

### Paper 1: Bojana Bajželj

#### Changing global diets is vital to reducing climate change

**Healthier diets and reducing food waste are part of a combination of solutions needed to ensure food security and avoid dangerous climate change, say the team behind a new study.**

*“Food production is a main driver of biodiversity loss and a large contributor to climate change and pollution, so our food choices matter”*

*Bojana Bajželj*



A new study, published today in *Nature Climate Change*, suggests that – if current trends continue – food production alone will reach, if not exceed, the global targets for total greenhouse gas (GHG) emissions in 2050.

The study’s authors say we should all think carefully about the food we choose and its environmental impact. A shift to healthier diets across the world is just one of a number of actions that need to be taken to avoid dangerous climate change and ensure there is enough food for all.

As populations rise and global tastes shift towards meat-heavy Western diets, increasing agricultural yields will not meet projected food demands of what is expected to be 9.6 billion people - making it necessary to bring more land into cultivation.

This will come at a high price, warn the authors, as the deforestation will increase carbon emissions as well as biodiversity loss, and increased livestock production will raise methane levels. They argue that current food demand trends must change through reducing waste and encouraging balanced diets.

If we maintain ‘business as usual’, say the authors, then by 2050 cropland will have expanded by 42% and fertiliser use increased sharply by 45% over 2009 levels. A further tenth of the world’s pristine tropical forests would disappear over the next 35 years.

The study shows that increased deforestation, fertilizer use and livestock methane emissions are likely to cause GHG from food production to increase by almost 80%. This will put emissions from food production alone roughly equal to the target greenhouse gas emissions in 2050 for the entire global economy.

The study’s authors write that halving the amount of food waste and managing demand for particularly environmentally-damaging food products by changing global diets should be key aims that, if achieved, might mitigate some of the greenhouse gases causing climate change.

“There are basic laws of biophysics that we cannot evade,” said lead researcher Bojana Bajželj from the University of Cambridge’s Department of Engineering, who authored the study with colleagues from Cambridge’s departments of Geography and Plant Sciences as well as the University of Aberdeen’s Institute of Biological and Environmental Sciences.

“The average efficiency of livestock converting plant feed to meat is less than 3%, and as we eat more meat, more arable cultivation is turned over to producing feedstock for animals that provide meat for humans. The losses at each stage are large, and as humans globally eat more and more meat, conversion from plants to food becomes less and less efficient, driving agricultural expansion and land cover conversion, and releasing more greenhouse gases. Agricultural practices are not necessarily at fault here – but our choice of food is,” said Bajželj.

“It is imperative to find ways to achieve global food security without expanding crop or pastureland. Food production is a main driver of biodiversity loss and a large contributor to climate change and pollution, so our food choices matter.”

The team analysed evidence such as land use, land suitability and agricultural biomass data to create a robust model that compares different scenarios for 2050, including scenarios based on maintaining current trends.

One scenario investigated by the team is on the supply side: the closing of ‘yield gaps’. Gaps between crop yields achieved in ‘best practice’ farming and the actual average yields exist all over the world, but are widest in developing countries – particularly in Sub-Saharan Africa. The researchers say that closing these gaps through sustainable intensification of farming should be actively pursued.



But even with the yield gaps closed, projected food demand will still require additional land – so the impact on GHG emissions and biodiversity remains. Bajzelj points out that higher yields will also require more mineral fertiliser use and increased water demand for irrigation.

Food waste, another scenario analysed by the team, occurs at all stages in the food chain. In developing countries, poor storage and transportation cause waste; in the west, wasteful consumption is rife. “The latter is in many ways worse because the wasted food products have already undergone various transformations that require input of other resources, especially energy,” said Bajzelj.

Yield gap closure alone still showed a greenhouse gas increase of just over 40% by 2050. Closing yield gaps and halving food waste still showed a small increase of 2% in greenhouse gas emissions. When healthy diets were added, the model suggests that all three measures combined result in agricultural GHG levels almost halving from their 2009 level – dropping 48%.

“Western diets are increasingly characterised by excessive consumption of food, including that of emission-intensive meat and dairy products. We tested a scenario where all countries were assumed to achieve an average balanced diet - without excessive consumption of sugars, fats, and meat products. This significantly reduced the pressures on the environment even further,” said the team.

The ‘average’ balanced diet used in the study is a relatively achievable goal for most. For example, the figures included two 85g portions of red meat and five eggs per week, as well as a portion of poultry a day.

“This is not a radical vegetarian argument; it is an argument about eating meat in sensible amounts as part of healthy, balanced diets,” said Cambridge co-author Prof Keith Richards. “Managing the demand better, for example by focusing on health education, would bring double benefits – maintaining healthy populations, and greatly reducing critical pressures on the environment.”

Co-author Prof Pete Smith from the University of Aberdeen said: “unless we make some serious changes in food consumption trends, we would have to completely de-carbonise the energy and industry sectors to stay within emissions budgets that avoid dangerous climate change. That is practically impossible – so, as well as encouraging sustainable agriculture, we need to re-think what we eat.”  
meat consumption in more balanced diets, are the essential ‘no-regrets’ options,” added Bajzelj.

Cutting f



This article was published on 1<sup>st</sup> September 2014 on the University of Cambridge Research News website:

<http://www.cam.ac.uk/research/news/changing-global-diets-is-vital-to-reducing-climate-change>

### Full reference:

Bojana Bajzelj, 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

## University of East Anglia research reveals true cost of farming to UK economy

**The British landscape is not being used to its best advantage according to a new report from environmental economists at the University of East Anglia (UEA).**

Research published today in the journal *Science* shows that allowing land use to be determined purely by an agricultural market, which is distorted by multi-billion pound subsidies, will result in considerable financial and environmental costs to the public.

It shows that a shake-up in the way EU subsidies are given out could greatly improve the way UK farm land is managed.

While the research has looked specifically at the UK, the same methods could be applied to any area of the world with similar results for many countries.



Land use in the UK is dominated by agriculture which accounts for almost three quarters of the total surface area. Payments to farmers in subsidies exceed £3billion per year, or nearly half the total annual value of UK agriculture.

The research team looked at half a million land use records and found that at present, UK land use represents poor value for society relative to that subsidy level. But a refocusing of payments could substantially improve the situation.

Alongside tangible financial costs in the form of subsidies, the researchers assessed the economic value of other costs, such as poor opportunities for recreation and high emissions of greenhouse gases associated with present land use. They also took into account the impact of declining wild species and biodiversity caused by intensive farming.

Looking to the future, they weighed up the consequences of alternative land uses and assessed a range of alternative scenarios going forward to the year 2060.

#### Key findings:

- Land use policy based on market prices alone results in decisions which lower overall values at national scale.
- Potential improvements in land use planning would generate social gains sufficient to more than compensate for any associated losses.
- Substantial improvements could be achieved through relatively modest changes in land use.
- Targeted measures would greatly help conserve wild species, while only marginally reducing market profitability.
- Converting comparatively small amounts of farm land into open access recreation space will yield a modest loss in farm produce value while generating a far greater value from increased recreation, with greatest benefits close to urban areas.

Prof Ian Bateman from UEA's School of Environmental Sciences led the research project. He said: "There is a good case for subsidising farmers to produce the things we want which are not paid for though market prices - and that includes better habitats for biodiversity, high quality recreation areas and lower greenhouse gas emissions.

"We worked out an economic value for each of these 'non-market' items to help us create a much more detailed economic picture of land use in the UK.

"We looked ahead to 2060 and took into account other factors that may impact farming such as changing policies, environmental regulations, market forces, changes in farming technology and climate change, which could altering the growing season and amounts of rainfall.

"We found that a conventional market dominated approach to decision making will reduce the overall values from the landscape in many parts of the country. However, taking into account these non-market environmental benefits or costs of land use would lead to net financial gains nationally, due to reduced pollution, enhanced recreation and urban greenspace, and improvements in biodiversity habitats.

"It is absolutely vital that impacts which are difficult to put a price on, such as a loss of biodiversity, should be incorporated into land use policy. But no single policy will be optimal everywhere. Our findings show that a targeted approach to decision making is the best approach.

"The clearest way to achieve this goal is to reform the EU's Common Agricultural Policy (CAP) which oversees payments to farmers in excess of £3 billion per year. The vast majority of these payments are made without consideration for environmental performance. Rewarding farmers for delivery of a broad spectrum of ecosystem services would provide policy makers with a very powerful tool to secure beneficial land use change."

This article was published on the UEA website on the 4<sup>th</sup> July 2013:

<https://www.uea.ac.uk/mac/comm/media/press/2013/July/true-cost-farming>

### Full reference:

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

### Related links

#### Funding: UK National Ecosystem Assessment

The research was funded by the UK National Ecosystem Assessment (NEA) and its Follow-On program (which are together supported by the UK Department for Environment, Food and Rural Affairs (Defra), the devolved administrations of Scotland, Wales and Northern Ireland, the Natural Environment Research Council (NERC) and the Economic and Social Research Council (ESRC)); and the Social and Environmental Economic Research (SEER) project.



Reports from the UK National Ecosystem Assessment Follow-on Phase can be found here:

<http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx>

### Paper 3: Theresa Marteau

#### Nudging consumers towards better health

**It seems at once the simplest and most complex of health problems: by eating healthily, not smoking, being more active and cutting down on alcohol, we can live longer, healthier lives. Why, then, do so many of us ignore this advice?**

The remit of Cambridge's Behaviour and Health Research Unit (BHRU), launched just over a year ago in April 2011 and funded by the Department of Health's Policy Research Programme, is to develop and evaluate ways of changing behaviour at a population level to improve health and reduce health inequalities. Something that, so far, many countries have tried to do, but with limited success.



The Unit brings together a team of experts from the University of Cambridge, two Medical Research Council units in Cambridge (Epidemiology and Human Nutrition Research), RAND Europe and the University of East Anglia. As well as researchers from the Clinical School, the Unit includes David Spiegelhalter, Winton Professor of Public Understanding of Risk at the Centre for Mathematical Sciences. The range of disciplines covered includes behavioural science, neuroscience, anthropology, economics and epidemiology.

This disciplinary mix is what marks out the new Unit, explained its Director and Honorary Professor of Behaviour and Health, Theresa Marteau. "It's a range of disciplines, some of which have been addressing similar problems but from different perspectives, for example bringing in neuroscience as well as epidemiology and behavioural science to understand the behaviour that contributes to population health and ill-health."

Insights from behavioural and neuroscience into the basis of everyday behaviour will be particularly important. "We will focus on two key systems. The first is the reflective, goal-directed system driven by values and intentions. We want to lose weight, we intend to eat less. The second system is the more automatic system that is driven by immediate feelings and habits. These two systems operate sometimes synergistically as well as antagonistically in shaping our behaviour," she said.

So, despite intending to eat less, we find we have bought the chocolate bar at the checkout. "As neuroscience increasingly reveals how our behaviour is governed by unconscious processes, we understand better how advertisers and retailers shape our behaviour, unfortunately often to the detriment of our health. The trick is to see how we can capitalise on this understanding to develop more effective interventions that cue healthier behaviours."

Focusing on four key behaviours – diet, physical activity, smoking and alcohol consumption – the Unit's research programme has two overlapping strands, primary research and synthesis of existing evidence.

According to Professor Marteau: "It's good science to start with what we know, based on rigorous evidence synthesis, and design new studies that contribute to the existing evidence base." One of the Unit's new primary research studies involves studying online food purchasing using a virtual, online supermarket. Using this, researchers will be able to vary the way purchasing decisions are presented to thousands of 'shoppers', as well as altering how foods are presented. "The virtual online supermarket provides the opportunity to run a large number of experiments in which we can change different features in a systematic way to identify the most promising interventions to take forward in real-life experiments," she explained.

How, for example, do our brains deal with a chocolate bar that looks very inviting but carries a nutritional label warning us about its calorie count? And does a web site adorned with fruit and vegetables prime people to buy more of this type of food? The virtual online supermarket goes to the heart of what researchers in the field call 'choice architecture' (i.e. the way that options or choices are presented to influence the decisions that are made) and how consumers might be 'nudged' into making healthier choices.

To be useful to policy makers, interventions need to be acceptable as well as effective, so another strand of research at BHRU is examining the public and political acceptability of interventions, something particularly relevant to alcohol.

According to Professor Marteau: "The majority of smokers want to quit and the majority of those who are overweight want not to be so. By contrast, most people in the UK don't want to reduce how much alcohol they consume. In part reflecting this, only half the population favours any kind of pricing policy to reduce alcohol consumption. This raises questions about the basis upon which such judgments are based. What happens if the evidence about the effectiveness of alcohol policies is presented not in terms of health but, for example, in terms of road accidents or violence? Does this alter how acceptable people find policies that at first glance



they reject? How sensitive are people's judgments to the weight of evidence including its uncertainty? Exploring these questions using experiments grounded in qualitative work could shed light on the complex relationship between science and policy in health and other areas of public policy."

This article was published on 25<sup>th</sup> May 2012 on the University of Cambridge Research News website:

<http://www.cam.ac.uk/research/news/nudging-consumers-towards-better-health>

### Full reference

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

### Related links

More articles related to Theresa's work can be found here: <http://www.cam.ac.uk/people/theresa-marteau>

The Cambridge Institute of Public Health can be found here: <http://www.iph.cam.ac.uk/>