GMOs. We heard today about the nutritional value of food and that GM crops are grown for yield. I wonder if, in your research, you found the scientific papers from Argentina that equated a GM soya bean with an 80% reduction in micronutrients, compared with the soya bean that is not GM? A similar thing was reported in the United States, last year, with GM corn and the normal hybrids with 80%, 90% less micronutrients. Are we creating empty calories with the GM?

A. *(Elizabeth Finkel)*: I am not aware of that finding. But why should that be? Surely the quality depends on the variety of corn that you breed it into?

Statement from the floor: I can answer that one. It all goes back to Monsanto and Roundup®, and Agent Orange. When Roundup® was released, around 35 years ago, there was evidence in the field that Roundup® was breaking down in 24 hours, so there was no remnant in the paddocks. These days Roundup® is not breaking down in the field any more. In 1966 it was found to be a chelator, which is like a magnet to attract minerals. So if you use Roundup®-ready crops, the Roundup® does not break down and it chelates the minerals, and the crop plant cannot take up the minerals and you get low mineral nutrition.

Facilitator *(Jim Woodhill)*: Thank you. Maybe you can email us the references for that work please, which would probably be quite useful.

Q. Dr Omot, I had the privilege of doing some work in your country a few years ago around NARI. One of the issues there, which relates to food waste and its challenges, was the ability to get fresh produce from the highlands into Port Moresby or to other population centres. A number of options were being looked at. Have there been developments in that, in relation to the ability to be able to get fresh vegetables into the city?

A. *(Norah Omot)*: Yes, there has been some work happening on that. A couple of years ago we had a project on sweet potato. That project included various studies on the different sectors in the food chain and where the losses are. There was a suggestion of looking at the packaging, because when farmers are shipping sweet potatoes they pack them into bags which can weigh 70 or even 100 kilograms. When someone lifts that up — it is not equipment lifting it up — they carry the bag on their shoulders and then just throw it off, and there is a lot of waste that happens as a result. So that study considered ways to reduce losses through good packaging material, and also the storage life, how long sweet potato can be stored — they are packed in the bags and the bags sweat and that also affects the quality of the sweet potato — and also some curing

practices. I think recently there have been some studies on whether we can grow vegetables closer to Port Moresby, the biggest urban market in Papua New Guinea, to avoid shipping produce from the highlands.

A, Q. *(Shenggen Fan, from the floor)*: The nutrition contents of modern varieties, whether from GMO or not, is still a risk topic. People have speculated that modern varieties may have low levels of micronutrients. This has been debated. There is no strong evidence to show that. We need scientific evidence. However, certain breeding methodologies could alter the micronutrients of certain crops. You might have heard of Golden Rice, adding vitamin A to rice, and zinc and iron into rice. Right now, most of the so-called bio-fortification is through traditional breeding, not GM. If the general environment allowed us to use GM to add nutrition into different crops, that could accelerate the progress, but the current environment just does not allow scientists to work on that.

My question is to Norah. You mentioned shifting from food security to nutrition security, and I think Dr Bo also said the same thing. What sort of mechanisms do you have to make sure that nutrition is indeed the objective of your research? Dr Bo, how can Vietnam reshape its agriculture for nutrition outcomes? How can you really make sure your agricultural practices, your agricultural policies, drive your outcome towards nutrition?

A. *(Norah Omot)*: Yes, in my paper I said that we did this massive exercise where we tried to understand the farming communities and the problems that they have, and that when we did our strategic planning we had not considered nutrition. Now we have to really have another look at how can we adjust the project implementation plans we already have, to see if it is possible to also mainstream nutrition into our projects. We can look at various ways to ensure that nutrition is being addressed in projects that we work on.

A. *(Nguyen Van Bo)*: The issue of how to shift from food security to nutrition security is very easy to recognise, but very difficult to realise in real life. It depends mainly on the incomes of the people. When we want to adjust the ratio between the sources of protein or carbohydrate, we have to improve the income of the farmer, because sources of energy coming from meat or fish or veggies are always more expensive compared to rice or the other food crops. We are implementing this strategy by several paths. The first one is to improve what we call the interiors or internal sectors. It is developing a new variety of rice, or maize, with higher protein content. We have a variety of rice with content of protein higher than 11%, whereas normal rice has only 6 or 7%. So, if you do not have a chance to get protein from other sources, you can use that one to adjust the protein percentage in the dietary index. The second method is to reduce some areas for growing food crops, for raising vegetables and fruit. We do not have large areas like Australia, where I have heard you may use about 13 hectares per one head of cattle. In our country, we graze 20 head of cattle per one hectare. It is a problem to increase the area for grazing to improve meat production, but we can obtain protein from other sources, like legumes. We produce a lot of legumes, so we can use the protein from vegetable sources.

A, Q. *(Tony Fischer, Crawford Fund, ACT)*: A quick comment and then a question. The comment is that 90% of United States corn is GM and the US is harvesting a record corn yield this year of 10.65 tonnes per hectare. I do not think there is too much micronutrient deficiency in that corn crop.

My question is to Dr Bo. We have heard a lot about smallholders in Asia — they dominate agriculture in Asia — but the farms are very small. We heard one success story from China this morning, but I think that may be the exception to the rule. You hinted at the problem, that when you engaged in and agreed on reform you gave ownership to the farmers, but now the farms are too small. How are you going to get out of this bind of having too many farmers with too small farms, in your country in particular?

A. *(Nguyen Van Bo)*: Thank you, Tony. We have developed a strategy and program that we call 'Large Farm'. We invite enterprises to invest in the production of one or two kinds of commodity, and they accumulate land from the farmer households by signing contracts. We call this contract farming with the farmer, and the farmer is a shareholder. It is like investing and holding a share in the company, only in this case we can make fewer larger farms for commodity production. There are already half a million hectares under this program and we hope to have 2 million hectares for rice in ten years. For coffee and other industrial crops we are already following this model of production.

Q. *(a Crawford Fund Scholar)*: My question is for Norah. You spoke about changing consumer preferences and household nutrition, and about some of the traditional vegetables which are not being accepted very well, because people do not like the taste. Are you thinking about making them into a processed food, or making them more acceptable, say by cooking them in different recipes, or introducing some new cooking methods so that they can be accepted?

A. *(Norah Omot)*: Yes, we are thinking of promoting them through recipe cards and we have some ideas on whether we can develop hand-size cards with attractive pictures of the recipes on one side and maybe the recipe itself on the back, and promote that, or hand it to shoppers when they go shopping in supermarkets. We have a lot of foreigners going into Papua New Guinea to work in the mines everywhere in PNG and they are not familiar with our food. So we would like to promote traditional vegetables by having these kinds of recipes and working with the institutions that cater for the mine workers. But we would also like to do cooking demonstrations with schools and with community groups, and we would like to engage also with women, especially in the women's groups and the communities, as a means of promoting traditional recipes for health, and to link up with the local health clinics so we create awareness and also do cooking demonstrations in those areas.

Facilitator *(Jim Woodhill)*: Very nice practical suggestions there to make a difference. Please, let us all thank our panel very much.

Delegates and Crawford Fund Scholars 2014

Delegates to the 2014 conference are listed below. The Crawford Fund also sponsored 26 young Australian agricultural scientists (asterisked) to attend. This initiative supports the Fund's aim of increasing young Australian agricultural scientists' involvement in international agricultural development.

ABAWI, Yahya	University of Southern Queensland
*ABDULLAH, Abu	Crawford Fund Scholar: Charles Darwin University
ACKLAND, Leigh Ann	The University of Sydney
ALDEN, Dave	Rural Industries Research & Development Corporation
*ALDEN, Rowan	Crawford Fund Scholar: Charles Sturt University
ALDERS, Robyn	Crawford Fund NSW Committee
ALFARO, Ana	The Australian National University
ALLAMI, Monica	Department of Agriculture
AMPT, Peter	The University of Sydney
ANDERSON, John	The Crawford Fund Board
ANDREW, Neil	The Crawford Fund
ANDREWS-MARNEY, Sean	University of Western Sydney
ANGUS, John	CSIRO
ARIAS, Francis	University of Western Sydney
ARMSTRONG, Tristan	Department of Foreign Affairs and Trade
*ASHLEY, Katherine	Crawford Fund Scholar: The University of Sydney
AUSTIN, Nick	Australian Centre for International Agricultural Research
BADGER, Murray	The Australian National University
BAJADA, Jaelle	CropLife Australia
BAKER, Derek	University of New England
BASFORD, Kaye	The Crawford Fund Board
BAYLISS, Kirsty	Murdoch University
BERTINI, Catherine	The Chicago Council on Global Affairs
BEVAN-JONES, Cat	Murdoch University
BIE, Elizabeth	Department of Agriculture
BITTISNICH, Dennis	Australian Centre for International Agricultural Research
BLAZER, Damien	University of Western Sydney
BLIGHT, Denis	The Crawford Fund
*BOGARD, Jessica	Crawford Fund Scholar: The University of Queensland
BOREVITZ, Justin	The Australian National University
BORTOLAZZO, Wendy	The Crawford Fund
*BROWN, Brendan	Crawford Fund Scholar: The University of Adelaide
BROWNE, April	University of Western Sydney
BUCKLEY, Michael	Department of Foreign Affairs and Trade
BURNS, Craig	Rural Industries Research & Development Corporation
BUSH, Russell	The University of Sydney
CAINGLET, Nina	Philippine Embassy, Canberra
CARBERRY, Peter	CSIRO
*CARRUTHERS-TAYLOR, Temma	Crawford Fund Scholar: The Australian National University
*CASSIN, Mardee	Crawford Fund Scholar: The University of Sydney
*CHAN, Jade	Crawford Fund Scholar: The University of Queensland
CHANDLER, Luke	Rabobank Australia & NZ
CHAPPLE, Katrina	The University of Queensland
CHARTRES, Colin	The Crawford Fund

CLEMENTS, Robert	Agricultural consultant
COGGINS, Georgina	The University of Sydney
*COGGINS, Sam	Crawford Fund Scholar: The University of Sydney
COLEMAN, David	
CONWAY, Sean	Office of Dr Dennis Jensen MP
CORISH, Peter	
CORNER, Sarah	University of Western Sydney
COUGHLAN, Kep	The Crawford Fund
CRAWFORD, Scarlett	The University of Sydney
DALY, Joanne	Crawford Fund ACT Committee
DAR, Willie	International Crops Research Institute for the Semi-Arid Tropics
*DE BRUYN, Julia	Crawford Fund Scholar: The University of Sydney
DEKKER, Jasper	The Crawford Fund
DELFORCE, Julie	Department of Foreign Affairs & Trade (Australia)
DEMPEWOLF, Hannes	Global Crop Diversity Trust
DESHA, Cheryl	Queensland University of Technology
DIXON, John	Australian Centre for International Agricultural Research
DORNBUSCH, Michael	Office of the Gene Technology Regulator
DORNOM, Helen	Dairy Australia
DOUGLAS, Fionna	The World Bank
DREW, Mark	Australian Khyber Pakhtunkhwa Agricultural Development
DRIESSEN, Susanna	Plant Health Australia
DUBS, Andreas	Australian Chicken Meat Federation
DUNBABIN, Matthew	Queensland University of Technology
EASDOWN, Warwick	AVRDC – The World Vegetable Center
EDGAR, Robert	Crawford Fund Victoria Committee
EDIS, Robert	Australian Centre for International Agricultural Research
EDWARDS, Sean	
ENRIGHT, Terry	The Crawford Fund Board
ETHERINGTON, Dan	Kokonut Pacific Pty Ltd
ETHERINGTON, Richard	Kokonut Pacific Pty Ltd
FAN, Shenggen	International Food Policy Research Institute
FARQUHAR, Graham	The Australian National University
*FEETHAM, Heather	Crawford Fund Scholar: The University of Adelaide
FERRIER, John	Birchip Cropping Group (BCG)
FERRO, Katelyn	The University of Queensland
FINKEL, Elizabeth	Cosmos Science Magazine
FIRN, Jennifer	Queenland University of Technology
FISCHER, Tony	Crawford Fund ACT Committee
FISHER, Judy	Fisher Research Pty Ltd
FITZGIBBON MP, Joel	Australian Labor Party
FLETCHER, Paul	Parliamentary Secretary to the Minister for Communications
FLOHR, Bonnie	Australian Centre for International Agricultural Research
FOSCARINI, Melissa	Department of Agriculture
*GALE, Danielle	Crawford Fund Scholar: Curtin University
GENDALL, Tony	La Trobe University
GIBSON, John	University of New England
GOLDIE, Jenny	Sustainable Population Australia
GOUDSWAARD, Laura	
GRAY, Ms	Department of Agriculture

GREADY, Jill	The Australian National University
GREGSON, Tony	The Crawford Fund Board
*HALL, Alison	Crawford Fund Scholar: Tasmanian Institute of Agriculture
HAMSHERE, Patrick	Australian Bureau of Agricultural and Resource Economics and Sciences
*HANKS, Jenny	Crawford Fund Scholar: The University of Melbourne
HARCH, Bronwyn	Queensland University of Technology
HARKIN, Ashley	University of Western Sydney
HART, Jeff	Australia–Africa Mining Industry Group / PAYDIRT MEDIA
HASTINGS, Andrew	Academy of Technological Sciences and Engineering
HAYES, Ted	Crawford Fund Victoria Committee
HEASLIP, John	Department of Agriculture
HESSION, Sophie	University of Western Sydney
HOUNSLOW, Megan	University of Western Sydney
HUANG, Longbin	The University of Queensland
HUDSON, Caitlin	Department of the Prime Minister and Cabinet
INALL, Neil	Crawford Fund NSW Committee
IVES, Stephen	Tasmanian Institute of Agriculture / University of Tasmania
JENKIN, Susan	Ironbark Citrus
JENSEN MP, Dennis	
JOOTHONG, Thanarbordee	Royal Thai Embassy
KAMATH, Gita	Department of Foreign Affairs and Trade
KANE-PATOKA, Joanna	International Crops Research Institute for the Semi-Arid Tropics
KAYE, Rebecca	Department of Agriculture
KEATINGE, John	AVRDC – The World Vegetable Center
KEATINGE, Penelope	AVRDC – The World Vegetable Center
KERIN, John	The Crawford Fund Chair
KNOBEL, Tom	
KOCI, Jack	Australian Centre for International Agricultural Research
KYTE, Rachel	The World Bank
LAMB, Moriah	Office of Dr Dennis Jensen MP
LANGFORD, Kate	World Agroforestry Centre
LAWN, Bob	Crawford Fund Queensland Committee
LEPANI, Charles	High Commissioner for Papua New Guinea
LOPEZ-REEVES, Patricia	Timothy G. Reeves and Associates P/L
LOWE, David	Department of Foreign Affairs and Trade
MACKAY, Michael	The University of Queensland
*MACKENZIE, Tara	Crawford Fund Scholar: University of the Sunshine Coast
MACKINNON, Ian	The Crawford Fund Board
MACPHERSON, Daniel	Department of Agriculture
MAHAR, Tony	National Farmers' Federation
MAK, Michelle	University of Western Sydney
*MANSON, James	Crawford Fund Scholar: La Trobe University
MARSHALL, Jonathan	Bondi Labs
MARTINO, Natasha	University of Western Sydney
MAYBERRY, Dianne	CSIRO Agriculture Flagship
MCBRIDE, Rebecca	Australian Centre for International Agricultural Research
MCCARTHY, John	The Australian National University
*MCCORMACK, Kirsty	Crawford Fund Scholar: University of New England
MCGILL, David	Charles Sturt University
MCGILLION, Therese	University of Western Sydney

MCGOWAN MP, Cathy	
MCLEAN, Lee	Department of Agriculture
MCNAIR, Susan	Currie Communications
MEALING, Rachel	Department of Agriculture
MENDHAM, Neville	Crawford Fund Tasmania Committee
MENDHAM, Robyn	
MENZIES, Karensa	Department of Environment and Primary Industries
MORRIS, Paul	Department of the Prime Minister and Cabinet
MORRISON, David	Murdoch University
*MUKHOPADHYAY, Soumi	Crawford Fund Scholar: Charles Sturt University
MWANGANGI, Munyasya	Deputy Head of Mission, Kenya High Commission
NADIRADZE, Kakha	Association for Farmers Rights Defense, Georgia
NEWMAN, Suzie	The University of Adelaide
NICOL, Julie	Crawford Fund Victoria Committee
NOOR, Yudi	Asian Association of Animal Production Societies
NÚÑEZ VILLACIS, Lorena De Los Angeles	The Australian National University
NUNN, Mike	Australian Centre for International Agricultural Research
OMOT, Norah	Papua New Guinea National Agricultural Research Institute
ORTIZ, Carolina	Dow AgroSciences
PAGE, Girija	University of Western Sydney
PARSONS, David	University of Tasmania
PAUL, Tania	The Crawford Fund
PEAKE, Brianna	CBH Group
PEISHI, Zalynn	Department of Foreign Affairs and Trade
PENGELLY, Bruce	The Crawford Fund
PENM, Jammie	Australian Bureau of Agricultural and Resource Economics and Sciences
PERMANI, Risti	Global Food Studies
PITT MP, Keith	
PRATLEY, Jim	Charles Sturt University
*PRESTON, Aaron	Crawford Fund Scholar: Charles Sturt University
PRIOR, Julian	University of New England
PRITCHARD, Bill	The University of Sydney
QURESHI, M. Ejaz	Australian Centre for International Agricultural Research
RABBI, Barkat	University of Western Sydney
RADCLIFFE, John	The Crawford Fund Board
RAMSDEN, Jessica	Elanco Animal Health
RAMSEY MP, Rowan	
READE, Cathy	The Crawford Fund
REEVES, Timothy	Timothy G. Reeves and Associates P/L
REID, Margaret	The Crawford Fund Board
RIDLEY, John	C-Logic Holdings Pty Ltd
RIDSDILL-SMITH, James	Crawford Fund Western Australia Committee
RIDSDILL-SMITH, Nicola	Retired
*RITCHIE, Zita	Crawford Fund Scholar: Dept of Environment & Primary Industries
RITMAN, Kim	Department of Agriculture
RIVERS, John	The Australian National University
ROBERTS, William	Plant Biosecurity Cooperative Research Centre
ROBINSON, Craig	Department of Foreign Affairs and Trade
ROBINSON, Michael	Plant Biosecurity Cooperative Research Centre
ROLLASON, Russell	Department of Foreign Affairs and Trade

RUSSELL FRENCH, Sarah	Dow AgroSciences
RYAN, Kelly	Crawford Fund Western Australia Committee
SAMNAKAY, Nadeem	Australian Centre for International Agricultural Research
SANGIAMPOMGSA, Maris	Royal Thai Embassy
SCOTT, Murray	C-Logic Holdings Pty Ltd
SCOTT, Paul	CBH Group
SCOTT-ORR, Helen	Crawford Fund NSW Committee
SHARMA, Shashi	Murdoch University
SHARP, Leeanne	Senior Adviser to Senator Penny Wong
SHEARER, David	Australian Centre for International Agricultural Research
SIKMAN, Natasha	Office of Joel Fitzgibbon
SILVA PEREZ, Viridiana	The Australian National University: Biological Sciences
SIMPFENDORFER, Colin	James Cook University
SINN, Michelle	Crawford Fund Queensland Committee
SMITH, Andrew	The University of Adelaide
SMITH, Cynthia	
SMITH, Jack	
*SMITH, Julia	Crawford Fund Scholar: Department of Agriculture and Food WA
SMITH, Rowan	University of Tasmania
SMITH, Sally	The University of Adelaide
SOEM, Thomas	The University of Sydney
STAPPER, Maarten	BioLogic AgFood
STEWART, Jenny	The University of New South Wales, Canberra
SULTANBAWA, Yasmina	Crawford Fund Queensland Committee
SZOKE, Helen	Oxfam
TANNER, Jon	New Zealand Wood Processors and Manufacturers Assoc.
THANH HOA, Nguyen	Vietnamese Women's Union
THYGESEN, Peter	Office of the Gene Technology Regulator
TORIBIO, Jenny-Ann	The University of Sydney
*TURNER, Lydia	Crawford Fund Scholar: Tasmanian Institute of Agriculture
VAN BO, Nguyen	Vietnamese Academy of Agricultural Sciences
*VAN BRONSWIJK, Sarah	Crawford Fund Scholar: The Australian National University
VANDERMARK, Sarah	Australian Centre for International Agricultural Research
VAN OOSTENDE, Marchien	The Crawford Fund
VELLA, Christopher	University of Western Sydney
VERCOE, Phil	The University of Western Australia
VERMAAK, Stuart	University of Western Sydney
*VOS, Amy	Crawford Fund Scholar: James Cook University
WARD, Michael	The University of Sydney
*WARREN, Annie	Crawford Fund Scholar: University of New England
WATSON, Laura	CSIRO
WEIR, Glen	Crawford Fund Western Australia Committee
WEIR, Robina	
WENHAM, Matt	Australian Academy of Technological Sciences & Engineering
WEST, Elspeth	Department of Agriculture
WHITTLE, Justin	University of Western Sydney
WICKES, Roger	Crawford Fund South Australia Committee
WILLEMSE, Jarrod	University of Western Sydney
WINDSOR, Peter	The University of Sydney
WONG, Johanna	The University of Sydney

WOOD, Mellissa	Australian Centre for International Agricultural Research
WOODHILL, Jim	Department of Foreign Affairs and Trade
ZALCMAN, Emma	Australian Centre for International Agricultural Research
ZESSLER, Laurent	United Nations Population Fund
ZHOU, Yi	Crawford Fund Scholar: The University of Adelaide
ZIBIAH, Ariela	United Nations Population Fund
ZSELECZKY, Laura	International Food Policy Research Institute

Media coverage 2014

4 Sep Kyte *Weekly Times* **World Bank official issues climate change warning for agriculture** <http://www.weeklytimesnow.com.au/business/horticulture/world-bank-official-issues-climate-change-warning-for-agriculture/story-fnker6g8-1227046452654>

3 Sep Szoke/Kyte/Fan *Agroforestry World Blog* **What needs fixing – our broken food systems, our attitudes to food, or both?** <http://blog.worldagroforestry.org/index.php/2014/09/03/what-needs-fixing-our-broken-food-systems-our-attitudes-to-food-or-both/>

2 Sep Kyte *Currie Communications* **Better food is what the world needs** <http://www.curriecommunications.com.au/agriculture/better-food-world-needs/>

2 Sep Risti Permani *Global Food Studies University of Adelaide* **Feeding the 9 billion, well: An urgent need for post-2015 agenda and improved partnerships** <http://blogs.adelaide.edu.au/global-food/>

1 Sept Kyte *Australian Financial Review* **World Bank official says Australia has key role on carbon** <http://www.afr.com/p/national/world_bank_official_says_australia_kEpnisUbSeCgWuPb7xHOsI>

1 Sept Kyte *Econews* **World Bank: rich have moral climate change obligation** <http://econews.com.au/news-to-sustain-our-world/world-bank-rich-have-moral-climate-change-obligation/>

1 Sept Kyte *The Land* **Food security on the line** <http://www.theland.com.au/news/agriculture/agribusiness/general-news/food-security-on-the-line/2710241.aspx>

1 Sept Kyte *Stock and Land* **Food security on the line** <http://www.stockandland.com.au/news/agriculture/agribusiness/general-news/food-security-on-the-line/2710241.aspx>

1 Sept Kyte *Farm Weekly* **Food security on the line** <http://www.farmweekly.com.au/news/agriculture/agribusiness/general-news/food-security-on-the-line/2710241.aspx>

1 Sept Kyte *Queensland Country Life* **Food security on the line** <http://www.queenslandcountrylife.com.au/news/agriculture/agribusiness/general-news/food-security-on-the-line/2710241.aspx>

1 Sept Kyte *Stock Journal* **Food security on the line** <http://www.stockjournal.com.au/news/agriculture/agribusiness/general-news/food-security-on-the-line/2710241.aspx>

1 Sept Kyte *North Queensland Register* **Food security on the line** <http://www.northqueenslandregister.com.au/news/agriculture/agribusiness/general-news/food-security-on-the-line/2710241.aspx>

1 Sept Kyte *Farmonline* **Food security on the line** <http://www.farmonline.com.au/news/agriculture/agribusiness/general-news/food-security-on-the-line/2710241.aspx>

1 Sep Bertini *Agroforestry World Blog* **If you don't pay attention to gender you will fail** <http://blog.worldagroforestry.org/index.php/2014/09/01/if-you-dont-pay-attention-to-gender-you-will-fail/>

29 Aug Kyte *Bloomberg TV* **We Are Heading Down a Dangerous Path: Kyte** <http://www.bloomberg.com/video/climate-change-we-are-heading-down-a-dangerous-path-kyte-VsAYEvC4RZO_Z_0PtCKRJw.html>

29 Aug Kyte *Radio National Breakfast* <http://www.abc.net.au/radionational/programs/breakfast/world-bank-wants-action-on-climate-change/5704800>

29 Aug Kyte *ABC Rural National News* <http://www.abc.net.au/news/2014-08-29/nrn-climate-warning/5706076>

29 Aug Bertini *Inter-American Social Protection Network* **Women essential to improving food security** <http://socialprotectionet.org/resources/women-essential-improving-food-security>

29 Aug Kyte *ABC Rural News Qld* <http://www.abc.net.au/news/2014-08-29/nrn-climate-warning/5705942/?site=southqld>

29 Aug Kyte *Radio Australia Pacific Beat* <http://www.radioaustralia.net.au/international/radio/program/pacific-beat/climate-change-on-agenda-at-sids-conference/1362594>

28 Aug Fan, Dar, Kyte *Agroforestry World* <http://blog.worldagroforestry.org/index.php/2014/08/28/moving-from-food-security-to-nutritional-security/>

28 Aug Kyte *Blue and Green Tomorrow* <blueandgreentomorrow.com/2014/08/28/climate-change-will-trigger-global-food-crisis-says-world-bank-official>

28 Aug Zessler *Fiji times* <http://www.fijitimes.com/story.aspx?id=278536>

28 Aug Bertini *Radio Australia Pacific Beat* <http://www.radioaustralia.net.au/international/radio/program/pacific-beat/women-essential-to-improving-food-security/1361838>

28 Aug Zessler *UNFPA Sub-Regional Office News* **Women, key to a food-secure world: UNFPA** <http://countryoffice.unfpa.org/pacific/2014/08/27/10449/women_key_to_a_food_secure_world_unfpa/>

28 Aug Kyte *The Age* <m.theage.com.au/environment/climate-change/climate-change-may-disrupt-global-food-system-within-a-decade-world-bank-says-20140827-108w8x.html>

28 Aug Kyte *Sydney Morning Herald* <http://www.smh.com.au/environment/climate-change/temperature-hiatus-periods-to-become-a-thing-of-the-past-as-emissions-soar-20140827-1091p3.html>

27 Aug Dar *The Non-Profit Press* **Biofuel initiatives should enhance, and not compromise, food and nutritional security of the poor** <http://www.tnpp.org/2014/08/biofuel-initiatives-should-enhance-and.html>

27 Aug Dar *Crawford Fund website* **Biofuel initiatives should enhance, and not compromise, food and nutritional security of the poor** <http://www.crawfordfund.org/wp-content/uploads/2014/05/Biofuelspr.pdf>

27 **Aug Kyte** *Eco-News* <http://www.eco-business.com/news/climate-change-may-disrupt-global-food-system-within-decade-world-bank-says/>

27 Aug Zessler *Radio New Zealand* Live from event

27 Aug Crawford Fund's Annual Parliamentary Conference *ACIAR website, General* <http://aciar.gov.au/news-and-media/crawford-funds-annual-parliamentary-conference>

27 Aug Kyte *CGIAR Fund Office website – Opinions* **Building a New Food System** <http://www.cgiar.org/consortium-news/building-a-new-food-system/>

27 Aug Kyte *Maine News* <http://newsmaine.net/20417-focus-should-be-climate-smart-agriculture-says-senior-world-bank-official>

27 Aug Kyte *Sydney Morning Herald* and *The Age* <http://www.smh.com.au/environment/climate-change/climate-change-may-disrupt-global-food-system-within-a-decade-world-bank-says-20140827-108w8x.html>

27 Aug Kyte *PNC Voice* <http://www.thepncvoice.com/world-bank-group-warns-global-food-system-disruption/34689>

27 Aug Kyte *Farm Online* – news <http://www.farmonline.com.au/news/metro/national/general/climate-change-may-disrupt-global-food-system-within-a-decade-world-bank-says/2709875.aspx>

27 Aug Bertini *Radio Australia Indonesian* <http://www.radioaustralia.net.au/indonesian/2014-08-27/atasi-kelaparan-global-perempuan-harus-dilibatkan/1361732>

27 Aug Zessler *Radio Australia Pacific Beat* <http://www.radioaustralia.net.au/international/radio/program/pacific-beat/food-security-conference-underway-in-canberra/1361324>

27 Aug Kyte *Sceptical Science* <http://www.skepticalscience.com/news.php?n=2648>

27 Aug Kyte *Good Fruit and Vegetables* <http://www.goodfruitandvegetables.com.au/news/metro/national/general/climate-change-may-disrupt-global-food-system-within-a-decade-world-bank-says/2709875.aspx>

27 Aug Kerin/Dar *New Indian Times express* <http://www.newindianexpress.com/business/news/John-Kerin-Named-ICRISAT-Ambassador-of-Goodwill/2014/08/27/article2400815.ece>

27 Aug Fan *Dev Policy* <http://devpolicy.org/good-economics-and-the-right-thing-to-do-how-to-eliminate-hunger-and-malnutrition-20140827/>

26 Aug Omot *Radio Australia Pacific Beat* <http://www.radioaustralia.net.au/international/radio/program/pacific-beat/how-to-feed-the-world-ethically-efficiently-sustainably-and-profitably/1360816>

26 Aug Bertini *Radio National Bush Tele* <http://www.abc.net.au/radionational/programs/bushtelegraph/un-woman/5697292>

26 Aug Bertini *ABC Canberra* Live interview

26 Aug Omot *Radio Australia Tok Pisin* <http://www.radioaustralia.net.au/tokpisin/>

26 Aug John Kerin, William Dar *ICRISAT Press Release* **75 per cent of world's extremely poor people live in rural areas: ICRISAT** <http://timesofindia.indiatimes.com/india/75-per-cent-of-worlds-extremely-poor-people-live-in-rural-areas-Icrisat/articleshow/40930556.cms>

26 Aug John Kerin, William Dar *The Economic Times* **John Kerin named ICRISAT Ambassador of Goodwill** <http://articles.economictimes.indiatimes.com/2014-08-27/news/53284873_1_semi-arid-tropics-international-crops-research-institute-goodwill>

26 Aug John Kerin, William Dar *Business Standard* **John Kerin named ICRISAT Ambassador of Goodwill** <http://www.business-standard.com/article/pti-stories/john-kerin-named-icrisat-ambassador-of-goodwill-114082700132_1.html>

26 Aug John Kerin, William Dar *New Indian Express* **John Kerin named ICRISAT Ambassador of Goodwill** <http://www.newindianexpress.com/business/news/John-Kerin-Named-ICRISAT-Ambassador-of-Goodwill/2014/08/27/article2400815.ece>

26 Aug John Kerin, William Dar *The Hindu* **John Kerin named ICRISAT Ambassador of Goodwill** <http://www.thehindu.com/todays-paper/tp-national/tp-andhrapradesh/john-kerin-isicrisat-goodwill-ambassador/article6355210.ece>

26 Aug John Kerin, William Dar *Hindustan Times* **John Kerin named ICRISAT Ambassador of Goodwill** <http://www.htsyndication.com/htsportal/article/John-Kerin-named-ICRISAT-Ambassador-of-Goodwill/5344270>

26 Aug John Kerin, William Dar *The Non-Profit Press* **John Kerin named ICRISAT Ambassador of Goodwill** <http://www.tnpp.org/2014/08/john-kerin-named-icrisat-ambassador-of.html>

26 Aug John Kerin, William Dar *Silicon India* **75 per cent of world's extremely poor people live in rural areas: ICRISAT** <http://www.siliconindia.com/news/general/Worlds-75-Percent-Poorest-Reside-In-Rural-Areas-Report-nid-171741-cid-1.html>

26 Aug John Kerin, William Dar *India.com* **John Kerin named ICRISAT Ambassador of Goodwill** <http://www.india.com/news/world/john-kerin-named-icrisat-ambassador-of-goodwill-130735/>

26 Aug John Kerin, William Dar *The Siasat Urdu Daily* **John Kerin named ICRISAT Ambassador of Goodwill** <http://www.siasat.com/english/news/john-kerin-named-icrisat-ambassador-goodwill>

26 Aug John Kerin, William Dar *Bulletin247* **75 per cent of world's extremely poor people live in rural areas: ICRISAT** <http://www.bulletin247.com/english-news/show/75-per-cent-of-worlds-extremely-poor-people-live-in-rural-areas-icrisat>

26 Aug John Kerin, William Dar *World News* **John Kerin named ICRISAT Ambassador of Goodwill** <http://article.wn.com/view/2014/08/27/John_Kerin_named_ICRISAT_Ambassador_of_Goodwill/>

26 Aug John Kerin, William Dar *London: The News* **75 per cent of world's extremely poor people live in rural areas: ICRISAT** <http://www.londonthenews.com/news/India/20140826/60828265/75-per-cent-of-world-extremely-poor.htm>

26 Aug John Kerin, William Dar *Cut Mirchi* **John Kerin named ICRISAT Ambassador of Goodwill** <http://cutmirchi.com/viewdetails.php?linkid=52363&title=John-Kerin-named-ICRISAT-Ambassador-of-Goodwill#.VAQBXPmSxHU>

26 Aug John Kerin, William Dar *Feeds* **John Kerin named ICRISAT Ambassador of Goodwill** <http://feeds.syzygy.in/markets-live/john-kerin-named-icrisat-ambassador-goodwill>

26 Aug John Kerin, William Dar *Inooz* **John Kerin named ICRISAT Ambassador of Goodwill** <http://www.inooz.in/article/view/3231748/john-kerin-named-icrisat-ambassador-of-goodwill/082014>

26 Aug John Kerin, William Dar *News.Nom* **John Kerin named ICRISAT Ambassador of Goodwill** <http://www.news.nom.co/john-kerin-named-icrisat-ambassador-11736117-news/>

26 Aug John Kerin, William Dar *News Waver* **John Kerin named ICRISAT Ambassador of Goodwill** <http://en-in.newswaver.com/38859>

26 Aug John Kerin, William Dar *Veooz* **75 per cent of world's extremely poor people live in rural areas: ICRISAT** <http://www.veooz.com/news/IHRkdvY.html>

26 Aug John Kerin, William Dar *Financial Chronicle* **John Kerin named ICRISAT Ambassador of Goodwill** <http://www.pressreader.com/india/financial-chronicle/20140828/textview">Kerin is ICRISAT goodwill envoy>

26 Aug John Kerin, William Dar *News Dippides* **John Kerin named ICRISAT Ambassador of Goodwill** <http://newsdippides.com/channel/7678>

26 Aug John Kerin, William Dar *Silo Breaker* **John Kerin named ICRISAT Ambassador of Goodwill** <http://news.silobreaker.com/john-kerin-named-icrisat-ambassador-of-goodwill-5_2268185176196513964>

26 Aug John Kerin, William Dar *NReader* **75 per cent of world's extremely poor people live in rural areas: ICRISAT**
<http://en.nreader.net/data/75-per-cent-of-worlds-extremely-poor-people-live-in-rural-areas-icrisat/>

26 Aug John Kerin, William Dar *Scoop.it!* **75 per cent of world's extremely poor people live in rural areas: ICRISAT**
<http://www.scoop.it/t/philanthropy-by-enzo-calamo/p/4026933229/2014/08/26/75-per-cent-of-world-s-extremely-poor-people-live-in-rural-areas-icrisat-the-times-of-india>

26 Aug John Kerin, William Dar *Daily India News* **75 per cent of world's extremely poor people live in rural areas: ICRISAT** <http://www.dailyindianews.com/news/75-per-cent-of-worlds-extremely-poor-people-live-in-rural-areas-icrisat>

25 Aug Blight *ABC Canberra* Live preview interview

25 Aug Risti Permani *Global Food Studies University of Adelaide*
<http://blogs.adelaide.edu.au/global-food/2014/08/25/the-2014-crawford-fund-parliamentary-conference-pre-conference-note-on-food-security/>

TWITTER ACTIVITY

Tweets on #CF2014conf

SocialMania @Gaurav_Ghansyam • 15h
#Climatechange intensifies threats to #GlobalFood system http://ow.ly/ALzqc #CF2014conf pic.twitter.com/Ak8MgPzlJF #BeingSocial #BeingAware

The Crawford Fund @CrawfordFund • 20h
Another gr8 @ICRAF blog frm #cf2014conf What's broken: food systems or our attitudes? @HelenSzoke @rkyte365 @ifpri http://blog.worldagroforestry.org/index.php/2014/09/03/what-needs-fixing-our-broken-food-systems-our-attitudes-to-food-or-both/ …

Cosmos Magazine @CosmosMagazine • 21h
Making More With Less - how do we feed the world as population soars? http://bit.ly/1oBNT52 @ScienceAU #cf2014conf via @CrawfordFund

The Crawford Fund @CrawfordFund • Sep 2
Making More With Less - how do we feed the world as popn soars? https://www.youtube.com/watch?v=tpzQljfALDQ … @ScienceAU #cf2014conf

The Crawford Fund @CrawfordFund • Sep 2
If u missed the #foodsecurity forum with our #cf2014conf spkrs JohnKerin @ElizabethFinkel @C_A_Bertini it's online -big thanks to @ScienceAU

Risti Permani @Risti_Permani • Sep 1
Post @CrawfordFund conference note #cf2014conf #cf14conf #FoodSecurity #Agriculture #agchatoz @ACIARAustralia http://blogs.adelaide.edu.au/global-food/2014/09/02/feeding-the-9-billion-well-an-urgent-need-for-post-2015-agenda-and-improved-partnerships/ …

The Crawford Fund @CrawfordFund • Sep 1
Lots of info available from our conf including presentations and details of special announcements http://www.crawfordfund.org #cf2014conf

The Crawford Fund @CrawfordFund • Sep 1
To all our Ethics Efficiency & Food Security young scientists, we're looking forward to your conf reports. #cf2014conf

Mubdi'Chud'Choudhury @NodeSystems • Sep 1
Check @ICRAF blog on #cf2014conf - @C_A_Bertini SirJohnCrawford address arguing need 2 focus on women 4 #foodsecurity http://ow.ly/3pFIAW

The Crawford Fund @CrawfordFund • Sep 1
Check @ICRAF blog on #cf2014conf - @C_A_Bertini SirJohnCrawford address arguing need 2 focus on women 4 #foodsecurity http://blog.worldagroforestry.org/index.php/2014/09/01/if-you-dont-pay-attention-to-gender-you-will-fail/ …

The Crawford Fund @CrawfordFund • Aug 31
And almost all presentations frm last week's Ethics, Efficiency & Food Security conference are now online #cf2014conf http://www.crawfordfund.org/events/parliamentary-conference/2014-parliamentary-conference-program/ …

The Crawford Fund @CrawfordFund • Aug 31
Starting to get together some photo galleries from last week's conference - can you find yourself? #cf2014conf http://www.crawfordfund.org/events/parliamentary-conference/photos/ …

Ulaha Joseph I. @UlahaJosephI • Aug 31
@WorldBank: When seawater rises along the Mekong Delta, the effects ripple through the economy: http://wrld.bg/ALAuX #CF2014conf.

Sang Gelombang @PrijantoRabbani • Aug 31
@WorldBank: When seawater rises along the Mekong Delta, the effects ripple through the economy: http://wrld.bg/ALAuX #CF2014conf

Toffleresque @Toffleresque • Aug 31
"When seawater rises along the Mekong Delta, the effects ripple through the economy: http://wrld.bg/ALAuX #CF2014conf #CharlieDontSurf

World Bank @WorldBank • Aug 31
When seawater rises along the Mekong Delta, the effects ripple through the economy: http://wrld.bg/ALAuX #CF2014conf

World Bank @WorldBank • Aug 30
When seawater rises along the Mekong Delta, the effects ripple through the economy: http://wrld.bg/ALArc #CF2014conf

INCR @INCRnews • Aug 30
"@WorldBank: Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAmB #CF2014conf" View conversation

Bare Essence @bareessence_ • Aug 30
"@WorldBank: Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAmB #CF2014conf" View conversation

joseph amenaghawon @jogbosky • Aug 30
#Africa (Big risk) @WorldBank: Climate change is a #foodsecurity risk 4 Africa: http://wrld.bg/ALAmB #CF2014conf @OSIWA1 @NnimmoB @censoj

sara cristaldi @saracristaldi • Aug 30
"@WorldBank: Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAmB #CF2014conf" @Expo2015Milano

Winnie Byanyima @Winnie_Byanyima • Aug 30
#climatechange is a #foodsecurity risk 4 Africa http://wrld.bg/ALAmB #CF2014conf #women find it harder to feed families @IFADnews @CGIAR

Marlene Morison @MorisonKay • Aug 30
G20 in Brisbane also needs to agenda @WorldBank: Climate change is a

World Bank @WorldBank • Aug 30
Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAmB #CF2014conf

The Crawford Fund @CrawfordFund • Aug 29
.@WorldBank wants action in lead to UN climate mtg @rkyte365 @CGIAR http://www.abc.net.au/radionational/programs/breakfast/world-bank-wants-action-on-climate-change/5704800 … #cf2014conf @RNBreakfast

The Crawford Fund @CrawfordFund • Aug 29
.@rkyte365 @CGIAR on @ABCRural "Farmers going to have 2 find ways to build resilience into their farming" #cf2014conf http://mobile.abc.net.au/news/2014-08-29/nrn-climate-warning/5706076 …

Pat Fuller @bannerite • Aug 29
RT@WorldBank Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAkh #CF2014conf #UniteBlue #PDMFNB

Syngenta @Syngenta • Aug 29
RT @WorldBank: Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAkh #CF2014conf

Mubdi'Chud'Choudhury @NodeSystems • Aug 29
Thanks to all the yng ag scientists who came to #cf2014conf and added so much to the event http://ow.ly/3poXQu

ohPolitics @ohPolitics1 • Aug 29
RT @cgiarclimate: Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAhr #CF2014conf @WorldBank

Rowan Alden @RowanAlden • Aug 29
@C_A_Bertini I was inspired by your talk at the Young Scholars day as a part of the @CrawfordFund #cf2014conf & I wanted to say thanks!

Rowan Alden @RowanAlden • Aug 29
@CrawfordFund Thankyou so much for the opportunity to attend. This was a fantastic event and I got a huge amount out of it. #cf2014conf

The Crawford Fund @CrawfordFund • Aug 29
Thanks to all the yng ag scientists who came to #cf2014conf and added so much to the event

The Crawford Fund @CrawfordFund • Aug 29
.@ACIARAustralia e-newsletter jam-packed with news frm busy few weeks including #cf2014conf #ihc2014 @RaidNetwork... http://us6.campaign-archive2.com/?u=6626638e1a860b30943b6a0eb&id=a58e7648de&e=f1d53f7e80 …

JoshTuraganivalu @Jbosurhiness • Aug 28
"@WorldBank: Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAkh #CF2014conf"

2 Days! @Ashh_Ali • Aug 28
Everything is. "@WorldBank: Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAkh #CF2014conf"

World Bank @WorldBank • Aug 28
Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAkh #CF2014conf

CondamineAg @condamineag • Aug 28
RT @CrawfordFund: 93% increase in vege consumption in ASEAN region in 2050 over 2007 level @ABARES @go_vegetables #cf2014conf

The Crawford Fund @CrawfordFund • Aug 28
Big thanks & safe travel to all our #cf2014conf speakers incl @C_A_Bertini @rkyte365

ohPolitics @ohPolitics1 • Aug 28
@WorldBank: Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAiM #CF2014conf"

Blue&GreenTomorrow @bluegreentweet • Aug 28
FROM TODAY: Climate change will trigger global food crisis, says World Bank official http://bit.ly/1pa5LUK #CFethics14 #cf2014conf

CCAFS cgiarclimate @cgiarclimate • Aug 28
How we are living, eating and wasting food matters as we work to fix the broken global food system: http://bit.ly/1pjraRf #cf2014conf

FIAN International @FIANista • Aug 28
RT @cgiarclimate: Climate change is a #foodsecurity risk for Africa: http://ln.is/wrld.bg/4rAG0 #CF2014conf @WorldBank

David Wainaina @dwainkuria • Aug 28
"@WorldBank: Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAiM #CF2014conf"

SoulSketcher @KeoTheSoul • Aug 28
RT "@WorldBank: Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAiM #CF2014conf"

Cecilia Schubert @Schubert_C • Aug 28
Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAhr #CF2014conf @WorldBank

CCAFS cgiarclimate @cgiarclimate • Aug 28
Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAhr #CF2014conf @WorldBank

Greg Barry @gregorycbarry • Aug 28
"@WorldBank: Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAhr #CF2014conf" @globalvoicesau

Iyaniwura adetunji @IAdetunji • Aug 28
"@WorldBank: Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAiM #CF2014conf"

GabrielaVeigaBarbant @GabrielaVB12 • Aug 28
It's a reality... "@WorldBank: Climate change is a #foodsecurity risk for #Africa: http://wrld.bg/ALAiM #CF2014conf"

World Bank @WorldBank • Aug 28
Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAiM #CF2014conf

CGIAR Consortium @CGIAR • Aug 28
Building a New Food System, @rkyte365 speaks at @CrawfordFund 2014 Annual Conference: http://bit.ly/1pjraRf #cf2014conf

Leanne Griffin @lgengage • Aug 28
RT @CrawfordFund: 93% increase in vege consumption in ASEAN region in 2050 over 2007 level @ABARES @go_vegetables #cf2014conf

Antonio Montano @AntoMon • Aug 28
@WorldBank: #Climate change is a #foodsecurity risk for #Africa: http://wrld.bg/ALAhr #CF2014conf #Sustainability

The Crawford Fund @CrawfordFund • Aug 28
Here's our wonderful #cf2014conf scholars with our coordinators & board - so gr8 to have their enthusiasm, yng & old pic.twitter.com/9NTMQhCgwH

Crop Wild Relatives @CropWildRelativ • Aug 28
Turn down the heat" http://goo.gl/7FXJcP #climatechange #foodsecurity #cf2014conf @WorldBank

Crop Wild Relatives @CropWildRelativ • Aug 28
RT @wbclimatechange Climate change intensifies threats to the global food system: http://ow.ly/ALzqc #CF2014conf pic.twitter.com/i3GW6mZpTC

Doreen Chilumbu @Chilumbud • Aug 28
#Climate #change is a #foodsecurity risk for #Africa: http://wrld.bg/ALAhr #CF2014conf @WorldBank

The Crawford Fund @CrawfordFund • Aug 27
Increasg social economic & political equality but much more to do - Zessler at Parlt Breakfast #cf2014conf @UNFPAPacific @UNFPA

The Crawford Fund @CrawfordFund • Aug 27
.@denis_blight explains strong msgs at #cf2014conf -need for focus on nutrition, women, R&D pic.twitter.com/ufq7K6Yauu

The Crawford Fund @CrawfordFund • Aug 27
Conference breakfast gets underway with Hon John Kerin welcoming delegates #cf2014conf pic.twitter.com/RDD6DCohwm

WB Sustainable Dev @wbsustaindev • Aug 27
Biodiversity loss is showing up on the farm & affecting #foodsecurity: http://ow.ly/ALzLF #CF2014conf #nutrition

UNFPA Pacific @UNFPAPacific • Aug 27
#Women, key to a #food-secure world: #UNFPA urges investment in #SRHR at @CrawfordFund parltconf http://lnkd.in/bcA2PpC #cf2014conf

UNFPA Pacific @UNFPAPacific • Aug 27
An interview on the link between population growth and food security from @CrawfordFund parlt.conf #cf2014conf …http://lnkd.in/bb6UG-r

World Bank @WorldBank • Aug 27
When seawater rises along the Mekong Delta, the effects ripple through the economy: http://wrld.bg/ALAfU #CF2014conf

World Bank Climate @wbclimatechange • Aug 27
Climate-smart ag is a triple win: better productivity & resilience, less climate impact http://ow.ly/AM9qc @rkyte365 speech #CF2014conf

The Crawford Fund @CrawfordFund • Aug 27
@CharlieAves #cf2014conf

WB Sustainable Dev @wbsustaindev • Aug 27
How we live, eat & waste food matters as we work to fix broken global food system. -@rkyte365 at #CF2014conf http://ow.ly/i/6duVW

ACIAR @ACIARAustralia • Aug 27
Read more about Dr Norah Omot on our FB page https://www.facebook.com/ACIARAustralia #cf2014conf

The Crawford Fund @CrawfordFund • Aug 27
Helping countries to count population to inform policy - Zessler @UNFPAPacific #cf2014conf

The Crawford Fund @CrawfordFund • Aug 27
Nbr of #women in Parlt important bearing on governance - Zessler @UNFPAPacific #cf2014conf

The Crawford Fund @CrawfordFund • Aug 27
Access and distrbn of food significant issues in #foodsecurity - Zessler @UNFPAPacific #cf2014conf

UNFPA Pacific @UNFPAPacific • Aug 27
Thank you @CrawfordFund for the opportunity to share the #UNFPA take on #foodSecurity on your #cf2014conf #SRHR pic.twitter.com/HhRAKVTsgi

Cosmos Magazine @CosmosMagazine • Aug 27
RT @CrawfordFund | Strategies to explain #GMOs around evidence not opinion - @ElizabethFinkel http://bit.ly/1vSuH95 #cf2014conf

Rowan Alden @RowanAlden • Aug 27
Looking forward to the @CrawfordFund Young Scholars day. Young people are so important to the future of agriculture #CF2014conf

The Crawford Fund @CrawfordFund • Aug 27
Need to invest in #women in R&D to support food security - Zessler @UNFPAPacific #cf2014conf

Rowan Alden @RowanAlden • Aug 27
Learnt alot at today's @CrawfordFund conference on food security. Good to see key themes emerging from the fantastic speakers. #CF2014conf

WB Sustainable Dev @wbsustaindev • Aug 27
We have a duty of care to developing world to help fix broken global food system. It will take climate-smart ag -@rkyte365 at #CF2014conf

The Crawford Fund @CrawfordFund • Aug 27
Shenggen Fan @ifpri -it's good economics & right thing to do to eliminate hunger and poverty http://devpolicy.org/good-economics-and-the-right-thing-to-do-how-to-eliminate-hunger-and-malnutrition-20140827/ … @devpolicy #cf2014conf

ACIAR @ACIARAustralia • Aug 27
Thanks for tweets! #cf2014conf @C_A_Bertini @CrawfordFund @Risti_Permani @UNFPA @PBCRC @RowanAlden @kelguest83 @RaidNetwork @SusanMcNair

HFKWH @hfkwh • Aug 27
"@WorldBank: Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAhr #CF2014conf"#follobackforfolloback #folloback

WB Sustainable Dev @wbsustaindev • Aug 27
World Bank's Erick Fernandes on the risks facing food production in a warming world: http://youtu.be/DTRdnR_hWhw #agriculture #CF2014conf

Bare Essence @bareessence_ • Aug 27
"@WorldBank: Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAhr #CF2014conf"

Richard TW @rtwhiting718 • Aug 27
"@WorldBank: Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAhr #CF2014conf" We're a #GlobalCommunity, make a change.

World Bank @WorldBank • Aug 27
Climate change is a #foodsecurity risk for Africa: http://wrld.bg/ALAhr #CF2014conf

piers_bocock @piers_bocock • Aug 27
The broken global food can be fixed; read how: http://www.cgiar.org/consortium-news/building-a-new-food-system/ … #CF2014conf

The Crawford Fund @CrawfordFund • Aug 27
Strong message from our conference on nutrition security explained in Agroforestry World http://blog.worldagroforestry.org/index.php/2014/08/28/moving-from-food-security-to-nutritional-security/ … @ICRAF #cf2014conf

CCAFS South Asia @cgiarclimate_SA • Aug 27
How we are living, eating and wasting food matters as we work to fix the broken global food system: http://bit.ly/1pjraRf #cf2014conf

Vietnam CIC @VietnamCIC • Aug 27
RT @wbclimatechange #ClimateChange intensifies threats to the global #food system: http://bit.ly/1lgoAdQ #CF2014conf

World Bank Climate @wbclimatechange • Aug 27
How a vault in frozen ground above the Arctic Circle is protecting Earth's crop diversity: http://ow.ly/ALF8o #video #CF2014conf

LenaJupiterLarsson @LenaJupiterLars • Aug 27
RT @wbclimatechange: Climate change intensifies threats to the global food system: http://ow.ly/ALzqc #CF2014conf pic.twitter.com/2Bj1fGrmoe

WB Sustainable Dev @wbsustaindev • Aug 27
.@rkyte365 on the challenge of nutritiously feeding a growing world population in uncertain times http://ow.ly/AMdK4 #CF2014conf @CGIAR

Rowan Alden @RowanAlden • Aug 27
Ensuring that every girl has at least a primary school education will decrease population growth - Catherine Bertini #cf2014conf

CGIAR Consortium @CGIAR • Aug 27
How we are living, eating and wasting food matters as we work to fix the broken global food system: http://bit.ly/1pjraRf #cf2014conf

The Crawford Fund @CrawfordFund • Aug 27
Girl with at least primary school educn has 1/2 as many children as her uneducated sister @C_A_Bertini #feedtheworld #cf2014conf @ScienceAU

Be Gibson @wgibson58 • Aug 27
@wbclimatechange @ClimateDepot #CF2014conf Yep: that's why we are now producing more food than ever before!

The Crawford Fund @CrawfordFund • Aug 27
As ppl become better off they seek diversified diets - what's key is nutrition security #feedtheworld #cf2014conf @ScienceAU

Sarah van Bronswijk @svonboombox • Aug 27
Three days of incredible speakers & minds on food security & the ethics & challenges ahead. Terrific @crawfordfund #CF2014conf #feedtheworld

The Crawford Fund @CrawfordFund • Aug 27
Great to have our chair John Kerin and #cf2014conf speakers @C_A_Bertini & @ElizabethFinkel at the @ScienceAU #foodsecurity panel today

World Bank Climate @wbclimatechange • Aug 27
Climate change intensifies threats to the global food system: http://ow.ly/ALzqc #CF2014conf pic.twitter.com/0wQAqj0g21

Shaun Coffey @ShaunCoffey • Aug 27
"@CharlieAves: "@CrawfordFund: @CharlieAves #cf2014conf" ping @ShaunCoffey" hi

Charlotte Aves @CharlieAves • Aug 27
"@CrawfordFund: @CharlieAves #cf2014conf" ping @ShaunCoffey

The Crawford Fund @CrawfordFund • Aug 27
We need to be multidisciplinary and collaborative to tackle food security - Colin Chartres #cf2014conf at yng ag scientists forum

The Crawford Fund @CrawfordFund • Aug 26
Need to focus on #nutrition as well as #foodsecurity - factor nutrition into ag research projects - Norah Omot #cf2014conf #foodsecurity risk for Africa: http://wrld.bg/ALAmB #CF2014conf

The Crawford Fund @CrawfordFund • Aug 26
I cup coffee in expensive hotel same as value to Vietnamese farmer of 2kg of coffee - unfair! #cf2014conf

The Crawford Fund @CrawfordFund • Aug 26
Dr Van Bo Vietnamese Academy Ag Science discusses ag restructuring towards higher global competitiveness #cf2014conf pic.twitter.com/reN9RlX6A0

The Crawford Fund @CrawfordFund • Aug 26
Little change in income for rural population in China to 2050, unlike urban popn - @ABARES #cf2014conf

The Crawford Fund @CrawfordFund • Aug 26
93% increase in vege consumption in ASEAN region in 2050 over 2007 level @ABARES @go_vegetables #cf2014conf

Risti Permani @Risti_Permani • Aug 26
In #India vegetables consumption will significantly increase as mamyn people are #vegetarian #cf2014conf pic.twitter.com/rWci97FGQV

The Crawford Fund @CrawfordFund • Aug 26
Willie Dar @ICRISAT @rkyte365 @CGIAR @WorldBank John Kerin at #cf2014conf pic.twitter.com/3eSo08gDsk

Risti Permani @Risti_Permani • Aug 26
Dr Jammie Pemm no significant increase in #food consumption in #Japan and #Korea but high-value markets #cf2014conf pic.twitter.com/rrXIhStz1H

The Crawford Fund @CrawfordFund • Aug 26
It will b difficult for domestic food prodn to satisfy demand in Asia - Jammie Penm @ABARES #cf2014conf

Risti Permani @Risti_Permani • Aug 26
@OxfamAustralia DrHelen Szoke "watch your waste:loss less,consume sustainably" #cf2014conf #agriculture #FoodSecurity pic.twitter.com/pFTGDQ2uJz

The Crawford Fund @CrawfordFund • Aug 26
Many cultures give men best food and they're fed first which impacts women & children nutrition & hunger - Norah Omot #png #cf2014conf

The Crawford Fund @CrawfordFund • Aug 26
Wonderful to have session of women spkrs #cf2014conf addressing #gmo #nutrition #waste pic.twitter.com/dlf9Q0vvYf

UNFPA Pacific @UNFPAPacific • Aug 26
RT "@CrawfordFund: Nutritional challenges faced by a dev. countries addressed by Dr Norah Omot NARI #png #cf2014conf" pic.twitter.com/qLTrhZLwI3

The Crawford Fund @CrawfordFund • Aug 26
'Evidence may not always win but without it we are back in the dark ages' @ElizabethFinkel @CosmosMagazine #GMO #cf2014conf

Risti Permani @Risti_Permani • Aug 26
#cf2014conf Dr Elizabeth Finkel -Cosmos Science Magazine Q:modern tech: good or bad?; A:Depends, compared to what :-) pic.twitter.com/grBqdh9BIQ

The Crawford Fund @CrawfordFund • Aug 26
Insects as an additional option in food security raised in Q&A #cf2014conf @icipe

Sarah van Bronswijk @svonboombox • Aug 26
@crawfordfund Asking the big questions on food security: why aren't we eating insects? #CF2014conf

Sarah van Bronswijk @svonboombox • Aug 26
@crawfordfund Crawford Fund Conference, Julie Bishop: Aus food feeds 60Mil, Aus knowledge feeds 400Mil #CF2014conf pic.twitt Bishop

Risti Permani @Risti_Permani • Aug 26
Dr Willie Dar #biofuels will take off in countries where subsidies are low to medium #FoodSecurity #cf2014conf pic.twitter.com/Iitn0DaPQo

Risti Permani @Risti_Permani • Aug 26
Ethical principles of #biofuels development #cf2014conf pic.twitter.com/QxIP186r0p

Risti Permani @Risti_Permani • Aug 26
Dr Willie Dar @ICRISAT on why #biofuels and its link with #land use change #agriculture #cf2014conf pic.twitter.com/pUOs3hbjPL

Risti Permani @Risti_Permani • Aug 26
Pak Yudi Noor #cattle production system #feedlot in #Indonesia #cf2014conf "cheapest feed: by-product" @NTCattlemen pic.twitter.com/HBgQWhDzPC

Risti Permani @Risti_Permani • Aug 26
Pak Yudi Noor on Indonesia today #cf2014conf #beef #Indonesia pic.twitter.com/tAhqEBvD0A

Risti Permani @Risti_Permani • Aug 26
Dr Zessler on partnership opportunities "stable governance and effective accountability" #cf2014conf pic.twitter.com/C5VoXp3fwl

AIFSC @AIFSCAustralia • Aug 26
Return on investment in nutrition research is 1:30 Shenggen Fan @ifpri at #cf2014conf @crawfordfund

Risti Permani @Risti_Permani • Aug 26
#CF2014conf Session II starts. Dr Laurent Zessler, Mr Yudi Guntara Noor and Dr Willie Dar @CBC_FapetUnpad pic.twitter.com/95OYTvtAzQ

Shaun Coffey @ShaunCoffey • Aug 26
What price cheap food? http://shauncoffey.blogspot.com.au/ #feedthe9 @CrawfordFund #cf2014conf

Risti Permani @Risti_Permani • Aug 26
Luke Chandler #Farmers need incentive @NationalFarmers #CF2014conf pic.twitter.com/8NgJu7feeK

Risti Permani @Risti_Permani • Aug 26
Luke Chandler when the #supplychain breaks #ouch #beef vs #horse meat #CF2014conf pic.twitter.com/tjpPCxceVS

RAID Network @RaidNetwork • Aug 26
Luke Chandler on trade, supply chains and food security. #cf2014conf. Video - Future Of Farming http://www.youtube.com/watch?v=ArvQtSmjgcg&sns=tw … via

Risti Permani @Risti_Permani • Aug 26
#Food and #agriculture #supplychain are becoming more complex #CF2014conf #Oz #trade pic.twitter.com/AVOspfzzhH

The Crawford Fund @CrawfordFund • Aug 26
@lukechandler100 explains China food demand & complex supply chains #cf2014conf pic.twitter.com/0RPXBHlrde

Risti Permani @Risti_Permani • Aug 26
Luke Chandler #Asia already dominates #Oz export returns but... #agriculture #CF2014conf pic.twitter.com/fJF0NFPZOF

ACIAR @ACIARAustralia • Aug 26
#cf2014conf Opening address from @JulieBishopMP 'Ag a priority for our aid program because ag works' pic.twitter.com/Iko3gpnlbU

Risti Permani @Risti_Permani • Aug 26
Luke Chandler #food and farming are in the spotlights #CF2014conf pic.twitter.com/RiUflBbyvR

Risti Permani @Risti_Permani • Aug 26
Dr Fan @ifpri on #gender equality in #agriculture #CF2014conf @influentialw @GlobalAgDev @RIRDCRuralWomen pic.twitter.com/QRQacaZbky

Risti Permani @Risti_Permani • Aug 26
Dr Fan @ifpri Smallholders in #agriculture: move up or move out? #cf2014conf pic.twitter.com/6nlFVcxF8a

Risti Permani @Risti_Permani • Aug 26
Dr Fan @ifpri on promoting sustainable intensification and resilient #food systems #CF2014conf #agriculture pic.twitter.com/8t7beTvHal

Risti Permani @Risti_Permani • Aug 26
Dr Shenggen Fan @ifpri on inefficient policies that add burden of hunger and malnutrition #CF2014conf #FoodSecurity pic.twitter.com/RDMpBZfOFF

Risti Permani @Risti_Permani • Aug 26
Hunger and malnutrition are costly #CF2014conf #nutrition #FoodSecurity pic.twitter.com/ftVMN6lsHO Congratulations Assoc Prof. @RobynAlders for recieving the crawford medal #cf2014conf @CrawfordFund @AIFSCAustralia @ACIARAustralia

Risti Permani @Risti_Permani • Aug 26
More than 2 billion people are micronutritient defficient #cf2014conf pic.twitter.com/8Td2CoDtoN

Favorited by ACIAR

DFAT @dfat • Aug 26
RT @CrawfordFund: 'Ag a priority for our aid program because ag works' @JulieBishopMP @dfat #cf2014conf @ACIARAustralia @CGIAR

Risti Permani @Risti_Permani • Aug 26
Dr Shenggen Fen @ifpri key messages #cf2014conf #FoodSecurity #agriculture pic.twitter.com/8FyMreO5m4

The Crawford Fund @CrawfordFund • Aug 26
@JulieBishopMP explains that coupling ag research and marketing important for success and impact #cf2014conf

The Crawford Fund @CrawfordFund • Aug 26
'Ag a priority for our aid program because ag works' @JulieBishopMP @dfat #cf2014conf @ACIARAustralia @CGIAR

Risti Permani @Risti_Permani • Aug 26
Prominent speakers session1 #CF2014conf Rachel Kyte, Shenggen Fan and Luke Chandler @ifpri @WorldBank @CrawfordFund pic.twitter.com/dsa37LrkJw

The Crawford Fund @CrawfordFund • Aug 26
Follow #cf2014conf for 'Ethics efficiency and food security' today. @JulieBishopMP about to open.

Risti Permani @Risti_Permani • Aug 26
A beautiful morning in #Canberra ready for #CF2014conf #parliamenthouse pic.twitter.com/YMDLV7JnZj

Risti Permani @Risti_Permani • Aug 26
A post from #CF2014conf dinner @C_A_Bertini @GlobalAgDev "Dont forget the ladies: #women in #agriculture @CrawfordFund http://blogs.adelaide.edu.au/global-food/2014/08/27/dont-forget-the-ladies-the- role-of-women-in-agriculture/ …

Chicago Council Ag @GlobalAgDev • Aug 26
RT: Most important time of our lives is first 1000 days - are we growing baby friendly foods? @C_A_Bertini at #cf2014conf via @CrawfordFund

The Crawford Fund @CrawfordFund • Aug 26
Congrats to @RobynAlders who received a Crawford Fund medal for extensive work & impact in Asia & Africa #cf2014conf pic.twitter.com/FogzgAooeP

Risti Permani @Risti_Permani • Aug 26
#cf14conf #cf2014conf Nicholas Brown of ANU on Crawford's biography to open the networking dinner http://history.cass.anu.edu.au/story/grant-success- crawford-biography …

Risti Permani @Risti_Permani • Aug 25
Conference dinner at 6pm #FoodSecurity #Governance #cf2014conf #cf14conf http://blogs.adelaide.edu.au/global-food/2014/08/25/the-2014-crawford-fund-parliamentary-conference-pre-conference-note-on-food-security/ …

The Crawford Fund @CrawfordFund • Aug 25
.@C_A_Bertini "investing in women the best way to feed the world's hungry" http://www.abc.net.au/radionational/programs/bushtelegraph/un-woman/5697292 … @RNBushTele @SyracuseU @WFP #cf2014conf

The Crawford Fund @CrawfordFund • Aug 25
Media materials for our 'Ethics Efficiency & Food Security" conf available here http://www.crawfordfund.org/events/parliamentary-conference/2014-parliamentary-conference-media/ … #cf2014conf

Science&TechnologyAU @ScienceAU • Aug 25
Our next Topical Science Forum Th Aug 28: How do we feed the world as the population soars? #cf2014conf #feedtheworld http://buff.ly/1wqLggc

The Crawford Fund @CrawfordFund • Aug 23
#cf2014conf hashtag for this week's Ethics Efficiency & Food Security conference 26-28.8 Parlt House Canb http://www.crawfordfund.org/events/parliamentary-conference/ …

The Crawford Fund @CrawfordFund • Aug 21
#CF2014conf issues incl #ag4dev #foodsecurity #trade #biofuels #GMO #waste #population #nutrition http://www.crawfordfund.org/events/parliamentary-conference/ … Registn closes 5pm

The Crawford Fund @CrawfordFund • Aug 11
Students at our conf r welcome to our Young Ag Students Forum 28.8- more info soon #CF2014conf Our student scholars: http://www.crawfordfund.org/events/parliamentary-conference/young-scholars-program-conference-travel-scholarships-2014/ …

ETHICS, EFFICIENCY AND FOOD SECURITY: FEEDING THE 9 BILLION, WELL 2014 Annual Parliamentary Conference

THE CRAWFORD FUND

For a Food Secure World

For further information,
to support us or to be kept informed
of the Crawford Fund's work, contact:

PO Box 4477
Kingston ACT 2604

+61 2 6188 4370

www.crawfordfund.org

ABN: 86 141 714 490

An initiative of the Australian Academy of Technological Sciences and Engineering