The Cambridge Forum for Sustainability and the Environment

Meeting 2: 18th November 2014 in Downing College

Aims

The aim of our topic this year is to draw connections between food security, biodiversity and bioenergy and to use the meetings to think about the research pathways that will help us to prepare for and address the challenges we will face in the future. In October, we started to think about connections between biodiversity, energy and food security and this month, the three witnesses will help us to think about some of the pressures on natural resources from the demand side, including economics, politics and health.

Agenda

All the witnesses will give a 10 minute introduction and their perspective on the two core questions followed a general discussion:

5:00pm	Welcome by the Chair and an introduction to the topic
	Each witness gives a short introduction and thoughts about the questions (10 mins)
	Questions and beginning the open discussion
6:00pm	Coffee break
	Continue the discussion in three groups and then come together for final thoughts
7:15pm	Reception and dinner, which will include a working session

Witnesses

This month, the three witnesses are:

Bojana Bajželj	Doctoral Researcher, Low Carbon & Materials Processing group, Department of Engineering, University of Cambridge
Professor Ian Bateman	Professor of Environmental Sciences, School of Environmental Sciences, University of East Anglia
Professor Theresa Marteau	Director of the Behaviour and Health Research Unit, Institute of Public Health, University of Cambridge

Questions

This month, the witnesses have all been asked two core questions:

1) What do you perceive as being the main gaps in our knowledge?
2) What would you include in the 'next generation' of research questions?

Each of these questions will be posed to everyone and their answers will then be used as a springboard for further discussion. The main points raised will then sent to everyone to use as a starting point for the next meeting.

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Witnesses

Bojana Bajželj

Doctoral Researcher, Low Carbon and Materials Processing group,
Department of Engineering, University of Cambridge

Bojana is interested in the global food security, climate change and land use. Her research points to the importance of addressing food waste and sustainable diets from climate mitigation perspective. She is also contributing to the resource-nexus model called Foreseer, integrating a range of land-related topics: urbanisation, agricultural production, biodiversity and the role of land in global carbon and water cycle.

Before joining University of Cambridge, Bojana worked as environmental consultant. She holds an MSc in Environmental Technology form Imperial College London and a degree in Landscape Planning from University of Ljubljana.

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Professor Ian Bateman

Professor of Environmental Sciences,
School of Environmental Sciences, University of East Anglia

While it is human economic activity which has resulted in the major global environmental problems facing present and (to a greater extent) future generations, it is clear that reform of that economic activity provides the only viable solution to such problems. Ian Bateman's interests lie in attempting to achieve this reform by bringing the environment into everyday decision making whether at the highest level, by informing government policy, or at the supermarket checkout by ensuring that prices reflect the true resource costs of production. Much of his research therefore seeks to value the true cost of pollution and the true worth of environmental improvements.

He is the Director of the Centre for Social and Economic Research on the Global Environment (CSERGE). Based at the University of East Anglia, CSERGE is a leading interdisciplinary research centre in the field of sustainable development and decision making. Recently completed research projects include: ChREAM (land use); AQUAMONEY (water quality); VERHI (impacts on child health).

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Professor Theresa Marteau

Director of the Behaviour and Health Research Unit,
Institute of Public Health, University of Cambridge

Professor Theresa Marteau is director of the Behaviour and Health Research Unit, the Department of Health funded policy research unit in behaviour and health.

She is also Professor of Health Psychology at King's College London and Director of the Centre for the Study of Incentives in Health (with the London School of Economics and Queen Mary, University of London) . She studied psychology at the London School of Economics and Political Science and the University of Oxford.

Her current research focus is upon developing ways of changing behaviour at population levels, drawing on neuroscience, behavioural economics as well as psychology.

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Background papers

Paper 1: Bojana Bajželj

Importance of food-demand management for climate mitigation

Recent studies show that current trends in yield improvement will not be sufficient to meet projected global food demand in 2050, and suggest that a further expansion of agricultural area will be required. However, agriculture is the main driver of losses of biodiversity and a major contributor to climate change and pollution, and so further expansion is undesirable. The usual proposed alternative—intensification with increased resource use—also has negative effects. It is therefore imperative to find ways to achieve global food security without expanding crop or pastureland and without increasing greenhouse gas emissions. Some authors have emphasized a role for sustainable intensification in closing global 'yield gaps' between the currently realized and potentially achievable yields. However, in this paper we use a transparent, data-driven model, to show that even if yield gaps are closed, the projected demand will drive further agricultural expansion. There are, however, options for reduction on the demand side that are rarely considered. In the second part of this paper we quantify the potential for demand-side mitigation options, and show that improved diets and decreases in food waste are essential to deliver emissions reductions, and to provide global food security in 2050.

Bojana Bajželj, Keith S. Richards, Julian M. Allwood, Pete Smith, John S. Dennis, Elizabeth Curmi & Christopher A. Gilligan (2014) Importance of food-demand management for climate mitigation, *Nature Climate Change* **4**, 924–929 (2014)

Paper 2: Ian Bateman

Bringing ecosystem services into economic decision making: Land use in the UK

Landscapes generate a wide range of valuable ecosystem services, yet land-use decisions often ignore the value of these services. Using the example of the United Kingdom, we show the significance of land-use change not only for agricultural production but also for emissions and sequestration of greenhouse gases, open-access recreational visits, urban green space, and wild-species diversity. We use spatially explicit models in conjunction with valuation methods to estimate comparable economic values for these services, taking account of climate change impacts. We show that, although decisions that focus solely on agriculture reduce overall ecosystem service values, highly significant value increases can be obtained from targeted planning by incorporating all potential services and their values and that this approach also conserves wild-species diversity.

Ian J. Bateman, Amii R. Harwood, Georgina M. Mace, Robert T. Watson, David J. Abson, Barnaby Andrews, Amy Binner, Andrew Crowe, Brett H. Day, Steve Dugdale, Carlo Fezzi, Jo Foden, David Hadley, Roy Haines-Young, Mark Hulme, Andreas Kontoleon, Andrew A. Lovett, Paul Munday, Unai Pascual, James Paterson, Antara Sen, Gavin Siriwardena, Daan van Soest and Mette Termansen (2013) Bringing ecosystem services into economic decision making: Land use in the UK, *Science*, **341**: 45-50

Paper 3: Theresa Marteau

Changing Human Behavior to Prevent Disease: The Importance of Targeting Automatic Processes

Much of the global burden of disease is associated with behaviours —overeating, smoking, excessive alcohol consumption, and physical inactivity —that people recognize as health-harming and yet continue to engage in, even when undesired consequences emerge. To date, interventions aimed at changing such behaviors have largely encouraged people to reflect on their behaviors. These approaches are often ineffectual, which is in keeping with the observation that much human behavior is automatic, cued by environmental stimuli, resulting in actions that are largely unaccompanied by conscious reflection. We propose that interventions targeting these automatic bases of behaviors may be more effective. We discuss specific interventions and suggest ways to determine whether and how interventions that target automatic processes can enhance global efforts to prevent disease.

Changing Human Behavior to Prevent Disease: The Importance of Targeting Automatic Processes (2012) Theresa M. Marteau, Gareth J. Hollands and Paul C. Fletcher (2012) *Science,* **337**, 1492

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Guests

Dr Liz Curmi

Research Associate in the Low Carbon Material Group, Department of Engineering

- climate change
- water use and flow
- modelling, including the BP Foreseer model
- resource dynamics

Professor Paul Dupree

Professor of Biochemistry, Department of Biochemistry

- the development of renewable materials, such as fuels, from plants
- the generation of plant cell organelles, particularly the Golgi apparatus and the cell wall

Dr Jonathan Green

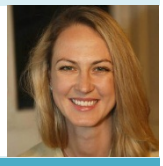
Research Associate, jointly between the Department of Geography and CISL

- the distribution of conservation costs and benefits
- engaging businesses in understanding their impacts and dependence on natural capital
- understanding the decisions that people make regarding the environment

Dr Elena Kazamia

Post-doctoral Research Associate, Department of Plant Sciences

- environmental sustainability
- evidence-based policy making
- algal community ecology
- cyanobacteria and ethanol production



Dr Dennis Konadu

Research Associate, Low Carbon and Materials Processing Group, Department of Engineering

- integrated assessment of land, water and energy nexus
- modelling energy supply and demand in the UK
- analysing and mapping terrestrial carbon sequestration opportunities in the UK
- connections between land and water use and UK energy systems

Grant Kopec

PhD Student and Project Manager of the Foreseer Project, Department of Engineering

- the integration of energy, water and land resource systems as well as regional energy flow aspects of the Foreseer project
- uncertainty, data estimation, systems dynamics and the intersection of physical- and policy-aspects of the tool

Dr David Nally

Senior Lecturer, Department of Geography

- the political economy of agrarian change
- the economic and socio-cultural dimensions of colonisation
- the history of subsistence crises
- the geopolitics of disaster relief

Therese Rudebeck

PhD student, Department of Geography

- global governance
- power structures
- water governance
- policy narratives

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Transcript

Duration: 0:64:30

Forum Members

Paul Dupree (PD)	Moira Faul (MF)
Hildegard Diemberger (HD)	Helen Curry (HC)
Therese Rudebeck (TR)	Koen Steemers (KS)
Theresa Marteau (TM)	Hua Chang (HC2)
Bojana Bajželj (BB)	Dave Nally (DN)
Ian Bateman (IB)	Rosamunde Almond (RA)
Dennis Konadu (DK)	Martin Rees (MR)
Liz Curmi (LC)	Miles Parker (MP)
Grant Kopec (GK)	Laurence Sherman (LS)
Howard Griffiths (HG)	Paul Linden (PL)
Susan Owens (SO)	

Meeting sections

Contents

Round table who's who

F1:	Representative, also from the [inaudible 0:00:01].
PD:	I'm Paul Dupree, I work on plant cell walls, so plant materials.
HD:	I'm Hildegard Diemberger and I'm a social anthropologist and a Director of the Mongolia and Inner Asia Studies Unit.
TR:	I am Therese Rudebeck, I'm a PhD student [inaudible 0:00:08] and I do global water governance.
TM:	I'm Theresa Marteau, I'm a psychologist and director of the Behaviour and Health Research Unit in the Clinical School.
BB:	I'm Bojana Bajzelj and I'm just finishing a PhD on land and other resources as part of the Foreseer team at the Department of Engineering.

IB:	I'm Ian Bateman from the University of East Anglia. I used to be a respectable economist, if there is such a thing, I've now been in the Natural Science Department for 26 years.
DK:	I'm Dennis Konadu, I work in the Engineering Department and I work on land and water connections to energy.
LC:	I'm Liz Curmi, I'm a senior postdoc in the Engineering Department also working with Bojana and Grant on the Foreseer project and I work mostly in water and other resources.
GK:	My name is Grant Kopec, I work on natural resource shortage and stress.
HG:	Howard Griffiths, Department of Plant Sciences and also Co-chair of the Global Food Security Initiative.
SO:	I'm Susan Owens, Department of Geography. I work on environmental governance with a particular interest in relations between science and politics.
MF:	Moira Faul, I work at the Centre for Science and Policy and the Humanitarian Centre.
HC:	I'm Helen Curry and I'm a Lecturer in the History and Philosophy of Science and I work on the history of agriculture, environment and life sciences in the 20th Century.
KS:	I'm Koen Steemers I work in sustainable design in the built environment, from the Department of Architecture.
HC2:	My name is Hua Chang [sounds like 0:01:54] Chinese [inaudible 0:01:56] at CISL working on long-term values of China, Africa economic relations and south climate governance issues.
DN:	David Nally from the Department of Geography with research interests on the histories and geographies of food systems, particularly with an interest in subsistence crises.
RA:	Hi, I'm Roz Almond, I'm a conservation biologist by background and within the Forum I help to bring together these discussions, thank you very much for coming, and also bring them together as an output beyond.
MR:	Thank you and welcome especially to those here for the first time. I think you can be a distinguished biologist or an extinguished biologist.
M1:	I'll remember that.
MR:	Well I think before we start I've invited Roz to give us some updates, if you want to do that?
RA:	Yeah, sure. So when we met last month I mentioned bringing together what we are calling a parallel forum of postdocs, PhD students and Masters students, they meet each month after this forum and the first one is next week, next Tuesday. So it's a really good group actually, there's from 11 different departments, 28 different people, a couple of postdocs from Theresa's group, you've given me some suggestions as well. John and Therese and Elena are going to be working with me on this with feeding the results of the discussion today, the papers from today, and that will act as a springboard for a completely and utterly different discussion next week about future research avenues with those PhD students and postdocs. Our intention is to bring this together each month, again working with a time lag of a week, and build up some really good links between students, between areas and allow us to explore more stuff through this so I'm really excited about it.
MR:	Do you want to say something about the programme for today? Because we're going to do an experiment.
RA:	Yes, we're doing an experiment today. So we'll add the introductions from the witnesses in a second and then just round table discussion as usual before coffee and then we're going to divide everyone into three groups with a witness in each group and a scribe in each group, John, Therese and I will take notes and the idea is that's a bit more of a

	chance to talk to the three witnesses. We're going to randomly allocate you in true facilitation fashion. But that will…we'll come together after about half an hour or so, a bit more of a discussion and then slide into dinner, so that's our experiment.
MR:	Well thank you very much indeed and so let's start and we've got the three witnesses then. They are listed here in alphabetical order but I understand they are happy to speak in that order, is that right? So that means Bojana kicks off.

Part 1: Introductions from the witnesses

Bojana Bajželj (BB)

BB:	So I'll just do a short introduction covering the paper that you have received and is kind of growing the baseline then I'll move on to some ideas for future research and what questions are still left open that are coming from this and a bit more brainstorming. So the work that I'm going to present is part of the Foreseer project which you might have heard mentioned but maybe don't know exactly what we do, which probably we don't either, but basically it's a project that takes very much a big picture approach to everything and it's looking particularly into connections between land, water, energy and other resources. And what we wanted to do with this work that I'm presenting is to kind of create land use scenarios for the world to 2050 that would kind of complement energy scenarios which is what many other groups around do and which we know are extremely important when we think about the future of climate change and so on. And because food demand is actually such a huge driver or has been historically and I think also will be in the future for land use we've actually focused more or less on food related land use issues and environmental issues.
	So we basically tried to explore how global land use system will play out into the future based on future food demand. Now obviously there are so many different factors here and yields, how are they going to change in the future, what actually food demand, how is that changing? So we needed to make some assumptions, those assumptions were for example that the global population will rise to 9.6 billion people which is the UN middle projection. We've taken the sort of current yield trends and extrapolated down to 2050, sort of in more or less linear fashion and we've also assumed that livestock production will continue to intensify as it has in the recent past and we've taken…so food and agricultural organisation projections for per capita food consumption, not only the quantity of it but also which food types people will like to eat in 2050. So that includes this move from plant-based foods to more livestock-based food which actually has quite huge consequences.
	So when we created this picture of current land use and agriculture based on all the agricultural statistics and other sources of information and using these assumptions that I've just described we then could calculate some possible scenarios for the future. And the most baseline one, which is more or less based around those four assumptions that I described, looks quite pessimistic and quite stark I would say. Because the way that the demand, the increase in the demand and the yield increases play out is that the yield increases would only actually cover about half of the increase in food demand or crop demand, and the other half would have to come from agriculture expansion. So there would have to be about 42% more crop land let's say, about 15% more pasture land as well. And because of that…so there would be an increased land use change which then also means more greenhouse gas emissions from that and also higher greenhouse gas emissions from bigger livestock numbers, so that all adds up to that greenhouse gas emissions from food production would increase for about three quarters, so 75%, which actually corresponds to the total budget in 2050 for all emissions, so for energy, agriculture and industry, if we want to stay within the let's say safety of 2° climate change.
	So that looks very serious. Then also we studied what can help and obviously sustainable intensification, so increasing the yields more than what we're seeing now, particularly in

	places where there are big yield gaps. So where there are big gaps between what's currently produced, what kind of yields we get from land and what would be the best practice or the best practice agriculture would achieve in the same local conditions. So if we can bring those up. These are particularly high in Sub-Saharan Africa, currently about five times below or as high as they should be. So that's one thing that would help, that would let's say reduce those emissions if you want by about a quarter I think. Also that would improve other things, so it would require less land use to be used for agriculture which means that there would be more land available for biodiversity. Also…well fertiliser is a different story because to actually underpin such intensification of agriculture we would actually need to use more fertiliser than in the baseline scenario. But it's not quite enough so there would still be an increase in those, let's say, impact of agriculture based on what we have today and ideally actually we should decrease them. But then what we found that does help enormously is to actually manage the demand side, so move away from just looking at how to change the supply into looking how we can mould the demand, obviously everyone still needs to be fed the right amount, right nutrition, it's not our goal to starve people. But we can actually reduce the per capita demand for food by reducing waste per capita and by changing the dietary patterns. So by changing…moving back from that increasing livestock-based back to more plant-based diets.
	That last part was particularly strong, it struck us as particularly strong because one of the scenarios we actually used was that we tried to look at…we're not health experts but we tried to look at nutrition literature and we tried to kind of make an average healthy diet if there can be one such thing. We used that into our scenarios and then we saw that it made a huge difference for all these environmental indicators that we were looking at.
	So that seems to be like a healthier people, healthier planet seems to be a good synergy which we might come back to later.
	So that's the summary I think. Now in terms of what's still left unanswered which is almost a lot of things and I think what strikes me which actually will tie in very nicely with what I think you're probably going to talk about is that obviously land use, farmers are growing food and that's why land use is happening and in a way we're not necessarily rewarding all the other possible land uses the same way as we do to people that grow food and they can then sell it, or that grow bioenergy feedstocks which they can also sell, or let's say timber. So that there is this…basically we need to find a way to quantify how all land uses or absence of land use can be equally rewarded based on…relative to the services that we value. So I think that's like a general one, everyone in land use is trying to grapple with. Obviously the fact that there is still no agreed carbon price is a big hindrance here but it's more than that, especially when we look in the developing world context, there's also a question who these landowners or land stakeholders are, how do we reach them? Because in a way if they can't use their land to grow food they need to have currency to buy food from elsewhere.
	But yeah, that was one of the underlying messages was that it's definitely worth saving land so that in a way we can minimise the amount of land that is used in agriculture. That's almost always beneficial, let's say, because natural vegetation brings so many uses and services, particularly carbon sequestration and biodiversity. But even more important than that is to just save the most valuable natural vegetation that is already there, particularly let's say tropical, peatland, forest.
	So that's one question, how do we grapple with this payment for ecosystem services or something similar? The next question is also how do we tackle this food waste reduction and I think now there's quite a good consensus that that's something that would be good if it happened. I think now we need to move onto some real practical and concrete strategies.
	The third one which is very similar is also in the field…it's the same but on the field of sustainable intensification, so we try the practices that have the best potential to close

	greenhouse gas, so what do we need to do that they are rolled out as soon as possible in places such as Sub-Saharan Africa?
	The last one is how do we achieve this behavioural change to induce transition to healthier and more sustainable diets, because there are double benefits there and it seems like a very worthwhile pursuit, although everyone of course should be free to eat whatever they want.
	Also in terms of what we're doing, I think we're still trying to work out, obviously these are just scenarios, there could be…you know, we could change any of these assumptions and see how that changes the result. What will make things better? What will make things worse? Climate change is one thing that we've already kind of looked at because that will…all the climate change will impact on agriculture differently in different places, but on average it will have negative impact, so climate change will probably make things slightly worse. Groundwater depletion is the next thing we are going to do and that could also make things worse, especially as a lot of food is grown in places that rely on groundwater-based irrigation and that groundwater seems to be running out. So what happens when they can't achieve their optimum irrigation anymore, their yields are going to drop, how will that affect the global food system is the next question we're going to look at.
	Obviously technical improvements can make things better and either GM crops or precision agriculture and similar. I think the only thing I have to say there is that they help a lot more if they are implemented in places where food demand increases and it's increasing. So if we double yield production in the USA of maize, let's say, that's not necessarily going to save as much environment, biodiversity and improve food security as if we would double maize yields in Sub-Saharan Africa for example.
MR:	Thank you very much, that's a very good introduction. We can have a couple of questions now but we'll have more questions when all three have spoken. Any particular questions?
HG:	Are you assuming single land uses? So you're saying that this is a bit of land and this is what it's used for and it is providing food and there's another bit of land and it's providing biodiversity.
BB:	Yes.
HG:	Or can you model…I guess in a sense more interesting, certainly in the European context more interesting, sort of multiple land uses where you say 'Actually we've got an area and it is farmland and it's producing some food but it's also producing some landscape and biodiversity and so on.' Is it possible to model that?
BB:	Yeah. I think it is definitely possible to model although a lot more difficult in…I think that in our ideal…when we first set out we wanted to do something like that, we wanted to recognise that every landscape has multiple uses or provides multiple services. But it's just…I think we got so wrapped up in that that we couldn't find a way out unless we really simplified it and then we saw…well actually, even if we do quite sort of in a way simplified analysis it would probably still hold for the global view and at least it's a starting point. So in a way, yeah, we've sort of…we didn't actually look at any more complex biodiversity indicators, we just took pristine natural habitats as a proxy for sort of biodiversity, but obviously it's not…it's far from being a good indicator I think.
MR:	Sue?
SO:	Thank you, very interesting talk. One observation and one question. One of my recent PhD students did his PhD on the science and politics of European biofuels policy and that really brought home to me the hideous complexity of these systems, energy, food, land, and in the end one of his conclusions was that you simply couldn't render something like indirect land use change material, you just couldn't do it, there were too many unknowns all interacting with each other. So I suppose one comment/question is about the sheer complexity and perhaps the dangers of simplification.

	The other question is perhaps deceptively simple which is when you say things like 'We can change demand' who is the 'we' that can change demand? I was fascinated by…in discussing with some US colleagues at a meeting a couple of months ago to discover that the latest thing is the Paleo Diet which I hadn't come across before, that slightly made the mind boggle, sort of the thought of us all running around East Anglia with spears or something. So I mean clearly diet is critical but those are my thoughts.
BB:	Yeah, I have to admit that I don't know who 'we' is. I think there is obviously…I mean the politically correct answer is that with education and when people are more better informed they will probably…more of them will make choices that might reflect these kind of environmental consequences of the food choices that they make. And I think that is true…
SO:	Sadly there is no empirical evidence.
LC:	But there is evidence that goes against that forcibly, yes, so it's not absence of evidence.
BB:	Okay.
SO:	Maybe for discussion.
HD:	[inaudible 0:22:55] complexity, I'm sorry, but when you were giving this very interesting and inspiring scenario in terms of trying to grapple with a whole range [inaudible 0:23:08] in my mind I was thinking about…so extreme situations where I've been working, so people who are practising high altitude agriculture, but also thinking about agriculture here and one of the factors that I notice is that for example in some areas there is a shift towards higher yielding species, say in barley for example, but the local farmers actually say that they really retain…at least some areas in which they use the older species because those might yield less but they're more resilient to the vagaries of weather and also over long-term. So I think the question is only measuring the quantity of yield might be a problematic indicator and thinking closer to home I was thinking about all the historical orchards that are coming up now and are extremely interesting and provide a variety that is not measurable in terms of high yield but nevertheless is perhaps more interesting than the Golden Delicious en masse that you buy at Tesco. So what I'm saying is that this adds complexity, so just that one [inaudible 0:24:25] in terms of yield might be an over simplification.
BB:	Yes I agree. I think there needs to be diversity within agriculture systems as well for other reasons as well, like pest control for example, yeah definitely. I think the ideal scenario is that they would stay, the diversity would stay but the overall yields would still increase.
MR:	I think this is overlapping with Ian's topic so perhaps it's best if we ask Ian to speak and then we can have more discussion [inaudible 0:25:05].
Ian Bateman (IB)	
IB:	Thank you very much. I'm going to start by assuming that you've all read my paper or that you never will so I don't need to summarise it either way!
	I'm going to start off with an objective for this question about research and I think it…well I'm going to assume that the objective is to achieve non-declining well-being over time. Now that might sound fairly innocuous but that is an anthropocentric objective, however of course human systems are a subset of natural systems and entirely dependent upon the natural environment so actually saying that you're looking after long-term human welfare probably means that you do have to look after natural capital as well, otherwise you won't achieve the latter.
	I'm going to consider three challenges: one, because of the focus of the talks is to talk about demand and supply of food and two, thinking about the impacts that are generated by changes in demand and supply of food and three, which is the one I'm going to talk

	about the most, trying to make better decisions given one and two.
	So first of all how your population and affluence change across the planet I think is a very important question. We have estimates, so Bojan mentioned the estimate about 9.6 billion which is pretty scary, and that of its own will generate a big impact on food demand, but of course there's this additional complication that the affluence of those people is changing over time and with it their diets are changing over time. Actually…although I think we'd all agree that a move to a lower impact diet would be very important for sustainability, actually all the evidence seems to be going the other way, that actually we are moving towards high input, high externality foods - externality being the wider consequences of any action.
	There's been some good work already starting on this, so the Royal Society's People and the Planet Report is one that I'd strongly advise people to have a look at of course the papers by Bojana and Theresa are both excellent and highly relevant to this. But I do think we also…while accepting that the demand side is probably the more important side, nevertheless I think there is reason to believe that we should carry on with research on the supply side as well. As I'm sure you're aware there has been…well there is evidence of a slowing down in the growth rate of agricultural production and of course that will accelerate any gap between demand and supply into the future. So the role of land management, agri-tech, we've already mentioned GM and precision agriculture, I think should all be a focus for research into the future.
	From an economic perspective I think it's vital to understand how changes in demand and supply will affect real prices into the future. That's the thing that is going to impact upon people's lives around the world and it's very likely that there will be a spatial and of course temporal variation in those changes in demand and supply. So different parts of the world are likely to be impacted in different ways and that will together determine the effect on human well-being.
	The second area I want to talk about is the environmental impact of any particular change in food production. Most of this I'm actually going to move into the third section about making better decisions but I will just pause for a minute to talk about the fact that there are many natural science questions which surprisingly haven't been answered yet and some of these are really pretty fundamental. If I was going to try and generalise them I think it is the relationship between stocks and flows and this can be applied to many different resources. So ecological resources, populations of species that we rely on, fish for example. What actually is the relationship between stock and the flow when we know we are putting pressure on those natural systems? If there are non-linearities in the relationships between pressure, stock and flow then we are going to be in major difficulties if we take the relationships from the past and just extrapolate them out into the future. We're basically…in effect we're assuming that things are just going to carry on as before and there is lots of evidence out there that populations respond in non-linear ways. But it's not just populations, of course the climate is a system which is non-linear and it's quite clear that we don't understand enough about the relationship between the pressure we put on it and how the climate is evolving. So we have this phenomena at the moment of the current hiatus in surface temperatures, this anomaly that although there is plenty evidence of the impact of climate change going on, the actual surface temperature doesn't seem to be reacting in a linear way.
	I think that is a major focus for research because unless we know what is happening with the climate we are taking major risks in terms of our use of resources. As I say there is plenty of evidence that impacts are still going on, we have incomplete evidence about what's happening to the ice sheets around the world. So for example there's been a lot of concern recently about the Antarctic, Western Antarctic ice shelf and I think that definitely needs more attention. Still on the climate change thing though I don't think…there's been quite a lot of work on adaptation but I don't think there's been enough on the dynamics of adaptation. So what are the second round effects of people reacting to change in

	climate? It's very likely that as climates change farming systems will change in response to it. It would be amazing if they didn't because that's what's happened round the world for all of human history, we do different things in different places because they're warmer, drier, wetter, whatever. As the climate changes we're going to change our land use but that change of land use will have secondary effects on a plethora of systems. So we will impact upon the water environment, we're going to change water quality, we're going to change the quantity and availability of water. Of course there's tons of feedbacks here. That in turn changes to water availability will in turn further constrain land use.
	So trying to bring this altogether, how do we make better decisions about this because it's quite clear that the failure to incorporate the natural environment into decision-making adequately has led to a long-term decline in what economies would call natural capital, stocks of natural resources and processes. And I think there's a lot of questions here that need to be answered but just very briefly so I keep to time, I think we need to develop truly integrated models of the spatial and temporal drivers of natural capital change. So I am still surprised that there is a lot of research out there where ecological changes are being considered in terms of the ecological drivers of those changes. Policy studies that look at the effects of policy but don't consider the natural science underpinning it and economic studies that just look at what the market is going to do and ignore the natural science and policy side. We really need properly integrated models. I'm not asking for perfect models, I'm asking for models that deliver better decisions than we have at the moment. So we need to integrate those together, they need to be spatially sensitive to allow for the fact that the environment changes. Just think of a small country like Britain, the environment from an agricultural point of view changes colossally across this small island. You can do…well not everything, but you can do almost every type of agriculture in this country and it's because the environment changes so much.
	Then the second area we need to model the multiple impacts of change in agricultural and other land uses and we need to include the dynamics in this, we need to include the fact that one thing changes another thing, that land use changes water, it changes greenhouse gas, changes habitat for biodiversity and so on.
	I think we have to accept we will never have perfect models and we have to explicitly tackle that by thinking about the problems of incomplete information and uncertainty and doing analyses of uncertainty I think will help us enormously in identifying where the new frontiers for research are. I actually…and this is just a hunch, I think we know much more about climate change and how it's going to change over the next 20 or 30 years than we do about agricultural markets and prices. I think to be honest we haven't got a clue what the real price of wheat is going to be in 30 years. If I did I would probably be in another job.
	Just finishing off, we need to…I do think economics has a place to play in this. I think that because resources are finite there's always an opportunity cost all of doing one thing as opposed to another, in other words there is always a value inside every decision. We can say “Oh I'm not bringing values into this, I'm just doing this.” Well why are you doing that? You’re doing that because you think it's of better value than doing something else, in other words you’re valuing things. It's about time we actually made these values explicit.
	I'm probably out of time so I'll finish with just a couple of application questions. I think we want to know about the impacts of alternative land use strategies, one last one the I'm particularly interested in, I think the Lawton Review on making space for nature is particularly appropriate if, as it says down here, you’re interested in conservation and biodiversity. Using land differently and in an intelligent way and linking up land to get synergies is to me an obvious way to get better returns from the resources that we've got.
	Sorry if I ran over.
MR:	Thank you very much. Are there one or two questions for Ian?

HG:	So what happens if we can't model it? I mean you're very persuasive about the complexity of the modelling and it's perhaps in a way easy to begin to say that "Well actually we can only model this little bit," and you're right, I don't know what the wheat price is going to be tomorrow let alone in 2050. Firstly I don't know what it is today but that's [overspeaking 0:38:50].
	So I guess the question is do we frame the question differently on the basis of the level of information we have? So do we think about efficiency which sort of implies we know quite a lot about the system I think that we're trying to make optimal, to optimise, or do we think about resilience and say "Well actually we don't really know so let's just play a bit safer."
IB:	Well let me give an example which probably incompletely answers your question but…a lot of the work that I do tries to bring natural science and economics together and tries to in effect work out what's the value of improving water resources and all that sort of stuff. There's some areas where I just don't think you can do that and the area that I would really pick on is particularly the existence of value associated with biodiversity. I just don't think we have a clue and I don't think we have robust methods for ever getting to that value, however much DEFRA would like us to put a number on it. Ooh, that's taped isn't it? Oh well, oh well. I'm on the DEFRA Committee, oh well. So what do we do? Well we can take some other information about what we want the future to look like and one of the things that I'm fairly confident that people's preferences would agree on is that we don't want species to go extinct, and therefore we can place that as a constraint on the system and basically say "Right, if we're looking at an option and it turns out that in this area it actually sends something extinct, or even less it just reduces the resilience of the species in that area, we're going to knock that option off the table, we're not going to allow that."
	So that actually is a very simple way of recognising we don't know everything and we're probably never going to know with regard to biodiversity sufficient. So a simple constraint.
MR:	Okay, I think we should move on and hear Theresa now.
Theresa Marteau (TM)	
TM:	Thanks very much. So what I thought I'd do is touch a little bit on behaviour and behaviour change and you might or might not have read the paper but I think you're all fast learners here, and then come on to apply some of those principles to two sets of behaviours. And what you're going to hear is a one person brainstorm so I'm delighted that there will be time to break up and discuss this, before making some concluding comments about the research and other challenges that we face in order to be able to change behaviour with the intention of reducing pressure on natural resources, that was the sort of broad aim that I thought I'd set myself.
	So our behaviour is largely influenced by immediate considerations and two that are particularly important are how we feel, so immediate gratification drive ours behaviour pretty well, and the environments in which we live cue our behaviour. So for instance we're all sitting down because we've been given tables and chairs. Anecdote - I heard the other day in DEFRA apparently when they're talking about jolly important things apparently cued by the Army people stand up for their meetings. Is that true?
HG:	It's absolutely true, the bird table approach.
TM:	Exactly right, exactly right. So we don't have that, clearly not that important although we're trying to save the planet. So these cue our behaviours much more than what we think cues our behaviour, so we all tend to think - and it's got a name in psychology, fundamental attribution error - that our behaviour is driven much more by what we think and our values than it actually is and this applies to the great unwashed, which includes us, as well as policymakers and politicians so it's worth bearing in mind.
	So for example to take broadly pro-environmental behaviours there's a new study which shows that your values, however much you value the environment, this does not predict

	your ecological footprint as defined in this particular paper. What does is your income. So the more you earn the bigger your footprint.
	That said if people are very motivated to act with an eye on the future that can happen, but usually that only happens when our limited cognitive capacity is emptied of all other considerations, and usually that's not the situation under which we're all functioning. So we have two broad options for changing behaviour: one is to attempt to change what's inside people's minds and that has driven health-related policy for the last 60 years. So you just have to look at obesity, the weight in populations and think of all the health education that people have had in high income countries. So that's gone up as has their weight. So that's not to say information isn't important, sometimes information is very important because it changes attitudes in the population which makes them less resistant to politicians doing things that can change our behaviour. We can come onto that in the discussion.
	So one option is to try and change our minds and generally this is not an effective way of changing behaviour across populations. So the other broad approach is to change our environments and in this context change our environments to make sustainable behaviour more likely by either not demanding our attention, so making it easy, automatic, so we could have had standing desks but they don't yet exist as a default, or by providing immediate reward for a behaviour that has longer term consequences. So sometimes by incentivising people, paying them money to engage in behaviours for which there is a long-term payoff.
	So the examples that I'm going to use which come from your papers and you've already mentioned them are what might we do to reduce food waste and what might we do to reduce the consumption of processed and red meats and for both there are health co-benefits - it's a terrible term, but anyway, that's what's used. As I say this is really a one person brainstorm because when I attempted to do a 10 minute literature review I couldn't find any reviews of interventions that have targeted those two behaviours. And I suspect I might have found something if I'd looked for longer but my sense is there isn't a large literature on interventions that have tried to change behaviour across populations in this area, which is why I think it's so exciting that there is this forum to bring together those in Cambridge who can begin to do something on this.
	So the two behaviours I'll touch on: reducing waste, again from the papers that you've been circulated apparently - this is all new to me - in affluent economies post-harvest losses are high and greatest loss is with perishable foods and the target has been suggested that retailers, those serving food as well as consumers. So the kinds of interventions might be portion size, reducing portion size, how much is provided both when purchasing in stores or being served in public places. Certainly in my own group we're just finishing a Cochrane Systematic Review looking at the impact of size in which food is served and the impact on purchasing and consumption and there is an effect.
	In terms of packaging it can be make the subdivisions within packages clearer rather than just providing information which doesn't seem to work. We can also think about pricing in the context of portion size so sell less for less because usually people sell less for more. Recycling food waste, biodigesters as well as initiatives like Rubies in the Rubble that some of you might have heard of. Labelling, there's quite a lot of talk about the labelling of food, the difference between sell by, best before dates. I'm not seeing any evaluations of the labelling to see whether there are ways of presenting that information in ways that reduce the likelihood that stuff gets chucked in the bin when it is potentially usable.
	The only UK government intervention that I could find on reducing waste is the Love Food Hate Waste initiative and that is based on providing information which is as I've already said is not where you would start and there's no evaluation of that programme.
	Moving swiftly on to reducing consumption of red and processed meat that may well be easier in theory because one can read across from what we know about reducing

	consumption of alcohol and tobacco and there are three main interventions there: increasing price, reducing availability and getting rid of marketing. In terms of availability there's a new report that is just come out from DEFRA on public procurement, some of you might have seen it or might even have been involved in it and apparently in the UK we spend…or is it England, I can't remember…£1.2 billion on food and drink every year and I can't see any reason why we should buy any processed or red meat out of the public purse. So anyway, so that's a suggestion. And I'm also not sure why we serve processed and red meat on public sector premises, so for example Cambridge University Hospital Trust continues to give floor space to Burger King. Guy's Hospital continues to provide McDonald's for 18 hours a day, seven days a week. So these are ways in which it is possible theoretically to have some control on availability, obviously there will be other foods in their place. Price, perhaps so there could be price interventions and marketing none, but I'm well aware that meat marketing is an important part of agriculture and the economy.
	So my concluding comments are some of the interventions I've mentioned I think from a behavioural science point of view will be worth evaluating. So they have the potential to shift consumption and change behaviour, but as is obvious to you all the politics and the philosophy and the economics of changing these are in stark contrast to what might be clear from a behavioural science point of view. And I think that they…for me anyway the key tension is between being crude being generating wealth, so selling us things that we don't need and probably throw away and generating planetary health along with human health.
MR:	Thank you very much. We've got about 10 or 15 minutes of general discussion and questions to you. I'd like to ask Bojana do you want to comment on what you've just heard in the context of say Africa rather than the UK where the waste is called a different word isn't it?
BB:	Well yeah, the waste happens in different places, so in the developed world it's mostly with the consumer or the retailer, in developing its mostly at storage or at harvesting, so there's a lot of spoilage and pests. So probably maybe different interventions, there's no need to incentivise the poor people to not throw away the food so they don't do it much.
TM:	Absolutely. And the extraordinary contrast in this country pre-World War II was 1% of food in my papers was thrown away and now it's 25% and it is thought that with austerity there's slightly less food wastage.
DN:	And also in Africa when buying groceries and food it's often very small sizes are purchased in very small shops as opposed to very large amounts of food which is then wasted. My question was about…I mean I totally get the idea that information-based campaigns and education of that kind may be…well not only ineffective but actually quite irritating at times. I also understand that health education or food education at schools it's done in the classroom context, it has the same effect, perhaps be considered boring and certainly not stick. What I wanted to ask is in the school context, in the early years context for example is there any evidence that habits can be formed through the example, not through the teaching or information, but simply through the example. For example of sitting down to a healthy lunch, it's not…it's simply the behaviour which has become so habitual through the lived experience to use my phrase. Is that something which could be built on because a lot of the campaigns in this space actually don't take that approach and you just gave an example of Burger King in hospital, they don't actually exemplify [inaudible 0:53:44] you're trying to achieve.
TM:	Yes, absolutely. So I've got three points. So the first is I'm just aware of one study that has looked at the opposite of a health halo effect of providing unhealthy foods in health contexts. [inaudible 0:54:15] observation study and what they do is they compare the beliefs of parents attending hospitals which did or didn't have these Ronald McDonald outlets and where they were present the parents rated those foods as less unhealthy than

	where they weren't present. Although it's not great evidence but I think it sort of speaks to what one knows about associations and I think it lends further weight to government intervention in these environments. In terms of what can be done in schools there is a programme called The Food Dudes' Programme run by…it was set up by psychologists at the beginning of…it was around 2004 was the first publication and it's a really neat example, not of modelling but looking at really classical conditioning. So exposing children at a very early age, age four or five to a small taste of fruit and vegetables and some social reinforcement and parents are involved as well and so I think it's 16 to 18 days exposure in this kind of way and one year later the children in those programmes bring to school in their lunchboxes significantly more fruit and vegetables. So that's one specific programme and then at the moment we have the School Food Plan that is being rolled out, I was a member of the expert committee for that and the whole idea of that is not primarily to improve nutritional status in children but to change the culture around food and exactly as you described. So for many children now they don't have meals sitting at a table, so it's about learning about where your food comes from and sharing a meal together and I would strongly encourage that there is evaluation of that because governments forget very quickly and without the evidence it won't continue.
MR:	Miles?
MP:	I wanted to pick up Theresa's point about the difference between now and the Second World War period and just to float the thought that there is a sort of ratchet effect here in that what we've grown used to over the last 30 or 40 years has been a system of handling food which has cost us less in terms of energy and time and if we're going to reverse that actually it's going to cost us more in energy and time. I don't have the evidence for that but I wonder whether that is a factor and I was thinking in the context of waste the very fact that people are now having to put energy and time back into sorting their waste and handling it in different ways might be the sort of thing that could help to reverse some of that. Even if Peter Guthrie would suggest it's a total waste of time at least it is making people…it's forcing people back into a cost of mishandling.
TM:	I think it's so interesting the concept of time in that…you know you said we might be wasting our time thinking about this, so this extraordinary resource that we have all these attitudes towards. So the food that is most likely to be thrown away is that green slimy bag of salad that's supposedly saved you time. So what are we saving all this time for?
SO:	It's the one that you bought in the two-for-one offer because you couldn't resist the extra one.
TM:	So it's partly that Susan, but so I think that there is a whole research area about people's idea of time and the conservation of that as a resource in order to squander. So all these judgements that we make about how we use time so I think it's a really good question.
MF:	So the question it's a question and a comment on pricing and valuing, just following up on a point that Theresa made and you also made about the size of portions in developing countries where you buy small things, there's the unit price markup that is immense on all of that and Unilever products that are in little sachets that are sold in little corner shops in Sub-Saharan Africa cost a huge amount more than what we pay for them here simply because they are packaged in that way and they know they can sell them in that way. So the cost of being poor is packaged in many different ways on one side of it. But then there's this question of valuing time, so there's this…did anybody see at the beginning of the week this new product the soylent…I don't know how to pronounce it, soylent as in the film *Soylent Green*? They've actually made something which is a foodstuff they've actually called soylent which I find quite astonishing and it's supposed to be…it's being marketed at the moment as something that will save you time because it will only take you a few minutes to make it so you don't have to bother with the preparation and dah, dah, dah, and all the rest of it. So the marketing is all about the time but actually the question is then back well what are you going to do with this time? Is it more about diversion and

	distraction, to have time to be distracted rather than to be doing these other things? So all of this is about what we value and how we value it and I was interested in your use of the word value and I could be wrong but it seemed that it could be change for price in many areas of what it was you were talking about and I just wanted to ask if for modelling purposes that is a requirement? What else…? And you said you can also put it as a constraint on the model but what are the other ways in which we could either quantify or qualify either value as a thing or the different things that we value?
DN:	That's very helpful actually because there's this big division actually between what I'm roughly going to call accounting and economics and most of the time when we think…when we use the term economics we are really talking about accounting and we're talking about pricing. Real economics which is actually a real minority sport, very few economists actually do it, Ian definitely does but…it's about true value, not about price and we know that there is a huge difference between value and price. Why do we go to walk round a woodland, so Thetford Forest about 30 miles around from there, there's no price to go in there so that would seem a very illogical thing to do if you thought value and price was the same thing. We go there because our value is higher than the price and actually that applies to absolutely everything…well I could say almost everything we do, but certainly everything we purchase we purchase it because it's got a value higher than the price and sometimes that price is zero, but we still have a higher value for it.
	So the economic definition of value is very different from the accountant's rather sloppy use of the word value which is exactly the same price and if there is no price there is no value. However of course that does flag up another thing which I think comes back to the first part of your question about the issue about prices for what are called parts as opposed to wholes, so things being split down, why do we do it? There is plenty of evidence, absolutely tons of evidence, it's in every supermarket every day that the reason why that's done is because the owner of the resource makes more money. That they increase the price times quantity that they get for doing it and we as consumers typically, either because of our income constraints, or even when income isn't constrained, we still seem to value parts more than wholes. We did an experiment years and years ago where we got people and removed…we got people who were really quite affluent and we were asking them about different courses in dinners. And when I say they were affluent, they were people like us, I don't mean millionaires or anything.
TM:	That's affluent.
DN:	It is affluent, yes, absolutely.
TM:	Yes it is, we're way above the [inaudible 1:03:57].
DN:	Yes absolutely. And what we found is that it was very easy to make people pay more for a meal by splitting it up into parts than by [inaudible 1:04:12], exactly the same as a whole. So it does seem to be there is some psychological affinity or anomaly that is being exploited. But thanks for the value of pricing.
	Coffee break

Part 2: Discussion groups

Theresa Marteau's Discussion Group

Duration:

0:34:00

HD:	I actually have an immediate question listening to your presentation and one point that you didn't mention but I think must be part of the equation is cooking skills because I think, at least from my experience as an anthropologist, one of the factors that really reduces waste is the ability to use what comes from the land or comes from the market, and use it and

	reuse it and really benefit. And what I notice here…I mean I'm half Italian so in Italy we tend to have kind of…at least we learn as kids to cook and it's very much part of how you grow up in many ways. What I noticed here in England is that kids tend not to learn very much how to cook and so there is much more reliance on…
DN:	Junk food.
HD:	Not only junk food but maybe something that is not really ready and you eat bits…
PD:	Just pizza and pasta and junk.
HD:	…and then you kind of throw away rather than reuse. You don't take a piece of meat and then you mash then you make into ravioli and so on, or you take the bones and you make the stock.
DN:	A question I'd have is are we targeted by food marketing more than the Italians? How much is this…?
HD:	Dolmio!
DN:	Can I play the victim card here, are we actually being subject to a lot of signals which are not reinforcing the right [inaudible 1:08:13] and which we're sadly just responding to as victims?
HD:	Well I've been afraid, I see in Italy actually very negative trends becoming increasingly…
TM:	The childhood obesity in Italy is [overspeaking 1:08:28] is really soaring.
LS:	You're catching up to the States.
HD:	Exactly, that's exactly it in a sense that what I'm telling you is a bit more the memory of quite a few years ago but I see that it perhaps is not quite as advanced as in England, but it seems that it's a kind of trend.
LC:	Is that just a change in culture maybe? You always imagine the stereotypical Italian mama who everyone comes home for lunch and you all share a meal. Has that changed so it's not just a…?
HD:	It doesn't need to be, it doesn't necessarily need to be that. In a sense what I tend to find say, also many Italians who live here for example, lots of them, is that you still have the idea that it's worth making your pasta or make your sauce and it doesn't take much, much more than putting something in the microwave. It takes in terms of time…
DN:	When you're skilled.
HD:	When you're skilled, exactly, and this is why…
DN:	It would take me all day.
HD:	If you have the skill you can do a lot of things, you can do rice, some [inaudible 1:09:33] you can do…
TM:	But I think we shouldn't underestimate the commercial environment and so it's probably all these things interacting. So into that space of probably reduced skills come somebody selling you something that is going to save time. Quite what we're saving it for is another thing. The right to go and watch more Downton Abbey, I don't know, so I'm sure that these things are interacting.
HD:	Not only, but the paradox is that then you have to buy all kind of toys whereas actually you could have a fantastic game with your children or grandchildren to bake cake for example, or you can bake pizzas or…
TM:	I completely agree. So I was saying to Miles, this is a reduced anecdote that I shared a house with two families, a weekend house and we had quite a long debate about whether or not get a dishwasher and two of the adults felt that washing-up didn't take that long and

	you have interesting conversations in a way that it's just very different standing up, doing the dishes, as opposed to automating it really. And again it comes back to the question what are we saving our time for? Anyway. So part of my response to you about the School Food Plan is this idea that children now compared to, say, their grandparents don't have those food skills and there been various initiatives I think with, say, football clubs, because football is so much part of our culture, using football spaces to get young people to go in and learn how to cook and cooking lessons being provided in those spaces. So all these initiatives come and pop up, whether it shifts cultures I've absolutely no idea.
PL:	This is my question, it's pretty clear isn't it that actually if we're going to live viably on this planet we've got to eat much less meat [inaudible 1:11:47], that seems to be very clear. Are we really going to be able to do that without it just being forced on us by not having it available? It's still not forced upon us.
TM:	So that's an interesting expression.
PL:	Forced on us in the sense that it won't be available at a price that we can afford, that it will be so expensive that we just can't…as you said and you said for alcohol and tobacco as a mechanism, I mean it will be, it will become scarce because lots of people want to eat it and it will be difficult to get hold of it. So I mean do you see any difficulty? I mean things have to go…if we didn't change our behaviour voluntarily what we eat, if there's lots of meat.
TM:	No absolutely not. I think one's serious about it so I think that much is clear, and I think it's very interesting people's ideas about what's okay and what isn't okay to do, so one isn't going to ban meat. But why do we have meat, say, why is it that your colleges to provide this, so not banning it but just making it more difficult to obtain.
PD:	But the point is that there isn't something cheaper that is more attractive than meat. If we could make something cheaper that is vegetarian people would perhaps go for it if it was really delicious.
TM:	Well they could have fish, mackerel.
PD:	If it was really delicious and that's the reason…
LC:	But I think it's…the narcolep…is it narcolep? No. What's the thing about taste and learning taste? I've got no… Lepsis is taste isn't it?
TM:	Ooh I don't know.
LC:	It's so that once you start having as a child, once you start having salty things then it's very difficult for you never to have them again, so the sort of traditional thing of bringing up children and you don't put salt in it and then they don't habituate, but once they've had a crisp you cannot stop that.
TM:	One of the successes of British food policy, or is claimed to be, is that the amount of salt in processed food has been reduced by stealth by a significant amount by all the manufacturers agreeing to do this and so palates have changed. So it is possible for people to relearn. But I'm interested in what you say about tasty food because as you were saying it's about what culture you've been exposed to.
PD:	And I think people do change their choices at the point of purchase, I think that was the point that you were making to some extent, and if the price is better and they enjoy eating it and even if it's trashy and they know that it's not as good as something else they will do it. So if we could make new foods, and this is something I raised at the last forum, if we could make new types of foods that were delicious and preferential in some way people would go for it. I think that that would…well, would it be the world? Would it work? What with your psychology?
TM:	So thinking about public procurement which I've only been thinking about for two days in preparation for this. So why…it's…so first of all it sends a signal, government decide we're not going to spend any more of taxpayers' money on red and processed meat and there are

	any number of foods that could be presented to people so people won't starve as a result of this and one of the best ways of changing people's attitudes is to change their behaviour first. Now this is arguably a slippery slope but generally what happens is once people's behaviours change through cognitive consistency their beliefs change. So for instance the banning of smoking in public places, so it's not banning tobacco but just in certain places, attitudes became much more favourable after that. Congestion charge in London actually became much more positive after it had happened. So I think the nature of the problem is such that we need some brave politicians…
LS:	But I want to ask…because all of this assumes a willing political class and I wonder about your…so [inaudible 1:16:18] to hear a lot of civil servants talk about turning its eyes on policy and their opinion of ministerial decisions is the equivalent of somebody grabbing a dozen doughnuts and [inaudible 1:16:30], about the way that those decisions are…I just wonder…
LC:	Well they worry about their majorities at the next election and things like that.
LS:	Yeah. And are you aware of the literature about this sort of changing human decision-making on that level?
TM:	So as I mentioned sometimes providing information to the public about harms to the planet or harm to health can be useful in increasing acceptability to them of governments intervening in ways that politicians might not want to do. So we've done a little bit of work in my group looking at acceptability in some experiments and to note how sensitive people are to evidence about effectiveness and we were looking at alcohol policy and people's attitudes. So one of the policies being pay more for alcohol and so the alcohol industry have been very active in dominating the discourse, why should responsible drinkers pay more, yeah, why should I pay more for my drink? But if people are given information about the change either in the health of the population or in the reduction of crime then they do become more accepting. So it still needs a shift in culture amongst our politicians.
LS:	But information surely isn't sufficient because your [inaudible 1:18:11] earlier that information [inaudible 1:18:13].
TM:	No, no, no, that's absolutely right. But this is about changing attitudes, it won't change behaviour, so you can change the attitudes of the general population by a small but significant amount and so that may well mean that it's a hypothesis to be less resistant when government does what they know is the right and proper thing to do in terms of the evidence.
LC:	Can you do it…? I'm really interested by it, you said the word stealth…
TM:	Yeah, by stealth, yeah.
LC:	Could you imagine a scenario that a politician has this like brilliant idea that they're going to ban you say all meat and processed food in Public Institute or something like that, no one is ever going to sign up to that but could there be a way of kind of drip feeding it or give some really even worse scenario that we're not going to give any…I don't know, hospital patients now have to bring their own food or something outrageous, would that…? Is there an opportunity to try and sort of feed it in a very gentle way or do you think something like that needs to be made as a big announcement that the whole country needs to get behind? I can't figure out what that… Isn't part of the problem with all of these things we don't actually know what the answer is really. Okay eating less meat might be an answer but…
TM:	It's red and processed meat. It is very specific meats.
PD:	For health, but not because [inaudible 1:19:45].
LC:	Yeah, so red and processed meat but it's the unintended consequences that might happen from that. So probably the fact that Burger King has a franchise in a hospital means that there are scanners in the oncology door, the maternity part and you get rid of those

	because… Wasn't there something in schools? So they banned soft…I think fizzy drinks [overspeaking 1:20:10].
TM:	Should we drink beverages in vending machines.
LC:	Yes, and then there was something that happened, you know schools, they didn't have the…
DN:	Yeah, schools were growing reliant on them for a cash flow but it's about alignment I think, I mean if they took Burger King away odds-on you could find the healthy and inspired alternative. I agree with Paul, strategies which take things away are politically very difficult, strategies which give people an alternative, which may even be a nicer alternative if they're given a few cultural transitions to make is probably the way to go. If you're sending mixed messages in public services and then you're employing the ARCOL consultant to define the passage across because you haven't fundamentally incorporated it in your policies, it just seems like a huge waste of public money. But that for me it's the public services have to be the exemplar, if you're not starting there it shows the government it isn't actually committed or it hasn't thought through how behaviour really needs to change and it can then commission a 2 million campaign to try and get some headlines and it's inconsistent.
TM:	But are they clashing values? I think that's part of the problem for government because this free market and wealth creation are very clear values and that's maybe why hospitals have these franchises. Then there's another value which is population health and there's another one possibly in the sort of planning [overspeaking 1:21:35].
DN:	Well I think most people can sign up to population health can't they? Do we have politicians who can't sign up to population health?
TM:	They can, but as you say, I'd say for instance with ARCOL they're not engaged within [inaudible 1:21:49], and the government response was "Our night time industry…" I think it was called, "generates X billion pounds a year" and then they just trashed the evidence [inaudible 1:22:00].
DN:	Sounds a message straight out of the drinks industry…
TM:	Absolutely.
DN:	Which is very powerful.
TM:	[inaudible 1:22:05].
DN:	One observation is - because we work with a lot of food and agriculture and drinks companies actually in our sustainability work - they prefer to keep the conversation on the production end where they can tell very nice stories about water efficiency, water shared management, pollution control, certification of the actual systems and all that sort of stuff. It's great, it fills their corporate reports, nice stories, do they want to talk about demand management, do they want to talk about not providing salt, fat and sugar to children? No of course not. Just steer away from that. It's not even a conversation they can have internally in their companies. It's a no-go area. It needs recognition to control that.
PL:	[inaudible 1:22:46]. Saying to people "We know what's good for you and we're going to do this, even if you don't want it, we're going to do this", in a democracy is a kind of strange [inaudible 1:23:01].
TM:	I absolutely agree.
PL:	You can take smoking. It seems to me smoking has been so effective because actually people began to really dislike it, I mean they really saw that people got sick and they'd grown up with their relatives who died and got to the point where they hated the smell of it. So it came from the people rather than [overspeaking 1:23:19].
TM:	No I disagree, I don't think it did. So another way of thinking about it is once the reports came out in the 60s clearly linking smoking with lung cancer there was then government

	intervention and it seems that what happens is you need the kind of critical almost majority to get behind dominant intervention. So at that time the majority were smoking and they weren't particularly [inaudible 1:23:51] intervention, but it was only as the number of smokers started going down that people then became in favour. We will never tease this out but my sense is that there was a public in our community who fought against government and commercial interest, they then changed the policy landscape and then public attitudes became kind of synergistic.
PL:	So why doesn't that happen with alcohol then? Why isn't there an equivalent example for it.
TM:	No that's absolutely right. So my reading of it is at the moment 20% of the population consume tobacco in this country and we know that the majority of people are in favour of tobacco control policies and even with that standardised packaging has not been implemented and that's industry lobby, despite the fact the majority of people are in favour. So for alcohol 85% of people in this country consume alcohol, so you've got…it's a dominant activity, it's a dominant behaviour and freedom of information requests have resulted in essays being written about how the industry got into No.10 in 2013 and they have priority in seeing the Prime Minister and Sarah Wollaston who is a Conservative MP, who is a GP, very much backing the move in price because of the evidence. All her appointments with the PM were cancelled.
	So you've got a perfect storm. So you've got the majority of people 'Why should I pay more?' and you've got industry helping them to frame that in terms of responsible people shouldn't be paying more and then you've got the industry. [inaudible 1:25:44]. So the concern is it will mean poor people will have to pay more. The modelling which is pretty good suggests that those who are poorest, I mean they were looking at a price of 45p, would pay on average 4p a year more. And those who drink at a harmful level, the poorest group, they already pay I think it's £3,500 a year on alcohol, so it is quite [inaudible1:26:11], and so [inaudible 1:26:13] price they could end up paying £300 more, so aggressive in terms of their profit but progressive in terms of their health. So that's not a bad [inaudible 1:26:22], anyway so government has failed indeed in those messages. So I think it's because…it's all those things that mean things haven't shifted for alcohol and similarly I think with shifting food, I think people would be even more resistant.
LC:	I think that's part of the thing, I think whether or not we would…I think we're all going to have a glass of wine, well [inaudible 1:26:46] you're not.
TM:	Well I shan't, I shan't.
DN:	Cigarette anyone?
LC:	But I think it's ambiguous about alcohol that most people [inaudible 1:26:56] to excess, I would say that one of the things that the forum is trying to do is to work out what would be the ideal thing in terms of sustainability for land use and that's not clear that then directly translates to…
TM:	In people's minds.
LC:	Yes. Now I'd agree with you about meat, I think that's for a long time…the inputs into agriculture for meat is very clear that that is much greater, but that's because of the way the agriculture, the way it is farmed at the moment. Now somebody mentioned the Palaeolithic Diet, that's meat diet, so meat and fish, hunter gatherer and there's not enough resources for us all to go out there and hunt wild rabbit. I don't know, I don't know whether anybody else thinks differently, but I don't think it's completely obvious how we change agriculture [inaudible 1:27:49], that's really what we're trying to do, so it's quite difficult to have a dictat for all of the population to change the behaviour about food because…
TM:	Would that not change agriculture though if there was a dramatic drop in demand?
LC:	It would do, yes, it means it probably would do but I'm not certain that that…you'd have to have something else to have its place and to have lots of vegetables, horticulture, there is

	much bigger waste for that sort of thing, fresh fruit, vegetables than for meat.
DN:	They have a lower carbon and water intensity though.
LC:	They do, you still have to…you might have to process them hugely in order to make them tasty so they are able to eat them.
DP:	But you see the alternative and successful diet in India and China a few years ago without the meat, it's beans and rice, pulses and rice.
LC:	But is that tasty?
DP:	Yes.
LC:	Is that what people want to eat?
DP:	Well it could be.
LC:	Is it delicious?
PD:	Yes I love it, I love it but it's not on the menu.
LC:	You love it but I'm just saying…I'm talking about people's behaviour.
PD:	Yes, fair point, yes okay.
DN:	Then that's back to the habits.
LC:	It's not very democratic to make people eat…
TM:	Well what is democratic about these large corporations deciding what's going to go inside your body? That doesn't strike me as particularly democratic. So all our taste, everything is constructed, so I think it's…
HD:	But also if you think actually in terms of long-term perspective it's actually only relatively few years that we have been having so much meat at such a low price and accessible to many people. In a sense that normally and I'm saying even a few decades ago people probably were eating meat maybe once a week or something and that was healthier and more normal, it was more expensive. If I think about the Himalayan village where I did fieldwork the price of butter or meat was not too different from the market price here, for people who were actually basically paying a day's salary to buy a fifth of butter. So what I'm saying is that we are in a way completely skewed in terms of the pricing of this kind of food and are very used to having them available and I think that…I know that it might sound undemocratic but if we had possibly higher quality, higher price and at the same time a more…
DN:	People need to know that they're going to survive perfectly well by not eating these things, because there's a lot…I think there's a lot of misinformation about 'I need to eat meat three times a week otherwise I've got a protein deficiency', that's not true.
LC:	Yes, but it's…I know nothing about this sort of culture so I'm just talking off the top of my head but my children do not hunger on that basis that they need to eat meat, they just like it and they don't like vegetables.
TM:	But I don't think that's the alternative…
DN:	The damage was done at school [inaudible 1:31:13].
LC:	[inaudible 1:31:14] so it's all my fault.
DN:	I can't blame you then.
TM:	So I don't know the information would make that much difference but as I've already said [inaudible 1:31:25] big signal that if the food bought out of the public purse [inaudible 1:31:32] diet that is sustainable, I think [inaudible 1:31:38] until you shift…

DN:	It will take time, take a decade.
TM:	Yeah, absolutely. But thinking about children at school, so the School Food Plan doesn't go that far but hopefully it will go further.
HD:	At the same time I think there probably would be ways of improving usage of the meat that we are producing, because I think we tend to use certain parts of the slaughtered animal and much less others.
PD:	I don't think it goes to dog food and cat [inaudible 1:32:11]. I think we should ban more cats and dogs in the country as well, I would vote for that.
DN:	Surely we should eat them Paul?
PD:	[inaudible 1:32:21] first.
LC:	Actually there was a period where we did eat all the bits of animals and now they're all processed and turned into pies and sausages and things and not given to cats actually, that's the problem.
TM:	Well that's the processed meat.
LC:	I've just been toying around...been rolling around the idea of luxury and when you were first saying about let's just stop making meat available and then I thought well does that then mean the price…
TM:	No, no, just stop buying it out of the public purse.
LC:	Out of the public purse. But then I was like well does that then mean if it's not available people will want it more so that's why a higher value on having access to it and then I started to think about, you know you think about that can of Coke that you can now get absolutely everywhere, so that's now a sign of status if you purchase a can of Coke, and I thought could it almost…I don't know, I was sort of challenging my thinking and could it go the other way round.
TM:	Generally the more effort people have to put in to obtain something the less likely they are to get it so all these experiments that have been done in something that is 10 cm, 70 cm, 100 cm, so it's almost linear whether or not you'll go to the other end of that room to go and get that Coke. So in the main of a population level it works to diminish [inaudible 1:34:04] for getting things. So there will be some people who just don't have absolutely a burning a hole in their head [overspeaking 1:34:10].
DN:	I think the summary is that governments can deal with this challenge of escalating energy and water and food and the disruption of ecosystems to produce it by very sensitive and culturally relevant interventions to…perhaps starting with their own example and perhaps broadening out by [inaudible 1:34:41] smoking and they can get on top of this. To be honest there's very few sustainability issues where you can say that simple intervention from government could be effective because they're normally very complex and very entrenched. So I'm quite optimistic actually. I don't necessarily…I don't actually think we're going to do this any time soon but if they did want to do it when the political conditions were right…
TM:	It's a big lever they could pull.
DN:	It's a huge lever they could pull.
LC:	I agree with you, I think it's very exciting that there is this potential, what I'm not certain is exactly what it is that they would be doing because I think that…I agree not having lots of red meat is right, I don't know what the alternative is, I don't know what the healthy thing is that you're going to put in its place.
PD:	I agree. We have to have cheaper, more available and better marketing of tasty alternatives which maybe is salty, fatty, sweet vegetables.

TM:	Yeah [inaudible 1:35:35].
LC:	[inaudible 1:35:36] carrots.
PD:	At least not ones with meat in.
TM:	So the celebrity chefs, so each government department has its own celebrity chef. So Department of Health has Jamie Oliver and the Department of Education had Henry Dimbleby and John Vincent because they were mates of Michael Gove's and they set up the Leon, the naturally fast food restaurant, so there aren't that many of them and some add [inaudible 1:36:03]. King's Cross, that's right. And so you can get delicious, natural lentil salads, why don't we have more of those around the place? So it certainly is possible to find those foods and I think to introduce children to those. One of the things in the School Food Plan is building on the cultural diversity in our country, that in a large number of schools they invite in the grandparents and they will take different parts of the world for different Fridays and the grandparents will come in and cook meals and talk about the culture behind the food. So there are some of these…I think it's quite costly because the vast majority if not all children go to school and that is a real opportunity which is being taken by the School Food Plan as long as the next government don't give it all up, because it was a LibDem project.
HD:	Do we have statistics or results?
TM:	No, no, no. So they only started to roll it out in September and one thing that went was the money that was allocated to evaluation so some of us are still very vehement, 'You've got to evaluate, got to evaluate.'
TR:	I can just add, like I told you that I'm from Sweden and in Sweden you get free food in school, like so from you are six years old until you are 15 you get your lunch in school for free, everyone is the same and as I said there is very [inaudible 1:37:47] there, but there is definitely an underlying assumption as well of teaching people what to eat and how and [inaudible 1:37:52].
DN:	Are Swedish children paid as well?
TR:	Sorry?
DN:	Somebody told me the other day that there is a financial incentive to go to school at a certain age.
TR:	Yep, well there's a financial inc…
TM:	Well used to have the education maintenance allowance didn't we?
DN:	Yeah. How young are children when they're…?
TR:	Well up until you're 18 there's a child subsidy.
PD:	From what age?
TR:	From newborn until you're 18.
PD:	But that goes to the parents at some...
TR:	Yeah, the parents get it but then when you enter high school you get it.
DN:	At secondary school it goes to the child, it goes to the student.
TR:	So from the age of 15 to 18. So yeah, we do.
LC:	Do you think that…I'm just wondering on this alternative idea and the kind of…reverting on the big business [inaudible 1:38:42], big, nasty, full of fat, salt and sugar, do you think we should be trying to encourage the marketing and these new products to be coming to the fore to say 'Hey, it's not hamburgers, it's mackerel salad', or whatever it might be. Do you think there's ever going to be…I suppose my question is how on earth do we convince

	business to make that…
TM:	Jump.
LC:	…jump, when there's not a market yet so it's a chicken and egg situation, how… Well I think one of the things that I think business recognises is sustainability, so this is…and actually not that I'm in favour of a multinational without any control, but one of the things I think that we've missed out in this is that before the war there were…people were relatively poor, they spent a large proportion of their income on food. Now with the result of increased agriculture, intensification and also processing and being able to use all the bits of the animal and the plant and what have you, food is much, much cheaper and people are probably better off up to a point and then obesity has taken over and that's probably human behaviour [inaudible 1:40:04].
Ian Bateman's Discussion Group	
Duration: 0:35:00	
MR:	But your focus is mainly UK, is that right?
IB:	Sadly yeah. I have done some work in other countries so…but it's an odd mix. I've just finished a study in Sumatra looking at trying to find ways to incentivise palm oil plantations to actually operate in a different way which is actually better for conservation. Being [inaudible 1:24:29] are very sceptical of anything that involves voluntary…
HC2:	Standards.
IB:	Standards, yeah, I just don't think it will work and there isn't enough money in the local population to fund this sort of stuff. Regulation doesn't work very well because of corruption. I don't know if it still is but it used to be that one of the biggest forest owners in the country was the environment minister, and when I say forest I mean one of the biggest loggers in the country was the environment minister, so you know I don't… So what we were looking at instead was something that might sound a bit lame but the economics of it do seem quite good, looking at in effect a sort of permits approach which allows you to market your goods as conservation friendly. So basically if…you can only get a permit if you stop poisoning, you stop shooting big mammals and you actually put a portion of your concession into conservation use.
HC2:	What is the fundamental difference from having an RSPO label on a…a sustainable palm label on it? What is the fundamental difference from that?
IB:	Oh not much, no. I mean the problem with RSPO is that at the moment it's not very…it's not particularly good at for example stopping people taking down new forest, it's really not very good at that at all and you shouldn't allow that.
HC2:	Yeah, I think the RSPO standard is not very good at doing many things.
IB:	No, I agree.
HC2:	But I thought you meant a different approach.
MR:	Can you tell us what that is?
HC2:	It's a Roundtable on Sustainable Palm Oil. It's basically the only sustainable palm industry standard, product standard.
IB:	Yeah, and the sort of thing we were providing is only a variant of that, it's that plus a bit stricter so you actually have to give up a certain amount of land and you can't get a permit if that land…if the land that you're planting on was virgin forest in the last 10 years, you can't get a… It's not perfect.
HG:	So is there a price premium? What's the incentive to go into it?

IB:	Yeah, yes. We did a…yes, that's exactly it, we did the experiment with consumers in the UK and we looked at how much the price premium actually would be and as you'd expect it varies according to what you tell them about the product, it varies on marketing, now you can definitely enhance it but why wouldn't you? You'd basically…you would put pictures of baby tigers on which is what we did and you get the highest premium when you tell people about the numbers of tigers, because they've absolutely nosedived. I can't remember there's supposed to be at the moment but we're looking at 700, that's nothing. Then you put a picture of a baby tiger on and you also give some information about what conservation friendly actually means in terms of they have to put…it can't be converted forest and you have to put this amount of land in.
M1:	So it seems that you have a…it's like a threshold approach, so you either get the label or you don't and so then that leads to thinking about when you're taking conservation action actually you can take a whole range of measures and the problem with the RSPO is that your certification lies below the threshold which you actually need to secure those things. So is your idea basically that your threshold is more stringent so everyone should get over that and therefore that you're actually talking about if you meet those standards, if everyone met those standards you would be sustainable.
IB:	It's slightly different to that. So there is no compulsion with this scheme, if you don't want to do it that's absolutely fine. However there is a price premium, or at least we've established that it looks like from experimental data that there would be a price premium if you did this. So the idea is that once you've got an incentive for perhaps a more go-ahead producer to think 'I can actually make more money through this scheme', then hopefully there will be a sort of market pressure where 'That guy is getting more profit than me'. So we did a profit analysis. We were incredibly lucky, a large company and I still don't completely…this is six years ago it started and I still don't understand why they did this, they totally opened their books up to us. And we actually stayed on this plantation, well not me personally, but three poor sods that I taught, they stayed on the plantation for four years. Certainly I am quite confident…it wasn't like there was two sets of books, at the end of the day they would just knock off and just leave us with the computers and that sort of stuff, you can't change anything, but download it, you know, they were really good.
M1:	But is there an incentive to push beyond the threshold?
HG:	Why is there a threshold?
M1:	So the threshold is that you either get certified or you're not, but you could be even better than that. That's what I'm wondering about.
HG:	So can you ratchet it up, yeah.
IB:	I suppose…so the sort of justification is once you've got a firm that is making profits, making bigger profits than other firms, it should attract other companies into that way of thinking. And the analogy that I use which I have no idea if it's true but I've used it to sort of stop conversation is how easy would it now be to market dolphin unfriendly tuna? I don't think it would be very easy because there's lots of companies now that are dolphin friendly. Once somebody does it there is this pressure on you to do it as well, whether it's for profit or you're avoiding loss.
HG:	You could but you'd never label that.
MP:	It's certainly not a good marketing slogan.
IB:	No, 'dolphin unfriendly'.
HG:	But you don't have to refer to dolphins on your label at all.
IB:	True, true.
HG:	And unless there is a mention of dolphins people won't automatically think dolphin when

	they're looking at things.
IB:	True. But it is interesting that a lot of companies are now marketing them as dolphin friendly and whether it's just because they think the logo looks a bit better and you're more likely to choose that can than another. It doesn't matter really does it?
MP:	In most retail markets the competition is such that any tiny edge is going to make a difference, so yeah, that does make sense.
HC2:	And the firm becoming more profitable from sustainable palm…
IB:	Yes.
HC2:	…the firm here you're talking about PNGE or the plantation?
IB:	Sorry I don't quite understand the question.
HC2:	The firm here you're referring to retailer or [inaudible 1:32:25]
HG:	You mean is it the original plantation, are they growing the palm oil or are they marketing it to the…so the marketing chain [inaudible 1:32:31].
IB:	Oh! Yeah, yeah. So this is right at the bottom. They are planting, they are harvesting and they are pressing.
HC2:	The whole supply.
IB:	Their product is oil.
HC2:	Ah okay.
HG:	So there's got to be a marketing chain then that connects that sale to the retailer.
IB:	Absolutely. And so what we've…and it's probably a big assumption, we've assumed that percentage wise the person at the bottom sees their margin increase by that percentage. So suppose the price goes up by 10% which it probably wouldn't, so we're assuming that everybody in the chain increases their profits by 10%. Okay? That's not that dramatic. So the oil only becomes 10%. We're not assuming that the premium which in pounds is actually…would be worth a lot, will all be passed down to the producer. We're assuming that everybody takes a cut all the way down. But if everybody takes more than that percentage cut that would mean there would be no incentive for the person right at the bottom and so we're assuming that given that everybody in the chain wants a bigger percentage they actually have an incentive to ensure that the person right at the bottom does get a better price. Otherwise they won't have the conservation oil to put in their products and…
HG:	So there's a chain of custody questions, so there needs to be a reward all the way through.
MP:	And then it's more expensive [inaudible 1:34:10] standard price.
HG:	So what's the experience with timber? It's presumably profit?
IB:	I'm afraid I don't know.
HG:	I mean I guess one of the implications is that the premium will reduce. If everybody does this then the premium declines and declines and I guess you need to somehow switch to the stage where consumers don't buy it unless… I'm not sure how that trans…
IB:	Yeah. [inaudible 1:34:34] and somebody said well that's unfair, that means the consumer ends up paying more. Well yes they do but actually not as much as you'd think because, okay, the first person that goes into it increases their profit by 10%, the second person that goes into it increases their profit but actually minutely by less than 10% because there is now a bigger supply of this and it would slowly get eroded down. So the actual increase in price to the consumer isn't as big as you think and then you get to this situation can you

	afford to produce the dolphin friendly tuna? You know the non-conservation one?
HG:	But logically the consumer should be paying.
IB:	Absolutely, yeah.
HG:	If the system says this is an external cost then we want consumer to pay. If the system says it isn't an external cost then I guess we want to pay them for it, but…
IB:	It's a very common question that I get, 'Why shouldn't we…surely the firm should pay for this?' Yes, well, the firm is only producing it because you want it.
HC2:	That externality cost that humans should have paid from the beginning but we kind of got away with it.
HG:	Yes, yes. So the polluter pays principle should be the consumer pays principle and passes it back to the polluter.
HC2:	However about this I had exactly the same conversation with a Chinese company called COFCO which is kind of the world's biggest foodstuff producing and also the biggest importer of palm. China produces no palm.
IB:	But it consumes huge amounts.
HC2:	Oh yeah. Also European Union and India.
IB:	Sorry that wasn't a…
HG:	It wasn't a dig.
IB:	It wasn't an attack on China!
HC2:	Wagging fingers!
IB:	I'm really sorry! We don't produce any palm here.
HC2:	No, I get too emotional in Cambridge, no emotional because of lots of China sympathy. I had the exact same conversation because COFCO the company does produce some of the sustainable palm, does take in some of the supply only when the supplies to some of the Western companies that explicitly request it and in a market where you have such fierce competition and you can't really expect your consumers to pay based on their bad news it doesn't really work. If you are the only company trying to kind of brainwash kind of your entire supply…
IB:	But remember there's loads of different types of cars out there and some of them are really high-end luxury cars and some are real basic runaround cars. This wasn't just an economic study, in fact the majority of the effort for this was on an ecological study, so we set up lots of camera traps and transits through the forest and walking through and seeing what animals were there and that sort of stuff and the results that came out of that were I think fairly interesting and it shows that actually…I'm going to say a small amount of land but I'm talking like 10,000 hectares, which you might think that's not a small amount of land, but compared to the…
HG:	Small in China.
IB:	Yeah, and compared to the amount of plantation in Sumatra it is a small amount, actually generated sustainable populations of quite a few red species and if you thought about say about three or four plantations coming together and saying right, well we'll all put 10,000 in, or even better for everybody we'll all put 8,000 in, it cost us less but you end up with a 36,000 acre conservation area, you can sustain a lot of animals including a lot of quite endangered animals.
HG:	Even though it's being used quite intensively for production?
IB:	No. These are the conservation… So there might be intensive use right next to it but

	actually we found that…
MR:	Goes back to your question you asked earlier on.
HG:	Well that's right. Whether there is scope for thinking about a network, I mean you talked about sort of Lawton, whether there is scope for having actually…we can re-create or maintain a network of…sort of infrastructure of forest or something and actually we can cultivate oil palm within that and that's better than saying 'Well we are just going to wipe out all this and just preserve this little bit there'.
MP:	This is the Lawton approach isn't it?
HG:	Yeah.
MP:	It's making the space.
HG:	But Lawton is about Britain and I guess the question is whether it works in Sumatra.
MP:	True, whether it applies elsewhere.
IB:	Well from the limited evidence we've got which…we talked to…36,000 hectares was the biggest we looked at, it looks like there is - as you'd expect - a non-linear relationship between conservation area and what gets conserved. If you had four blocks of 10,000 hectares which weren't connected you're going to conserve a lot less animals than 40,000 together. And you don't need 40,000 to get…you can actually begin to get economies of scale.
MP:	Ian can I take you off the specifics of the palm oil? It's a brilliant case study but what you were focusing on was the need for modelling of…whole systems modelling in effect. What I really wanted to ask you in relation to the work of Natural Capital Committee is having spent three years actually focusing down on that is it feasible at the technical level, I mean is it actually practical to handle this level of complexity just as modellers and even if it is, is it feasible to ensure that's actually going to feed into the decision-making processes? Because the outputs it seems to me from some of these models are not themselves very handleable, they're very intractable sorts of products.
IB:	Okay, those are two really good and different questions. So on the feasibility of modelling the system we've been looking at is a number of drivers, so climate change, policy change and we handle the market stuff through crises, going up and down and we have tested that. We assembled a long time series of disaggregated data, so…oh Martin you know all this sort of…
MR:	No, take it I've forgotten it all anyway.
IB:	So we took the census data, so that's now about 46, 47 years of data, 2 km resolution, whole of Britain, so it's pretty good data and each one of those datapoints has got hundreds of records associated with it. And we can prove that that works, as much as you can prove anything. We can show that that works very well in predicting responses to change in climate, in policy and in price by doing out of sample tests. So take the data, you chop a bit of it off and you put it on one side, you reassemble your model and get it to predict for the period you've omitted and then you compare actual with predicted - it works well for that. So we think we've got the land use all right. The connection…and foods, that comes…and the incomes from it…the connection to greenhouse gases is through a series of process models and I am told they're really good. I didn't do them, that's from natural scientists and they must be right!
MR:	Of course.
HC2:	Must be right.
IB:	But they do very sensible things and that's for CO2, N2O and methane. We have a big biodiversity module in it and that uses the British Trust for Ornithology data and so a big

	dataset, seems to work pretty well again.
HG:	So you're proxying on farmland birds and such.
IB:	That is absolutely true, yeah. I mean how good are birds as a proxy of biodiversity. When I started doing this I thought this is going to be great, all the ecologists are going to love me because here's an economist doing stuff…and all the bird ecologists do love me but all the others absolutely hate it because they say 'Birds? Birds don't matter, it's soil fauna that matters'. Anyway so…
MP:	[inaudible 1:44:19] dependent on soil fauna, yeah, okay.
IB:	And there's other modules as well. I think that we have a decent, a much better approximation of the consequence of change than was available before. It's not perfect but it's all right. It's got some dynamics in it, oh I forgot, it's got water…
MP:	I was going to ask that, yeah.
IB:	So we use the Environment Agency water data so that's good.
MP:	Air quality data?
IB:	No we haven't got anything, apart from greenhouse gas emission.
F1:	Is this just the UK model?
IB:	Yes I'm afraid it is.
F1:	So maybe we should have a chat afterwards [inaudible 1:45:02] because we look at water, food, energy or land, water, land, energy and greenhouse gas emissions together and what we found…so this is quite complicated modelling…
HG:	This is Foreseer is it?
F1:	Yes. Then what we did on top of that is we created visualisations to allow policymakers or our users or our funders to look at the change of those resources. So we use [inaudible 1:45:28] Sankey diagrams, but each of those flows have a lot of datapoints underneath them and the reason why we created this visualisation because it is hard to communicate sometimes the interaction with those resources. Our model isn't perfect, it's growing so Dennis is working on the UK so I'm sure he'd love to have a chat with you afterwards. We're working on China at the moment which is even harder to do because very difficult to get data. A fantastic case study though because it is one that is moving, changing economies which is just great to model.
HC2:	Very difficult to get data. Yeah you will never get the data.
F1:	But it is…the [inaudible 1:46:07] of modelling in this is a lot of them feedback loops that come back and they're really hard to actually model with 70, some of these feedback loops and so that's the thing. What we lack I think where you can potentially help us is the biodiversity element of it which is very difficult to measure. So we assumed there's ecosystems rather than biodiversity which are two very different things because we look at the services that land provides, [inaudible 1:46:35] but biodiversity measurement of it very, very difficult to include in some of these models. We have struggled with it.
DK:	Yeah, the other thing really is multiple use of land which…I mean capturing that is very difficult. So if you take farmers who are planting miscanthus, assuming they would like to plant miscanthus, it's providing [inaudible 1:46:57] services, [inaudible 1:47:00], it's providing energy, then to ask a farmer to go into miscanthus on Grade 4 in the UK you need to incentivise and that's quite a good area to go out to but people don't look at it that way, they look at miscanthus into energy is going to compete with food, which is something that is not well represented and not well articulated, therefore… I mean in developing policies which it's quite important to bring these things up we sometimes don't see them. I mean you've worked for DEFRA and so you probably know we've had a lot of

	conversations with DEFRA, well we're doing now, but they seem not to see that broader field, they look at exactly what vector can they give us in the end and saying there's going to be a land issue exactly and that's not what scientists want to know, we want to see how [inaudible 1:47:54] vegetable, but then also how diverse the whole system is and how multiple land use can actually be incorporated in the policy making which is difficult…
IB:	This is an advantage of trying to go the extra step between the natural science and the economics because…my first reaction with what you've just said is well actually do we want miscanthus on Grade 4 land? Because that's actually pretty good land for growing food on and miscanthus will grow in a lot of places and if you looked at it from the value side you might find well actually the value of the energy generated by miscanthus might be less than the value of food [inaudible 1:48:42]. Economics is…well I'd describe it as the least worst way of looking at it, it's not great, it's really not great but almost anything else is worse. So looking at things in terms of calorific values or just in terms of quantities you get this problem that how do you trade off a tonne of carbon with a quantity of degradation in water supplies with maybe a number of visits to a recreational area and…it's difficult. I sympathise with it…so I've been now associated with DEFRA for it's about five or six years now and I really…
MP:	Must be, yeah.
IB:	Yeah, it's getting on. I really sympathise with them. Most of them are…no, actually I've not found one person there who doesn't want to do a really good job and improve decision-making. But how do you make a decision about all those trade-offs when they're just in these disparate [inaudible 1:49:57].
MP:	Well that was what was underlying my question in a way, was that as the number of trade-offs multiply and as the uncertainties in every single component of your model multiply how much value are you going to get out at the end of the model? I thought your Sankey diagrams were absolutely fascinating, not least because they all added up to 100% which I thought was astounding!
F1:	There's a lot…I think it's visualised like that but really there's a lot of loops that go around and around and around.
DK:	If you take land, so you take UK land for example it's finite, so it should add up to 100%, you divide land use, so you wouldn't have more than that, I mean that's…
MP:	I'm being flippant. But I mean the uncertainties around each of those flows must be enormous and it's how do you actually make that genuinely useful in decision-making then.
IB:	Okay. So two…well I think three points I want to make: one is we've as you know we've made a big thing of trying to get things [inaudible 1:51:01] but also gets things mapped.
MP:	Yeah, I think mapping is crucial here isn't it?
IB:	So actually show that actually this is the area you want to be looking at. On uncertainty at the moment that's just stuff that is within our research, it's not stuff that we've shared with DEFRA at the moment because we know what we want to do, we haven't achieved it yet. We have programmed the whole system together, so now it moves much, much faster than it used to, it's really fast. We hired a programmer from the UK Plasma Initiative or whatever it was? I assume you know about this thing.
MR:	No, no. They'd need to learn a lot to do your stuff.
IB:	He's very good at programming and one of the things that we had programmed that took us four days to run he got it down to half a second. He's really good!
F1:	You can lend him to us.
MP:	Is this somebody off ITER, the plasma physics stuff in the future programme?

IB:	Yes, yes.
MP:	There's some interesting stuff in there.
IB:	So because it moves very fast now we can begin to do uncertainty analysis. You can't really do uncertainty until you can run things through…
MR:	Do you do Monte Carlo? [inaudible 1:52:24]
IB:	Exactly. Yes that's exactly what we're…and that's what we're doing at the moment.
F1:	We do a lot of that for our academic papers [inaudible 1:52:31] because you have to do it, but for actually showing policymakers sometimes it's very difficult to actually show them how uncertain things are really.
MP:	That's the most difficult thing for policymakers to grip in any case.
F1:	To grip with it…
MP:	The thing that always scares me but…
F1:	Because okay it could be up here, but it could be down here so it's all this thing… And sometimes it is difficult not to [inaudible 1:52:49] because we have to do it.
IB:	I still think you could probably…I mean our objective once we've really got the uncertainties understood…well I suppose there's two purposes, one is to try and say well what areas can we improve, what areas would extra information really make a difference and what areas [inaudible 1:53:11], but also use it to say right, what decisions, even accepting quite high levels of uncertainty are still good things to do? Because there must be…there's an infinite number of things you could do and some of them will still be good things to do [inaudible 1:53:35].
MP:	That's the real value I think. If you can use the models to constrain the decision-making space rather than to actually support the decision I think that is hugely valuable and that's always the difficulty, it's trying to constrain the area within which decisions have to be taken to as small as possible, but it's going to be pretty big it seems to me in this case because of the multiplication of uncertainties.
IB:	It's probably likely to be, yes. Although I will say…the third thing I was going to say about decisions is [inaudible 1:54:07], not a jibe against…the reason there are problems…
HG:	It's all right, I'll take it personally.
IB:	From the institutional [inaudible 1:54:17] in that I don't think the institutions are very well set up to deal with the sort of outputs from this res…so you say or we say to them 'Right, well actually this is the area you should do it in', and they're just like 'Well we don't make policy like that, we have a UK policy'. That's less and less true but it's still quite true for many things.
MP:	But that's why this point about being able to map the outputs, however crudely, to give a spatial picture as well as a temporal one I think is massively valuable. With GIS systems and so forth now that must be a great deal more possible than it was.
IB:	Oh absolutely.
MP:	I mean thinking back to Martin Parry's very crude mappings early in the climate change stuff, we can get much better than that now.
IB:	Absolutely amazing and…
MP:	And dynamic presentations coupling your flowcharts with mapped data I thought actually are seriously helpful.
F1:	Yes, that's where we want to move to.

HG:	So the implication presumably is then that you shift from a sort of sectoral decision-making context into a territorial decision-making context because you can actually look at the trade-offs between the different outputs in a given place. But we're probably still set up in terms of sectoral so we think about particular industries or sectors, we think about Environment Agency, we think about naturally when we think about DEFRA or whatever in agriculture.
MP:	Less so that we used to be, I mean the unit now for decision-making is often the catchment area and that's…I mean in the water sense, not in the political sense…
IB:	No, no, I agree.
MP:	…or the education or whatever.
IB:	[inaudible 1:56:01] natural areas that we have.
HG:	Could you use that as a framework and then say well actually we should be making our decisions about biodiversity or food production at a catchment level rather than a national level.
IB:	We probably should, yes.
F1:	There's always one issue with government, so food and [inaudible 1:56:19] you can do [inaudible1:56:21] energy, if you [inaudible 1:56:23] at that level is really difficult to do because most of the statistics I've found at a national scale, big statistics found in energy scale and then you have to map out things like power generation around and that kind of level of detail you have to go and find and it's difficult to get them too. So that's a difficulty with coupling things like water, land and energy resources.
MP:	Yeah, that's an interesting one.
HG:	Does energy vary spatially very much? I mean if it doesn't you say well okay you give your catchment the price, the national price and that's what it has to accept. A
MP:	It's more on the consumption end, I mean being crude, the energy costs of farming heavy clay is very different to light sand.
HG:	But that's a cost of production and you buy your energy at a national price.
F1:	Yeah for example if you want to couple in like the use of say in China, you want a couple in the use of power generation and water use you need to go down to the provincial level to see where they're taking their water, it's that level of detail that is missing or it's difficult to find out exactly where the power stations are placed on a spatial map for example.
MP:	Even in the UK that's difficult.
DK:	Well with the UK you know the big catchment where you can extract water for electricity cooling, so if you want to do something like that you go to those catchments which is fine. So you look at the Severn Trent area, you look at the Yorkshire, the Humber area, you know definitely there will be some water extraction if you know they are close to the coast and therefore you're looking at tidal water rather than freshwater.
END OF AUDIO	