Lang, T. & Ingram, J. (2014). Food Security Twists and Turns: Why Food Systems need Complex Governance. In: T. O'Riordan & T. Lenton (Eds.), Addressing Tipping Points for a Precarious Future. (pp. 81-103). British Academy Scholarship. ISBN 9780197265536

CITY UNIVERSITY LONDON

EST 1894

City Research Online

Original citation: Lang, T. & Ingram, J. (2014). Food Security Twists and Turns: Why Food Systems need Complex Governance. In: T. O'Riordan & T. Lenton (Eds.), Addressing Tipping Points for a Precarious Future. (pp. 81-103). British Academy Scholarship. ISBN 9780197265536

Permanent City Research Online URL: http://openaccess.city.ac.uk/12918/

4.1

Food security twists and turns

Why food systems need complex governance

TIM LANG AND JOHN INGRAM

<A> A note of caution about Mr Gladwell's metaphor

<FO> The language and theory of tipping points have become popular in academic, political and everyday discourse since Malcolm Gladwell's book of the same name was published (Gladwell 2000). We are well aware of the arguments advanced around the association with metaphors in the introductory chapter to this book (1.1). But while metaphors and analogies are useful (and beloved of the human mind as well as culture) we believe some caution is necessary. Gladwell's popular book is a pot-pourri of ideas, an intelligent journalist's interpretation of insights from psychology, sociology and, above all, his reading of epidemiology. That he is a journalist is not a criticism. We offer it as a comment on how fissured modern academia and the sciences are. As is suggested by Giles Foden (3.1), Joe Smith (7.1), and Paul Brown (Commentary 7.3), it is often left to brilliant journalists and science writers to offer overviews or narratives that inform our lives and outlooks, especially where there is no solid evidentiary ground.

Gladwell's thesis is attractively simple. It filled a vacuum: how to interpret threats in a language that suits a political era infused (some say made) by the sound-bite. His concern is for change and whether there are points at which internal dynamics can go haywire. From epidemiology, for example, he takes the notion that we need to understand how diseases 'tip' from minorities to the masses. This is a deeply rooted and fearful notion, the age-old threat of contagion as superior force, and an unstoppable set of sequences and consequences, which can overwhelm human existence. The 'tipping points' metaphor thus can lead to deep pessimism, if not fatalism. History gives this some legitimacy, of course. There is a vast human experience of viruses, boiling points, catastrophe, and plagues. No wonder the

'tipping points' metaphor features so much in science fiction and sci-fi films. But Gladwell's is a very American book in its inherent optimism. You can turn crisis into opportunity. You can make a difference. In this he is on a par with another popular metaphor now given credence in an era which favours light-touch government – 'nudge' theory (Thaler and Sunstein 2008).

Although we are wary of the consequences of politicians believing their favoured metaphors, this chapter is not a critique of Gladwell's metaphor per se. Rather, it suggests that policymakers need more subtle analyses and metaphors if, in the case of food security, they are to begin to address the complexities of the real problems. Metaphors are useful if they help funnel activity in appropriate directions. They become dangerous if they encourage decision-makers to pursue single 'triggers' or tension points. In food security, the best contemporary analyses suggest the need for multi-layered, systemic approaches to ensure availability and affordability of food. On a positive note, Gladwell himself has acknowledged that the real question is to ask what generates change, not the characteristics of tipping points. Our chapter tries to stay true to that wider task. Policy needs to be better informed by an understanding of the dynamics, drivers and challenges that shape or ought to shape food demand and supply ahead. The goal ought to be a world where societies are able to feed all people equitably, healthily, and in ways which enhance rather than destroy the habitability of the planet.

That is clearly not the case at present. There is a troubling but not unfamiliar gap between evidence and policy. And looking ahead, unless the vast majority of forecasting is wrong, humanity faces awesome challenges in this first half of the twenty-first century. It will have to adapt food systems to improve food resilience. Already, climate change is upon us; water stress too; and biodiversity loss (as Patricia Howard (4.2) and Toby Gardiner (4.3) cover in their companion chapters) endemic. The parameters of such environmental pressures have begun to be outlined by science and are impinging on the attention of policymakers. Less attention, however, is being given to the two other nodes of sustainable development's triangle – society and economy – yet the social and economic implications of coming environmental change for food are considerable: threats of social dislocation, price volatility, and speculation. Over the last half-century, modes of consuming food have become normalized in the West which are unsustainable but profitable. The lock-in to unsustainability is tight. If food security is to be tackled,

innovative thinking which integrates environment, society and economy will be required from institutions and governance. This is currently not the case, and it is a failure not just of government, but of commerce and consumer culture.

<A> Food security and food systems

<FO> Like tipping points, 'food security' is a term with much baggage, used in many ways and with many different meanings (Maxwell 2001). Nonetheless a cluster of meanings dominates contemporary discourse (see examples in Table 4.1). In public policy, the notion of food security centres on the pursuit of a situation where everyone is fed or could be fed adequately, appropriately, affordably and regularly. The key issues are often described as three As: Availability, Access and Affordability. Analyses have tended to assume that insecurity stems from insufficiency of production or dislocation of supply. Yet from the 1970s, just as the term 'food security' came into policy discourse, the old awareness that hunger and insecurity can occur despite there being sufficient food on the planet to feed everyone had been reasserted by Drèze, Sen, and others (Drèze *et al.* 1999). Sen's own argument stressed the role of entitlements as a key factor in famines. A deciding factor in whether famine takes hold is the social expression of rights and demand for food; it makes or breaks political demands to resolve or ride out harvest failure. Such analyses of food security stress the need for not just sustainable production, but for equitable distribution and sensitive culture change. Why is it that some people are well fed (and now over-fed) while many others are not?

Table 4.1 Strands in the food security discourse

Term	Focus	Comment
Food security	The extent to which food systems can deliver adequate, affordable, accessible supplies, at many levels	Currently this does not connect with the sustainability agenda. Security implies food systems which are 'likely to continue or remain safe' (OED).
Food nationalism	Policy priority to food from national resources and land	May range from general desire for more self-sufficiency to autarky
Food control	Actions of state or other power sources to shape food systems	Top-down control systems; rationing, at the most extreme
Food defence	Feeding in extreme emergencies	Assessment of minimum requirements for survival
Food resilience	Capacity to withstand and recover from shock	Used widely in food security discourse with ecological roots but appeals elsewhere, e.g. insurance, military
Food risks	Factors which threaten food goals	Appeals to systems thinking and suggests need to identify, rate and prevent risks
Food entitlement	Citizens' sense of their rights to have access to adequate food	Articulated by Nobel laureate Amartya Sen to explain why famines occur despite supply
Food sovereignty	Ensuring bottom-up societal control of primary production	Championed by small farmer movements and development NGOs
Food democracy	Social engagement and pressure for food rights	Emphasises political processes within societal demands for adequate food
Food capacity	Capabilities and requirements for any system of food production	Environmental, economic and societal requirements for and limits to sustainable food systems
Community food security	Building local food systems	Mainly used in developed world to indicate locally led food provision. Tends to be used by organizations committed to sustainability frameworks.

Source: adapted from Lang (2008)

In mainstream policy, the conventional definition of food security is that offered by the Food and Agriculture Organisation (FAO). Morally based on the articulation of rights in the 1948 Universal Declaration of Human Rights, and voiced loudly at the 1974 World Food Conference (FAO 1974), a definition of food security emerged which, by the 1996 World Food Summit, saw it as a state when:

<EXT>

all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

(FAO 1996)

</EXT>

<FO> This definition suggests a broader notion than just the three As. But some key words, such as 'food production' and 'agriculture' – which might have been expected in such a definition – are *not* included. Most formal discussions of food security, therefore, recognize that it sits in a web of issues including food production, distribution, demand, rights, environment and health, all shaped by actors whose moral buy-in is assumed or expected. Yet this is not the case. Hunger remains on a mass scale today. And this approach to food security barely acknowledges that mal-consumption and over-consumption might be factors in under-consumption. The discourse is pitched on welfarist terrain, with the developing world as supplicant or applicant and the developed world as donor (Lang *et al.* 2009).

The politics that this implies has a very long history. Arguably, the entire food security debate goes back centrally to Malthus's *Essay on the Principle of Population* (Malthus 1798). Malthus, like Gladwell two centuries later, worried about irresolvable forces and trends; above all he feared population rising faster than the potential to increase food supply. His core question – and why his writing remains so potent today – was partly philosophical, partly political: can humans escape the limits of nature? (Malthus 1815).

Malthus was not one to shirk the politics of food security, which is why in part Karl Marx later in the nineteenth century was so exercised with finding flaws in his arguments. Societal structures, particularly land ownership and capital distribution, were downplayed, when the potential lay to unleash technology which could remove the barriers to hunger. Ossified social structures, not Malthusian inevitabilities create hunger, said Marx.

In the mid-twentieth century, science and technical advance were posited as value-neutral means through which the Malthusian spectre could be banished. The Green Revolution's plant breeding remains a prime example of that approach to food security; Norman Borlaug won the *Peace* Nobel Prize. By the end of the twentieth century, however, the social dimension of food (in)security was once more being reasserted. Even if technical change was needed, a social framework would be necessary to unlock its potential. A recent example of this more balanced approach was the World Bank's and FAO's evidence-based review published as the *International Assessment of Agricultural Science and Technology Development Knowledge* (IAASTD) (IAASTD 2008). This assessment proposed that social support, particularly to small-scale farming and to women in Africa, would help them achieve large increases in output and create economic pathways by which food demand could be met. Other recent large-scale reviews of the global food system conducted by national scientific teams in Australia, France and the UK have concurred with the case for a more balanced mix of technical, social and economic improvements to deliver food security (Foresight 2011; Paillard *et al.* 2011; PMSEIC (Australia) 2010). If this is the case, a framework of thinking based on systems analysis becomes almost inevitable. Food security has to blend multiple strands of issues – land, people, economics, social structures, environment, health, distribution – not reduce their complex interactions to one factor or favoured approach.

This is why policy discussion of food security inexorably dovetails into the challenge of wider sustainable development; indeed, food security is a microcosm of sustainable development. Equal attention to societal, economic and environmental drivers and outcomes is needed to ensure that food systems operate stably and adaptably.

The literature on food security amply justifies the necessity of such a systems analysis, pointing to critical stresses emerging for food supplies from:
<B/L>
- *Environmental forces*, such as climate change, water stress, soil, land use, biodiversity loss;
- *Economic forces*, such as inappropriate price signals and uncosted externalities, fossil fuel reliance, labour force reorganization, urbanization, and first regionalization and now globalization;

• *Social forces*, such as population demand, the nutrition transition (changed eating patterns), diet-based ill-health patterns, the triumph of choice culture, the continuation of high levels of food waste.

</B/L>

<FO> The challenge ahead is not just producing enough but changing expectations that everyone can and should aspire to eat like the USA or UK. To eat like the former implies a society consuming as though there are five planets, and the latter a mere three planets (Global Footprint Network 2010). How did such an extraordinary state of affairs come about?

<A> The world of food policy

<FO> Throughout the twentieth century, while communist bloc politics were driving their experiments in one direction, the West was taking different routes. At the global level, food production kept ahead of rising population until relatively recently. Building on chemical, biological and transport advances, food production rose. 'Researchers turned policy advocates' such as John Boyd Orr, the first Director General of FAO, charted a pathway past the opposing poles of Malthus and Marx. More food could be produced, by applying science, technology and capital, working *with* rather than imposing on primary producers. Knowledge could be dispersed, for example via extension services, rather than enforced through social control. Science could unleash potential everywhere. It could also help prevent waste from poor storage and inefficient distribution techniques. Thus food costs would come down, and availability would increase, delivering general welfare and preventing ill health (Boyd Orr 1943; Boyd Orr and Lubbock 1953). This had been a powerful and dominant analysis of food security for most of the twentieth century (Vernon 2007). Termed variously the 'productivist' or 'productionist' analysis, it emphasized underproduction as the policy problem to be resolved. The environment was to be reshaped, mined, and indeed tamed, to meet core human needs. With variations, it has been the paradigm for food policy for the last 70 years; food policy sought a planet tailored for people.

Part of the rationale for the paradigm's adoption was the powerful evidence of hunger and mal-distribution of food in the West itself. Boyd Orr's book, *Food, Health and Income* – a study of food poverty in the UK – was enormously influential throughout the British Empire (Boyd Orr 1936; Ostry 2006). The institutional architecture created in and after the Second World War owed its existence to such arguments. In the crisis of wartime, they began to plan for better structures to share knowledge and food, while avoiding draconian USSR-type intervention. The evidence of poor social distribution within the capitalist West – hunger in the USA and UK being particularly cited – reminded political decision-makers of how underconsumption and unaffordability were core problems, not just underproduction. Hence the visionary language of rights and possibilities in the 1943 Hot Springs Conference that spawned the FAO (Hot Springs Conference 1943), and the strand of 'Right to Food' legalism from the 1948 UN Declaration to the 1974 World Food Conference, to the creation of the UN's 'Special Rapporteur on the Right to Food' (Eide and Kracht 2005).

Recognition of the history of food security thinking clarifies why global and national institutions are as they are, and why they struggle to address food security as sustainability. They have adapted, of course, but they clearly struggle to face, let alone resolve, the complexity now emerging from multi-factorial analyses, such as from IAASTD and the Global Environmental Change and Food Security project (IAASTD 2008; Liverman and Kapadia 2010). Even in its decades of success, much of the pressure on the productionist paradigm came from mounting evidence about environmental damage and externalities. Evidence grew about the complexity of ecosystems' infrastructure and about the impact of a runaway food culture based on untrammelled choice. Yet policy remained overwhelmingly productionist, with a welfarist safety net at global, but not always at national level (Shaw 2007).

In the twenty-first century, the world faces both old and new food dynamics. Today, for instance, hunger is again rising; after three decades of dropping as a proportion of world population, it is now back up to affecting a billion people. But this is outstripped by the 1.2 billion estimated to be overweight or obese (Gardner and Halweil 2000). Nowadays under-, over-, and mal-consumption of food co-exist. Loosened tastes and rampant consumerism have become major drivers of land use, as we see in the Amazon case study provided by Toby Gardner (4.3). Powerful global retailers and traders, not just national governments, dominate how food is

grown, distributed, priced and consumed (Burch and Lawrence 2007). The marketing budget of one giant soft-drinks corporation exceeds the World Health Organizations' bi-annual public health budget (Lang *et al.* 2006). Billions of people today eat as only kings and the rich ate in the past; more people are clinically obese or overweight than are malnourished (Gardner and Halweil 2000). Entire new structures and networks of food commodity routes have been created, aided by the age of oil. Cheap oil has fuelled both the nutrition and logistics revolutions. Neither is sustainable.

At the start of the twenty-first century, therefore, public policy over food security is in some turmoil. On the one hand, there is widespread specialist recognition that a structural reassessment is in order. On the other hand, there is institutional and consumer lifestyle 'lock-in' to productionism's inappropriate brilliance. This mismatch emerged clearly in 2006–08, when world political leaders began to realize something serious and new was facing the future of food and agriculture. In 2006, world agricultural commodity prices began to rise, and then rocketed in 2007–08 (see Figure 4.3). These peaked in 2008, but not before the FAO had won attention for the view that unless agriculture received more R&D investment and political support, the world would enter a neo-Malthusian crisis (FAO 2008). Neoliberal economists disagreed, arguing that price signals would reinvigorate production. As prices dropped and crop figures rose, it seemed they were right, only for the FAO Food Price Index to rise slowly again to the point where by 2011 they had exceeded 2008 peak levels. Oil prices, too, exceeded $125 a barrel. This added weight to the structural analyses urging fundamental review. Although the seriousness of the situation helped trigger many national inquiries and processes, such as former French President Sarkozy's G20 inquiry into food price volatility, the fundamental 'blank sheet' rethink has not yet happened. Dominant thinking still centres on 'produce more' rather than 'consume less or differently', let alone radical redistributive politics.

The significance of this policy mess cannot be overestimated. There is much lock-in to the status quo. Who could not want to maintain a supermarket culture which offers 30,000 food items for the consumer to choose? But who takes seriously that, behind this astonishing feat, is an unsustainable reliance on oil? In the UK, for instance, one company sells a third of all food and drink consumed, one quarter of all lorries on UK roads are food-related, and half travel empty. Vast investment has

been expended on building the twentieth-century food infrastructure to enable this affront to sustainability. Yet policymakers continue to believe that somehow 'business as usual' is both possible and desirable; they are either in a state of denial or else believe that market dynamics will resolve the difficulties.

Meanwhile evidence that addressing greenhouse gas (GHG) emissions alone requires huge change in rich countries' food and lifestyles mounts (Audsley *et al.* 2010). Future challenges go further than just GHGs, of course. A 'one planet' food system must develop new relationships with not just oil, but water, carbon, land, climate and ecosystems support. The transition to sustainability and long-term food security will be rocky and requires culture change, not just a few products with 'lo carbon' or 'bird friendly' labels.

UK governments since the 1970s have championed liberal food policy analyses despite (sometimes because of) membership of the Common Agricultural Policy (HM Treasury and Defra 2005). Today, with home food production back down to 1950s proportions (after a high point in the 1980s) UK governments are acutely aware of their reliance on external sources, on how sterling levels shape food prices, and how reliance on big food retailers to lower food prices has its limits (Collingham 2011). Investment in sustainable food systems is a priority, yet consumers and retailers themselves are hooked on the pursuit of 'cheap food' rather than sustainable food. This tension began to surface in the UK, and across OECD economies more generally, when world agricultural commodity prices rocketed in the 2007–08 price spike.

Concerned, the UK set up a Cabinet Office review. The resulting *Food Matters* report in 2008 proposed a more integrated analysis and policy (Cabinet Office 2008). It suggested a new 'low carbon and healthy' framework for the UK and de facto EU food system. This new perspective suggested that equal emphasis needs to be given to supply and consumption; to push and pull; to society, environment and production, not just production; to the interface of people, natural systems and socio-economic structures. It called for processes and institutions to manage change, and the need to acknowledge not just technical but socio-political options; to incorporate not just economic but cultural factors; to address not just farming but ever longer supply chains. The discourse thus began to move from mapping problems and their extent to what to do about it, and to scoping policy re-engagement with the world of investment, and better coordination between state,

companies and consumerism. In short, what began to emerge from just one high level review of one relatively small country was a case for renewed integrated public policy, not just narrow 'market-think'. 'Leave it to Tesco *et al.'* is not a sustainable nor sensible public policy, not least since big retailers and processors are only too aware of how coming crises might destabilize their own supply chains and market value – hence their creation of some interesting parallel processes such as the Sustainable Agriculture Initiative and GlobalGAP (GlobalGAP 2008; SAI 2008). These are company-specific rather than planetary global initiatives, but they are signs that even the powerful are nervous. Certainly, the undertow is that not just academics and analysts are voicing the question as to whether public food governance and institutions are 'fit for purpose'.

It is important not to lose sight of the enormous successes of twentieth-century agriculture. The impact of 150 years of research and field experimentation has delivered major advances in food production, most notably in food crops (and especially in the 'green revolution' in the 1960s and 1970s). There have also been significant advances in animal sciences and in understanding fisheries. Globally, however, although food production has kept ahead of global demand, there are still marked regional differences in food security. And the fragility of the current global food system was illustrated by the immediate consequences of the 2008 price rises.

This is important in the context of tipping points. The 2006–08 food price spike propelled the broader notion of food security into the policy and public eye. Almost overnight, governments were issuing statements about food security (as opposed to food production) and the media were relaying these to civil society. A key consideration for the tipping points discussion is that many reasons were advanced for the 'food crisis' including not only poor harvests due to weather anomalies but also commodity price speculation, increased demand for grains, export bans on selected foodstuffs, inadequate grain stocks, higher oil prices and the use of crop lands for the production of biofuels (Gregrory and Ingram 2008).

The world of food policy now has to address a wide range of drivers. These are highly complex. While climate change could well accentuate the interaction of factors shaping access, affordability, and utilisation, it is but one of several external stressors acting on the food system. Economic access to food, and hence livelihoods, is critically important. If policymakers are to consider future change successfully and based on evidence, they require understanding of the whole food

system rather than just the production component. In this context we share the argument, advanced in Chapter 1.1, that tipping points could be better understood as combinations of intertwining factors.

<A> Food systems, food security and food vulnerabilities

<FO> The Global Environmental Change and Food Security (GECAFS) project is an example of a major research effort in the 2000s which ideally ought to have been central to this process of building integrated policy understanding. For GECAFS, Ericksen (2008) conceptually divided food security into three major components, each of which needs to be stable over time: *food availability* (which depends on food production, distribution and exchange), *food access* (which depends on food affordability, allocation and preference), and *food utilization* (which depends on nutritional value, social value, and food safety) (Ericksen 2008). These components are all *outcomes* of a number of *activities* of the 'food chain': (1) producing food; (2) processing food and packaging food; (3) distributing and retailing food; and (4) consuming food. Both the food systems activities and the consequences of these activities for food security (i.e. their outcomes), are influenced by global environmental change; and the activities have environmental feedbacks as well as food security implications.

These activities lead to a number of outcomes, many of which contribute to food security, and others which relate to environmental and other social welfare concern. The GECAFS food-system model attempted to capture this dynamic. Ingram (2011) details five contrasting examples where its application has helped focus research and policy formulation. Food security is compromised as and when any of the components of food security is diminished, as is usually the case when food-system activities are disrupted by any stress. While each activity is to some extent vulnerable to global environmental change, it is the combined vulnerability of the food system as a whole, which is critically important for food security. This is what the Royal Institute for International Affairs (Chatham House) called the 'new fundamentals' for food policy (Ambler-Edwards *et al.* 2009). The massive floods in Pakistan in 2010 affected the whole food system: storing food, distributing food,

retailing and consuming food as well as severely disrupting production itself. Single issues affect all food system activities, but are influenced by cultural and social capacities for accommodation and adjustment, as covered by Emily Boyd (7.2).

So what are the likely pressures for change in food systems which might lead to increased food insecurity? While climate change will undoubtedly be a major factor impacting food production in many regions, it is the combination of increasing demand for food, coupled with growing climate stress (combined with yet further environmental stresses such as reduced water availability or soil degradation), that will be critical. While producing food has kept ahead of food demand historically, global demand is now growing fast. Economic growth in countries such as China and India, coupled with urbanization and the increasing influence of the retailing sector, is pushing up the consumption of meat and dairy products, projected to increase by up to 2.4 per cent annually between 2007 and 2016 (Von Braun, 2007). Goodland and Anhang (2009) suggest that the total contribution to global GHG emission could be as high as 51 per cent. This kind of analysis contributes to the lively debate for one meatless day per week.

Diets don't 'Westernize' by themselves. Very aggressive campaigns on the part of major corporations and Western governments to shift diets to Western patterns in poorer economies continue to have a very substantial impact, as have Western subsidies and 'dumping' of products – e.g. milk powder from the EU into China. Different policy discourses emerge from this picture. On the one hand some argue that this is progress; why shouldn't the Chinese or Indians eat more and differently? On the other hand, evidence from Western countries already suggests costly healthcare consequences from the nutrition transition. How can Mumbai afford its rocketing type 2 diabetes rate? Or China its rise of non-communicable disease as it consumes more fat? (Chen *et al.* 1991). Even the West has political difficulties with the health aspects of its unsustainable food footprint. One European Commission study, for instance, estimated that food accounts for 30 per cent of European consumers' environmental impact (Tukker *et al.* 2006). A study of UK food GHG emissions also estimated that food accounts for 30 per cent (Audsley *et al.* 2010). If GHGs are to be reduced, considerable changes in Western food consumption patterns will be crucial.

This is what troubles politicians. In developing countries, the rising middle classes would love to be able to eat like their counterparts in the West. In the

developed world, companies and politicians are both nervous of weaning consumers off that lifestyle. Yet already policy decisions are being made which add further pressures to the already unsustainable mix. Commitments to increase and subsidise biofuel production are a case in point. On the supply side, the diversion of a significant proportion of the US maize crop to bio-ethanol production (25 per cent of the crop in 2007), coupled with poor harvests of wheat in Australia and parts of eastern Europe, reduced the amount of long-distance tradable grains at a time when global cereal stocks (about 400 million tonnes) were at their lowest levels since the early 1980s (Gregrory and Ingram 2008). Maize exports from the USA averaged 47 million tonnes per year from 2000 to 2005, but in 2007 80 million tonnes went to ethanol refineries. Oil prices have also risen leading to increased fertilizer, transport and distribution coats, and a growing realization that world cereal and energy prices are not independent (Von Braun 2007). This was realized in the early 1970s but was politically marginalized, ironically due to the success of the Green Revolution and the new political compact between the oil-rich Middle East and dependent OECD Western states (Green 1978). The linkage is clearly seen in wheat prices, which like oil tripled between January 2000 and July 2007, and in the doubling of maize and rice prices over the same period (Von Braun 2007).

The OECD and FAO have now acknowledged that the era of dropping agricultural commodity prices may well be over. While average food prices have declined, food prices for many of the poor have not dropped over time as a percentage of their disposable income. This may be good news for urbanized consumers and food processors, but troubling for primary producers (OECD and FAO 2008). Their joint *Agricultural Outlook* report predicts price rises in the 2010s. The lack of stocks may be a major factor in the short-term increase in grain prices, but while the current high prices are unlikely to be sustained as farmers increase production in 2008, they are likely to remain relatively high for the medium term. This will bring benefits to some producers but it poses problems for the poor, governments of low income countries, and aid agencies supplying food, although with the appropriate policies higher prices could provide incentives to produce local food and stimulate agriculture.

But how will the additional impacts of climate change, and its likely growing importance in the future as a factor affecting food systems, further complicate what is already a very complex situation? Gregory and Ingram (2008) reviewed the present

14

knowledge of recorded impacts of climate change and variability on crop production, and estimated its contribution to the then current 'food crisis' (Gregrory and Ingram 2008). Such contributions might arise directly through the impact of existing climate change and/or climate variability on crop production, or arise indirectly through actions to mitigate or adapt to anticipated changes in climate. As they point out, the effect of increasing the mean temperature is relatively straightforward with the frequency distribution moved towards hotter and away from colder temperatures. However, increased variability of temperature becomes very important if crop biological responses are non-linear, and there are absolute thresholds for crop resilience.

Increasing variability of weather (and thus climate) may stem from three sources:

<B/L>

• Changes in the mean weather, such as an increase in annual mean temperature and/or precipitation;
• A change in the distribution of weather so that there are more frequent extreme weather events such as physiologically damaging temperatures or longer periods of drought;
• A combination of changes to the mean and its variability.

</B/L>

The consequences of the dry conditions on grain production and exports have been significant. Recent volatility in wheat prices has shown the impact of drought and seasonal fluctuation and has been a reminder that small variations in Australia, for example, can throw price predictions, open up opportunities for speculation and compound the effects of US and EU decisions to build biofuel production (Gregrory and Ingram 2008).

<A> Environmental interactions with food systems

<FO> There is now a substantial body of work that shows how sensitive agricultural production is to climate change, water and energy inputs (e.g. IPCC 2007, Stern 2008). Agricultural systems could be thrown by weather extremes, such as a drought

season (or successive droughts), thereby accelerating migration and urbanization which in turn stresses food distribution and labour markets.

While the impacts of environmental change on food production might be the most obvious issue, other food system activities are vulnerable to such stress. Food transport is one determinant of food availability; most people do not grow their own food and they rely on distribution systems to bring food to them. The world has now passed the point where a majority is urbanized. At a local level, food distribution might be stressed if a critical piece of distribution infrastructure (e.g. a railway or road bridge) is destroyed by a flood. In many cases a 'work around' can reduce its impact (by finding another route for example) but not always. Emily Boyd (7.2) takes this further, but relevant here are aspects of community response.

Concentrating on the vulnerability of distinct-level food systems to global environmental change in the Indo-Gangetic Plain, a GECAFS food-systems approach identified that the 'vulnerability points' were due to a number of interacting socio-economic and bio-geophysical factors; the context is fundamentally important (Aggarwal *et al.* 2004). In Ludhiana District of the Indian Punjab, for instance, where socio-economic development has led to a dependence on irrigation, the key vulnerability point is reduced irrigation supply due to lowering groundwater tables due to excessive extraction. This threatens crop productivity and overall production. In contrast, in the Ruhani Basin District, in the Nepali Terai, food security depends on moving food from village to village, especially in times of stress. Increased flooding due to glacier melt, coupled with more extreme weather, disrupts footpaths, bridges, and other vital food distribution infrastructure. Taking a food-system approach helped identify the vulnerability points in two contrasting Districts in the Indian Punjab and the Nepali Terai and showed them to be quite different. They will need very different adaptation responses to reduce their respective vulnerabilities: agronomic in the Indian case, structural and policy in the Nepali case.

Climate change and other aspects of environmental change stress food systems in a number of ways which may lead to organized responses of the kinds described by Emily Boyd. But food-system activities feed back to environmental conditions, which may in turn exacerbate these stresses. From a food perspective, agriculture is usually thought of as the main culprit. 12–14 per cent of total GHG emissions are attributed to agriculture, and a further 18 per cent attributed to land use change and forestry, much of which relates to clearing land for agriculture and

pasture (Foresight 2011). While agriculture and associated activities clearly contribute substantially to GHG emissions and other aspects of environmental degradation, all food-system activities lead to GHG emissions. Edwards and colleagues estimated that in the US food system 40 per cent of emissions are due to non-agricultural food-system activities (Edwards *et al.* 2009). But GHG emission is not the only environmental consequence of food systems. Impacts on biodiversity, on biogeochemical cycles, on fresh water resources, and on other environmental parameters are all in part caused by food-system activities.

An initial analysis by Ingram (2011) uses a matrix to indicate where the four sets of food-system activities contribute to crossing a number of 'planetary boundaries' (as identified by Rockstrom *et al.* 2009; see Table 4.2). Far from reducing the impacts attributed to agriculture, Table 4.2 provides examples in almost all cells of the matrix. Clearly mitigation opportunities exist across the food system. But it is also well worth noting that much of the GHG emission could be reduced across the whole food system if less food was wasted by consumers (Foresight 2011). Parfitt and colleagues report that 25 per cent of food purchased (by weight) is wasted in UK households, and that the 8.3 million tonnes of food and drink wasted each year in the UK has a carbon impact exceeding 20 million tonnes of CO_2-equivalent (Parfitt *et al.* 2010). Reducing food waste by only 25 per cent in the USA would reduce CO_2-equivalent by 65 million tonnes annually (Lyutse 2010).

Table 4.2 Examples of how food-chain activities (columns) affect key environmental variables (rows**)**

	Producing food	**Processing and packaging food**	**Distributing and retailing food**	**Consuming food**
Climate change	GHGs from fertilizers; changing albedo	GHGs from energy production	GHGs from transport and refrigeration systems	GHGs from cooking

Nitrogen cycle	Eutrophication and GHGs from fertilization	Effluent from processing and packaging plants	NOx emissions from transport	Food waste
Phosphorus cycle	P mining for fertilizers	Detergents from processing plants		Food waste
Fresh water use	Irrigation	Washing, heating, cooling		Cooking, cleaning
Land use change	Extensification and intensification	Deforestation for paper/card	Transport and retail infrastructure	
Biodiversity loss (including agro-biodiversity)	Land use change, pesticide and fertilizer pollution, overhunting, overfishing; crop homogenization, irrigation	Hydroelectricity dams for aluminium smelting	Invasive species	Consumer choices
Atmospheric aerosols	Smoke and dust from land use change		Emissions from shipping	
Chemical pollution	Pesticides	Effluent from processing and packaging plants	Transport emissions	Cooking, cleaning

Source: Ingram (2011)

<A> The institutional challenge

<FO> The picture of food security sketched here is one whose complexity and global reach poses significant challenges for governance. In the mid-twentieth century, after the Second World War, governments were the drivers of reformed food policies designed principally to raise production. But, in the twenty-first century, power and

influence lie in a new global configuration of vast companies alongside altered national governmental powers, along with consumer and environmental groups. This ill-coordinated patchwork of multilevel governance – part public, part private, part global, part national – has to address global to local capacities in order to feed an unprecedented combination of 9 billion people in 2050, in an era of climate change with changed economies, societal expectations and consumer cultures. Figure 4.10 provides a conceptual model of current food systems. This conceives of food flowing down a supply chain, drawing upon natural, social and economic capital, with outputs and consequences which feed back on the system dynamics. Around this central flow, other forces operate. Multiple stresses and interactions are possible, whose direction is affected by institutions and governance.

The mid-twentieth century policy model was more top-down than it is today, with government broadly shaping the relationship between supply-chain actors, consumers and civil society. That model has been frayed by new dynamics: regionalization and globalization, consumerism and the astonishing expansion of choice culture, and the spread and flow of information and other technologies. The result is that the activities of farmers and growers is largely dictated away from the land, even in the developing world, let alone in Western societies where more people are employed off than on the land. Farming and food production remain hugely important for food security, of course, not least because they are the largest employers on the planet, engaging nearly 400 million people.

It is primarily governments which have the legitimacy and policy potential to facilitate any transition to sustainable food systems for food security. Are governments able to do this? Attempts to create new policy frameworks, even in the area of trade (which governments almost universally state through the World Trade Organization is their top priority), have not successfully engaged with the challenge of sustainability. Trade rules have been framed around the pursuit of commerce rather than living within environmental limits. Yet, as we noted above, along with Amanda Long (Commentary 6.4), some giant commercial companies now realize the urgency of sustainability, if only as threats to their brands and their own survival. The assumption is often made that food governance will inevitably be delivered by existing institutions, as though they are (a) functioning adequately, (b) have appropriate terms of reference, and (c) have a good understanding of how best to integrate environmental, social and economic policy demands for food systems.

19

These assumptions do not hold. And there are good reasons for why modern food governance is fraying. First, there are tensions over priorities – trade, environment, health, and consumers. Secondly, governance is inexorably multilevel, with competing pulls from local, sub-national, national, regional and global levels of democratic accountability. And thirdly, institutional complexity has been compounded by failure to restructure. At the UN level alone there is fragmentation among the big organizations. The FAO dwarfs the World Health Organization. Environmental issues are championed by the UN Environment Programme (UNEP), but are largely sidelined by the sole body which is supposed to arch across the UN, the old Administrative Committee on Co-ordination/Sub-Committee on Nutrition (ACC/SCN), now renamed the 'Standing Committee on Nutrition'.

No one champions an integrated approach to food policy per se. Food security de facto receives most policy attention from the World Food Programme, which has an overt crisis-mitigation role, but which is entirely dependent on donor beneficence. A welfarist backstop or safety net is essential, but prevention rather than crisis management is what is now required. In government, like commerce, institutional divisions are inevitable. What matters is cross-sectoral or ministerial coordination. And it is here that failures of governance have been most marked.

Happily, pressures to reform world food security governance have begun to emerge. In the UN, a Special Rapporteur on the Right to Food was created in the late 1990s. This office has become a remarkable voice for reformed governance through a series of powerful papers addressed to the Secretary General (www.srfood.org). In 2010, the Committee on World Food Security, created in 1974, was revamped and given new urgency. It remains to be seen whether the renewed body will get a grip of the new policy requirements, and drive action on prevention and the delivery of sustainable food systems.

Our recommendation is that more thought needs to be given to how global, regional, national, and local policy architecture could help the transition to sustainable food systems. Better coordination, thinking capacity and sharing of experimentation are clearly required. But where is the political will? For this to happen, policymakers need to give equal emphasis to all aspects of sustainability. History suggests that food shocks are not always anticipated. As Emily Boyd (7.2) suggests, resilience stems from building capacities, not assuming 'business as usual'.

<A> References

Aggarwal, P.K., Joshi, P.K., Ingram, J.S.I., and Gupta, R.K. (2004), 'Adapting Food Systems of the Indo-Gangetic Plains to Global Environmental Change: Key Information Needs to Improve Policy Formulation', *Environmental Science and Policy*, 7: 487–98.

Ambler-Edwards, S., Bailey, K., Kiff, A., Lang, T., Lee, R., Marsden, T., *et al.* (2009), 'Food Futures: Rethinking UK Strategy', *Chatham House Report* (London: Royal Institute of International Affairs (Chatham House)).

Audsley, E., Brander, M., Chatterton, J., Murphy-Bokern, D., Webster, C., and Williams, A. (2010), 'How Low Can We Go? An Assessment of Greenhouse Gas Emissions from the UK Food System and the Scope for Reduction by 2050 ', (Godalming, Surrey: FCRN and WWF).

Boyd Orr, J. (1936), *Food, Health and Income: Report on Adequacy of Diet in Relation to Income* (London: Macmillan).

Boyd Orr, J. and Lubbock, D. (1953), *The White Man's Dilemma* (London: George Allen & Unwin), 124.

Boyd Orr, J. (1943), *Food and the People* (Target for Tomorrow No 3), (London: Pilot Press).

Burch, D. and Lawrence, G. (eds) (2007), *Supermarkets and Agri-Food Supply Chains* (Cheltenham: Edward Elgar).

Cabinet Office (2008), *Food Matters: Towards a Strategy for the 21st Century* (London: Cabinet Office Strategy Unit), http://webarchive.nationalarchives.gov.uk/20080804124019/http://www.cabinetoffice.gov.uk/strategy/work_areas/food_policy.aspx (accessed 3 April 2012).

Chen, J., Campbell, T.C., Li, J., and Peto, R. (1991), *Diet, Life-Style and Mortality in China: A Study of the Characteristics of 65 Chinese Counties* (Oxford/Ithaca, NY/Beijing: Oxford University Press/Cornell University Press/People's Medical Publishing House).

Collingham, L. (2011), *Taste of War: World War Two and the Battle for Food* (London: Allen Lane).

Drèze, J., Sen, A.K., and Hussain, A. (1999), *The Political Economy of Hunger: Selected Essays* (New Delhi/Oxford: Oxford India Paperbacks/Oxford University Press).

Edwards, J., Kleinschmit, J., and Schoonover, H. (2009), 'Identifying Our Climate "Foodprint": Assessing and Reducing the Global Warming Impacts of Food and Agriculture in the U.S.', (Minneapolis: Institute for Agriculture and Trade Policy).

Eide, W.B. and Kracht, U. (eds) (2005), *Food and Human Rights in Development, Volume I: Legal and Institutional Dimensions and Selected Topics* (Antwerp: Intersentia).

Ericksen, P.J. (2008), 'Conceptualizing Food Systems for Global Environmental Change Research', *Global Environmental Change*, 18: 234–45.

FAO (1974), 'Report of the World Food Conference, Rome, 5–16 November 1974', (Rome: Food and Agriculture Organisation).

FAO (1996), 'Rome Declaration on World Food Security and World Food Summit Plan of Action (World Food Summit 13–17 November 1996)', (Rome: Food and Agriculture Organisation).

FAO (2008), 'Declaration of the High-Level Conference on World Food Security: The Challenges of Climate Change and Bioenergy, June 3–5 2008' (Rome: Food and Agriculture Organisation), http://www.fao.org/fileadmin/user_upload/foodclimate/HLCdocs/declaration-E.pdf (accessed 3 April 2012).

Foresight (2011), 'The Future of Food and Farming: Final Project Report', (London: Government Office for Science).

Gardner, G. and Halweil, B. (2000), 'Underfed and Overfed: The Global Epidemic of Malnutrition', *Worldwatch Paper 15* (Washington DC: Worldwatch Institute).

Gladwell, M. (2000), *The Tipping Point: How Little Things Can Make a Big Difference* (London: Abacus).

Global Footprint Network (2010), 'Living Planet Report 2010: Biodiversity, Biocapactity and Development', (Gland/London/Oakland, CA: WWF/Institute of Zoology/Global Footprint Network).

GlobalGAP (2008), 'What Is Globalgap?' Http://Www.Globalgap.Org/ (accessed 15 June 2008).

Goodland, R. and Anhang, J. (2009), 'Livestock and Climate Change: What if the Key Actors in Climate Change are . . . Cows, Pigs, and Chickens?', *World Watch*, Nov./Dec.: 10–19.

Green, B.M. (1978), *Eating Oil: Energy Use in Food Production* (Boulder, CO: Westview Press).

Gregrory, P.J. and Ingram, J.S.I. (2008), 'Climate Change and the Current "Food Crisis"', *CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources*, 3 (99): 1–10.

HM Treasury and Defra (2005), 'A Vision for the Common Agricultural Policy', (London: HM Treasury and the Department for Environment, Food and Rural Affairs).

Hot Springs Conference (1943), 'Final Act of the Hot Springs [VA] Conference, 18 May–3 June 1943', Http://Www.Worldfooddayusa.Org/?Id=16367 (accessed 3 April 2012).

IAASTD (2008), 'Global Report and Synthesis Report', (London: International Assessment of Agricultural Science and Technology Development Knowledge).

Ingram, J.S.I. (2011), 'A Food Systems Approach to Researching Interactions between Food Security and Global Environmental Change', *Food Security*, 3: 417–31.

IPCC (2007), *Intergovernmental Panel on Climate Change Fourth Assessment Report: Climate Change 2007: The Physical Science Basis: Summary for Policymakers*, http://www.ipcc.ch/SPM2feb07.pdf (accessed 24 June 2008).

Lang, T. (2008), 'Food Security: Are We Sleep-Walking into a Crisis?' (London: City Leaders Lecture, City University), Http://Www.City.Ac.Uk/News/Archive/2008/03_March/04032008_1.Html (accessed 3 April 2012).

Lang, T., Rayner, G., and Kaelin, E. (2006), 'The Food Industry, Diet, Physical Activity and Health: A Review of Reported Commitments and Practice of 25 of the World's Largest Food Companies', (London: City University Centre for Food Policy).

Lang, T., Barling, D., and Caraher, M. (2009), *Food Policy: Integrating Health, Environment and Society* (Oxford: Oxford University Press).

Liverman, D. and Kapadia, K. (2010), 'Food Systems and the Global Environment: An Overview', in J. Ingram, P. Ericksen, and D. Liverman (eds), *Security and Global Environmental Change* (London: Earthscan).

Lyutse, S. (2010), 'The One Billion Ton Opportunity Cont'd, Part IV: Diet and Food Waste', *Switchboard: Natural Resources Defense Council Staff Blog* (Washington DC: Natural Resources Defense Council).

Malthus, T.R. (1798), *An Essay on the Principle of Population, as It Affects the Future Improvement of Society with Remarks on the Speculations of Mr. Godwin, M. Condorcet and Other Writers* (London: Printed for J. Johnson).

Malthus, T.R. (1815), *The Grounds of an Opinion on the Policy of Restricting the Importation of Foreign Corn: Intended as an Appendix to 'Observations on the Corn Law'* (London: John Murray & J. Johnson).

Maxwell, S. (2001), 'The Evolution of Thinking About Food Security', in S. Devereux and S. Maxwell (eds), *Food Security in Sub-Saharan Africa* (London: ITDG Publishing), 13–31.

OECD and FAO (2008), 'Agricultural Outlook 2008–2017', (Rome/Paris: Organisation for Economic Co-operation and Development/Food and Agriculture Organisation).

Ostry, A.S. (2006), *Nutrition Policy in Canada, 1870–1939* (Vancouver: UBC Press), 143.

Paillard, S., Treyer, S., and Dorin, B. (eds) (2011), *Agrimonde: Scenarios and Challenges for Feeding the World in 2050* (Paris: Editions Quae).

Parfitt, J., Barthel, M., and Macnaughton, S. (2010), 'Food Waste within Food Supply Chains: Quantification and Potential for Change to 2050', *Philosophical Transactions of the Royal Society B: Biological Sciences*, 365 (1554): 3065–81.

PMSEIC (Australia) (2010), 'Australia and Food Security in a Changing World', (Canberra: Science, Engineering and Innovation Council of Australia).

Rockström, J. *et al.* (2009), 'Planetary Boundaries: Exploring the Safe Operating Space for Humanity', *Ecology and Society*, 14 (2): 32, http://www.ecologyandsociety.org/vol14/iss2/art32/ (accessed 3 April 2012).

SAI (2008), 'Sustainable Agriculture Initiative Platform' (Brussels: Sustainable Agriculture Initiative), Http://Www.Saiplatform.Org/ (accessed 3 April 2012).

Shaw, D.J. (2007), *World Food Security: A History since 1945* (London: Palgrave Macmillan).

Stern, N. (2008), *The Economics of Climate Change: The Stern Review* (Cambridge: Cambridge University Press).

Thaler, R. and Sunstein, C. (2008), *Nudge: Improving Decisions About Health, Wealth, and Happiness* (New Haven, CT, Yale University Press).

Tukker, A., Huppes, G., Guinée, J., Heijungs, R., de Koning, A., van Oers, L., *et al.* (2006), 'Environmental Impact of Products (Eipro): Analysis of the Life Cycle Environmental Impacts Related to the Final Consumption of the Eu-25. Eur 22284 En', (Brussels: European Commission Joint Research Centre).

Vernon, J. (2007), *Hunger: A Modern History* (Cambridge, MA: Harvard University Press).

Von Braun, J. (2007), 'The World Food Situation: New Driving Forces and Required Actions', (Washington DC: International Food Policy Research Institute).