

# Food security policy-making: an interdisciplinary approach



**Wednesday 5<sup>th</sup> November 2015**

**16:00–17:30**

(followed by a networking reception)

**The University of Warwick Brussels Office**

6<sup>th</sup> Floor

Avenue d'Auderghem 22-28

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1040 Brussels

Food security is a complex contemporary policy problem, needing critical and innovative research to help address it, since it requires a means for networking together expert evidence from different and disparate areas which nevertheless interlock and interact, as well as managing complex questions at different scales. The collaborative, multi-disciplinary research group in food at the University of Warwick is exploring how such networking can be enabled through the use of mathematical models to aid decision-making in complexity.

In this short session we summarise our recent systematic approaches using specific case studies: how can local or national governments be enabled to unpick some of the complex webs linking food production and supply, environmental and social sustainability, governance, nutrition and social justice? Under what conditions can different kinds of evidence from such disparate areas be coherently combined, as if by a single logical decision-maker, and how can such a network be used to compare the effects of different policies on each of the areas food security can affect (in particular, health, education, social cohesion)? How can new evidence be incorporated in a coherent way, and appropriate respect for uncertainties be retained within the solutions?

**Professor Jim Smith** will outline how decision support systems can help inform policy choice and provide narratives for the eventual decision. He will describe various challenges for developing analogues designed to support policy design to ameliorate the impact of various food crises on food poverty within the UK. He will then proceed to describe tentatively how these systems might be scaled up to help inform and try to address the analogous challenges faced by European policymakers.

**Dr Martine J. Barons** will describe two specific case studies and the potential for future research.

These presentations will be followed by lively debate with:

- **Dr Albino Maggio** - European Commission - DG Joint Research Centre - Foresight and Behavioural Insight
- **Dr Patrik Kolar** - European Commission - DG Research and Innovation - Head of Unit of Agri-Food Chain Unit
- **Mr Zoran Kovac** - Programme coordinator at the Consumers, Health and Food Executive Agency (CHAFAEA)
- **Dr Rosemary Collier**: Director of Warwick Crop Centre and an Academic Lead for the Warwick Global Research Priority (GRP) on Food.
- **Professor Elizabeth Dowler**: Food & Social Policy in the Sociology Department, the University of Warwick and an Academic Lead for the Warwick Global Research Priority (GRP) on Food.

The discussion will be moderated by **Mr Geoff Meade**.

## Probabilistic systems for decision support with applications to food security

### Introducing the problem

Policy and other decisions made to influence large and complex systems, such as the EU food system, need the input of expertise from many disparate knowledge domains. Since it is unreasonable to expect a single decision maker to acquire sufficient expertise in all the domains, reliance on panels of domain experts is necessary. Their contributions must then be combined coherently to allow the decision makers to formulate an optimal strategy from the range of decisions that are acceptable and open to them. It is now possible to do this within the framework of a principled Bayesian network and its dynamic analogues. Bayesian methods are a widely-used approach which allows domain expert judgements to be incorporated seamlessly with information from data.

### Our Task

Supported by the UK government, we have been tasked to assess the feasibility of use of these dynamic Bayesian methods to provide decision support for policies designed to address food security within the UK. Food security was once considered to be a third world problem but this is no longer so. Recently, food security has been acknowledged as a potential problem by the many EU governments. In 2010, the UK Department for Environment, Food and Rural Affairs (DEFRA) identified the important issues associated with food security and also identified various scenarios that might lead to crises within the UK. The multiplicity of interrelated, dynamically-changing causal factors influencing this threat, the diverse sources of expert judgment and observational evidence informing the composite system, and the very real needs that policies must address, make this an ideal context for testing and refining methodological development of dynamic probabilistic models.

### Case Study 1

We are working with Warwickshire County Council (WCC), exploring with them the impacts that food security, and in particular, inadequate access to food, has on their areas of responsibility. We have held a series of meetings with them, with more planned, in which we have demonstrated the potential of a Dynamic Bayesian Networks approach to networking the information from distinct areas of expertise and responsibility in an appropriate way to provide decision support within the WCC remit as a whole. We have elicited from WCC the information sources that are available and routinely collected, and a utility function (measure of success) which they would find informative to evaluate

candidate policies. We are now building on this to produce a Dynamic Bayesian Network which captures the entire UK food system, identifying all available data and any missing information which should, ideally, be collected. We expect to be able to identify the drivers of the system and to evaluate the food poverty and other impacts of policy changes and exogenous shocks to the system.

### Case Study 2

We have already described a Dynamic Bayesian network that captures the dynamics of certain parts of the food market as it applies to food security. In this example, we explored the British sugar industry using a Dynamic Bayesian Network [1]. The sugar industry is a particularly interesting example, as the UK is a producer of part of its requirement, whilst relying on overseas supply, principally from Brazil, for the rest. Sugar can also be used for the production of bio-ethanol, linking its supply, demand and price to that of oil. We elicited distributions of conditional probabilities from sugar market experts and encoded these in a Dynamic Bayesian Network which then gave posterior distributions under various policy applications and uncontrolled events. These were shown to produce results in line with current expert opinion. We were also able to calculate the increase in the proportion of the UK population who would become food-poor under various scenarios leading to increases in the UK sugar price, even if all other prices remained stable. Thus we demonstrated a clear potential for this methodology to be extended to a broader food security decision support system.<sup>1</sup>



### Worldwide collaborations

To support and develop the ongoing work, we are organising and hosting a workshop, with collaborators from mainland Europe, CCanada, USA and Australia, as well as the UK. The invitees are a mixture of domain experts, users (policy makers) and academics from all relevant fields (WCC and DEFRA, academics in statistics, health, social sciences and agriculture). Having started with local decision-makers, we are now broadening our approach to the whole UK and collaborating around the world to share expertise with others who wish to do something similar on food security in their own country or continent.

<sup>1</sup> [1] Barons, Zhong & Smith [2014] Martine J. Barons, Xiaoyan Zhong & James Q. Smith "Dynamic Bayesian Networks for decision support and sugar food security" Submitted to Applied Artificial Intelligence

## University of Warwick Global Research Priorities Programme on Food

'Food security' is a complex issue that involves many aspects of contemporary society and the 'solutions' to 'food security' are a truly interdisciplinary problem. Through its **Global Research Priority** focused on 'food', academics at the University of Warwick are bringing together issues of food production and supply, environmental and social sustainability, governance (including science and technology), complexity and tools for decision making, social justice, nutrition and public health. We are a truly interdisciplinary group, drawing on crop production, cell biology, public health, political science, social policy, mathematics and statistics, history, philosophy and the performing arts.

Our vision for the Food GRP is to enable the best intellectual creativity and teaching capacity to address this highly complex, fundamental contemporary issue, so that people should eat regularly, sustainably, fairly and well, served by a food system which draws on the best science and social science to meet continual challenges. Warwick's strengths are a willingness to be radical and critical in thinking and collaborative practice, and to bring the best minds together.

Current work includes:

- exploring the combination of expertise and evidence from many disparate knowledge domains in a principled and coherent way so that a decision maker can evaluate competing strategy options for intervening in a complex and dynamically changing situation from the range of decisions that are acceptable and open to her (lead: Jim Smith, Mathematics and Statistics).
- using the arts to imagine 'Future Foodscapes' to 'Grow Warwick': an interdisciplinary imaginative collaboration to increase public knowledge about how food is produced and to encourage practice change through engagement in performance installations created by Warwick students and staff, artists, and community volunteers (lead: Susan Haedicke, School of Theatre, Performance and Cultural Policy Studies).
- improving policy and citizen understanding of, and engagement with, food poverty in richer countries; examining the effectiveness of interventions to address problems and to challenge the framing of responsibilities away from charitable response to state respect for food rights (lead: Elizabeth Dowler in Department of Sociology).

- considering what it means to treat food as a question of security rather than one of poverty, rights or sovereignty; looking at how food has been politicised in Brazil (lead: Ben Richardson in the Department of Politics and International Studies).
- researching both crop and livestock systems: plant research includes genetics, plant-pathogen interactions and plant development, whilst research at Warwick Crop Centre focuses on the sustainable production of field crops, particularly vegetables. The study of disease in animal populations ranges from theoretical modelling to clinical trials, and from population ecology to molecular biology of bacteria and viruses (leads: Rosemary Collier and Laura Green, School of Life Sciences).
- tracing the historical roots of our conviction that food, agriculture, health and state security are intrinsically linked, through a study centred around the potato, and investigating the moment, in the late eighteenth century, when historical actors began to insist that strong, secure states were inconceivable without a resilient agricultural programme grounded on significant changes in the dietary practices of the population as a whole. (lead: Rebecca Earle, School of Comparative American Studies).



The Warwick Food GRP also hosts seminars, workshops and visiting fellows and sponsors on- and off-campus activities such as Disco Soup and Disco Salad events (inspired by a visit by environmental campaigner Tristram Stuart), production of a 2014-15 calendar featuring photographs taken by students and a one-day arts event on campus 'Grow Warwick'. Collaborators include the Pod (Coventry City Council), the Centre for Agroecology, Water and Resilience (University of Coventry) and Fiches Théâtre Urbain.

## About Rosemary Collier

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Rosemary is Director of Warwick Crop Centre and an Academic Lead for the Warwick Global Research Priority (GRP) on Food. Rosemary trained as an entomologist and has worked on the pest insects of horticultural crops for many years and her main research area is in the development and application of Integrated Pest Management strategies for horticultural crops. Rosemary is also interested in the wider aspects of food production and consumption and in recent years has collaborated with colleagues from a range of disciplines (sociology, geography, statistics, engineering, theatre studies) on projects associated with food and food security. She currently leads the taught Masters courses at Warwick on Sustainable Crop Production and Food Security and within these leads modules on the Challenges of Global Food Security and Organic and Low Input Systems and teaches Integrated Pest Management. She also teaches undergraduates and postgraduates about the concept of ecosystem services and particularly those delivered by land managers. Rosemary is a member of Advisory Committee on Releases to the Environment, the Royal Horticultural Society Science Committee, the UK Insecticide Resistance Action Group and the IOBC-WPRS Council.

## About Jim Smith

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Prof Jim Smith is an established methodological statistician, decision analyst and machine learner specializing in probabilistic decision support and inference for high dimensional networked systems. He is a Mathematician with a Statistics PhD and has been a Full Professor of Statistics at the University of Warwick for about 20 years, now Deputy Head of Department with particular responsibility for Research. As Chairman of RISCU - the consultancy arm of Warwick Statistics Department - he also acts as a consultant for the university for a number of well-known companies and has worked for the Home Office of the UK on a number of occasions. He has a strong interest in developing good and defensible ways of combining complementary judgments given by different collections of domain experts to provide a holistic picture of a developing crisis and robust interventions to address its consequences. He is particularly committed in developing methods that can be of practical use as well as technical novelty. He currently holds an EPSRC award to work with Liz Dowler and Rosemary Collier to investigate ways groups of experts can ensure the coherence of their judgments when managing food crises within the UK.

## About Liz Dowler

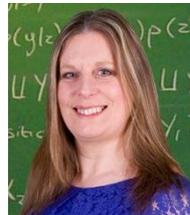
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Prof Liz Dowler is a public health nutritionist located in social science and an Academic lead for the Warwick Global Research Priority (GRP) on Food. Her research and teaching are on the social and policy dimensions of food and human nutrition; she works in multi-disciplinary collaborations in the UK, elsewhere in Europe and the global South. Current research is on food poverty, security, rights and justice, nationally and internationally; local food initiatives; evaluating policy intervention at local and national levels; and the practice of food ethics. Liz has explored consumer identities and perceptions of risk and trust in relation to food and new technologies, and the implications of negotiated new relationships with producers and the food system. She is widely used as a public speaker; gives expert advice to national commissions and research on food poverty, as well as non-governmental organisations, and often serves on government committees advising on food policy. In 2014 she was a member of the Expert External Panel evaluating Framework 7 programme 2006-2013 for Food, Agriculture, Fisheries and Biotechnology (KBBE) for the European Commission. She is a member of the Food Ethics Council, a small NGO working for a more sustainable, just food system.

## About Martine J. Barons

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Dr Martine J. Barons took her undergraduate degree in Mathematics as a mature student, after working in finance, insurance, health promotion, bringing up her family and taking a variety of community roles. Martine discovered that her mathematical forte and interest is in modelling human systems to better understand them and to improve people's lives. Martine continued in this direction, completing a MSc in Complexity Science and PhD in Complexity Science and Health Sciences at the University of Warwick's EPSRC-funded Centre for Complexity Science. Martine's thesis was on ways of classifying patients in order to tailor medical interventions more closely to individuals. Martine moved to Warwick's Statistics department where she worked on an NIH-funded project with Prof Jane Hutton and Prof Jim Smith on exploring the role of Chain Event Graphs in modelling and managing chronic diseases. Martine now works with Prof Jim Smith on an EPSRC-funded project on coherent inference over a network of probabilistic systems for decision support with applications to food security.



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