UNIVERSITY OF CAMBRIDGE

GLOBAL FOOD SECURITY

Report of the Cambridge Conference on Global Food Security

23-24 June 2016

The David Attenborough Building, Cambridge

Incorporating the Cambridge Conservation Forum Summer Symposium

Contents

Acknowledgements

The conference organisers would like to thank speakers, panellists, session chairs, rapporteurs and other student volunteers who contributed in many valuable ways to the success of the event. In addition we would like to recognise the support of Cambridge Conservation Initiative in hosting the conference, the logistical help of its services staff at the David Attenborough Building, and Origin8 who provided the catering with locally sourced food and minimal waste.

Conference organising committee

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Conference background

Cambridge Global Food Security (CGFS) is the University of Cambridge Strategic Research Initiative on Global Food Security. As one of 12 SRIs, the aim of the initiative is to encourage inter-disciplinary collaboration on impactful research relevant to the key challenge of achieving the affordable access by all to food needed for an active and healthy life, maintaining sufficient natural capital to do so sustainably in the context of future global population growth, economic development and climate change. The Initiative is co-chaired by Professor Chris Gilligan and Professor Howard Griffiths of the Department of Plant Sciences, with a steering committee representing six other University departments as well as its Research Strategy Office, and the National Institute of Agricultural Botany (NIAB).

Building on the information sharing that took place at the Global Food Security Cambridge Symposium 2015 held at the The Sainsbury Laboratory on 8 July 2015, the 2016 Cambridge Conference aimed to gather academics, policy-makers and practitioners to explore priorities and means for making a more positive impact on food security outcomes in the future, and look at latest innovations in research and practice to this end. With the major conference focus on food security, sustainability and conservation, CGFS collaborated with the Cambridge Conservation Initiative (CCI), University of Cambridge Conservation Research Institute (UCCRI) and Cambridge Conservation Forum (CCF) in the organisation of the event. We also partnered with the Centre of Development Studies on covering questions of the economics, politics and culture of food.

Conference participation

Attendance at the Cambridge Conference included many participants from the University and City of Cambridge, as well as from outside including other European countries. A total of 225 people were involved over the one-and-a-half days as speakers, chairs, volunteers and other delegates. An estimated 140 people attended on the Thursday afternoon of 23 June and 180+ on the Friday, 24 June.

Conference programme

Thursday 23 June 2016: Framing the challenge

14.15–16.00 Opening plenary session: the challenge we face (Chair: Prof. Chris Gilligan, Cambridge Global Food Security)

- Welcome and introduction (Prof. Chris Gilligan)
- Viewpoint from the international NGO community (Dame Barbara Stocking, Murray Edwards College)
- Viewpoint from politics and policy making (Zahid Jahoi, First Secretary, High Commission for Pakistan)
- 'Agriculture is the backbone of our countries' - viewpoint from the grassroots (Shadrack Yoash and John Opio, Farm Africa)
- Fresh notes from the field (Toby Smith, University of Cambridge Conservation Research Initiative)

16.00–16.30 Refreshment break

16.30–18.15 Plenary session: Priority research questions and opportunities for impact (Chair: Prof Sir Brian Heap)

- Perspective from students and young career researchers: conclusions from the Oxford-Cambridge Food Forum (David Rose)
- A year in discussion: conclusions from the 2014-2015 meetings of the Forum on Sustainability and the Environment (Will Simonson, Cambridge Global Food Security)
- Panel debate: priority research questions and opportunities for impact (Prof Charles Godfray and Dr John Ingram, University of Oxford; Professor Corinna Hawkes, City University; Dr Nigel Poole, ICRISAT; Prof Jiping Sheng, Remnin University)

18.15–19.30 Drinks reception and posters

Friday 24 June 2016

Stream 1 (CCF Summer Symposium): Food security, sustainability and conservation

09.30–11.00 Plenary session 1: Landscapes for people and nature – the science and the practice (Chair: Bhaskar Vira)

- Sustainable intensification, its framing and implementation (Prof Charles Godfray, University of Oxford)
- Would land sharing or land sparing allow more wild species to survive? (Prof Rhys Green, University of Cambridge and RSPB)
- Birds, bees and butter – Enhancing ecosystem services and livelihoods in the Shea parklands of sub-Sahara Africa (Dr Cath Tayleur, Birdlife)

11.30–12.45 Plenary session 2: Actors in the landscape – smallholders, supply chains and sustainability (Chair: Dr Liz Watson, University of Cambridge)

- Where next for agricultural research and extension (Dr Nigel Poole, ICRISAT)

- Making smallholder resilient agriculture work for women farmers - the case of system of rice intensification (SRI) in India (Dr Regina Handsa, University of Cambridge)
- Gola's landscape approach, connecting forest and people with cocoa (Dr Nicolas Tubbs, RSPB)

13.45–15.00 Plenary session 3: Citizens and consumers – from individual responsibility to planetary health (Chair: Teresa Mulliken, TRAFFIC)

- Dietary choices and planetary impacts (Dr Tara Garnett, Food Climate Research Network, University of Oxford)
- Hungry and obese: The challenge of household food insecurity (Dr Pablo Monsivais, Centre for Diet and Activity Research, Cambridge)
- Eating insects: finding innovative ways to feed a growing population (Shami Radia, Grub)
- Reducing food waste to reduce our environmental impact (Niki Charalampopoulou, Feedback)

15.30–16.45 Plenary session 4: Environmental boundaries – managing what we can measure (Chair: Howard Griffiths)

- Food systems, food security and global environmental change (Dr John Ingram, University of Oxford)
- The energy-water-food nexus in Brazil (Dr Jean Francois Mercure, Radboud University)
- Early warning for building resilience to food crises in Africa (Dr Francois Kayitakare, Joint Research Centre)
- Food versus forests in sub-Saharan Africa (Dr Phil Franks, International Institute for Environment and Development)

Stream 2: Economics, culture and politics of food

09.30–11.00 Plenary session 1: Economies of food production – 'old' questions and 'new' models (Chair Dr Shailaja Fennell, Centre of Development Studies)

- Agricultural growth for economic development (Jolly Dusabe, Centre of Development Studies)
- How production of food crops can help national GDP to grow: case study of Rwanda (Jane Lichtenstein, Centre of Development Studies)
- Pioneering food systems (Dr Harnik Deol, Senior Research Visitor in the Centre of Development Studies, University of Cambridge)
- TEEB for Agriculture and Food: Valuing impacts and dependencies in the eco-agri-food systems complex (Dr Salman Hussain, United Nations Environment Programme)

11.30–12.45 Plenary session 2: Global governance of food (Chair: Dr Kun-Chin Lin, Department of Politics and International Studies)

- Feeding a growing population: food sustainability and international economic law (Prof Fiona Smith, Warwick University)
- Governing Food Security: why has the multilateral trading system failed? (Prof Amrita Narlikar, German Institute of Global and Area Studies)
- Governing fragmented food systems (Prof Catrien Termeer, Wageningen University)

13.45–15.00 Plenary session 3: Food and culture (Chair Ksenia Gerasimova)

- How the modern Chinese choose what to eat (Prof Jiping Sheng, Remnin University)
- When East meets West: learning about wine culture in Italy and bringing it to Japan (Prof Takayuki Shoji, Rikkyo University, Japan)
- Sustainable food, culture and integration in Solidarity Purchase Groups Movement: the case of Barikamà in Rome (Daniela Bernaschi, University of Florence)

15.30–16.45 Plenary session 4: Food justice and food equality (Chair: Dr David Nally)

- Golden Rice: Discussion of Humanitarian and Environmental Rights (Dr Ksenia Gerasimova, Centre of Development Studies)
- Famine past and future (Prof Cormac O'Grada)
- The right to food in the Anthropocene: Equality and sustainability in the South African food system (Dr Laura Pereira, Centre for Complex Systems in Transition, Stellenbosch University)

16.45–17.30 Pulling it together – feedback session, panel discussion and closing remarks

Summaries of talks

The following summaries are based on notes from student rapporteurs Rekha Bhangaonkar, Lucy Greenwood and Joanna Wolstenholme.

Thursday 23 June 2016: Framing the challenge

Opening plenary session: The Challenge we face
Chair, Professor Christ Gilligan

Introduction by the chair
Professor Chris Gilligan

Today, we are talking about harnessing the natural and social sciences in pursuit of food sustainability, security and quality. This meeting incorporates the combined efforts of the Cambridge Conservation Initiative (CCI) and the Cambridge Global Food Security Initiative (GFSI).

In solving food security problems across the globe, it is vital to form partnerships between social science and natural science organisations. One example of success in this regard is the Cambridge Centre for Crop Science, working in collaboration with NIAB. This partnership incorporates the social sciences by looking not only at the development of different crop varieties, but also their acceptability.

Within the GFSI, there are a number of food security related research themes:

- Infectious diseases
- Plant biology
- Food landscapes
- Supply chains
- Political economy (what can we learn from famines in the past, was it a supply problem, or one of distribution?).
- Global governance
- Modelling (how can we carry out "what if" scenarios to make better decisions?).
- Land resources and regulatory influences – legal aspects of food health
- Food and health

Two examples of how modelling can be useful:

1. *How do we feed the world between now and 2050?* Modelling can help us look at the energy and other resource requirements along the food production system. This is helpful in answering the question, "is there going to be sufficient energy to expand the cultivation of land in order to feed the world's growing food demand?" From these models, we predict that sustainable production alone is not enough – and so we need to think about *demand mitigation* if there is going to be enough food for all in the future.

2. *Modelling concerning epidemics.* Marcel Meyer (Dept. Plant Sciences) has undertaken research in this area looking at emerging strains of wheat stem rust in Africa. This disease has been caused by homogeneity of wheat production, leading to the erosion of gene diversity. Modelling in Ethiopia (where new strains of the disease have arisen) reveal major outbreaks of the disease. The model is able to show the spread of the disease, and also to predict how far and where it moves in the Rift Valley. The answers from Meyer's

study are encouraging: we can examine the main routes over which the spores will travel, right up into the Middle East and East Africa; and this knowledge enables preventative action to be taken.

Viewpoint from the international NGO community
Dame Barbara Stocking, Murray Edwards College

Some statistics from the FAO:

- 1 billion people are undernourished (according to calories only). The highest percentage of this figure in absolute terms is in South-east Asia, and the highest actual number in sub-Saharan Africa.
- If distributed evenly, there would be enough food for all.
- If there were no over-consumption of food in the middle classes, we would only need a 1% increase in production to ensure the world is fed.

The FAO also predicts that we need a 70% increase in food production to feed a world population of 9 billion by (by 2050). How do we do this? We cannot ignore climate change and its impacts. We need to stop food waste. In Europe the average person wastes 100kg of food per year! In the poorest nations it is also wasted, but for different reasons (such as poor storage facilities). In summary there are two big ways to address the issue: first, a straightforward increase in the output of food; and second to fix the global food system to make it fair.

Production
Here, the focus is on big farms for production. The mainstream view is to promulgate big farms for the purpose of output. The real difficulty about this is that if you take all the small farmers off land, this fuels urbanisation and many towns and cities in developing countries do not have the services or infrastructure to cope with this migration. This means that there is a great incentive to make sure small farmers can keep producing. To push people off the land now is a disaster given what is already going on. The second problem with big farms is their environmental impact: the fertilizers they use degrades the land.

There are currently 1.5 billion small farms globally, and we should make them produce more – help them out, as opposed to only focusing on big farms. So why have we not been doing this? This is political. In 1983, agricultural aid was 20% of all aid. By 2006 it was only 3.7%, and so very little has been done (and is being done) to improve agriculture in the poorest nations. Women especially are in need of help because they play such a prominent role in food production and provision throughout the developing world. They need: organic fertilizer; transport to markets; the ability to access finance; and also to own their own land so they can invest in it (security is key).

The other key thing to help small farms is to get organised. Cooperatives and production companies can bring loads of farmers together. For example, in Ethiopia 9000 women are involved in a bee-keeping cooperative, which is producing honey in vats (no small amount!). This is then exported to the French bakery market. Cooperatives such as this are able to negotiate into big markets – but this requires cooperation. Major food companies and retailers are now more prepared to buy from co-ops.

Land grabs
Sometimes land is grabbed as an asset: to realise an increase in its value. Governments are often the ones responsible for land grabbing (thinking ahead to feed their own people). Saudi Arabia, for example, has been buying up productive land in Africa – really they are buying water!

Land grabbing requires the consent of the people on the land, and their compensation. However, 22,000 have been pushed off their land in Uganda by the British government for logging and were not compensated. Oxfam had an on-going legal case there… and tried to point out that the

World Bank was breaching their own rules - as was HSBC, which was represented on the board of the Forest Company. The land issue comes back to small farmers and ownership – small farmers need to own their own land to invest in it.

The whole food system

The whole food system and who actually owns it is a massive problem. There are 1.5 billion producers, but only 4 firms deal with the inputs! A high monopoly position enables them to control prices and to decide where the production is going. Three major companies control 90% of the global grain trade, and it is not transparent what they hold, where it is, and what they intend to do with it. In 2008, at the time of the Global Food Crisis, we did not know where the food was. It is easier to shift behaviour of consumers than to attack these large companies. There are 7 billion consumers – they can start acting now, and they are. One example is the fair trade industry (coffee in Europe and the US). Fair trade is not the answer to everything – but it does send signals to companies that consumers are aware of what they are doing. We cannot let a small number of companies hold us hostage on our food.

Climate change exacerbates everything

It is inevitable that climate change will push up food prices – especially for staples such as maize and paddy rice. This is a real issue for poor people. If you are spending 70% of your income on food, and the food price doubles – you are in trouble. This does not have the same impact for the middle and upper classes. Poor people simply will not be able to buy the food that exists for purchase.

The number of extreme weather events (includes drought and heavy rain) will also increase. Indeed, between 1990 and 2005 they doubled. It is expected that the increase in extreme weather will disproportionally affect countries in the developing world. For example, during the 2010 Pakistan floods 40 million people were displaced. At this moment, 60 million people in Africa are affected by the current drought, but this is not recorded in the media. The numbers are so large because of the extremes in the way that the weather is changing.

The issue for everyone is what will happen to production in the face of climate change? If there is no adaptation, and we manage to constrain warming to 2 degrees, yields will drop at 0.2% per decade. Under this scenario, temperate climates will do better. But if there is a 3-4 degree increase in temperature (which is a real possibility) – all latitudes will be affected.

So what to do in the face of climate change?

How many more people will have to suffer before we take serious action on climate change? It is the poor who are being affected now – we can only hope that the rich act *before* they start to feel the impacts of climate change also. In the meantime, we need to help poor people to cope. Making agriculture more sustainable is all very well – but we also need to help poor people survive. Disaster risk reduction is key. With the threat of sea level rise in Bangladesh, for example, a women's group is saving lives. Climate disasters here used to leads to tens of thousands of deaths, but disaster management has meant that this figure has been reduced to a few.

Another example is cash distribution in Turkana. Here, the aid agencies see that a lack of punching power is causative of food insecurity. The task is to first get the traders to bring in the food, but then the poor need the money to buy it. In Turkana, the Equity Bank gave out money (based on how much families need) using a smart card with a thumb print system. In Somalia there is a similar problem, and aid agencies paid the traders and the consumers to fuel supply and demand.

Climate change and what it does to poor people is the KEY message to take from this talk.

Questions for Dame Barbara Stocking

Q. The aim to help small holders and not take people off the land is all very well, but total factor productive can be terrible in small farms. Is it better to encourage the development of larger farms and to make sure there are the jobs in the cities for small farmers who lose out?

A. I agree – we can do better in the cities, but there remains a need for a case-by-case analysis. In Bangladesh, people could not live where they were living because of the salt in the soil and here, moving people to small towns was necessary. We need planning at all levels. Assumptions cannot be made that urban migration is always the best solution.

Q. Local food producer. I am interested that there is enough food (and it's a matter of distribution rather than production), and so I am curious about the statistic you cited that here is a need for a 70% increase in production? This number is being used by large agriculture companies to argue for increased outputs – but they do not talk about waste and distribution. Is the number correct?

A. It is probably not accurate – but an estimate from the FAO. But, there does need to be a significant increase if you take into account the increase in population (to 9-10 billion) and the rising middle class who want to eat more. Plus, agricultural land is being reserved for biofuels. 30% of the price rise in food could be attributed to taking out land in the Americas for biofuel production.

Q. You mention that Saudi Arabia is essentially buying water. In California, water usage rights are a big issue – especially the amount that goes into agriculture. Do you think water is more important than food and how do you manage both?

A. One is not more important than the other. Water management, trying to use it as sparingly as possible (for example by using drip irrigation and rain collection) is so important. It is also important for companies to be conservative with water – and climate change makes things more difficult. There are big issues around water and this intersects with food prices.

Viewpoint from politics and policy making
Zahid Jahoi, First Secretary, High Commission for Pakistan

I am part of the policy execution arm of the Government in Pakistan. Food is a fundamental human right and a driver of economic growth, a precursor in fact. There is a proven link here, between food security and growth, and also for stability in the developing world. In nations where there have been food shortages, there have been conflicts; and in a globalised world, it does not take long for local discontents and conflict to become international concerns.

There is a need to go beyond simple production in solving food security crises. Also, just responding with food aid is not enough. There is a need to invest in infrastructure to support production. In Pakistan, there is a prioritisation on this issue.

Pakistan provides a case study to prove that production is not enough. Here, the agricultural sector sustains 45% of the population – wheat production in particular is the mainstay of food security. Rice has also been considered as a main crop and stable food in terms of its export value. But despite growth in the production of both crops, there has been a sharp decline in food security because of conflict and instability. In the recent past, the first natural disaster in decades – flooding over 1/5th of the land mass – left 20 million without access to food and other basics. The food insecure percentage of the population rose to 50 million and rose again to 90 million after the 2010 floods.

This prompted Government action. A full Ministry of Food Security was established in 2011 (replacing the old Agriculture Ministry) and was assigned responsibility for policy and planning

for food and agriculture to meet the needs of its growing population, now at 200 million. The barriers in Pakistan as in many nations include: poverty, inadequate food distribution, supply, government policy, climate, weather changes and conflict. The key challenge to the world is to eradicate food want – and to feed its growing population. Guaranteed access to healthy and nutritious food requires a global approach/solution and actions on a global level. This will only be possible if the social and natural sciences work together.

'Agriculture is the backbone of our countries' - viewpoint from the grassroots
Shadrack Yoash and John Opio, Farm Africa

Shadrack
Agriculture is the backbone of our two nations. In Tanzania it employs 75-80% farmers; in Uganda 85%. In terms of technology, much manual work in land preparation is required – people have to rely on their body energy to open up their land, which is covered by the weeds you can see. It is very difficult to open up new plots!

What does famine mean to us?
Subsistence agriculture is what most people do, and it is a sustainable way of getting nutrition – in most cases, as you can see, it is women who are doing the job. Men do assist in some cases and at some stages of production, but it is the women who are highly involved in feeding families. What remains is distributed to those in need in a community. Agriculture is for subsistence – not much business is involved – and so it is really only people with families doing farming. The young and educated do not farm.

Crops grown for subsistence purposes include maize, beans, peas, rice, cassava and sweet potatoes. These are not really cash crops – they are mostly for food. What they grow for food is also what they sell if there is a surplus. The cash from market is used for the purpose of education, celebrations etc. People use shifting cultivation – opening the land and using it for 2 to 5 years, then shifting to another plot – leaving the used one to fallow and regenerate.

The issues of nutrition from a subsistence diet – how do the people get their energy to live?
In terms of nutrition, there is very little animal protein. Only the crops supply protein. This is a problem, because the farmers need energy to open up their land for their survival. How do they make more energy? Training on new technologies is needed because they survive though selling crops, vegetables and fruits. Families have to cultivate in smaller plots – to mix things up to get diversity into their diet. But technology would really help so that farmers do not have to use so much energy to get energy back out of their land. There are also farmers with livestock – Maasai people. They rely on livestock to survive, buying food from others.

There are local selling agreements and initiatives. The most lucrative business is selling local root vegetables (sweet potato and cassava). It is mostly women who are involved in doing this. There are also small businesses to a minor extent, for example the selling of timber, mushrooms, forest fruits and other things from the forest.

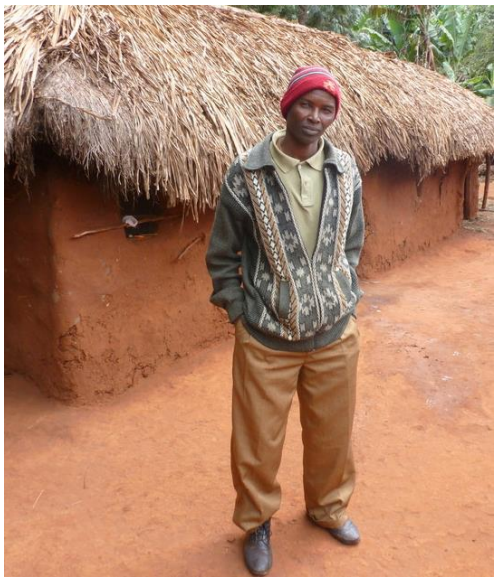
Problems with selling produce
It is important for people to be able to earn money to send their children to school, to pay off debts, and for celebration – this drives people to sell. The problem is that in most cases, the sellers do not set the price – the consumer does. If your child is sick, you cannot argue on the price. So the middlemen dominate and then sell at much higher prices. It is called "throwing prices". How much is actually left to sell is another issue. This depends on the area opened, the crops grown, and the season (rainy, dry etc.). With climate change there is less production, so less to sell – this is worrying. Seasons are not as predictable as they used to be – and this also restricts growing areas. Floods are also a problem.

We need to strengthen the capacities of farmers for production. The type of storage is also important – what capacity they have in this regard determines how much land can be opened up. Because if they have no storage capacity, there is little point opening up a lot of land – because the crop will rot before it can all be transported to a market. A limited ability to transport crops is a problem in itself, many farmers only have their legs, or bikes. So when they get to a market, they have little choice but to sell at the price offered by the consumer: they cannot find another market easily before the food goes off. Village Service Lending (VSL) can also determine how much you sell. Members of VSLs are better off. If a family only has a small plot – they work for fellow farmer or big growers to earn.

John
In Uganda, there are a number of challenges for farmers. Right now, I am trying to bring a picture of this place for you – we both bring a picture of what our people struggle with.

Among the many challenges is energy
It is very difficult to clear land with a hoe as small as your foot, to dig a massive area to feed one's family – which often includes 10 children. These people are quite literally using their backbone to produce food! And so, they need energy to produce food. How much land is opened – compared to tractors? This is a huge disparity. The little food they produce is only enough to feed themselves and their family. But they need surplus to get money for education.

Lack of access to markets
Take the case of this boy (pictured) – he wants to market his produce. The problem is a lack of access to markets. Even if one manages to produce enough, or a collective looks for markets, there may be nothing, and then very little money can be gained from the local market.



To add to this, there is poor infrastructure. In Britain there are so many roads! In Uganda, our roads have so many potholes, and if it rains you cannot get though. In the villages they may only have bikes to carry produce from home to the market and this limits what they can carry. Also, the middlemen move all the time, and cheat the farmers. They know that the farmers cannot travel around to find the best price.

The use of hands and hoes
Look at this lady trying to do her best (pictured), but the poor technology – and land which has been used for several years means that what she will get from this cassava crop is very little. The land is degraded by rains. Land degradation is a problem in itself. Poor soil quality results in poor quality crops. It is very difficult for her to feed her family.

Support farmers' needs through good policies
Government policies to sustain and support food production can help people live better lives. When I was born in 1960, when there was a good harvest the government would fill up the storage barns. People were then not allowed to use it until they actually need it.

Good policies are needed: prioritising food over energy production; helping domestic farmers to sell their produce; providing soft loans to open enough land to buy oxen; supporting access to markets by improving infrastructure; leading on

environmental protection, because at the moment forest are being cut down – so the Sahara is expanding; education on climate change to help with mitigation and adaptation; early warning systems for climate events; research and extension services (information for farmers) to increase the productivity of farmers and their access to markets.

Farmers don't want to be given food or money – they want to produce their own and to lift up the productivity of their own land. The organisation Farm Africa promotes this.

Questions for Shadrack and John

Q. I am interested in property rights for seeds. If there is such a high number of small-holder farmers, and if the challenge is access to markets and infrastructure, and the solution is government policy to support them – can they sustainably feed their countries?

A. The key is to start with markets. Only though paying markets can we can incentivise and motivate them to do the farming targeted to reach the market demand (rather than just subsistence). If they do not have this – why should they produce more? The land is fertile in most places, it just needs opening – but motivation is lacking – because where do they take the produce and how do they get it there? So the market needs to be the first step.

Q. Going back to the slide with the lady tending cassava. If the challenge is to help farmers shift away from this traditional style of farming, as an extension officer (with your role in communication and tech innovation) how do you help people to make this shift?

A. Innovation is about adaption. This is a process – it cannot happen immediately. People who are the first innovators inspire others to make the shift, because they will see that people who have innovated benefit.

Question/comment. I think you are painting a negative picture, because I know Farm Africa is doing very positive work in Tanzania. Also, you have not acknowledged that you have some great entrepreneurs. I can think of a chief in Tanzania who was concerned about migration away from his village to the city. So, he tried to find out why. It was because of milk. So he set up a dairy farm – and now exports cheese to the Netherlands. One of the key things is not just food, but the energy to produce it. Now in his village the energy sector is starting to develop.

A. I agree – in Uganda there are many positive things happening. Many are opening businesses and smallholder farms are successful with better technology. In Nigeria we are trying to think of the majority, which are small holder farmers.

Fresh notes from the field
Toby Smith, University of Cambridge Conservation Research Initiative

I am a photo-journalist and today I am going to take you on a visual journey of two assignments I undertook in April, the first in Madagascar and the second in Zambia. My first assignment focused on documenting the illegal cutting of rosewood in Madagascar, and helped to see the successful prosecution of loggers. The Second, in partnership with Unknown Fields, looks at illegal sapphire mining in Zambia.

Good journalism should amplify voices in the field, which should not patronise or be replaced with western views. We are guilty of serving our audiences – so you will see a lot of sensationalism in order to meet this demand. Journalism is, however, becoming more embedded with NGOs and locals. We all need to consider how the news is brought to bear.

#Cropsincolour – Madagascar assignment
April rice crops come in a variety of colours and this is reflective of genetic variety and methods of production. On average individuals in Madagascar consume 120 kg of rice each per year! The type of rice eaten varies from meal to meal: red rice is usually eaten for breakfast and white in the evening. Nothing from rice production goes to waste. Rice husks are fed to cattle, and surplus is sold to the market. Interestingly, the standard measurement of rice is an empty tin of condensed milk. A "bad year" is detrimental for households dependent on rice. Of consequence, there is a need for resilience strategies – specifically against drought and cold snaps. Another problem is the red flour parasite.

Here, you can see the grain field in the north east of the country – they are so vast and of great importance for food security – but there is little online information about them. Here, one problem is how to transport the produced grain to markets.

Slash and burn for charcoal or cattle grazing. The deforestation required for these purposes reduces soil structures and leaves scars on the landscapes. The soil is easily washed away from steep slopes. This clogs local rice paddies, stunts growth, and can destroy a whole harvest. Deforestation is a huge issue for food security.

Second Zambia assignment
I was in Zambia during its mini dry season. The main crops grown are maize and cassava. Cassava is a low input tuber crop. Most of Zambia is made up of subsistence farmers – and there is a spirit of openness here, with community meetings.

Farmers receive massive benefits from roads. The small farms are organised, and want transport to break free from the middle man. Big farms are competition for the small holder farmer. Huge rotor-irrigated farms are not run by locals, but mostly by South Africans or other expats. They take water from the river and so are independent of rains and seasonal panting.

For small farmers – when there is a reliance on natural hydrology – it is a double blow to them if there is a dry year. While there is national food reserve bank, this is a thin armour against climate change if the drought gets too bad.

Cassava production in Luapula. East of the peninsula of Congo, the Luapula Providence has a road built by China. The sandy soils here are perfect for cassava. Cassava competes with brush and weeds – and has less need for storage compared to maize. The cassava tubers are peeled and soaked to dilute the cyanide in them. There is a preference for bitter cassava varieties because they are less likely to be stolen! The cassava is then broken and dried in the sun and turned into flour. It tastes similar to maize. Fresh cassava leaves can be picked from the crop and they are full of iron and Vitamin D. None of the biomass is wasted, the peelings are fed to cattle. And 50 new plants can grow from a single cassava stem. Intercropping of legumes produced higher nutrients when land is opened for maize after the cassava crop.

At the Mansa research station in Luapula, they are looking into the problem of white fly and brown streak (the latter can destroy the tuber undetected from above). There have been efforts to cross breed – but specimens are being outrun by the illegal movement of cassava across borders. Despite all the great things about cassava, it is viewed as a poor man's crop – a backup in times of hardship. Maize is more attractive.

Questions

Comment from the Chair. Field distribution size in Madagascar is interesting – tonnage is more important in the North (larger area for grain production), and they employ more labour here. I wonder about the size of this enterprise and what risks go with it? It is interesting the land races you identify.

Q. Thinking about how recently maize and cassava have been in Africa – why is cassava not viewed so favourably?

A. I get the impression from farmers of a family history – and the changing place of cassava and maize in their lives. There is more of a gold rush feel to maize. On the ground, maize was preferred over cassava because of the cash people can get for it.

Q. Is there any realisation that because of drought, and because cassava is drought resistant, it is a better idea to plant this crop than maize?

A. It is a knowing gamble of yield over safety – so farmers plant both crops. They are aware. The point is that there is an artificially elevated price tag on maize.

Q. In Madagascar, why is there such a high diversity of rice?

A. It is a diverse landscape to start with – with that comes cold snaps. In some places they farm "dry rice"; in others "wet rice". The variety of the land means that many different types of rice production have evolved, I think.

Plenary Session: Priority research questions and opportunities for impact

Chair, Professor Sir Brian Heap

The challenges of scale, discourse and inter-disciplinarity

Dr David Rose

Most discussions on agricultural changes divulge as a dichotomy between scientists focussed on pure technology in agriculture and social scientists engaged with issues in adoption. Discussion on inter-disciplinarity should encourage looking for solutions to a problem rather than to criticize solutions offered to a problem.

The core factors contributing to adoption of technology is: performance impact after adoption; ease of use; previous experience; trust; cost; relevance of the technology to the user: and habits. Facilitating conditions of technology adoption are: age; scale; farming type; and IT education. More work could be done on 'entitlements'.

A year in discussion: conclusions from the 2014-2015 meetings of the Forum for Sustainability and the Environment

Dr Will Simonson

Eight meetings between October 2014 and May 2015 took place, attracting a total of over 50 witnesses and other guests, and involving a core group of about 20 of the University's leading experts in areas ranging from energy, biodiversity and food security to anthropology, architecture, history and economics. The question was approached from different angles:

- A global view of land use change.
- The economic and social drivers behind the changes
- 'What can we tell from the sky?' using satellite imagery
- 'Does the way we think need to change?'
- Case studies of cotton and wood – the supply and demand of these natural materials
- From global to local: focussing on the impacts of changes in land use, climate change and the demand for resources at a range of scales.
- And finally considering many of these issues play out in the region of East African

These Forum discussions were a valuable resource to the Global Food Security Initiative, and indeed have informed the arrangement of sessions that we have planned in the current conference.

The main messages that emerged, and links to the conference programme, were:

- The need to limit our agricultural footprint – we are at the end game of land use
- We need to better understanding the spatial, temporal and economic interconnectedness of our globalised world, to limit the unintended and often undesirable consequences of our resource-use decision making.
- We need coherence in policy as well as research. Policies controlling food and fibre production and distribution, water use, energy production and biodiversity conservation must be aligned to minimise trade-offs and maximise synergies.
- We need to synthesise information. The flow of data and information on the state of the environment and natural resources has become a torrent, but is it being turned into useful knowledge, evidence and models for decision making?
- We need to build in behaviour: taking into account the importance of human behaviour in moderating what sorts of solutions really work on the ground.
- We need to grow from grassroots. Instead of techno-fixes that are often mal-adapted to the socioeconomic and cultural context, there needs to be a focus on creating 'good enough solutions' that are developed using local knowledge, resources and expertise and designed to help the greatest number of people.
- Finally, markets, demand, distribution and waste were recurring important areas in the discussions, as indeed they are to this conference.

Panel Debate

The theme of the discussion was 'what are the research questions that are really going to deliver change?' Some of the research areas suggested were:

1. Use and exchange of informatics between developed and developing countries
2. The focus of large buyer companies and their global trading
3. Urbanization and its impact on agriculture, particularly with reference to urban poor
4. Funding for orphan crops
5. Understanding small farmers of Asia and Africa, as they are significantly different from those of developed countries in many ways.
6. Focus on dry tropical agriculture.
7. Focus on what constitutes the food basket of people, for instance few crops contributing to most of the food basket. The notion of sustainable diet
8. Better understanding of policy intervention and its impact on agriculture
9. Understanding food security with in environmental limits, social goals and governance system
10. Crop resilience
11. Actors in food supply chains
12. Food system thinking and analysis
13. Organic food and genetically modified food
14. Financial institution support to agriculture.

Friday 24 June 2016: Stream 1 (CCF Summer Symposium)
Food security, sustainability and conservation

Plenary session 1: Landscapes for people and nature – the science and the practice
Chair, Dr Bhaskar Vira

Sustainable intensification, its framing and implementation
Professor Charles Godfray, University of Oxford

Barbara Stocking has summarised some of the main challenges: richer, bigger population, urbanisation, megacities, good progress on hunger, but crisis on obesity. Supply side pressures of water, land. Risk of political shocks. Food price spikes in 2008 and 2010.

The 'Reaping the Benefits' report describes how food is unlike any other system – it is vital for life, but also has a huge impact on environment. On the production side, sustainable intensification is key. Charles has received negative reactions to talk of sustainable intensification – he was once picketed by Compassion in World Farming – a rude awakening, showing how much choice of words matters. CiWF see intensification as synonymous with poor animal welfare. The 'Wolf in Sheep's Clothing?' report by Friends of the Earth – represents similar backlash.

What is meant by SI? Let's get beyond the words and proceed by logical deduction. The accusation: too much focus on production side. A response: we need action on all fronts – demand, waste, governance. SI is part of this – as important as other aspects – we can't just work on waste issues. We should have the ability to respond to price signals and produce more food where and when needed.

SI must help us keep to the current agricultural footprint where possible, for when we turn forests into agriculture we produce CO_2 (Stern Report). There is the worry that sustainability is just an add-on in SI. Sustainable principles just laid over what we have now. But this is not true – SI is a radical challenge to the agricultural community, and a radical challenge to the environmental community. We may want to take some land to produce more wildlife benefits at the risk of yield penalties – but these penalties must be balanced elsewhere. The 'A Wolf in Sheep's Clothing?' report argues this SI is a way to smuggle in new tech through the back door. We must decide as a society which strategies and technologies (e.g. GM) are and are not acceptable.

Another worry is that SI is an agenda that crowds out other agendas. This is also not true – it is just one of many issues – see Garnett et al (2015) Sustainable intensification in agriculture: premises and promises, *Food Security*, and Godfray (2015) The debate over sustainable intensification, *Food Security*.

Moving on to look at the political implications of Brexit, what are going to be the new narratives on food and the environment, and how will they be formed? They will be different.

- Isolationist? Aim for self-sufficiency?
- Replacement to CAP?
- Go back to 'noble farmer feeding the world' narrative for British farmers? Will it survive?
- What will happen to pillar 2 of CAP? How will we support rural communities?
- Public money should be for public good. We want rural communities to survive, but need to balance that.
- Potential for rewilding?
- Regulations: no longer one size fits all – could lead to more granular rural policy?

Questions

Q. How does SI relate to/address issues of food sovereignty and self-sufficiency?

A. I am deeply suspicious of the food sovereignty idea. Example of Egypt – reliant on other countries for grain. Biggest worry is global south cities starving because they can't afford grain. SI does not mean producing more food from every place – some areas will be for nature, with less intense or no farming. But the sums have to add up – people have to be able to feed themselves at prices they can afford.

Q. Unemployment caused by SI – what will people do?

A. Work of Andrew Doorwood, SOAS. We can improve agriculture in different ways, and it doesn't have to lead to loss of jobs. The big challenge is how do you get jobs in cities and towns so that people leave rural areas voluntarily? That way, those left behind can have better paid work.

Q. SI and novel crops?

A. Agreed that novel crops should certainly be a part of expansion of SI.

Q. Food growing in new housing?

A. Urban agriculture is great, agree it should be a part of new housing – but we shouldn't kid ourselves that it will feed whole populations.

Would land sparing or land sharing allow more wild species to survive?
Professor Rhys Green, RSPB and University of Cambridge

In this talk the demand side questions are not addressed – instead, we focus more about how we produce what we need. In particular, would it be better for biodiversity if production in farmed landscapes was low, allowing them to be benign to wildlife? Or would it be better to have high production farmed landscapes, thereby sparing natural habitats? In 2005 we came up with a model to work out what to measure to answer this question – a trade-off model based on a density-yield curve. Surveys have now been carried out to see if the data matches up with the model. PhD students have measured population density of various animal species and crop yields in various types of farmed landscape: Malvika in India and Ben Phalan in Ghana.

We were surprised by the results – there is a general trend that more species do better with sparing than sharing, although there are always more losers than winners. Small-range species have more losers than larger-range ones. This broadly holds across all different categories of landscape/region and different parts of the world where further investigations have been carried out. Does demand affect these results? We repeated the study in Poland looking at higher and lower production demand scenarios and found that the general trends stay the same. We have also been interested in quantifying external environmental effects that high-intensity agriculture has on surrounding areas. (e.g. pesticide leakage). We want to quantify which high-yield systems have low external effects.

Can this land sparing be realised on the ground? It would require linking high-yielding farming to restoration of wild areas from existing farmland. Markets cannot achieve this alone. Eco-certification can be used as an incentive, but current examples are only really for land sharing, though they could be reinvented to work for land sparing farms too (e.g. for farms with reserve areas on their land). Public policy and subsidies could be another option, or strategic deployment of investment. As yet, the benefits of land sparing are only theoretical.

Questions

Q. How do you decide which areas to maximise for agriculture? Wouldn't this just result in losing the most productive, fertile environments?

A. In practice this would require scenarios for land use – we would need to work out where best to restore/intensify.

Q. Should those of us trying to be ethical consumers start buying intensively-grown produce then, if sparing is better?

A. At the moment buying intensive food is not really the answer, unless we know the bigger picture – i.e. if you know that the other half of the intensive coffee plantation is a reserve.

Birds, bees and butter – Enhancing ecosystem services and livelihoods in the Shea parklands of sub-Sahara Africa
Dr Cath Tayleur, Birdlife

Shea butter is found in cosmetics and also in chocolate as a cocoa butter replacement. It is the primary edible oil in sub-Saharan Africa, for 80 million people. It is mainly collected by women, and studies have found that women put more of their money into education. This makes shea production a tool for development. It is grown as an in-field tree (like oak is here). Fruits mature during the 'hungry season', so are a good gap-filling food. The fruits are eaten; butter comes from the kernel. There is a huge distribution across the Sahel, but this is an area suffering from desertification and conflict leading to migration.

Small-holder farms in a parkland landscape. 90-100% of in-field trees are Shea – so this is really a monoculture. Shea is selectively retained as it is a crop plant. There is an absence of tree planting in the culture. In the past, fields were left fallow for up to 10 year and trees would naturally reseed. Now they don't, and neither are trees planted.

The Sahel is important for migrating birds, which are struggling with population declines. Species which overlap with the Shea zone are doing particularly badly. A Dutch partner organisation did a migrant tree preference survey and found that Shea trees were not popular at all – they were hardly used by the birds. So Shea parklands are actually quite hostile for migrants.

It was suspected that Shea is insect-pollinated but very little was known about the need for pollination for Shea. Preliminary results for insect-exclusion experiments show that pollination is very important for Shea, and so there is a major risk of a negative cycle: monoculture → reduced insects → reduced crops → damaged livelihoods.

Birdlife International will work with 10 communities in Burkina Faso to instil an understanding of the importance of biodiversity. Consultations with the local community will be held to see which techniques will be most useful to them: e.g. bee keeping is already popular in many areas. A key aspect of the project is education. Pollination ambassadors will be trained up, and

examples of pollination exclusion experiments in the villages can be used to demonstrate the importance of pollination first hand.

Questions

Q. Do the farmers really need educating on pollinators?

A. The project is responding to a call for help from villagers – the link between pollinators and what they do is not well known.

Q. Shea butter is not really a food – more an oil – will this really help diversify diet?

A. Increasing the number of tree species will help diversify diet. Vegetable growing also good for pollinators so will be encouraged.

Plenary session 2: Actors in the landscape – smallholders, supply chains and sustainability

Chair, Dr Liz Watson

What next for agricultural research and extension?

Dr Nigel Poole, ICRISAT

Forming partnerships is very important to working in the tropics. This is a selection of stories about working in partnership.

Dryland tropics – some of the poorest areas in the world. Need investment in orphan crops. Farming is a very risky business, wherever you are. If your new crop is not accepted by the farmer it is not a success! 80% of the seed the farmers use (in dryland tropics) is saved/from neighbours – so there is low genetic potential. It is hard to decide who is in charge of the pulse markets – trade goes one way, information the other. To mitigate risk farmers need information – where from and how? Through written form? There are issues of language (lots of variation), literacy levels, and distrust in foreign scientists. One approach is using voice messages – supplied and translated from gov't/Met Office, etc. – in local languages, voiced by local farmers. Another innovation is the use of phablets – two-way communication, as info can be sent back. There is now a Microsoft app that provides advice on when to plant seed and facilitates two-way communications. It will be rolled out next year. An ICRISAT hackathon led to an app linking farmers to market/buyers.

India have a very serious protein shortage – there is a deficit of pigeon pea, so import markets are important. The case of a farm visited in Tanzania: the farmer had previously grown maize but only got a crop one year in four due to drought and other issues. They then changed to pigeon pea, but this got wilt. So a suitable Indian wilt-resistant form was found, distributed and grown successfully to the extent that it is now exported to India. Such success leads to spare money for schooling, housing, motorbikes, etc.

New hurdles: communications with the wider market. Warehouses in India are owned by the government, but they don't know what the going rates are. Merchants rip them off and control the price. Higher price for pigeon pea depends on whiteness. So somewhere clean is needed to thrash seed (it is currently done on red earth) but this requires support from the bank. There is a need for acceptance of higher-yielding hybrid pigeon pea in India – the federal government has called for improvements.

Work is also needed on the market side – to take market interest away from wheat and maize and towards locally grown pulses – i.e. generate a consumer pull.

Questions

Q. How do you get farmers to buy hybrid seed every year?

A. Government subsidy would be a good approach.

Q. Who were the winners and losers with the introduction of pigeon pea?

A. The vast majority were winners. The governments win as they get more taxes. US farmers might lose out. There are similarities with the development of teff in Ethiopia, which needed participatory breeding – farmers picked the traits they wanted. These models need to be participatory and farmer-led.

Making smallholder resilient agriculture work for women farmers - the case of system of rice intensification (SRI) in India
Dr Regina Handsa, University of Cambridge

Smallholders are key for food security, and women farmers are a large part of that group. There are institutional, structural and cultural challenges for smallholders. A case study of Bihar, Eastern India is presented:

System of Rice Intensification (SRI) is a more sustainable form of rice growing. Rice is a crop where women are prevalent, but the discussion generally focuses on technology rather than gender. Here the focus is on gender. SRI involves minimal use of water, but the practice leads to the risk of more weeds. A special weeding tool (like a hoe) is used – it is more ergonomic, but heavier. So whilst weeding is traditionally women's work, with SRI men are hired and women labourers lose their jobs. Also, weeding with the weeder is solitary work, but women prefer working in groups to protect against sexual assault. Some women let men be employed over them – would rather the men were occupied.

Suggested improvements: currently there are limited opportunities to buy weeders – more access to them is needed. Mustn't forget differences within the female gender – help often taken up more by upper castes. There should be training sessions for women on the use of the weeder, but also for women to be seen using the tool, and start to get the image accepted in the nation's psyche. Need to visibilise the reality – currently there are lots of images of women using weeders in development literature, but this is not the reality.

In conclusion, the introduction of technology has saved labour, but has led to gender inequalities being reinforced.

Comment from chair: these trends have been seen throughout history. When new technology is introduced it displaces people, especially women.

Gola's landscape approach, connecting forest and people with cocoa
Dr Nicolas Tubbs, RSPB

BirdLife International is working with local partners in Sierra Leone, where there is only 5% of the biodiversity hotspot left. The focus in on the Greater Gola Landscape, and working under the REDD+ umbrella, preventing deforestation to generate carbon credits. It is important to avoid 'leakage' – i.e. displacing deforestation to areas outside of the reserve. RSPB and the Sierra Leone government have been partners for 26 years – through conflict and through Ebola. The

aim is to make community members active environmental stewards. The project has involved more than two years of consultations. Five key pillars have been developed:

1. Crop intensification and production increase
2. Improved cocoa production
3. Savings and internal lending communities
4. Co-management and land-use planning
5. Education

Global chocolate market worth is $100 billion/yr. Cocoa is produced mainly by small farmers living on <$2/day. They are mainly from the Ivory Coast (40%) and Ghana (25%). There are concerns that supply will be affected by climate change. Cocoa is only grown in a narrow band in the tropics. Producers want to expand areas that cocoa is grown to ensure stability of supply. There is likely to be a big increase in demand for chocolate from the growing middle classes – especially in China. War in Sierra Leone in the 1980s led to an end to cocoa production in the country. So there is a need to relearn the skills and re-capture knowledge and capacity.

The aim of the project is to export cocoa direct from the Gola region – a high-end single origin product and cut out middle man. One problem is crop raiding. We need to find out what steals the pods – chimps and rodents? – and how big this impact is versus damage from black pod (a disease).

Cocoa plantations could act as corridors between forests. There is a huge increase in number of corporations who want to become certified. We need to get the story of Gola out. www.golarainforest.org

Questions

Q. Why focus on cash crops like cocoa, shea, etc., when talking about food security? These aren't vital to food supply.

A. People need cash, increases their purchasing power – and cocoa is one of the crops that does this.

Plenary session 3: Citizens and consumers – from individual responsibility to planetary health

Chair, Dr Teresa Mulliken

Dietary choices and planetary impacts

Dr Tara Garnett, Food Climate Research Network, University of Oxford

Sustainable diets require fairness, justice, vision, equity and a bit of rational thinking. It is obvious that we need to focus on consumption. If we change this, will we actually reduce GHG? Then what will happen to our health? Is a focus on GHG and nutrition enough?

At a global perspective, the Paris Agreement Requires us to keep to a 2 degree target – this requires drastic action when it comes to food. Food demand is expected to rise (and is already rising). How much more food is needed is a really difficult question. From the production side, many measure have been proposed: changing livestock farming practices, for example.

A paper by the IPPC shows the projection of emissions based on different scenarios. The thing people focus on, in terms of lowering our emissions, is animal products because they take up so much energy production. The lower the amount of animal products in a diet – the greater the GHG savings can be for an individual. BUT, are these "no animal diets" healthy? What is the

relationship between a low meat diet and health (if any)? There is conflict in the research. A problem is what a 'healthy diet' is in the first place.

A Dutch study found synergy between low meat diets, health and low GHG. However, an American study looked at what would happen if USA cut down calorie intake and also ate more fruits and vegetables – and came to the conclusion that this would lead to increases in energy (despite lower input!). This is because they would have to eat far more dairy (US health recommendations are for high dairy and fruit intakes). A French study, meanwhile, looked at 'healthier diets', and found they are actually associated with higher GHG emissions, because these diets have more dairy and fruit & veg instead of sugar (which is GHG efficient to produce, yet very damaging to health). A British study identified a diet with animal products – and culturally recognised as nutritionally balanced – and still reduced 40% GHG for the individual. We have differences between countries regarding whether a healthy diet is GHG efficient based on different ideas of a 'healthy diet'. So the results all depend on how you define the health component of the study.

Are GHG reductions enough? A Swedish study said that if we are all only allowed 1-2 tons of C per year, and 50% of this is attributable to food (based on the Swedish healthy diet) – this is not enough. So how low is enough? This is what we also need to think about. Simply switching to the 'healthy' diet is not enough – it depends on what is healthy. Current diets are not good for us and do have high GHG. So what is a sustainable diet? The FAO defines this as:

"Those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations."

The FAO definition sounds great – but it has many different dimensions: environment; nutrition (macro and micro nutrients); livelihoods affected; economic development (what this means for different people?); animal welfare; culture (is this important in itself?). These things may conflict! So there are trade-offs within the definition. For example, fish have lower GHG – but may damage the environment. We need a definition that goes beyond all of these things and looks at what we do production wise: and how this influences demand; different assumption about the role of grazing livestock in sequestering soil carbon; change in production and consumption in one nation triggering changes in others; impacts in developing nations.

The big question is how to change diets? There are many influences on consumption: infrastructure, economy, religion, institutions, beliefs, the media and advertising etc. BUT, there are three things to take away: do not assume you cannot change; more time needs to be spent on the social nuisances – how people behave and interact with technology; and to think beyond the label. Awareness raising is only a small part of the solution. We need to look at many different approaches to shift our eating habits.

Hungry and obese: The challenge of household food insecurity
Dr Pablo Monsivais, Centre for Diet and Activity Research (CEDAR)

Food security definition: when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life (WTO). FAO more specifically takes food preferences into account, as well as physical and social access. Their 4 pillars of food security are: availability (calories, protein etc.); access (grow it or buy it); utilization; stability. Measuring these globally enables cross nation analysis, as in the 2015 FAO report on the State of Food Insecurity in the World. Looking at hunger as an indicator, the FAO has a global map – macro analysis – based on access to sufficient calories.

I am interested in household food security, and this looks at the micro. Just because you have a lot of food, does not mean that you are food secure. Micro analysis of food security in the UK: volatility in food markets have been experienced, and also declining incomes. This has profound

implications for access to food. This has been demonstrated most acutely with the rise of food banks in the UK. In 2005, no one really knew what food banks were – now there are almost 1 million people using them! We have entered a new phase in our relationship with food in the UK. This gives rise to heath and equity concerns, and has prompted a number of government commission reports.

Household food insecurity in the UK: A Review of Food Aid (Food Ethics Council, University of Warwick) and Food Banks and Food Security (House of Commons) reports. The latter report looks at what is driving the rise of food banks when it comes to food insecurity in the nation. In the US, this idea has been around for 20 years. In the UK, we use the term "food poverty" – an inability to secure adequate and nutritious diets. This can be a social justice issue. But in terms of nutrition and public health, a co-occurrence of obesity and food insecurity is the issue.

Bill Dietz did a case study 20 years ago of an obese child from a poor family: a paradoxical occurrence of intermittent hunger and obesity. Dietz proposed ideas that have been worked on by other researchers. Food insecure adults are more likely to have a High BMI, be obese, gain more weight over time and develop type 2 diabetes. This is more of a problem for women rather than men. Basiotis (1992) identified a relationship between income and food energy. If you have enough income you get enough energy to meet food requirements. But as income drops, you spend less on food, so you change the kind of foods you are purchasing: go for cheaper calories, which can lead to overconsumption. Only if spending is severely curtailed do you get too few calories. Another study links consumer price index to food. Foods are defined as more or less healthy in the UK. There is a growing gap, and a tendency to gravitate towards "affordable food". People with more education and money have more diversity in their diet. In lower income and lower educated people we see a trend towards consumption of foods that are processed, high in fat and sugar, and cheap per calorie. A national diet and nutrition survey shows that dietary recommendations are harder to meet if you have a lower income.

Changing diets in hard times. Analyses by Economic and Social Research Council (2013) showed how people switched from fruit and veg to wheat and cheese during the recession. The USA has been monitoring this relationship for 20 years. Even though we are now out of the recession that began in 2008, spending on food is still low. It is estimated in the UK that over 6% of adults suffer from food insecurity.

In conclusion, there are parallels with global and household food insecurity, especially in terms of access. Some people have fewer options and have to focus on cheaper and less nutritious foods – we should pay more attention to them.

Reducing food waste to reduce our environmental impact
Niki Charalampopoulou, Feedback

Waste has gone up the agenda hugely over the years. We waste one third or more of the food which is produced globally, and this has a substantial toll on the environment. The UK is the third largest waster of food after China and the US. Most of the wastage happens outside our borders, because of imports. NB: none of the official figures include pre-farm gate wastage.

Food waste can happen for absurd reasons. Example of farmers growing asparagus in Peru – only the straight ones make it to the shelves. 1000 tonnes of tangelo oranges wasted on a farm because of minor blemishes. In Kenya, there is a similar issue with snow peas and with green beans – rejected for being less than 9 cm – but then they are cut anyway to fit the packaging. For farmers in Kenya, 50% of their produce can be rejected because of cosmetic standards, and there is a 32.9% average reject at the farm level reported by farmers. There is a social impact of food standards on small farmers. There is a social impact of this on food security, because when orders are cancelled or produce rejected, the farmer's income suffers and workers do not get paid. "When the order is cancelled I don't get any income".

The food waste pyramid (see figure): Reduce (cosmetic standards); Feed people in need with what is left (no need to waste perfectly fresh and nutritious food); Feed livestock; Compost; Only then dispose!

This is relevant to the question of how much more we need to produce. We do not necessarily need to increase as much as we think. We can utilize what we already produce. The solutions may be simpler than we think.

The Feedback organisation. Collaboration with organisations around the world to foster national coalitions against food waste – to put this as an issue on the public agenda. Eating food that would otherwise be wasted. Empowering people to send this message to supermarkets. They have organised these events around Europe, and it is turning into a global movement. Gleaning network where volunteers go to farms to harvest foods that would otherwise be wasted. This movement is spreading in around Europe, and is very active in Belgium and Spain.

The tangible difference that this creates. TESCO approached Feedback and asked them for advice regarding reducing wastage. Feedback responded that they should publish how much they waste to meet 'demands' – the first supermarket in the world to do so! Wastage in own stores (but not on the farms). TESCO has now made a commitment to not trim beans so much. It only trims one side of the beans now. So the farmers they work with were able to increase their income by 100,000 euros per year! This is a clear example of the immediate and tangible impact of simple changes.

Questions (to all panellists)

Q. Have you done work on the sell-by and use-by dates of supermarket products?

A. Yes, but we have not focused research on this. However, it is an important issue, especially in the US where there are very confusing data. Every State has its own label, and there is much research from Harvard showing that wastage happens because of this. Things are slightly better in the UK re the need to simplify use-by dates on products because there is a legal mandate to make such information digestible to consumers. (Niki)

Q. The problem is getting people to congregate around a point of agreement. What would be an umbrella issue and priority that all can agree on? I think it is health.

A. I think if you arrange all food issues to optimise health, it does not follow that the food system we should design would be the most sustainable. There may be tensions. But research could identify how much tensions can be overcome with technology and how much is related to social processes governing the food choices we make.

A. I think food wastage can be a uniting issue. It is a waste of money and strongly unites people – and requires a reassessment of preferences and values. My only concern is when people think that this is the answer - when it is actually only one small part of the picture. (Tara)

A. I agree with Tara. Waste is unifying. Most people get angry seeing food wastage. But, there is a danger of green washing by companies who use this idea to hide other issues (more serious sustainability concerns/impacts), because it is the "easy subject" to talk about. It is a window for looking at what is wrong with the food system – and this is also related is obesity (wastage by overconsumption) and meat eating (also uses a lot of unnecessary energy). The problem is that our food system is not just about feeding people; the system is currently about making money – we need to change this. (Niki)

Q. A vegetarian diet is cheaper – how can we get this in to the system?

A. WRAP did work looking at waste – and tried to factor in the rebound effect of increased spending on other things – but it was very small. There is a bigger systemic issue which is they talk about food in isolation of all the other aspects of sustainability in our lives. A question of trying to internalise how to do what you do! A need to look at food as part of a global economy in a wider sense and how we arrange society – without 'bubbles' in the wall paper. Cross thinking of issues. (Tara)

Q. I have a question on knowledge and awareness. In the US and the UK, even if people can afford to eat healthily – do they know what they should eat? How to cook? Can this explain food poverty?

A. There is evidence people in poverty have less knowledge about food – but nothing on difference in skills or behaviour around food. There is the idea that if people with little money cooked, they could eat well cheaply. But this presupposes access, time and the stuff to cook with! (and the knowledge of course). (Pablo)

Q. How effective are different mechanisms, such as a sugar or fat tax, to shift dietary behaviour? Or is labelling more effective?

A. Tax is a simple and straightforward solution, but it cannot be introduced in isolation. Taxing soft drinks would be good in terms of health, and there is some evidence that if a food tax is high enough it has an effect. But other foods – such as meat, which has clear benefits in reducing consumption from an environmental point of view (including GHG savings) is complicated. There is a need to carefully examine the impacts of such a tax to introduce complementary measures to soften its negative effects. This is because a meat tax may mean that producers end up intensifying production (to earn more money as demand drops) which can actually increase emissions – thus negating the tax! Also, people may just buy cheaper, more rubbish meat, and this has health implications. When you look at taxes, you need to look at a package deal, e.g.

targeting collaborating agreements in the industry and education and awareness raising. No one thing is enough – a need for political will to take a multi-sector approach. (Tara)

A. Studies of different approaches for behaviour change show that the more the individual has to engage cognitively – the less successful they are. So, it is not good to approach it too technically. Structural things that affect cost and the environment may be the way to go.

Comment from the Chair: Ideas as to how to effect social changes are thought about at the Cambridge Sustainable Food Hub project. There is a stall about it – come and see me!

Q. I am a lecturer on Global food security. I have a question on the wastage issue. Are there options to feed food waste back into the agricultural system?

A. Yes! Our pig project is an example. When we talk about legislation that could make dramatic change in meat production – feeding waste back into the system is one. Now you can have organic pork and chicken – at present, this is not sustainable because it is fed on food grown in the rainforest in South America. This is taking food away from the people that need it. It would be much better to feeds pigs compost – and this is also more environmentally friendly – but the UK legislation and EU regulations are currently against this. (Niki)

Q. You say we need more emphasis on social research. What do you mean by this?

A. Three examples. How to change consumption behaviour and understand the influences on consumption: what they are, their relative importance and how they differ in status. Secondly, the production side – study how to effectively make sure solutions are accepted by producers – why people do or don't do things. Thirdly, why people do or do not believe in climate change – values etc. and the way we frame the messages around its acceptance. The same happened with Brexit. This has shown the need to engage with value – and how you can influence that. (Tara)

Q. Who is responsible for social research?

A. The research council. We need to be looking at "new" solutions – but sometimes the answers are already there, and we need to implement them. This is where the social sciences come in. Peoples' mind-sets are so relevant!

Comment: On the issue of pig protein. I am from the organic issues group in the UK. This comment is relevant to the past question on pigs on an organic diet. Insect protein can be possible. We are trying to get this through as an EU standard.

Q. Is there any way we could introduce to the public that it is ok not to eat perfect looking foods? This is a demand right? Secondly, fruits and veg that do not look nice can be used as canned food?

A. My view is that supermarkets create an image of the perfect veg, and the resulting cosmetic specifications are used to reject produce. It can be an excuse to source, for example, cheaper asparagus elsewhere. But if there is a shortage, suddenly the bendy ones are ok! So there is a lot to do to show what demand actually is. There is a move to using rejected products for making dried food (e.g. mango chips).

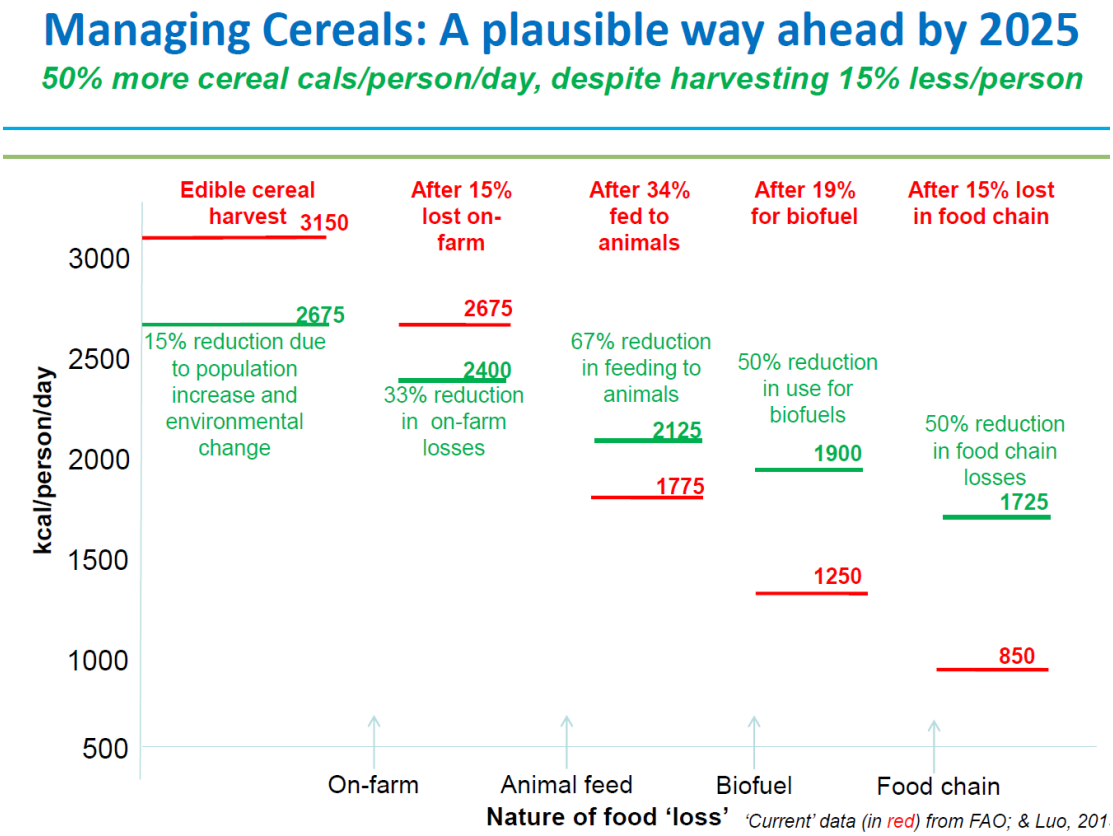
Plenary session 4: Environmental boundaries - managing what we can measure
Chair: Prof. Howard Griffiths

Food systems, food security and global environmental change
Dr John Ingram, University of Oxford

Food systems contain a set of activities, all of which can be managed. We should be striving for 'sufficient' calories – not too much or too little. There are different and overlapping forms of malnutrition (starvation and obesity) affecting most of the world.

What is it that constrains dietary choice and diversity? Affordability, allocation, cooking skills. The role of agriculture in questions on planetary boundaries is very large. It is not just agriculture that creates GHGs in the food system, for example refrigerant leakage from supermarkets is quite a big factor and this is now something supermarkets are looking into.

A big concern is people eating too many calories – and the associated health and environmental impacts. Following cereals through the supply chain, there is a large amount of wastage – 3150 calories harvested/person/day, yet only 850 make it to the plate. This is due to on- and off-farm loss, animal feed, biofuels. If you can make small gains at all of these points, it can have a big impact overall. It is feasible to reduce feed fed to animals, but it would take a large behaviour change to reduce meat intake.



In summary, food security concerns balanced diets as well as sufficiency and availability of food. A good food system is one which will have higher productivity and diversity of food produced. There should be diverse producers (farming, horticulture, livestock raising, aquaculture and fishing) receiving fair prices for their produce. Post-farm-gate activities such as processing, packing, trading, advertising and retailing (the food chain actors) should be responsible for the addition/alteration of calories of basic food produced, and should also charge a fair price. At the

final stage, where food is available to the consumers, factors such as affordability, dietary choice, allocation, cooking skill, convenience and cultural norms would determine the choice of food consumed. The food system is constrained by planetary boundaries (fresh water use, biodiversity loss, nitrogen (eutrophic consequences) and potassium (chemical pollution, including fertilizers) cycles and climate change. Policies should be geared towards attaining a complete food security system.

The Food-Water-Energy Nexus in Brazil
Dr Jean-Francois Mercure

A very cross-disciplinary approach was described in this presentation, involving lawyers, political scientists, climate scientists and macroeconomists. This is a necessary approach to tackling such issues. Brazil is representative of the world's nexus; it will show the first symptoms of global disturbance due to pressure from environmental and economic changes. Climate change is heterogeneous – Brazil will see drought in the north, more rain in the south, and overall temperature rises. These will all have impacts on agriculture. Much of Brazil's export is food (38%), and food is responsible for 19% of employment. There have been huge increases in growth of soybean, mostly exported to China. We have now entered a phase of volatility in food prices.

Comment from the floor

Sugar cane is much more efficient than maize as a biofuel – and so is expanding – leads to more water and land impact.

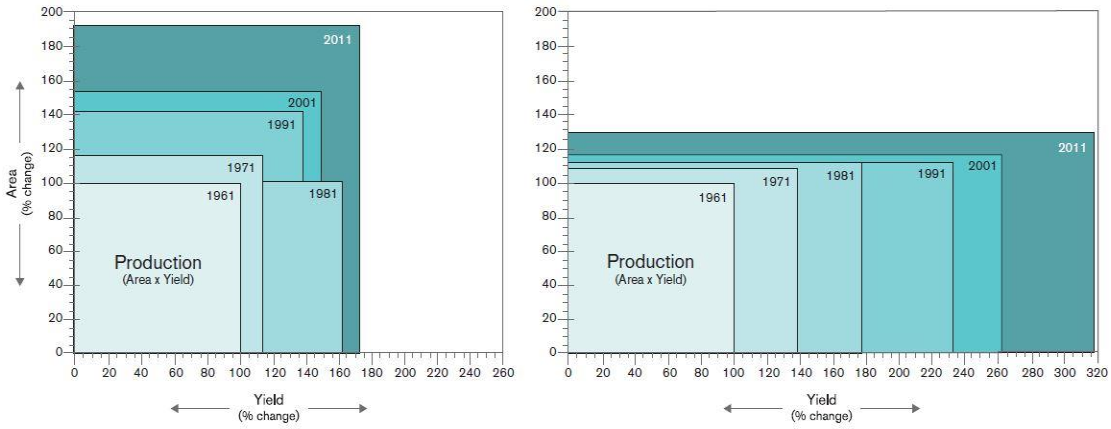
Early warning for building resilience to food crises in Africa
Dr Francois Kayitakire, Joint Research Centre

The Joint Research Council in the European Commission provides one voice when member states can't agree on scientific issues. One aspect is to work out how many people are in a state of food crisis/stress, to enable the EU to budget. 80 million people were affected by food crises last year. It is important to have an accurate map of the crop lands – satellite imagery is relied on for this, and the map is updated every 5 years. A processing solution is needed to update the map every year. Looking to Microsoft to find a solution.

People have settled where there is less forest and less rain, so there is high agricultural uptake in areas of high drought risk, especially in Africa. Satellite data at 20 x 20 m resolution, every 10 days (soon to be every 5), allows developments in crop growth to be followed. The satellites are not able to look through clouds, so data have to be combined over periods of 10 days. Satellite data can be used to see the growth rate of crops, and to detect where growth is negative/static. This allows the international community to see impact and prepare interventions – it is much more reliable than self-reporting from farmers. The issue now is not early warning, but action!

Food versus forests in sub-Saharan Africa
Dr Phil Franks, International Institute for Environment and Development

Global food production has increased but also have shown different patterns of increase. The food production increase in Africa is due to agricultural land extensification while in the case of India it is through an increase in yield per unit of land. The increase in India has been due to use of more chemical inputs in agriculture. The green revolution was much more impactful in Asia than Africa; Asian agriculture is now much more efficient.



Ethiopia case study: 30% of land holds forest and woodlands, but deforestation occurs at 1.2–2.4% a year. 32% of land is under crop production, mostly in small farms. Food demand will be 2.6–3x 2010 levels by 2050. Ethiopian yield increases have improved, but not enough to cope with growing demand. Ethiopia is developing a green economy strategy, but will it actually stick to it?

The food system needs to understood more carefully, as there are unrecognized trade-offs, insufficient attention paid to climate change, disconnect between agriculture and forest sector targets and policies, and the political economy realm of this system needs significant amount of investigation. Some of the political economic drivers mentioned were, (1) sectorial silos between agriculture and forestry, (2) scale silos with in the country, (3) market failure issues, (4) insufficient and inappropriate incentives (5) poor accountability (6) urban migration (7) historical legacies and their continued impact, for instance – structural adjust programme, colonial rule, and power imbalances.

Friday 24 June 2016: Stream 1 (CCF Summer Symposium)
Economics, culture and politics of food

Plenary session 1: Economies of food production – 'old' questions and 'new' models

Chair: Dr Shailaja Fennell

Agricultural growth for economic development

Jolly Dusabe, Centre of Development Studies

Food production is very important and agriculture is a driver for economic growth. I am going to use the example of Rwanda to explain how this can happen.

Rwanda has a diverse landscape. In the valleys, farmers plant rice as there are wet marshlands. Agriculture and its role has evolved over the years. Prior to the 1950s it was ignored as a driver of economic growth and the industrial sector was emphasised. Agriculture was seen as a fuel for the industrial sector, but subsequently its influence on growth has been seen as very important.

How to grow agriculture?

Globally, the focus has been on increasing output per hectare. During the Green Revolution, the introduction of better technology, high yielding seeds of wheat and rice, and an increase in fertilizer and mechanisation, coupled with the fact that farmers had good markets at all scales, led

to a boost in income and economic growth. However, the story was different for Africa, which missed the Green Revolution agricultural boom. Africa is vast in terms of agricultural systems and ecology – so it needs a different technological approach and it is limited in finance and infrastructure. Only 5% of land is irrigated, so there are more weather risks. There are marketing difficulties also, and the policies for agriculture from most governments are inadequate.

A focus on export of crops from colonial times was encouraged by subsequent agricultural policy, which also required governments to marketize, liberalize and open up to trade. This has made it difficult for farmers to access markets – it is difficult for domestic farmers to compete in international markets. Now the question is whether small agricultural farmers are capable of growing the economy in Africa. Small-holder farmers make up the majority (85%) of Africa farming and so cannot be ignored. Growth is starting to happen. The 2/3 % growth rate in the sector is much higher than in the 1980s when it was less than 1%. Rwanda and Ethiopia have the best growth.

Agricultural growth in Rwanda
Rwanda is at the heart of agriculture in Africa and the fastest growing nation of East Africa. It has maintained 8% economic growth, with agriculture contributing 45% to this. There are 11 million people in this sector, which has enabled a reduction of the poor from 60% to 39%, and this is mostly attributable to agriculture.

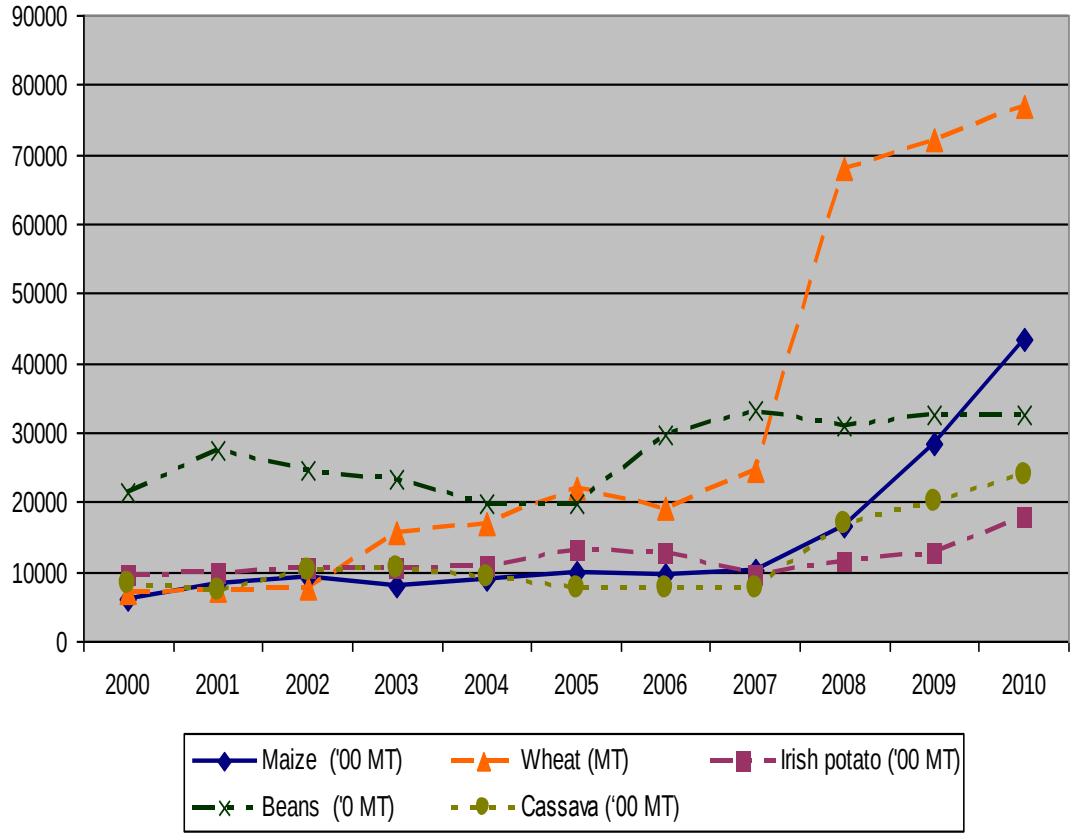
What is the current state of agriculture and how does this relate to policy?
60% of land is in the hills. This means that the nation deals with soil erosion and infertility. A lot of land is used for subsistence, and less than 5% is irrigated. Mostly it is cultivated for food crops. This cultivation engages 75% of the population – the vast majority! Because of this, Rwanda has developed a policy to: drive agricultural growth; to increase food and nutrition security; and to increase income in rural areas. Agriculture is used to drive the development agenda in rural areas, to ensure that the nation is food secure and to secure economic growth. To be able to do this, we need to increase productivity.

The past two years has seen a transition
Irrigation systems have been, and are being, built, and there is a real transformation for rice growing. In the hills where there is the problem of high soil erosion and infertility, Rwanda is using different techniques to address these problems. There has been a five-fold increase in productivity from the changes.

So, how did these changes come about?
It all started with talking to people, to brainstorm how change can happen. This initiative came from the top down – the government decided there was a need to ascertain the views of the people as to how Rwanda should develop post-genocide. In the small groups, this is where the real change happens. The farmers call themselves "help groups", and talk about putting things in action. Training also happens in these groups and it is important to increase knowledge, trust and confidence, and to try new things. Many groups then decide to do similar things and cooperatives are formed – with extension system involving lead farmers – and this has resulted in a self-sufficient farmers system.

Enhancing the landscape for the purpose of agriculture then increases jobs along the production chain and increases savings. There are invitations for private sector involvement – and many opportunities for access at different points in the chain or production, for example small businesses producing manure (increased use of fertilizer has come about from education).

The graph shows from 2007 when the policy kicked in. As you can see, there has been high growth in wheat, maize and potatoes etc.



It is not just about production increase, but the fact that farmers have a chance to take what they produce to the markets. The amount of commercialisation has increased. 30% exports are from agriculture.

The transformation using agriculture as a base has enabled people to build houses, purchase things like motorcycles and mattresses, and also begin new activities and shift from agriculture into other sectors (because as it becomes more intensive, this allows people to do other things). In Rwanda 80% of the work force was in agriculture in 2000, now it is 70%. Agriculture nevertheless remains critical for economic development in Rwanda, because it employs the majority of people and contributes the most to its GDP.

How production of food crops can help national GDP to grow: case study of Rwanda
Jane Lichtenstein, Centre of Development Studies

Farmers own small pieces of land and grow crops in crazy landscapes including steep hills. This is the main livelihood system. We are now beginning to see an increase in technology, but agriculture is still a hard and grinding life.

Context of the Genocide. Mass murder of 1 million people, by their own neighbours or armed forces from the outside. The genocide was organised by the government of the day, and those who resisted were killed. It saw the systematic removal of those who were not inclined to take part, and occurred in just 100 days. During this period, human and social capital was completely destroyed. 1994 was a ground zero for Rwanda – and this is an import background for change now.

Rwanda today. Now the pop is 11 million. Most have engagement in the agricultural sector – wholly or mixed. The level of government corruption is low, a post-genocide phenomenon

which sets it apart from the rest of sub-Saharan Africa. The people have a high level of trust in government; but within communities, trust is low. The Government is characterised as authoritarian. However, it does speak clearly and loudly to the population, and uses public information and appearances to communicate policy and expectations from Government to people as to what their roles should be.

The Vision 20/20 policy was written in 2000, following discussions in every community (and over the radio and press), with the objective to imagine the society that Rwanda could and should be by 2020. It is a visionary document, and provides good "tram rails" for policy and strategic thinking. It is important to bare this Vision in mind when you meet individual farmers in Rwanda. They mostly engage in subsistence farming: they grow diverse crops, invest as little as possible in energy and finance to produce a sure supply of food. By definition, subsistence farming is not the most productive way of using one's land. Yet, through all of the economic changes in Rwanda, subsistence is still the main farming technique. Technological transformation is not for all.

These farmers have to face difficult decisions at present. They are told their economy is transforming; and their government could achieve its desired outcomes by buying up land for big farms, and then employing ex-small scale farmers. However, Rwanda's Vision is different, because it invites small holders to invest in their own farming future.

Transformation is risky. It is a risk to grow only one crop, and to buys seeds. This represents a big change for traditional subsistence farmers, because it is a shift to buying food rather than growing all that you need.

The policy is very strongly top down, but the farmers, even within an enabling environment, are actually the implementers of this policy: millions of small-scale farmers make up the private sector. Evidence gathering by Officials has led to the insight that however strong top-down policy is, the *implementation that follows is wholly a bottom up process*.

Development indicators.
Life Expectancy at birth: Rwanda is improving a bit faster than the rest. In 1990, pre-genocide, it was in the mid to late 30s, now the highest in the area is 64 years and still on the up. (A lot less than the west, but closing the gap). Maternal mortality ratio: in 1990, it was ten times less likely to die in child birth than 10-15 years previously. So there has been development. Transformation happening in what is still a very poor country.

Case study impacts of the Policy on farmers – the Mahende Rice Growers. I undertook fieldwork in 2010 with a maize cooperative. It was learning to save for business – to create investment in agriculture. Termed the "Mahende Rice" growers, the whole cooperative now numbers 5000. This is very exciting because they started as a savings group, then decided to buy things with the savings (like wellington boots, pigs and goats). Each decided to save $0.50 to $1.00 a month, then distributed it between cooperative members. But they all wanted to keep some aside for emergencies such as security issues. The manager of the cooperative told them drop it into an office and they can bank it. After one month $1000 has been raised. This amount enabled the set-up of a loan scheme for the members of the cooperative. Members can borrow money for social emergencies. The local bank saw what was going on and suggested partnership. This resulted in an income-smoothing loan scheme, so farmers get cash in the growing season to help. They are able to pay this back at harvest. This is an example of a very local initiative. And now people in the cooperative are applying for business loans and crop insurance, and a home growth life insurance scheme is also being built out of the accumulated savings.

This demonstrates that while a strong policy was required to get farmers on-board – its implantation and solutions for growth are local and home grown. This example is characteristic of growth in Rwanda. Savings groups show how a traditional activity can become a modern

activity. Repurposed and reshaped – they feel familiar to the people who have been asked to engage.

Implementation happens when the beneficiary joins in and this is an important take-away message. Central coordination is important, but local engagement is so key. Notably, there is a rapidly emerging change in the role of women in Rwanda: they are involved in the implementation of the Vision. Government policy-making happens in the open, in the public sphere, and this kind of transparency builds trust. Hopefully the trust lacking between neighbours soon builds.

Conversations can be heated, but people like to build consensus and there is an understanding that there are often two ways (or more) to proceed. From local discussions, policy-makers then take away both sides of the story back to Central Government where policy decisions are made. This shows us the value of strong policy, but the absolute centrality of flexibility and in the way that policy can be implemented.

Questions

Q. How important is it to secure title to land in Rwanda in terms of the financialization of its economy, and the importance of financial stability? There needs to be certainty here in order to encourage investment.

A. Rwanda stands out from its neighbours in its management of inflation. It takes a mixed economic approach. The Financial Minister of Rwanda is committed to a united Rwanda, and he is a hard-nosed financier and well regarded in international circles. Titles to land are not in the work I have done and are not of central importance because they happen at local levels. I do know that 97% of land is registered. This has been important in finishing off the tensions with immigration related to the genocides. There is, I think, a need for mechanisms to sort out land ownership. (Jane)

A. Land issues are very important for the country. Since 2005, there have been land distribution schemes to promote equality and this has really impacted on agricultural development. 1% of land is still in dispute – 97% is sorted. (Jolly)

Q. I am reflecting on the development economics I was taught. My question relates to the photos, which imply people are literate? What is the micro relationship between literacy and these new credit innovations? My second question is about the market – and its links with increasing living standards and aspirations. Is this a reason why pessimistic predictions of population might be tapered down?

A. I can tell you if I ask farmers to get into groups of three, one can read and write well enough to capture ideas. Part of the extension activities involves filling in exercise books for the saving programmes. On the fertility rate question, there is a known strong association between falling birth and literacy. There is a whole talk about how this can be achieved. Again it was a community approach to get quick wins. (Jane)

A. 75% of the population is literate. And even if one cannot read and write – they still have capacity to communicate – and move forward.

Water Sustainability in India's bread basket
Dr Harnik Deol, Centre of Development Studies

The relationship between energy, food and water from a policy perspective. My story is about what happened after the Green Revolution strategy for development in India.

Global context. 1.7 billion people have no clean drinking water and 0.2 billion are hungry. By 2030, we will need 30% more water, 40% more energy, and 50% more food – these things are all interdependent. In terms of nations who use the most water, India is the largest ground water consumer: 2.51 billion cm^3, mostly for irrigation. The second is the US, followed by China.

Use of groundwater for irrigation in India – implication of depletion for the Globe. In India, ground water contributes hugely to irrigation. Rice is the most water-intensive crop. As a result of our intensive use of water in India, the ground water levels have been depleting at the highest rate in the world. Aquifers are still depleting, and if things continue at this rate there will be no rice production. Punjab contributes 60% of food grains to the central global pool, so there are huge implications for the world if this happens. The largest quantum decline in groundwater levels are here. The levels of electricity and tube wells to pump out groundwater for agriculture has increased hugely since 1970.

Against this background, I am interested in what policy can contribute to alleviating these issues. The design of policy to conserve water is very limited. Punjab is a primarily agricultural economy.

The Punjab problem. Energy is subsidised in Punjab, so no Government would think of a policy for farmers to pay for energy, but this has been a recommendation for some time. Instead, government implemented the 2009 Subsoil Water Act, forbidding the sowing of rice before the monsoon. The idea is that if they sow rice at the onset of the monsoon, they will use less water, and thus less energy. My research looks at the impact of this on the conservation of water and energy: an econometric method of evaluation to assess the policy. The main research focused on the impact of the policy on groundwater, its effect on energy consumption, and spatial modelling approaches. On the policy side, the government focuses on supply over demand side interventions.

In the high rice growing districts, the impact is on water, energy and food. Three models were used. In the districts analysed (where the Government policy was applied), the water levels rose by a few mm; and there was a positive correlation with the consumption of power. Thus, overall the policy has been effective. I was interested in why farmers decided to implement the policy, because it was quite a change in routine. The punishment for not following it was 5000 rupees, and farmers have to dig out the rice they planted when not allowed to do so (so this is one incentive). No farmer was brought to Court; they all decided to implement the policy. Because the policy has been effective in Punjab, it has been introduced into other neighbouring sites and there has also been talk of implementing it in other states.

TEEB for Agriculture and Food: Valuing impacts and dependencies in the eco-agri-food systems complex
Dr Salman Hussain, United Nations Environment Programme

TEEB (The Economics of Ecosystems and Biodiversity) is changing the way we think about agriculture. It is a UNEP-led project building upon the Stern review on the economics of climate change (released in 2006). This report states that climate change is the greatest and most pervasive market failure the world has yet seen, and presents a "unique challenge" for economists. It analyses the economic impacts of climate change, and concludes that the benefits of strong action now will far outweigh the costs associated with inaction.

TEEB was launched in 2008 with the aim of demonstrating the growing cost of biodiversity loss and ecosystem degradation. To communicate the urgency for action, TEEB has "five deliverables":

1. Science and economic foundations; policy costs; and costs of inaction.
2. Policy opportunities for national and international policy makers.
3. Decision support for local administrators.
4. Business risks, opportunities and metrics.

5. Citizen and consumer ownership.

Numerous TEEB models have now been developed – and it is time for implementation.

TEEB tries to develop products which different stakeholders can use to assess why markets fail. Because agriculture is such a big contributor to business and the economy, there was a mandate to focus TEEB models on this. Agriculture is not a typical sector. Profit maximisation cannot be taken for granted because we are not just talking about a commodity. But it is still a sector, and people are entrepreneurial. So there is a need for greater understanding of the natural capital and social capital, and the market in which agriculture operates.

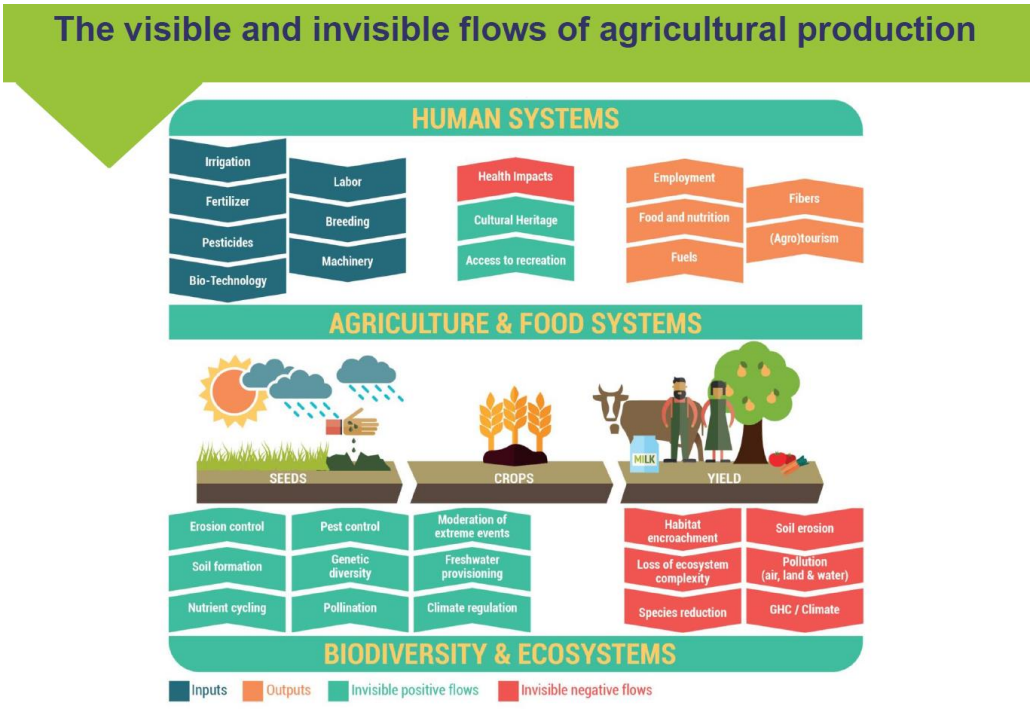
TEEB is comprehensive. Models can be distorted by significant externalities and a lack of awareness as to what natural and social capital does, how these influence the market.

Agriculture employs 1 in 3 people globally, that is a 1.3 billion labour force. A neoclassical model is not sufficient to take account of how smallholder farmers act. There is a need to understand how to modify models to take into account the actions of smallholder farmers.

TEEB also takes into account of the fact that:

- Globally, there is enough food – food security is a distribution issue.
- 80% of new agricultural land has replaced tropical forests since the 1980s.
- The impacts on livestock and fisheries of climate change are huge.
- The water-food nexus is an important issue

The eco-agri-food systems complex – invisible services and costs. There are biodiversity systems and human systems. There are inputs (how can we change these)? But the main argument from TEEB is that in the agricultural food system ecosystem services (soil formation etc.) are invisible flows. There are also invisible negative flows: broadly, we ignore pollution and species production when thinking about agricultural growth. So the fundamental premise is that these aspects tend to be ignored – so that no matter at what level you analyse things, you make the wrong choices because of these invisibilities.



In 2014, TEEB 'sector specific' studies were carried out to look at natural capital accounting. How can we provide guidelines using the typology of farms to guide them to report on their use and impact on the natural environment? TEEB is now moving forward to 'landscape assessments' to see the complete picture (of invisible services and costs) of agricultural production. For example, can we look at palm oil practices to assess which ecosystem services are impacted, and can we evaluate its effects? If so, this may encourage a shift to alternative production.

One case study was on rice, led by FAO in collaboration with International Rice Research Institute, Bioversity International and True Cost Consulting (they looked also at livestock with an ecosystem based approach). 80 million ha of land is planted with rice. If we can get a handle on rice, the global impact will be enormous. This partnership examined and compared management interventions associated with conventional rice production and system of rice intensification (SRI). These include intermittent flooding, transplanting of seedlings and weed control for SRI. TEEB models explored changes in yields and costs (including invisible services and costs) between the two systems. An important result is that with SRI, as well as yields increasing, yield *variability* decreases, and this is significant for food security.

Overall, TEEB recognises ecosystem value and tries to capture it. After that, we can then ask how we can implement change at the national level.

Questions

Comment from chair: We have gone from the specifics, to a systematic and integrated way to looking at where value is before we go into the micro.

Q. The monsoon is expected to be more varied and extreme – is this going to pose risks to the policy?

A. Yes – I think there has already been variation in recent years. But in my research I did not include climate risks. I am now making the model more complex and have collected data on temperature, rainfall and other variables to strengthen the model further. So far, the government has not changed the dates set in the law. But as time goes by, I expect they will be taken into consideration. (Harnik)

Q. What is the role of IP in terms of access to seeds and lands? I am interested in the legal aspect. How is this incorporated into TEEB*?*

A. In terms of the legal side, this is part of capturing value. We do need to understand what the legal preparedness is in a nation. So, for example, if there is no land tenure, and reforms requires this, we have a problem. TEEB has not yet analysed this, but we will get there. TEEB does have the capacity to answer specific policy questions. (Salman)

Q. Is it legitimate to think outside the box and envisage, for say Senegal and other countries that do not grow rice, what the impacts of rice farming could be? Perhaps we could figure out more efficient places for rice production?

A. It is feasible for TEEB to do this. How to modify the behaviour in this global system is a difficult question. Wider discussion is required looking at the 'optimal [global] food plate'. Once we know this – we could determine where exactly rice should be grown (the most cost effective areas). As a UN entity, though, we have to respond directly to the country's needs – and it would be colonial to tell them what to do. But possible, certainly. (Salman)

Q. We have been doing maps for water stress, including Punjab – and looking at the likelihood of water stress. Looking back at how policy has initially had an impact, what are your views for forward-looking policy? Our tools let us look at the future; are yours forward looking too?

A. Yes – my aim is to advise the government with concrete recommendations for the future given that soon there might not be any groundwater irrigation in Punjab and there could be serious consequences; not only Interstate in India but also with Pakistan. I hope to pioneer groundwater accounts with the government. This is my aim. This is a regional government task to begin with. In India, there is conflict between regional and national government, and this poses a problem for water management. Punjab contributes its rice to the central government (bought from farmers by the centre at a minimum rate). Consequently, it is not in the interests of central government to have any policy interventions that will change the status quo. A tension between state and government policy exists in this regard. This is an interesting example of a state rather than central government policy. (Harnik)

Summing up from the Chair. The most important point to garner from these speakers is the importance of a bottom-up approach – and the use of small farmers in development – to recognise their value in the system. As researchers, we talk about collaboration. How does this reflect on the future of agriculture? Also, we are seeing a shift from theories of intensification and diversification, to ones grounded in sustainability.

Plenary session 2: Global governance of food

Chair: Dr Kun-Chin Lin

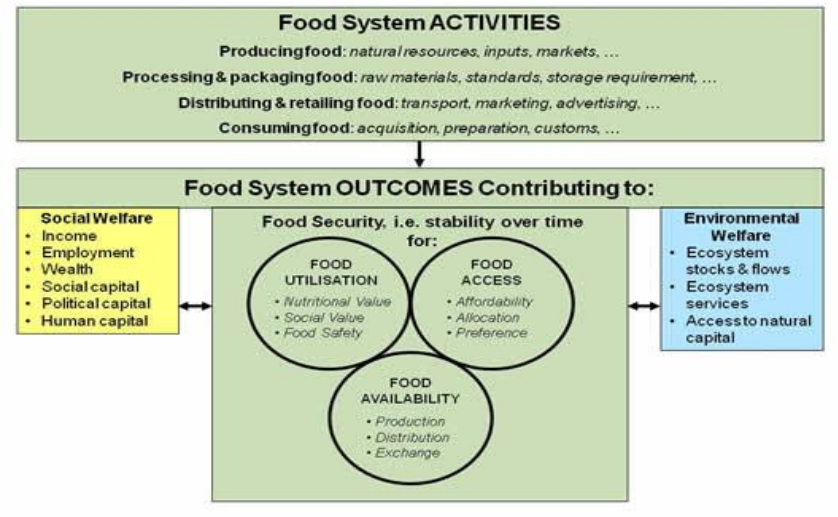
Chair, Dr Kun-Chin Lin: The Centre for Rising Powers is a Centre that started off examining rising global powers – and looking at how they affect the global architecture and trade. In the past we focused on maritime governance; and global financial architecture; resilience and sustainable development. The fourth track of focus is on faith in the markets.

Governing fragmented food systems

Prof Catrien Termeer, Wageningen University

In addressing food security, there is a need to deal with an inherently fragmented food system.

This is a familiar picture of the 'Food Systems approach', which is used now all over the world. Scholars and policy makers are embracing a more holistic approach to food issues to address challenges. It is nice to think from a 'food governance' perspective, but this is not well reflected in governance practices and science.



The first question is – who is governing the food system? Numerous actors! Looking at the food system, there are so many actors at different scales in different domains, both public and private. So it is inherently fragmented. This has advantages (learning, adaptation) and disadvantages: solutions in one policy domain cause issues in another; and today's solutions cause tomorrow's problems; and decisions at different levels of administration cause issues in others.

There are many people who recognise this fragmentation and write documents on it, pleading for a more 'coherent and holistic' policy approach. But, the question is how to organise those integrated policy approaches? The response of governments is top-down integrated food policy. For example, a new Ministry of Food, or a law requiring coordination for those in the food sector. This top-down coordination, however, will not work because we all know that when you try to coordinate from the top down you still have to deal with silos and administrative structures.

Organising integration. There are three types of government: the optimist, the realist and the pessimist. The top down is optimistic! This is a very naïve approach because it ignores power within the system. Plus there is a need to make sure important actors like Civil Society are not excluded. The pessimistic perspective is too negative! Despite best efforts, it assumes that elite control stops action, so why bother. So what we really want is a realist perspective on government action to alter the food system. This requires dynamism, with formal and informal rules. We are talking about holistic policy *and* integrated policy – which requires searching for collaboration to develop smart food system and governance arrangements. An example of the realist approach is the Dutch installation of the Ministry of Food.

In conclusion, there is no simple solution. But journalists do not like nuanced stories – so my interview on this topic was not published.

Questions

Q. What are the smart food systems governance arrangements?

A. There is no single smart arrangement that can singularly address the challenge of the food system. To signify what are smart governance arrangements, I have five principles that together qualify as smart food systems governance arrangements.

First, system-based governance and problem framing. This requires a departure from seeking a purely integrated approach, because this does not address the underlying power problem. There is a report in the Netherlands on the issue of food policy on the political agenda, but there is a risk of an 'integrated framework' becoming a 'consensus framework'. The idea that all things can be integrated, and everyone can be on the same page, is not realistic. There is an underlying values conflict. It is nice to say, for example, that we need a sustainable food system, but here there is political conflict – and a consensus framework tries to hide this, so that it is technical and depoliticised. This is problematic. The framework needs to reflect the politics of food.

The second principle is boundary spanning structures. This means governance that includes new structures to connect stakeholders. For example, the Global Alliance for Climate-Smart Agriculture. This aims to connect agriculture and climate domains and global and regional initiatives. A trade-off is always made. You always draw new boundaries in the case of this alliance. It is limited to agriculture alone. Why not call it a 'Climate-Smart Food' alliance, but then it gets to complex!

The third principle is adaptability. A challenge of food systems is to adapt to changing prices and patterns. There is a need for government arrangements to learn more about this. For example, ETHOS takes combined monitoring and real-time data and knowledge generation – and with farmers tries to develop a citizen-based model tool for farmers to add in their own data. This can

provide them with real-time data, so all can learn about how to adapt to new circumstances. This is an age of adaptability.

The fourth principle is the most difficult. It is that of transformative capacity. The idea that many farming systems are locked into path dependency. Example of the Common Agricultural Policy that started as a European policy on food security. Because this policy had subsidies, decisions made in the past are not so easily adjusted today. Another path dependency is in African states, where the political elites want to keep building dams to deal with water scarcity.

Leadership is the final principle. As discussed, the answer to the food system problem is not a single governance arrangement. Leadership is important to connect the different arrangements and to ensure that the four principles are balanced and achieved in practice. Leadership cannot be a single thing. Leadership always involves multiple leaders – people who are visionary and entrepreneurial and who collaborate.

Finally, I want to say that, when I speak of these principles for food systems governance arrangements, only small steps can be made at a time. It is a gradual approach. We must try to be happy with small steps that can lead to big societal changes.

Why has the multilateral trading system failed?
Prof Amrita Narlikar, German Institute of Global and Area Studies

Agriculture has been historically the most emotive and contested of issues in multi-lateral trade. The WTO has not been able to correct two major and contradictory issues in agriculture: oversupply and undersupply. High price volatility and undersupply have raised great concern.

This presentation is in three steps:

1. Overview
2. Why the WTO cannot effectively cope with the over- and under-supply problems
3. What can be done given the lacklustre state of Doha[1].

(1) Overview
Concerns about food security have always been integral to the WTO. The Agreement on Agriculture recognises food security as one of the non-trade concerns that should be taken into account. The 2001 Ministerial declaration, launching the current Doha round, also recognises this and goes a step further. It states that the special and differential treatment of developing nations will enable them to take into account their development needs, including food security and rural development. But despite this – Doha is in trouble! It is in deadlock. There are multiple causes, but agriculture and food security is at the heart of the problem. So why are we in this sorry state of affairs? This requires an understanding of the contentious issues.

There are two main issues, both resulting in price volatility and thereby jeopardising the four pillars of food security.

First problem: oversupply and depressed food prices. Historically, this was a product of high export subsidies, domestic price support mechanisms and protective market access by the developed world (the US and Europe). The fact that agriculture entered the General Agreement on Tariffs and Trade (GATT) was because the EU and US recognised that subsidies resulted in low prices and was not sustainable. It also prevented access for exports. Overall, GATT and subsequent agreements have been damaging to the Comparative Advantage for developing nations.

[1] The Doha Development Round or Doha Development Agenda (DDA) is the latest trade-negotiation round of the World Trade Organization (WTO) which commenced in November 2001 under then director-general Mike Moore. Its objective was to lower trade barriers around the world, and thus facilitate increased global trade. (Wikipedia)

Australia, Canada and NZ (and Brazil and Argentina to an extent) worked to include agricultural liberalisation into the negotiations. This remains their agenda. West African cotton producers also seek this end. The G20 group of developing countries shared this agenda for liberalisation to further their own Comparative Advantage in agricultural exports. This agenda has been very hard to advance considering the high level of protectionism this sector still has.

But there are also issues of undersupply. This came to the fore as the Doha round progressed. Cancun in 2003, and then the formation of G33, pushed for the right to designate products as "special" which would enable them to be exempt from liberalisation, plus for a "safe card" from import surges. The sharp increase in food prices between 2006 and 2008 highlight the urgency of food security to developing nations. The July 2008 deadlock resulted from the assistance of India and its allies, insisting that developing nations should be able to raise tariffs if faced with import surges, but US and other developed countries resisted this.

The 2008 food crises highlighted the WTO's inadequate rules. When food prices increased, export bans and tariffs occurred, along with food hording of rice and increased exports. Some attributed the price to the demand side and rising consumption in India and China. But the fundamental cause rests in the supply side. There has been a significant decline in land available for food production, replaced by biofuels and a decline in agricultural investment.

Others talk about the role of financial speculation in considerably exacerbating the crisis. The sharp shift from "glut to scarcity" undermines confidence in the system. And the fact that the WTO could do so little has resulted in a misguided trade focus equating food security with food sovereignty and sufficiency.

Why are proposals for food sovereignty the wrong reaction?

1. The idea of self-sufficiency not being a good idea is based on Adam Smith. It is possible to grow food, for example, hot house grapes in Scotland. But the cost of heating would make it more expensive. So food security as self-sufficiency is less efficient.
2. Closing borders does not decrease the risk of instability. Reliance on world markets facilitates a diverse range of supplies – but also risks price in stability. But economists including Allan Matthews point out that increasing self-sufficiency would not decrease price volatility, due to domestic price shocks, which can be larger than volatility in international markets.
3. Why can't we pick and choose and use international trade as a buffer? This will not work because it may result in "beggar thy neighbour" policies – that is, destabilisation in other nations.

None of these arguments are against investing in domestic production and market infrastructure. Indeed, these things are very important and need to go hand-in-hand with trade for farmers to access large markets. But, the case for food sovereignty is not sensible. Their concerns are spot on – but we need more effective solutions.

(2) Why the WTO cannot effectively cope with the over and under supply problems

Explaining the deadlock. Three causes. Firstly, BATNA (best alternative to a negotiated agreement). Whether a deadlock can be broken depends on this. If one BATNA is superior, there is no incentive to agree. This is the case with US and Europe, which find that bilateral agreements are better options, partly because they can include issues such as labour standards (which are not possible to include in a world trade agreement). Secondly, given the high level of protectionism that agriculture traditionally enjoys, the potential losers of liberalisation have significant legal clout. Thirdly, the polarised negotiation frames used with reference to food security within the WTO. Sovereignty is couched in terms of 'fairness and justice'. Bargains are more difficult when you make claims based on this (because these concepts are contentious in themselves). Arguing for self-sufficiency and India (for public stock holding for example), and appealing to normative

principles, makes common ground difficult. The trade unions are just as ideological. A too-extreme politician makes reaching an agreement very tricky.

(3) What can be done given the lacklustre state of Doha?

Ways forward. There are three possible ways:

1. Rules and export restrictions need to be addressed seriously. This means greater market access and lowering subsidies. A process of clarification of binding export tariffs etc. Equally, the agenda of market access (oversupply). Both over- and under-supply to address price volatility need to be addressed. BUT we cannot take the route of binding commitment, because the WTO's negotiation machinery is broken. At best we can hope for agreement on other areas.
2. BATNAs – developing countries should try to reintroduce issues of food security and agricultural liberalization. This would tempt the major players back to the multi-lateral table, and secure better terms for the developing nations.
3. Even if the WTO was working efficiently, food security would not be guaranteed because the price volatility associated with food markets has much to do with speculation in agricultural derivative markets – which is outside the mandate of the WTO. It has to be accounted for by the economics sector. Reform here is necessary, as is better regulation of financial markets.

Questions

Q. How does China fit in?

A. Very tough to say. In the real world, there is great resistance between China and other negotiators. This is one reason why we need the TPP, because things will get very difficult if China changes its status in the WTO. In economies the size of China and India, they have the potential to have a huge impact on agricultural markets (for example by hoarding then dumping food – which would drastically lower global prices). It is important to make a differentiation between developing nations and developed ones.

Q. When we talk about trade – there are three or four big traders like Cargill. How are they involved?

A. This is the elephant in the room. Firstly, they have no direct influence, but it is huge via their home countries! The big issue is that they have an oligopoly market, because markets have been distorted for so long. State actions in this context – little attention is played to this skewed balance of power in markets. For food security, we can do a lot in the WTO context along the lines I spoke of – but we also need to change the oligopolistic nature of the market. The same applies to food producers like Monsanto. The WTO is not mandated to do all of these things. Perhaps the G20 summit should pay more interest to this issue.

Feeding a growing population: food sustainability and international economic law
Prof. Fiona Smith, Warwick University

Following on from the last presenter, I am going to offer a different perspective. Where does law fit into this debate, where does it cause problems and how can it contribute to fixing these problems? I want to distinguish between governance and law. Governance: who are the actors and what is the power relationship between them? What forms, ideas and policy do we want? The issue with this analysis is treating lawyers like a car mechanic. Come in at the end, and make it work! But this is so difficult. What lawyers can do is find space within existing regulations, so that they can be used more effectively – and also offer advice on how to change regulations.

I am going to talk about international economic law. There are four issues. Firstly, how to feed a growing population sustainably in the light of climate change. International economic law has a role to play, but is underpinned by a neoliberal agenda which isn't very helpful. The three possibilities for change are a move to food security, food sovereignty, or the Right to Food. In my opinion, these options are just as difficult as the current neoliberal situation. I think the way forward is 'food sustainability'. The problem was set out by Barbara yesterday – an unfair economic system which is biased to the growth of the northern and western dominated food systems. International environmental law is part of that problem. When I speak of this, it is wider than just trade law. International investment law governs the actions between nations and large state corporations who wish to invest within a state (like Monsanto with seeds). Laws govern what they can do (the main issue here is with land grabs). International economic law promotes oversupply and industry with high input (a focus on production). This is an issue for the environment, plus export restraints are not regulated properly.

One thing we can do is remove the whole idea of free trade and neoliberal economics, and replace it with something else. First option is food security, but as a lawyer, we need something to capture and put in an agreement to make it work. A definition of food security is tricky. The FAO definition is one, but there are actually 194 definitions of it! It can incorporate issues of: scale (looking macro, international, national or micro, the household or individual); gender issues (access of women and children to food); time (when are we food secure, when will this be?). Food security is an amorphous concept used by so many organisations and industries. It also sees climate as a risk to food security, but actually food security is contributing to this problem!

We can use the FAO definition, but a problem is that the emphasis is on security, not food. It does not tell us what is food? This is a gap for lawyers. States decide when they are food secure, so it is difficult when we speak across borders. Time is an issue, as is the narrative of risk and security and cooperation.

Food sovereignty. This is elephant in the room number two.

Definition from the Mali declaration.

> "Food sovereignty is the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems. It puts those who produce, distribute and consume food at the heart of food systems and policies rather than the demands of markets and corporations. It defends the interests and inclusion of the next generation. It offers a strategy to resist and dismantle the current corporate trade and food regime, and directions for food, farming, pastoral and fisheries systems determined by local producers. Food sovereignty prioritises local and national economies and markets and empowers peasant and family farmer-driven agriculture, artisanal fishing, pastoralist-led grazing, and food production, distribution and consumption based on environmental, social and economic sustainability."

Food sovereignty is a very complex set of ideas, including self-sufficiency, and covers a huge range of issues. It also includes the rights of individuals: to eat what want, to property, to the economy and of women. It is essentially a counter-narrative to the neoliberal agenda, and also to sustainable development: the idea that you can keep doing more with less.

It is difficult also because we can ask, is food sovereignty a way to achieve food security? Or is it just a "protest movement" to show opposition to the system, and not designed to be embedded in any legal system? Perhaps its strength is in sitting outside the law? Or is it a distinct way to address the problem of access to food? The way it has been legalised, in terms of enabling "the right to food" is not helpful. Also, in terms of returning to self-sufficiency, this may not be the choice of many small-scale farmers. Do people really want food sovereignty is another question? Overall, it is very difficult to scale this concept up to an international agreement.

Turning to the Right to Food, everyone loves this, the idea that if the WTO adopts this, all will be OK. This is not like the other two concepts. Food security and sovereignty are ideas to be embedded into existing rules. The right to food is a new legal system. Problem: is it a way of operationalising food security, or food sovereignty? What is the right to food giving? If it is a recognition of an individual's right to access food – fine, but what does this mean? It is articulated nationally, but this is problematic for trade agreements. *The issue is what the individual regards as food in a Human Rights context – this is key*. Trade is across borders. For example, in 2008 during the food crisis, people were starving. The right to food can be disguised as hunger. Russia imposed an export restriction on the West during this time, as it was scared there was not enough bread for Russia. They were not starving but culturally bread is very important to them. The basis of the Russian revolution! The right to food recognises the right to food as hunger and as food culturally appropriate for a people. So the difficulty with Human Rights is that those rights are equal, and cannot be traded off against each other. As soon as you do this, you are back into cost benefit analysis. But trade requires us to consider rights. Is the Russian right to culture more important than Mozambique's right not to be hungry? Also, how do you balance an equal right to food: to understand India wanting to stock pile food with the risk this will cause in other nations?

The other problem with the right to food – lawyers understand relationships with regimes, the plurality of regimes, and they are asked to resolve problems with relationships between regimes. Phillip Allison argues you do not want Human Rights in a trade context because the essence of HR is lost if transliterated into trade regime. A need to be careful about legal imperialism. Fragmentation is not a problem - an expression of multiple legal environments. Lawyers are always trying to make these things work together.

A better way forward – food sustainability. I am looking for a descriptive core. I need an understanding and description of food so that I can raise the importance of trade in a particular product, away from a commodity to one of food – and this changes how I regulate it. Food sustainability is more inclusive than sovereignty.

Questions

Q. Are there other commodities that are treated as special?

A. Agriculture (including livestock but not fish) has managed to make itself special in the WTO! It is interesting how this has evolved over time. An argument for not making agriculture special is that there are other things that should have special treatment – like medicine.

Q. How is a definition of 'food' problematic? And also what does 'sustainability' mean to lawyers. Can you say more about legal thinking into developing definition of these two words?

A. A difficulty in defining food is that it is very contextual, e.g. in the UK I would not think that dog meat was food, but in other parts of the world, it is a regular part of diet. This is why people steer clear of defining food. But, concepts like sustainability are equally difficult. Lawyers try to classify aspects of food via a tariff schedule, or there is self-designation by nations for special products from developing nations, so perhaps there is some kind of list for food (it could be defined based on this). There has been some more work done on sustainability.

Q. Sovereignty and self-sufficiency: is one more useful than the other?

A. Sovereignty is about what you want for your own nations. Forms of domestic regulations that have their own effect. It is successful in the context of technological barriers to trade agreement – as long as you say this is a domestic and regulatory measure you use, you will be more successful. On self-sufficiency and relationship with trade, the idea of regulation of agriculture with food is missing.

Plenary session 3: Food and culture
Chair: Dr Ksenia Gerasimova

How the modern Chinese choose what to eat
Prof Jiping Sheng, Remnin University

Modern Chinese choose food based on financial conditions, medical condition, food that suits the body type of the person, food that does not cause any adverse reaction and relies on the concept of food therapy or what a reasonable diet is. Various diet patterns have been identified and documented. The government has published guidelines that aid choice of food. The first such publication was in the year 1989, followed by 1997, 2007 and 2016.

Based on the geographical location, broadly eight kind of food patterns can be identified within China. Food is a combination of sweet, acidic, salty, bitter and spicy tastes. These tastes can be classified as yin (sour, bitter and salty) and yang (sweet, spicy and bland). Food is also associated with specific organs of the body, and consumption of the recommended food aids well-functioning of that organ.

With the rising population, genetically modified food is a part of agriculture, but people prefer to have organic food in comparison to genetically modified food.

When East meets West: learning about wine culture in Italy and bringing it to Japan
Prof Takayuki Shoji, Rikkyo University, Japan

'Food culture as a resource for tourism' was the central idea of the presentation.

The concept of 'slow food' supports food culture. Slow food implies maintaining or inculcating the native flavours into culinary cuisine. An idea contradicting fast food, which aims to reproduce the same taste across the globe.

Institutions such as the University of Gastronomic Science, Italy, are pioneering how to preserve the traditional ways to preparing food. For instance the University has a wine bank and attempts to preserve history of wine making and wine culture of Italy.

Food is elevated from being a bodily requirement to fine dining experience immersed in local culture. To take this effort a step further, food production is monitored from the very first stages of crop growth to fine dining, encouraging integration of primary, secondary and tertiary sectors in agriculture. In other words, taking care of food from the primary produce to finished produce, sustaining the local ecosystem and cultural heritage.

Sustainable food, culture and integration in Solidarity Purchase Groups Movement: the case of Barikamà in Rome
Daniela Bernaschi, University of Florence

The Burtland commission does not consider culture integral to sustainable development. The key point the presenter emphasises is that people can be agents of change/growth. To illustrate this, the success of a Solidarity Purchase Group was presented.

Barikama Cooperative was a small scale agricultural farm set up by a group of Sub-Saharan African migrants in Italy. The farm took up organic farming and the producers were supported by Solidarity Purchase Groups. The Purchase groups value locally produced food and are also willing to pay a genuine price for agricultural produce, as the members of the groups have respect

for the environment and sympathy for food producers. The produce is more expensive than mass produced food, but is cheaper than the branded organic products. The strength of this local model of development is that the producers and the consumers know each other, rendering alternative to certification and such standardizing processes to organic food.

Italy, due to its geographical location, is an important destination for migrant populations and these local development models have been able to integrate migrant people amiably into the society.

Plenary session 4: Food justice and food equality

Chair: Dr David Nally

Famines drivers old and new

Professor Cormac O'Grada, University College Dublin

I am going to talk about recent famines, which are killing events where there is scope for agency, and also disasters, crises, serious states that come to an end. We could spend the whole session discussing this definition. One aspect is that they are horrific. It is not just a question of exploitation and cruelty, the poor doing terrible things to other poor. It brings out the best and the worst.

Of the Irish potato famine, a US philanthropist commented about travelling around the island, how pre-famine she was never mugged. But when famine struck, human nature changed. People started to behave in ways she could not imagine based on her past experience.

In 1968, there was a prediction that was almost exactly wrong, that hundreds of thousands will starve to death despite any programme newly embarked on. I argue that we are at a state where peace-time famine is difficult to envisage. The story is one of gradual improvement – fewer and less serious famines. In the early 1970s it looked like the predictions of doom and gloom would bear out. In this period, we saw famine in sub-Saharan Africa (SSA) and Cambodia. In the 1980s, we had Darfur and Ethiopia. In the 1990s, there were still famines and it is too difficult to figure out the exact number of deaths from them. In this century: examples are Malawi and Niger, but in the context of world history, they do not warrant mention. There was a conflation of malnutrition and famine, the former being a steady state. I went and spoke to people in Niger at this time, and they did not think there was a famine happening.

In the new millennium, something has changed in the previously famine-prone nations. With GDP growth, linked to population growth, in SSA there is no heavy Malthusian message. But you can see that in the past ten years people are getting richer, so the vulnerability has receded.

Focusing on three nations prone to crises in the past, malnutrition has reduced. In Ethiopia there is still a high percentage malnourished, but the trend has been downwards. In terms of GDP, countries have been growing pretty fast; in terms of equality, not very. Bit I would still argue that this growth is partly why we have seen an end to famine for the time being.

What policy measures should we draw? Firstly, do not conflate famine and hunger. The cure for malnutrition is very difficult and very different from the cure for famine. NGOs working in disaster relief are guilty of conflating malnutrition because people donate more when there is a crisis. It is more mundane to give money to increase GDP.

Secondly, there is a need to distinguish between famines caused by wars and other famines.

Thirdly, information is critical – prices, early warning – and enables a more effective response than in the past. News and relief can now be instantaneous. A crisis can bring out the best in human nature. But it is also important not to abuse this and cry wolf when there is no crisis.

This also raises issues of food aid. When there is a famine, it is fine, and important, but do you want to make it permanent? If you do this, will there be damage to local farmers? This was a problem in Niger when there was no justification for importing food aid.

How high do prices rise during famines? There does not need to be a super high price for there to be a famine, because poor people already spend such a high percentage of their income on food. If prices double, this will cause a famine. There is much historical evidence for this

The case of siena: prices doubled in 1555, and again in the 1640s and 1679 in England. In England the last famine was in Elizabethan times; the price did not quite double, but there was a famine. Two points to make: it is not how high the rise is but how steep and big the mountain is. If the price does not stay high for long, there is no famine.

The case of wheat and rice in the 2000s. In 2007 and 2008 the increase in price caused riots. There was no famine anywhere in the world even though the price rose more than what the level that would have caused a famine in 18th century Europe.

The exception is the war famine in Somalia in 2011 and 2012. Chechen and Robinson estimated 260,000 deaths, but I question this. They headlined this number, and I think there are good if not compelling reasons for thinking that this number is too high. If you compare the last big Somali famine with 2011/12, the stories from people who lived during the famines, the narratives are so different. They are apocalyptic. But this is what you also get in 2011/12. There is mortality, but mostly of small children and in that context infant survival is already precarious. There are few reports of adults dying. So should it be confined to history? No, because war famines are likely in the future and could happen in rich nations. 10,000 people died in the Netherlands in WW2 in 1944/45.

The other difficulty, which has not been mentioned much here: what will happen with climate change, especially in SSA. Will this push people back into vulnerability? There are two views on how agriculture can react. One is that farmers are adaptable; so as temperature rises, they will adapt, along with corporations. (There is historical evidence for this in the 19th century; and in the wake of the cornbelt drought in the 1930s when there was sudden and dramatic climate change). Should we treat this as historical evidence and determinative? There is a tendency to treat these things as unusual.

The right to food in the Anthropocene: Equality and sustainability in the South African food system

Dr Laura Pereira¸ Centre for Complex Systems in Transition, Stellenbosch University

Definition Committee on Economic, Social and Cultural Rights: For the Special Rapporteur, the right to food is the right to have regular, permanent and unrestricted access, either directly or by means of financial purchases, to quantitatively and qualitatively adequate and sufficient food corresponding to the cultural traditions of the people to which the consumer belongs, and which ensure a physical and mental, individual and collective, fulfilling and dignified life free of fear. Only 23 countries have ratified this; India was added in 2013.

The concept has been problematic as to how it is interpreted. It also comes from the notion that we have a broken food system. The food system we have inherited from the 20th century is about calories, but what about nutrition? Food system has focussed on maximising output. Sustainable intensification needs to take into account the eco crisis.

The SDGs – in essence the right to food, security and standard of living is covered by these. It is also about economic access, which speaks to poverty. You can fit a food narrative into all of the SDGs, and there is also an environmental imperative (a difference to the MDGs) as they incorporate the idea of planetary systems.

The Anthropocene is a new era where humans are dominant in shaping ecosystems. Since around the 1950s, triggered by the industrial revolution, there has been a great acceleration with enormous social and ecological changes and corresponding impact on the environment, including ozone depletion, floods, GHG emissions. It also represents a crisis of equality, because with acceleration of economic growth has come inequality. The richest 22% consume 77% of the world's resources

Why a rights-based framework? Arguments come back to the notion of entitlements. There have been no famines caused by failed entitlements – structural and institutional impediments to accessing food. So the right to food could provide a framework for states to actually engage.

Socio-economic rights framework – is the obligation to respect different rights; the obligation to protect aims to ensure that enterprises do not deprive others of their access to food. These obligations should apply to non-state actors (like the WTO) and an obligation to fulfil. So if an individual cannot fulfil, the state has an obligation to provide (an interesting case in South Africa).

How can we realise these rights without compromising the planet? For socio-economic rights are dependent on ecosystem services, so should be called socio-ecological rights (to bridge the environmental and human rights discourse).

In South Africa there is a right to sustainable development. Right to equality is fundamental and ingrained in the constitution – a purposive reading on substantive equality – we are all equal but receive different treatment because of factual circumstances; cannot treat matters in a mechanical way. Section 27(b) is on the right of access to sufficient food and water. Two cases on water:

First: water meters went into a township in Johannesburg, but people could not afford the water. There was a fire and two kids were killed. The court overturned a case against the City Council. The government argument that the policy reflected a need to conserve water meant they were reasonable.

Second: a case in Carolina, with a community's water supply was contaminated by industrial acid waste. There was a duty to provide the people with water.

The principle of substantive equality was lost when it came to reasonableness, because the need for water is not only to the wealthy but also the poor – lost in discussion if government had acted reasonably. Also a valid argument that there is a scarcity and need to conserve. Court more concerned with mechanism of allocation rather than how fair it is. Idea of social and economic right not just dependent on the State, but also the ecosystem! A double blow!

The Indian right to food. Average consumption of 0.5 kg/grain per month. Continuing ability to deliver, but can they actually do this in the context of increased scarcity?

The challenge of reallocation of resources under scarcity. How are legal and political regulation able to deal with decisions? Is it possible to predict scenarios to deal with all of this?

Campaign over Golden Rice: Environmental Rights versus Humanitarian Rights
Dr Ksenia Gerasimova, Centre of Development Studies

See: Gerasimova K. (2014) Campaign over Golden Rice: Environmental Rights versus Humanitarian Rights, in Enacting Environmental Justice through Global Citizenship, eds. Maciej Nyka and Emma Schneider. Inter-Disciplinary Press: Oxford.

Questions

Q. What about the rights of nature?

Q. I am curious about the concept of economic rights, and the Human Rights approach as being too anthropogenic centred. What do you think about this?

A. The citizens are entitled to the rights, and the State should deliver these rights. The accountability of NGOs is relevant to your question. Anyone can set them up to work on the right to food, but there are significant failures of NGOs. The role of the State should not be undermined. The presence of NGOs is huge – we have to live with this complexity. (*Ksenia*)

A. I think the rights based approach comes back to the link between wellbeing, ecosystem services and need. What is need? Can we reach global consensus on this? The right of nature – and genocide and eco-cide are also relevant. There is an interesting discussion to be had – necessary to extend idea of social and ecological – we can only provide human rights by ensuring the environment is safe. The two are not mutually exclusive.

A. One of the difficulties of the human rights conception is that we have been talking about the benefits of the rights side, the whole point on the human rights debate is the individual. But what if the State does not have the capacity to fulfil it? If a nation is in a particular state, or lacks the administrative capacity (may not be unwilling), then you will know further on that, unless you can deal with the capacity side, rights fall apart. Also, there is a different concept of rights between west and other nations. In Africa, rights are collective, because individuals work together.

Q. A weakness with golden rice is that there is no evidence that golden rice will improve the nutrition of children. There has been no research done here, so the evidence base is poor for the importance of GM golden rice. Very difficult study as need permission to do this on young children. This is a hole in your argument…?

A. It is true – and not just for gold rice – with all GM crops, there is a concern for safety. But there are stages of safety checking while it is being produced. (*Ksenia*)

Q. I do not think that is right – the US has been eating GM rice for 20 years – and there are no issues with safety there. But there have been no trials with golden rice.

A. What about China? A need to discuss, so much money spent on investment, yet we do not have yields of expected results. (*Ksenia*)

Comment: In China, the genes with vit A. used in GM have higher than the human need, so the golden rice in China must fulfil its role. The concern here is not GM, but because parents did not know that their children were being fed this.

Chair: I recommend the book Hidden Hunger. The basic point is that development is ruled by experts, and we need to include those affected by the 'experts' in the conversation.

Q. Malnutrition requires a differ response to famine: can you elaborate on this?

A. You need longer term investment. Food aid may work in the case of famine, but not in the case of malnutrition. A temptation for NGOs is to confuse the two. Some NGOs actually started as famine relief agencies and have had to reinvent themselves. See David Reef on this matter.

Final summing up: comments from the participants in the two streams

- Had never thought of the cultural aspect of sustainability – culture can bring people together, or drive them apart.
- As scientists we like to generalise, but there are different trends worldwide. For example, in developing countries obesity is a sign of wealth, but in the developed world it is a sign of poverty. Important to keep context.
- Hunger and malnutrition require different approaches.
- Discussion around social and ecological rights – humans are entitled to food, but are also responsible for sustainable production.
- Individual responsibility is key: we have small-scale solutions, but now we need to build responsibility world-wide.
- Haven't really touched on the idea of aspirations – Coca Cola do a very good job of generating aspirations – should we be harnessing that or disengaging?
- It is the responsibility of scientists to educate food/corporate leaders. Tell them why they should be interested in food security.
- We need to be working with industry to have big impact.
- We need ongoing collaborations with industry; start modestly to build confidence and trust, then develop. The Institute for Manufacturing is a good place to start for industry links
- Knowledge transfer is still a massive issue – we need to get information to farmers.
- Global food security should really be 'Global food and environmental security' – can't have one without the other.

Things people felt had been omitted:

- Genomics and open data, for orphan crops;
- Addiction to fossil fuels in agriculture – particularly diesel;
- More cross-over between streams;
- Ecosystem services;
- Aquaculture;
- Genetic diversity (erosion of) – seedbanks not the answer – diversity as a social goal – bringing seedbanks into breeding programs.

Poster abstracts

(In alphabetical order of first author surname)

Rethinking Intellectual Property Rights for Seeds in the Global South
Titilayo Adebola, School of Law, University of Warwick
Theme: Global Governance

Access to seeds is vital to achieving food security. Intellectual property rights systems such as the 'Plant Breeders' Rights' in the International Convention for the Protection of New Varieties of Plants (UPOV) threatens small-holder farmers' access to seeds. UPOV (1991) limits traditional farming practices such as saving, using, exchanging and selling farm-saved seeds. This is detrimental to the interests of small-holder farmers especially in the global South, as they depend on traditional farming practices for their livelihoods. Nonetheless, global South members of the WTO cannot escape from providing intellectual property rights for seeds because the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) obliges all members of the WTO to protect plant varieties.

This poster presents an alternative intellectual property rights system for plant varieties suited to the socio-economic realities of the global South. Employing the Third World Approaches to International Law, it unpacks salient countervailing legal norms and principles such as farmers' rights to save, use, exchange and sell farm-saved seeds provided in the International Treaty on Plant Genetic Resources for Food and Agriculture. The proposed alternative system can be adopted by countries in the global South seeking to fulfil obligations under TRIPS. Although constructing an alternative system would be prima facie aimed at fulfilling obligations under TRIPS, more significantly, it puts the future control of seeds in the hands of small-holder farmers. Control of seeds by small-holder farmers safeguards their access to seeds.

Does sustainable intensification offer a pathway to improved food security for aquatic agricultural system-dependent communities?
Simon Attwood (Bioversity International), Park, S.E. (WorldFish), Loos, J. (Agroecology, Göttingen University), Phillips, M. (Worldfish), Mills, D. (Worldfish, 4ARC Centre of Excellence on Coral Reef Studies, James Cook University) McDougall, C. (WorldFish)
Theme: Landscapes for People and Nature

Sustainably intensifying food production will require engaging countries on how to increase and diversify practices and policies in a more sustainable and equitable manner. This is particularly important in sub-Saharan Africa and Asia, where around 80% of farmland is still managed by smallholders and more than 90% of fishers operate in small scale and subsistence sectors. We explore how aquatic and terrestrial production activities in complex social-ecological systems need to be intensified using a systems approach that integrates both the multiple ecological scales and interdependent components of the landscape and seascape, and the social components that mediate the use and management of natural resources.

An argument for integrating wild and agricultural biodiversity conservation
Simon Attwood (Bioversity International), Park S. E (WorldFish), Marshall P. (University of Queensland, Brisbane), Fanshawe, J.H. (Birdlife International), Gaisberger, H. (Bioversity International)
Theme: Economies of Food Production

We consider how wild biodiversity (WBD), such as birds and insects, has been valued over time through both utilitarian and intrinsic lenses, and the implications this has had on conservation policy and practice. In doing so, we reflect on the evolution in biological conservation theory with respect to valuing WBD and highlight how the recent shift to a more utilitarian perspective has underpinned Payments for Ecosystem Services (PES). Meanwhile, the conservation of

agricultural biodiversity (ABD), such as domesticated crop species and varieties and crop wild relatives, has taken a notably different evolution, being firmly rooted in intrinsic values. Yet, although PES has provided mechanisms to formalise the market for WBD and ecosystem services for some time, it is only relatively recently that Payments for Agrobiodiversity Conservation Services (PACS) have started to explore the potential to incentivise the conservation of ABD.

Present WBD and ABD conservation attempts are largely being pursued separately in terms of research, policy, implementation and incentivised payment schemes. As such, these separate conservation approaches fail to adequately acknowledge the intricate and intrinsic connections between the two domains. WBD and ABD are often spatially and temporally juxtaposed at field, farm, landscape and biome scales, resulting in multiple interactions and flows of services between wild and agricultural biodiversity. Both provide multiple ecosystem services that support food production, underpin food security and human wellbeing, and often suffer the impact of similar threatening processes, such as agricultural intensification. We argue the value of an integrated perspective on biodiversity conservation in agriculture that acknowledges and acts upon the synergies between WBD and ABD. This provides opportunities for the early development of incentive mechanisms and market-based instruments for conserving ABD to draw on lessons from the analogous, more established PES. We end by offering cautionary words around an over-reliance on an ecosystem service rationale for conserving all biodiversity.

Sustainable animal health services
Polly Compston, (The Brooke)
Theme: Actors in the landscape

Working horses, donkeys and mules play an essential role in many agricultural value chains in low-income countries. There is a range of service providers that form the healthcare infrastructure around these working equids. The exact structure varies by context; but vets, paravets, traditional healers, farriers, hair clippers and agropharmacists make some or all of their income by providing services to the owners or users of working equids. Creating viable animal healthcare businesses in these contexts is challenging, due to the initial costs of stocking pharmaceuticals and equipment, high ongoing fixed and variable costs and the level of technical skill required. Moreover some service providers are illiterate and there is limited infrastructure for technical support. Payments are often made in kind and multiple sources of income for households are the norm. Demand for quality healthcare services is often low, due in part to high opportunity costs against a historical backdrop of dependency on no-cost government and NGO structures. This poster will look at a framework that explores this market's supply/demand curve: externalities that exist, where public good is found, transaction costs, willingness-to-pay/elasticities and information asymmetries within this market.

Dependency of Crop Production Losses between Global Breadbaskets: A Copula Approach for the Assessment of Risk Pools
Franziska Gaupp, Georg Pflug, Stefan Hochrainer-Stigler, Simon Dadson, Jim Hall (University of Oxford)
Theme: Global Governance

As the 2008 food price crisis or the 2010 drought in Russia and other cereal producing areas have shown, it is mainly the confluence of crop losses in different parts of the world that cause immense price shocks and risks to global food security which can lead to famine and political instability. However, to date, little is known about the yield loss dependence structures of the global "breadbaskets". In order to model the interdependencies between historically observed wheat yield deviations in 5 "breadbaskets" - USA, Argentina, India, China and Australia – the copula methodology is used, a statistical tool to build multivariate distributions by joining univariate marginal distributions. This study uses and compares three different ways of constructing multivariate copulas: vine copulas, ordered coupling using the mini-max approach

and hierarchical structuring. Investigating the correlation structures of wheat yield deviations, both within and between "breadbaskets", high correlations within and not very significant correlations between the regions were found. Comparing wheat production losses in the "breadbaskets", it is shown that ignoring correlation structures within breadbaskets leads to a significant underestimation of risks of production losses. This is especially interesting for crop insurance schemes or crop price forecasting. On a global scale, it is shown that inter-regional risk pooling between the breadbaskets could improve crop insurance schemes and decrease post-disaster liabilities of governments and international donors.

Assessing the impacts of agri-environmental schemes
Claudia Havranek (University of Oxford)
Theme: Landscapes for people and nature

The impact of agri-environmental schemes within the EU has so far been shown to have limited effect on the environment, whilst exerting considerable financial costs. In the UK, 71% of land is committed to agriculture. Over 40% of the EU budget is paid out to farmers through the Common Agricultural Policy (including agri-environmental schemes), guaranteeing €28 billion to UK agriculture between 2014-2020. With the UK signed up to numerous environmental targets by 2020, agri-environmental schemes provide a significant opportunity to meet these targets. However, there exists limited data on the impacts of these schemes, in part due to the need for a specialist work force to complete comprehensive ecological analysis.

The advance of GIS technology provides an opportunity for large scale ecosystem analysis, and an opportunity to reduce on-the-ground fieldwork required to analyse the effectiveness of agri-environmental schemes. Limitations exist in both the extent and grain size of GIS data available. With reference to fieldwork in Ditchley Park, Oxfordshire, I will be looking into the effectiveness of agri-environmental schemes in the UK, and exploring if technological advances provide an opportunity to better these schemes.

The proof of the pudding is in the eating: Design's potential in enabling societal changes towards sustainable eating habits, especially related to the impact of diets in climate change
Silvana Juri
Theme: Citizens and Consumers

Current eating habits are unsustainable. Meat and dairy overconsumption is affecting the health of people and planet, contributing to climate change. Diet changes hold great potential for emission mitigation. However, this complex issue requires a holistic approach, one that accounts for socio-economical, psychological and cultural aspects. Design is a promising tool for change. It enables cross-disciplinarity, flexibility and innovation with commercial, social and cultural value. Collaborative methods involving stakeholders have proven to foster engagement and discussion while delivering immediate results more likely to be successful. It can help re-shape our future tables, towards a world in which people and ecosystems can thrive.

Agricultural Innovation System: Actors' Motivation, Roles, Linkages and Constraints in the Rice Seed System in Sierra Leone
Lamin Ibrahim Kamara (School of Agriculture, Policy and Development, University of Reading)
Theme: Actors in the Landscape

The development of agriculture is to a large extent a function of the innovative capacity of a myriad of actors – beyond the agriculture environment – responding to smallholder farmers' demands. The recognition of the relevance of these actors in increasing agricultural productivity, profitability and incomes of smallholder farmers has led to a shift in perspective from a Diffusion and Adoption model in the provision of research and extension services, to a more inclusive and participatory Agricultural Innovation System (AIS) model. The AIS model sees

scientists as partners - one of many responding to farmers' demands, rather than the only "innovators" generating innovations in the laboratory to be adopted by farmers.

This study therefore examines the various actors involved in the rice seed system in Sierra Leone with an AIS lens. It specifically seeks to identify the actors involved in the generation, multiplication, promotion and use of rice seed innovations, their motivation for doing so, and the roles they each play. Further, it identifies the interdependence/linkages among the actors and the constraints limiting their effectiveness in the innovation system.

The study employs qualitative techniques including Workshops and Key Informant Interviews with Research Scientists and Extension Personnel from the public and private sectors nationwide. Preliminary analysis of the data reveals insights that will be of interest to researchers and policy makers, and with implications for the achievement of food security among smallholder farmers in the target country (and even beyond).

Government acquisition of food from small farmers in the global South: A political ecology research proposal
Thiago Hector Kanashiro Uehara & Chris Sandbrook (University of Cambridge)
Theme: Actors in the landscape

This project addresses governmental action towards food security and biodiversity conservation in a globalized economy rooted in unsustainable consumption and production patterns. The overall aim of the project is to critically evaluate the origins, impacts, and politics of state procurement of food from smallholders in the global South, whose stated purposes are fighting hunger while protecting biodiversity to promote food security. Little is known about the different interests involved and the actual effects of these programmes, which might not necessarily be benefitting these communities. We aim to foster understanding about how government programmes of food procurement from small farmers contribute to debates about food security and sovereignty, biodiversity conservation, agricultural production, and sustainable public procurement. We will draw on political ecology perspectives to track and illustrate these processes in Brazil and Africa. This will start by evaluating state action within Brazil, and then expand the analysis to local and international institutions such as the Food and Agricultural Organization, producers/rural communities, beneficiaries/recipients of food from the state such as schoolchildren, and the ecological systems. Some of the methods that shall guide the research are surveys and ethnographical methods, semi-structured interviews, normative/legislative analysis, and narrative analysis. This research is expected to inform policy makers and help the building of pathways toward a more environmentally sustainable and food secure world.

Terminology, Conceptualisation and Measurement of Food Security
Larissa Kersten (Government Department, University of Essex)
Theme: Food Justice and Food Equality

The terminology, conceptualisation and measurement of food security has remained inconclusive throughout the literature. Terminology to depict food security and/or related concepts has not only been diversely but also incoherently applied within and across academic disciplines and beyond. Attempts to systematize the fuzzy terminology of and surrounding concepts of food security has brought even more contradiction, and therefore confusion to the debate. Despite Amartya Sen's work on the theory of food security since the 1980s, there is, apart from some limited attempts no coherent, comprehensive and compact conceptual framework suggested in the literature. There is though consent across authors on the observation that the lack of a common terminology and coherent conceptualisation might have contributed to a rather dizzying array of measurement options.

This poster contextualises the concept of food security within the applied terminology and develops a theory driven conceptual framework which highlights the multifaceted and multidimensional characteristics of food security. The new coherent, comprehensive and

compact framework suggests, besides a list of concrete indicators, that, first, food security is a latent variable which can be measured via multifaceted observable indicators which proxy food (in-)security outcomes, and second, further multidimensional indicators contribute to the explanation of the latent concept food security.

Sustainable intensification: 7 approaches, 7 enabling conditions
Prof Jules Pretty and Dr Zareen Pervez Bharucha (University of Essex)
Theme: Landscapes for People and Nature

Sustainable intensification is an approach to agriculture that seeks to improve yields while building social and natural capital. We review evidence on seven approaches that show promise for 'win-win-win' outcomes: increased yields, improved ecosystem function and direct contributions to the human development needs of smallholders. Reviewing the evidence base, we distil seven key enabling conditions that helped drive these outcomes. We conclude with reflections on the evidence base, and implications for further research.

Training future actors in the food system
Dr Kelly Reed, Teaching Fellow (University of Warwick)
Theme: Actors in the Landscape

There is an urgent need to address the increasing number of fundamental systemic failings in the global 'food system'. For example, food system activities – from producing to consuming food – are significantly degrading the natural resources upon which food security outcomes depend. However, the solutions to these challenges go far beyond the production of food. They are embedded within broad political, economic, business, social, cultural and environmental contexts related to the whole food system, including all aspects of the supply chain, diets and consumption patterns. The challenge of developing efficient, sustainable and socially acceptable food systems that meet the growing demand can only be tackled in an interdisciplinary way that integrates technological solutions with social, economic and environmental considerations. It therefore requires a systematised approach by people in the workplace who are able to use enhanced 'food systems' thinking and engage others with this approach. The significant implementation of such thinking will depend on there being a critical mass of practitioners trained in the process. The new cross-institution IFSTAL (Innovative Food Systems Teaching and Learning) programme aims to address this. This poster outlines the programme and presents some observations from the first year.

Increasingly underutilised crops in northern Sudan and their potential role in agricultural risk management strategies
Philippa Ryan, Science Department (British Museum) & Katherine Homewood (UCL)
Theme: Food and Culture

This poster will predominantly present data on changes in food crops grown in northern Sudan over the last century. Ethnographic fieldwork has focused on small scale Nile village settlements between the 2nd and 3rd cataracts, and interviews with farmers have identified several dramatic shifts in crops grown and associated foodstuffs (particularly bread cultures). These changes are related to a complex mix of factors, including crop introductions, technological and environmental developments, as well as changing attitudes towards certain cereals and pulses. Preserving local knowledge about food crops, processing and cuisine has implications for future food security because of the information contained within these knowledge systems about adaptive solutions. This research is part of a broader research project 'Sustainability and subsistence systems in a changing Sudan', which is funded by the Arts and Humanities Research Council and part of their broader research theme 'Care for the future: thinking forward through the past – environment and sustainability'. Research explores how comparisons of present-day and ancient crop choices can inform on risk management within agricultural strategies. Several of

today's increasingly underutilised crops were key food crops until recent decades, and also have a long history in the archaeological record – suggesting their particular suitability to the environment.

Thought for Food: Next Generation Innovation in Food Security
Juan-Diego Santillana-Ortiz (University of Düsseldorf, Germany), Caroline Marie-Inez Steiblin (University of St. Gallen, Switzerland) & Christine Gould (Thought for Food Foundation/Syngenta AG, Switzerland)
Theme: Economies of Food Production

How can humanity sustainably feed more than 9 billion people by 2050? Our 2016 research report, with inputs collected from expert interviews and stakeholder questionnaires, has shown that established organizations must understand the mindset, skills, and tools that the next generation inherently represents. They must also adopt more collaborative and inclusive approaches to successfully tackle these strategic issues and challenges. We showcase Thought for Food (TFF), a foundation established in 2011 that has helped over 5000 students, from 105 countries and 578 universities, translate knowledge into action by enabling social entrepreneurship, and empowering them to become next-generation innovators. The yearly TFF Challenge, a start-up competition, has helped at least ten student-led companies dedicated to food and nutrition security to be incorporated and attract financing. Additionally, TFF has forged beneficial relationships with a variety of influential organizations such as the Global Knowledge Initiative, the Secretariat for Global Open Data for Agriculture and Nutrition (GODAN), the Norman Borlaug Institute for International Agriculture, and the Kirchner Group. These institutions are, respectively, driving the future of design-thinking, open data, education, and finance in agriculture. Thus, we present TFF as a pioneer in entrepreneurship for food security that furthers student initiatives through training, mentorship, and product development. By doing so, TFF simultaneously promotes environmental and economic sustainability, as well as student empowerment.

The RSPB and Nature Friendly Farming in Cambridgeshire
Gemma Wells (RSPB)
Theme: Landscapes for People and Nature

Farmland wildlife in the UK is suffering massive ongoing declines. Many birds that specialise on farmland, such as the corn bunting, turtle dove and grey partridge, have declined by 90% since the 1970s. Other farmland wildlife, including bumblebees, butterflies, hedgehogs and arable plants, has also seen similar declines. The problem is simple: farming has changed considerably in recent decades, leaving wildlife in a struggle to adapt fast enough to survive. However the solution is far from clear: with growing demand, a return to the less efficient farming techniques of the past is not an option. Individual farmers have to make the choice to reduce their impact on the environment. They are encouraged to do so by governmental agri-environment stewardship schemes that provide subsidies in exchange for farmers delivering habitats for farm wildlife.

Research at the RSPB's own commercial farm in Cambridgeshire has shown that when land is farmed with stewardship of the countryside in mind, declines in farmland wildlife can be halted and even reversed. At Hope Farm we've even helped develop new ways of enabling food production and wildlife conservation to go hand in hand, such as skylark plots and the best combination of agri-environment options for year-round habitat for wildlife.
In our Farm Advice Focus Areas we proactively engage with farmers to help them use agri-environment schemes to deliver the best possible outcomes for nature. We also work with groups of farmers to develop "Nature Friendly Zones". Here, farmers in stewardship agreements connect with their peers to share knowledge and experience of habitat management, and actively involve local communities in learning about farming and farm wildlife. When landscape-scale conservation is delivered in harmony with food production, there is hope for the future of Cambridgeshire's farmland wildlife.

The environmental footprint of China's dietary transition
Erasmus zu Ermgassen (Department of Zoology, University of Cambridge)
Theme: Economies of Food Production

As developing economies urbanise and grow, their populations tend to undergo a dietary transition. The consumption of traditional staple foods declines, and meat and dairy consumption rises. Livestock products, however, have a disproportionate impact on the environment, and so there is concern about the sustainability of these emerging diets. Using government data on the grain use in different pork production systems, we quantified the changing land use of Chinese pork production – which increased 50% from 2000-2013. We find that while the total arable land used for Chinese pork production increased by 17%, international land use rose 2.5-fold. This figure masks two competing trends: the increasing efficiency and growth of modern, industrial pig and arable farming, and the decline of and increasing use of grain- and soybean-feed in smallholder production. We find that land use would have been 29% larger if yields had not increased over the time period, 4% larger if large farms had not become more efficient, and 9% lower if smallholder production had not declined in importance. Our results highlight both the importance of efforts to increase agricultural yields, and promote the use of low impact animal feeds – such as the food and green wastes used in traditional pork production systems.

Brief biographies of speakers and chairs

Daniela Bernaschi is a development economist and PhD candidate in Political and Social Change at University of Florence and Turin. Her work is centred around food poverty and food security with a special focus on the role played by civil society organizations.

Niki Charalampopoulou is Managing Director of Feedback, a London-based organisation campaigning against global food waste.

Dr Kun-Chin Lin is Lecturer in the Department of Politics and International Studies (POLIS). He joined the Department in 2011 from King's College London where he was a Lecturer at the China Institute, affiliated with the Department of Political Economy.

Dr Harnik Deol is a Senior Research Visitor at the Centre of Development Studies, University of Cambridge. Harnik is an international development expert working in environmental policy design, implementation and impact assessment in Africa, Asia, North America and Europe.

Jolly Dusabe is an agriculture development expert, currently pursuing a PhD at the University of Cambridge studying the core drivers to agricultural growth in Rwanda. Previously, she was a Senior Government official in Rwanda, leading multi-donor, rural development projects within the Ministry of Agriculture.

Dr Shailaja Fennell is University Lecturer in Development Studies in the Centre of Development Studies, University of Cambridge, attached to the Department of Land Economy. She is also a Fellow of Jesus College.

Dr Phil Franks is Senior Researcher (biodiversity) in the Natural Resources Group of the International Institute for Environment and Development (IIED). He is an expert on the social dimension of natural resource management and conservation, with a particular focus on better understanding and applying social equity principles in this context.

Dr Tara Garnett initiated and runs the Food Climate Research Network, now based at the Environmental Change Institute, University of Oxford. Her work focuses on the contribution that the food system makes to greenhouse gas emissions and the scope for emissions reduction, looking at the technological options, at what could be achieved by changes in behaviour and how policies could help promote both these approaches.

Dr Ksenia Gerasimova is a Research Associate at the Centre for Development Studies, University of Cambridge, coordinating and teaching on the MPhil paper 'Food, Agriculture and Development'.

Prof. Chris Gilligan CBE is head of the Epidemiology and Modelling Group at the Department of Plant Sciences, University of Cambridge, and Fellow at Kings College. He is co-chair of the Cambridge Global Food Security, a strategic research initiative of the University of Cambridge.

Prof. Charles Godfray CBE FRS is Director of the Oxford Martin Programme on the Future of Food and Hope Professor in the Department of Zoology, University of Oxford. He chaired the Lead Expert Group of the UK Government's Foresight Project on the Future of Food and Farming and is a member of the Strategy Advisory Board of the UK Global Food Security Programme and is contributing to the UN's Committee on World Food Security, High Level Panel of Experts report on Climate Change and Food Security.

Prof. Rhys Green is Honorary Professor of Conservation Science at the Department of Zoology, University of Cambridge, and Principal Research Biologist at the RSPB.

Prof. Howard Griffiths is head of the Physiological Ecology group at the Department of Plant Sciences, University of Cambridge, co-chair of Cambridge Global Food Security, and Fellow at Clare College.

Dr Regina Handsa holds a PhD from the Department of Geography, University of Cambridge. She has seven years of work experience in the development (natural resources) sector in India.

Prof. Corinna Hawkes is Professor of Food Policy at City University London. She is a specialist in, and adviser to governments on, the links between food policy, food systems, diet and health. She previously worked for the World Health Organization (Geneva) and the International Food Policy Research Institute (Washington DC).

Prof. Sir Brian Heap CBE FRS is former President of the European Academies Science Advisory Council, former chair of Trustee Boards of Academia Europaea, and Associate of the Faraday Institute for Science and Religion. As a biological scientist he published extensively on endocrine physiology, reproductive biology and biotechnology. He is a project leader of Biosciences for Farming in Africa (B4FA).

Dr Salman Hussein is Coordinator of TEEB (The Economics of Ecosystems and Biodiversity) for the United Nations Environment Programme. Previously Salman was with Scotland's Rural College, where he directed the University of Edinburgh's Masters programme in Ecological Economics and headed a team focusing on marine ecosystem economics.

Dr John Ingram is Food Systems Programme Leader for the Environmental Change Institute, University of Oxford. He has worked for the 'Global Environmental Change and Food Systems' (GECAFS) research project and 'Climate Change, Agriculture and Food Security' programme, and is Food Security Leader for the Nature and Environment Research Council.

Zahid Ahmed Khan Jatoi is First Secretary at the High Commission for Pakistan.

Dr Francois Kayitakare is Senior Scientist in the Joint Research Center (JRC) of the European Commission, based in Ispra, Italy. He leads a team working on resilience and on food and nutrition security assessment within the Food Security (FOODSEC) Group.

Jane Lichtenstein is a PhD candidate at the Centre of Development Studies, University of Cambridge. She is a former lawyer and charity administrator and recently served in Africa with VSO.

Dr Jean Francois Mercure is Assistant Professor at Radboud University in The Netherlands. He is an affiliated Departmental Fellow at the Cambridge Centre for Climate Change Mitigation Research (4CMR), Department of Land Economy, and research fellow at the Cambridge Centre for Energy, Environment and Natural Resources Governance (C-EENRG).

Dr Pablo Monsivais is Programme Lead for Social, Economic and Neighbourhood Determinants of Diet in the Centre for Diet and Activity Research. He is Senior Lecturer in the MRC Epidemiology Unit, University of Cambridge School of Clinical Medicine.

Teresa Mulliken is Director of Programme Development and Evaluation at TRAFFIC, Cambridge. She has worked for TRAFFIC since 1989 in research and advocacy on a wide range of wildlife trade issues.

Dr David Nally is a Senior Lecturer in the Department of Geography, University of Cambridge. He is a member of the Department's 'Natures, Cultures, Knowledges' and the 'Population, Health and Histories' Research Groups.

Prof. Amrita Narlikar is the president of the GIGA German Institute of Global and Area Studies and Professor at the Faculty of Economic and Social Sciences at the University of Hamburg, Germany. She was previously Reader in International Political Economy in the Department of Politics and International Studies (POLIS) at the University of Cambridge, founding Director of the Centre for Rising Powers.

Prof. Cormac O'Grada is a Professor of Economics at University College Dublin. He has written extensively on famine past and present, including the Great Irish Famine.

Dr Laura Pereira is a researcher at the Centre for Complex Systems in Transition, Stellenbosch University. She was previously a post-doctoral research fellow at the University of Cape Town looking at orphan crop innovation for food system transformation. She is also a co-founder of FEW4ALL, a sustainability consultancy firm that focuses on business and policy solutions to the complexity of food-energy-water issues.

Dr Nigel Poole OBE is Goodwill Ambassador for ICRISAT: The International Crops Research Institute for the Semi-Arid Tropics. He served on ICRISAT's Governing Board for six years, with five years as Board Chair.

Dr David Rose is a Postdoctoral Researcher in the Department of Geography, University of Cambridge, and Director of Studies for Geography at Gonville and Caius College.

John Rusoke, of Farm Africa, is a farmer from Katine in Uganda. John is currently in the UK on a Marshal Papworth scholarship to attend an agricultural course at Shuttleworth College in Bedfordshire.

Prof. Jiping Sheng is a Professor in the School of Agricultural Economics and Rural Development, Renmin University of China. She is Vice-chairman of Department of Food Bio-technology, where she conducts teaching, research on food science and food safety control and inspection and certification of organic food.

Prof. Taka Shoji is a Professor from Rikkyo University, Tokyo. His research interests are regional development and tourism. He is a number of the Japan Society and actively promotes collaboration with the UK.

Dr Will Simonson is a staff member and former coordinator of Cambridge Global Food Security, and Deputy-chair of the Cambridge Conservation Forum. He is also part-time Senior Programme Officer of the Climate Change and Biodiversity Programme of UNEP-World Conservation Monitoring Centre.

Prof. Fiona Smith is a Professor in the School of Law, University of Warwick. Her research interests encompass international economic law, food security international agricultural trade, WTO law and policy, investment arbitration and the right to food. She previously held posts at UCL, the University of Sheffield and the University of Leicester.

Toby Smith is an award-winning contemporary reportage photographer and has been Leverhulme Artist in Residence at the University of Cambridge Conservation Research Institute since October 2015.

Dame Barbara Stocking DBE is President of Murray Edwards College, and commenced her role in July 2013. She was previously the Chief Executive of Oxfam GB, which she led for nearly twelve years.

Dr Cath Tayleur is Conservation Scientist with the RSPB based within the Conservation Science Group at Cambridge University. She is also project officer for 'Agriculture, biodiversity and livelihoods', BirdLife International.

Dr Katrien Termeer is Chair of the Public Administration and Policy Group in the University of Wageningen. The mission of this group is to study the governance of wicked problems in the interrelated domains of water and climate, and food and agriculture, and to use the generated insights to develop governance arrangements.

Dr Nicolas Tubbs is Tropical Forest Conservation Manager in the RSPB. Nicolas has worked in Africa for over 10 years and is particularly interested in the nexus between development and conservation.

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