

Systems, food security and human health

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Abstract Food security is not just a food policy issue. What, when, where and how much people eat is influenced by a complex mix of factors at the societal and individual levels. These influences operate both directly through the food system and indirectly through political, economic, social, and cultural pathways - peoples' dietary behaviours are a response to the broader daily living conditions in which they are born, live, learn, work and age. In this paper we propose that to address food insecurity and diet-related death and disease, policy must tackle the systemic problems that generate poor nutrition in all its forms, and reflect how our food systems are making people sick. This has implications for economic, agriculture, food, social and health policy at the global, regional, national and local levels.

Keywords Diet · Inequalities in health · Food insecurity · Food systems · Public policy · Social determinants · Environment

Introduction

In the mid-1970s, the World Food Conference defined food security in terms of a food supply that could ensure the availability and price stability of basic foodstuffs at the international and national level (FAO 1996). This paper uses a wider

framing of food security that includes not just quantity of food but also its nutritional quality, the wider social context in which consumption occurs and also environmental dimensions (Wahlqvist et al. 2009). By using such a framing, food insecurity encompasses both a lack of food and a lack of good nutrition. It also recognises that it is not just nutritional health that is compromised in food-poor households, but also social behaviour when, due to issues of affordability and access, people cannot eat, shop for, provide or exchange food in the manner that has become the acceptable norm in society (Dowler 1998).

Using this comprehensive framing of food insecurity, the situation globally is more concerning than we may have thought previously. Almost 1 billion people continue to be under-nourished, with an insufficient intake of calories, protein, and micro-nutrients (FAO et al. 2014). Concurrently, there has been a large global shift towards diets of highly refined, and often ultra-processed foods, and of meat and dairy products containing high levels of saturated fats (Popkin 2004; Monteiro et al. 2011; Moubarac et al. 2013). This unhealthy transition has been accompanied by large numbers of people consuming excess calories, thereby contributing to overweight and obesity in more than two billion people in 2013 (Ng et al. 2014).

Food is very closely linked to human survival, and people's physical and mental health. Food insecurity, via insufficient quantity, poor nutritional quality, contaminated foods, or social exclusion can result in an increased risk of death or illness from stunting, wasting, weakened responses to infection, obesity, diabetes, cardiovascular diseases, some cancers, foodborne disease and mental ill health (WHO 2009; Hanson et al. 2012; Melchior et al. 2009).

These global food and health challenges are currently on the world policy stage. The Second International Conference on Nutrition (ICN2), an inter-governmental meeting on nutrition jointly organized by the Food and Agriculture

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Organization (FAO) and the World Health Organization (WHO) took place in Rome, November 2014. As was discussed at the ICN2, addressing these issues is complex (WHO and FAO 2014). What, when, where and how much people eat is influenced by a mix of factors at the societal and individual levels. These factors operate directly through the food system and indirectly through political, economic, social, and cultural pathways—people's dietary behaviours are a response to the broader daily living conditions in which they are born, live, learn, work and age (Friel 2009; Popkin 2006).

In this paper we explore the relationship between food, nutrition and health. We discuss how action to address 21st century food insecurity, as defined in our comprehensive way, requires the focus of food policy to evolve from only seeking to increase the amount of food available for consumption, to also considering wider public health and environmental consequences. The paper also discusses the implications for economic, social and health policy at global, regional and national levels.

A brief overview of the food and health relationship

Undernutrition

For some individuals, communities and even nations it is a matter of not having enough food, of there being little nutritious food readily available and being unable to afford food. An inadequate intake of food results in undernutrition which

can cause stunting, wasting, and physiological stress, with marked changes in the functioning of the autonomic nervous system, abnormal blood cortisol concentrations, and weakened responses to infection (Martins et al. 2011). Undernutrition often also means a deficiency in micronutrients, which can result in impaired immunity, growth, blindness, cognitive functioning, and poor reproductive outcomes (Black 2003; Viteri and Gonzalez 2002; Bhutta et al. 2013; Gibson 2011). Undernutrition is a significant threat to health, as the physiological stress and adverse health outcomes of inadequate food and nutrient intake over time can cause the body to deteriorate, affecting the function and recovery of every organ system (Saunders and Smith 2010), and result in death.

The Food and Agriculture Organization of the United Nations (FAO) estimated that in 2012, 805 million people globally were chronically undernourished (FAO et al. 2014). The burden of undernutrition is unevenly distributed, with those in low-income countries, pregnant women, and children being most affected. For example, countries in Africa, Asia and Latin America have a higher prevalence of stunting than other developed nations (Fig. 1). Maternal and child undernutrition is estimated to be the underlying cause of approximately 3.5 million deaths a year in low- and middle- income countries, and in 2011, an estimated 19 million children younger than 5 years had severe acute malnutrition worldwide, with the vast majority living in Africa and South East Asia (The Lancet 2013; Bhutta and Salam 2012; Black et al. 2008). Adverse outcomes from both insufficient food intake and micronutrient

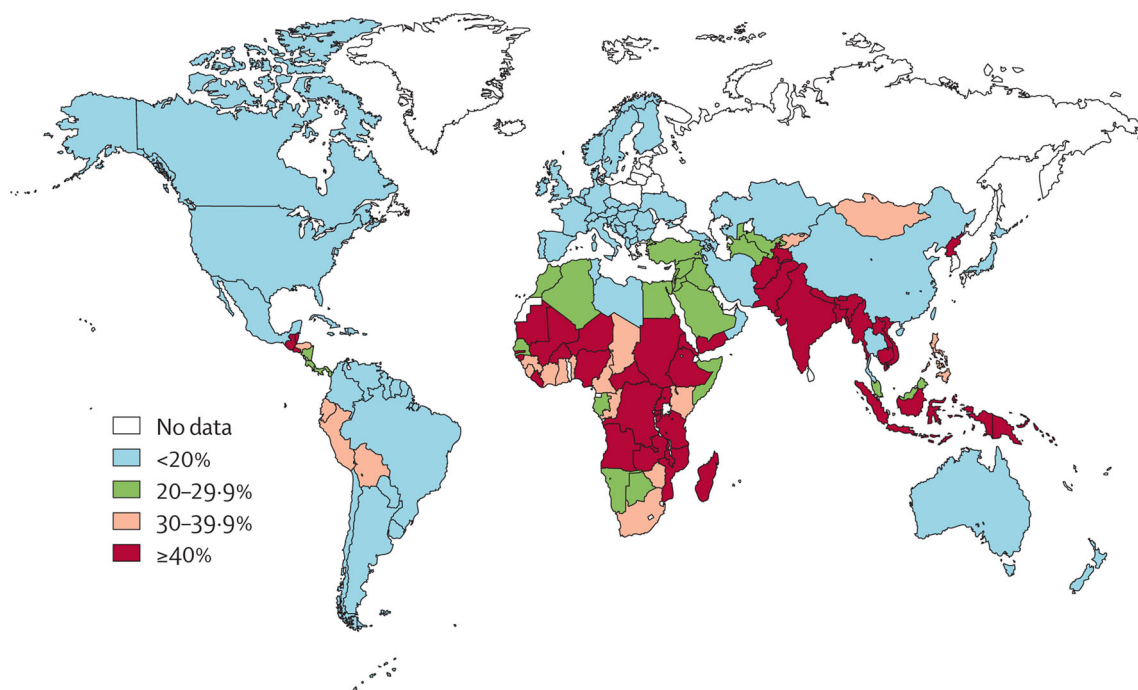


Fig. 1 Prevalence of stunting in children under 5 years. Reprinted from The Lancet, Vol. 371, Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M, Mathers C, Rivera, J, Maternal and child

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deficiencies have been observed in these populations, with stunting and low birth weight estimated to be responsible for 2.2 million deaths among children younger than 5, and iron and calcium deficiencies contributing substantially to maternal deaths (Black et al. 2008, 2013; Ezzati et al. 2002).

Undernutrition can affect the quality of life throughout the lifecourse. The consequences of not having enough food and nutrients, in utero, infancy and/or childhood can affect cognitive and mental development, and has been linked to poor school achievement and behaviour abnormalities (Martins et al. 2011; Victora et al. 2008; Black et al. 2013). In adulthood, undernutrition has been associated with increased absenteeism and lower productivity in jobs requiring manual labour (Martins et al. 2011), which further impedes successful economic participation. Additionally, undernutrition can affect the health and quality of life of multiple generations, as undernourished adults are more likely to give birth to infants with low birth weight, which has been associated with increased risk of chronic disease conditions (Victora et al. 2008).

Excess consumption

While almost 1 billion people go hungry, there are increasing numbers of people who consume too many calories but also too few micronutrients. There is not a shortage of food among these populations but its nutritional quality is compromised, access to healthy food is poor and cost of healthy food is high relative to other foods. In industrialized countries, the transition to diets higher in fats, sweeteners and highly-processed foods has been gathering momentum over time. More recent analysis show that this nutrition transition is now taking place at a much faster rate in middle- and low-income countries (Popkin et al. 2012).

Diets containing excessive amounts of these foods are associated with increased risk of non-communicable diseases (NCDs) including ischaemic heart disease, stroke, atherosclerosis, insulin resistance, diabetes, chronic kidney disease, osteoporosis, dental decay, gall bladder disease, and some cancers (including colorectal, breast and prostate) (Lim et al. 2012; Popkin 2006). These nutrition-related chronic diseases are among the leading causes of death worldwide, with the burden increasing most quickly in low-income countries (Hawkesworth et al. 2010). Five diet-related risk factors (high blood pressure, high blood glucose, overweight/obesity, high cholesterol, and low fruit and vegetable intake), when combined with insufficient exercise, have been found to be responsible for 19 % of all global deaths and 57 % of deaths due to heart disease (Lim et al. 2012; WHO 2009).

Without high levels of physical activity, energy-dense diets can result in weight gain over and above a healthy weight. Obesity is associated with higher risk of morbidity and premature mortality from hypertension, ischaemic heart disease, stroke, diabetes, osteoarthritis, musculoskeletal conditions,

asthma, sleep apnoea, polycystic ovary syndrome (PCOS), depression and other mental health disorders, and some cancers (including oesophageal, colorectal, breast, endometrial and kidney) (Popkin 2004; Guh et al. 2009). Obesity has become increasingly prevalent globally over the last couple decades (Fig. 2), with 50 % or more of the population overweight in over half of countries in the Organisation for Economic Co-operation and Development, and growing obesity rates in countries such as China, Brazil, India, Indonesia, South Africa, Thailand and Russia (Cecchini et al. 2010; Popkin 2006; Ng et al. 2014).

Foodborne diseases

Even when there is sufficient nutritious food available, health can be threatened through the ingestion of contaminated food. Microbial pathogens, chemicals, biotoxins and parasites can contaminate food during the production and/or preparation processes, often resulting in outbreaks, and can cause a variety of symptoms and clinical conditions, although gastroenteritis is the most common (Hanson et al. 2012). The majority of foodborne illnesses is acute; however, in some cases foodborne illness can cause chronic sequelae, including renal disease, neurological disorders (Lindsay 1997), and death. Diarrhoeal diseases, of which a considerable proportion is foodborne, are responsible for 2.2 million deaths globally. Although most of these deaths occur in low and middle-income countries, foodborne disease also results in deaths in high-income countries, including an estimated 3037 deaths in the US, 233 deaths in the Netherlands, and 86 deaths in Australia annually (Hanson et al. 2012; WHO 2008; Scallan et al. 2011a, b; Kirk et al. 2014; Ford et al. 2014; Havelaar et al. 2012).

Action to address food insecurity and diet-related health

Freedoms and empowerment - the core of food security

If good nutrition and related health for all social groups and nations were simply unattainable this would be unfortunate. However, as is the case with many of the marked differences in diet-related health between and within countries these are avoidable through reasonable social action but yet are not avoided. These differences in nutrition and health are inequitable (CSDH 2008).

Sen's notion of having the freedom to lead a life we have reason to value (Sen 1999) can be applied to the right to food – having the freedom to produce, access and consume a nutritious diet. Food insecurity is not equally distributed across social groups or indeed nations, suggesting that not all people have such freedoms. Most modern societies are hierarchical, with economic, social and other health producing resources including food, distributed unequally. Pursuit of

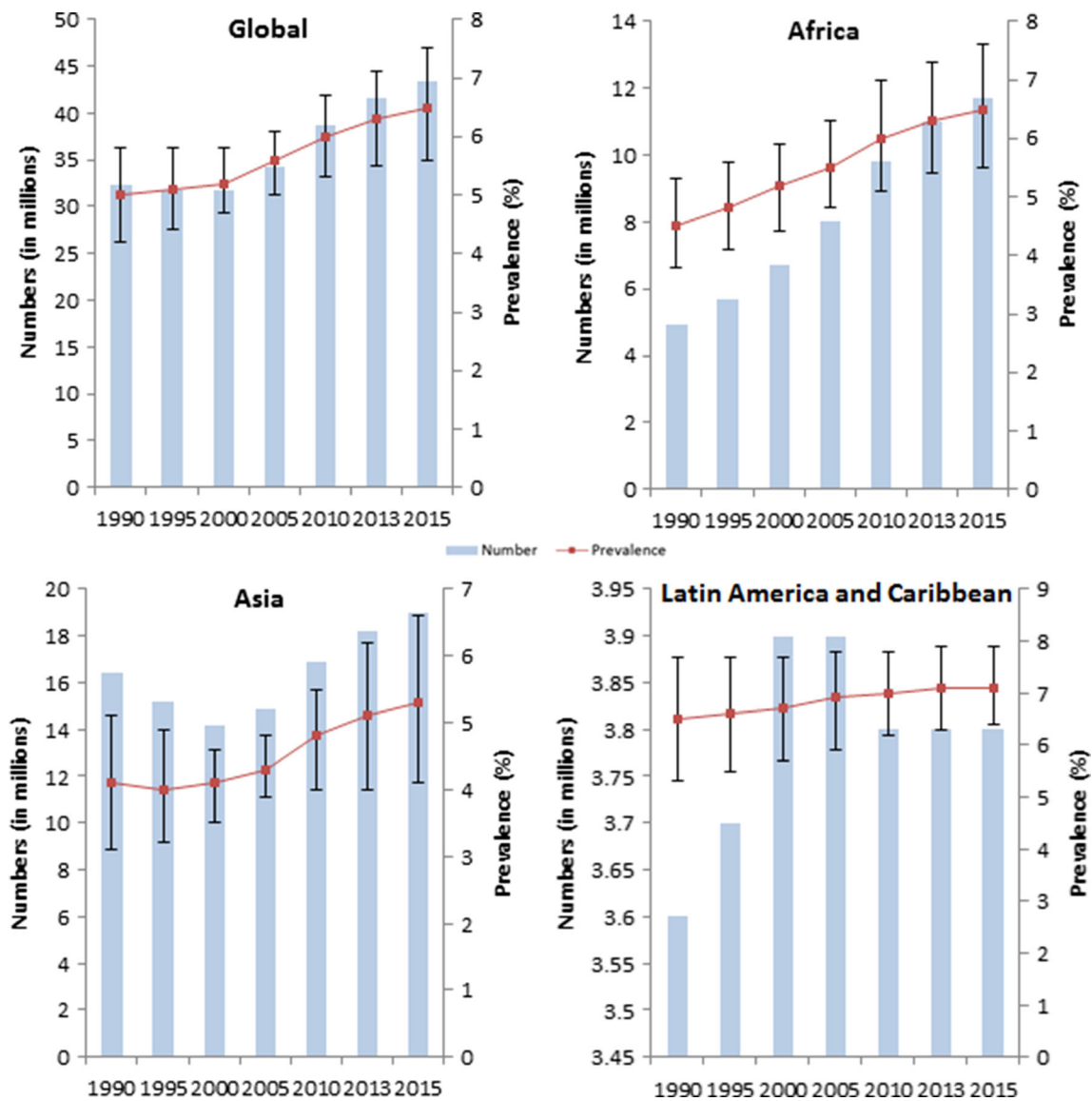
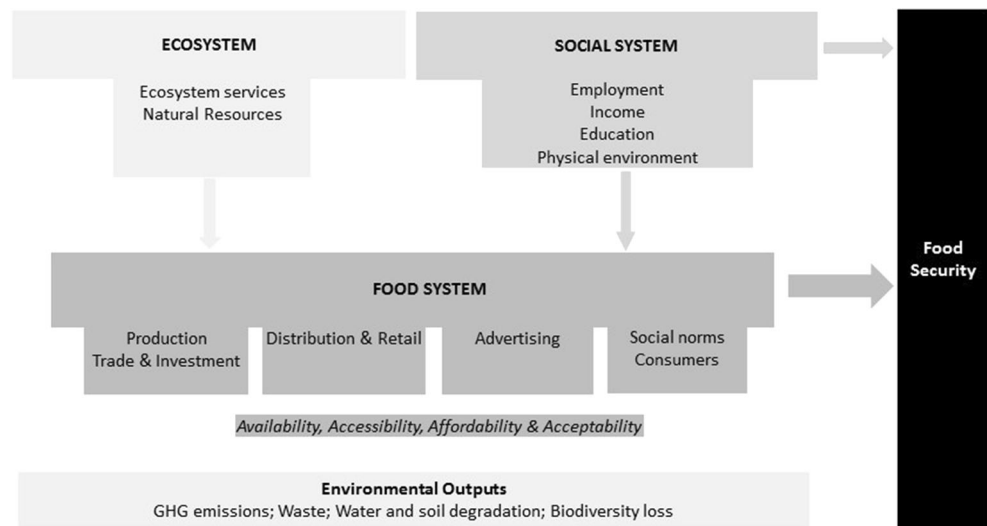


Fig. 2 Overweight numbers and prevalence globally and in selected UN Regions, 1990–2015. *Source:* (Global Health Observatory 2014a; b)

food security recognises the need to redress the unequal distribution of these resources. This relates to empowerment of individuals, communities, and whole countries. Empowerment operates along three interconnected dimensions: material, psychosocial, and political. People need the basic material requisites for a decent life, they need to have control over their lives, and they need voice and participation in decision-making processes.

What, when, where and how much people eat is influenced therefore by a complex mix of factors at the societal and individual levels. These influences operate both directly through the food system, and indirectly through the natural environment, and political, economic, social, and cultural pathways - peoples' food security and dietary behaviours are a response to the broader daily living conditions in which they are born, live, learn, work and age (Fig. 3).

The characteristics of modern global society - especially economic priorities and processes, and social conditions - arguably underlie the problem of food insecurity. The policies that generate and distribute political power, income, goods and services, at all levels, also shape how people live, what they eat and ultimately their health. The economic trajectory, particularly since the 1980s, has markedly increased global interconnectedness and interdependence. While facilitating greater mobility of technology, knowledge and people, the attendant gains in power, income, goods and services have been uneven. Economic development has contributed to longer life expectancy and better nutrition in most countries. However as the previous sections of this paper illustrate, almost 1 billion people continue to be hungry and more than 2 billion people consume energy-dense nutrient poor foods.

Fig. 3 Conceptual pathways to food security

Inequities in the food system

The food system itself is both a contributor to inequities in food security and a solution to global food security through its influence on the amount of food available for consumption, the physical access to food, its safety, nutritional quality, price, and acceptability of different foods in local environments. Food systems are highly complex, operating horizontally across sectors from production (producers and manufacturers) to distribution (retailers and food services), to advertising (marketers) and consumption (consumers). They also operate across different scales: highly industrial globalised supply chains (anchored by transnational and national food commodity producers, supermarket chains, food service sector) are by far the most dominant food system. This sits alongside ‘alternative commercial’ national and localised food chains (producer co-ops, community supported agriculture, artisanal farms), as well as civic agriculture chains based on household and community gardens (James and Friel 2015; McCullough et al. 2008).

Three important changes have taken place in the industrialised food system: 1) opening of domestic markets towards international food trade and foreign direct investment; 2) subsequent entry of transnational food companies and their global market, and 3) global food advertising (Hawkes and Murphy 2010; Friel et al. 2013a). These changes have made energy-dense, nutrient-poor foods relatively more readily available, affordable, and acceptable than nutritious foods (Hawkes et al. 2009). However the local effects are not experienced equally, hence why some populations and nations show higher levels of food insecurity compared to others (Friel and Baker 2009). The resulting shifts in food practices, dietary consumption patterns and nutritional status, each of which varies by social position (Kennedy et al. 2004), has culminated in the rise of NCDs and the persistence of

micronutrient deficiencies (Friel and Lichacz 2010; Stuckler and Nestle 2012). In addition, the growth of industrial production of animals, alongside the global movement of food and people have contributed to the emergence of significant foodborne disease pathogens (McEntire 2013; Broglia and Kapel 2011; Kuchenmuller et al. 2013). Some scholars have argued that these changes have also meant that the means of and control over the production of food has shifted from the farmers in the South to big agri-food businesses and transnational retail companies based mainly in the North, removing power from local producers, consumers and in many instances policy-makers (Friel et al. 2013b; Ghosh 2010; Epstein and Guest 2005).

Trade and agriculture policy

Until the 1980s, the dominant agricultural policy approach globally was state-intervention. The focus of this approach was for countries to increase their agricultural output in order to be self-sufficient and/or raise production dramatically thus providing cheap food for the urban workforce and enabling urban-industrial growth (Lang et al. 2009; Mazoyer and Roudart 2006). Production did rise in Europe and the USA, however production growth in developing nations was not as fast, and undernutrition remained widespread (Hawkes et al. 2012). At the time, concerns were raised by international financial institutions that state regulation and fiscal measures were reducing incentives for productivity growth and creating inefficiencies (McMichael 2004). Subsequently, in the 1980s the financial institutions embraced a set of economic development policies known as “the Washington consensus” (Williamson 2004), in which the free flow of market forces were seen as key to national and global economic development.

Two main policy processes were put into action: Structural Adjustment Programs and trade agreements that were inclusive of food. Following the Uruguay rounds of multilateral trade talks in 1994, the General Agreement on Tariffs and Trade (GATT) became the World Trade Organization (WTO) and food, which was typically excluded from negotiations in GATT, was now included in trade agreements. Countries were asked to open their agri-food markets by reducing tariffs, non-tariff barriers, export subsidies and domestic agricultural support. WTO rules promoted the integration of national food markets (e.g. through harmonization of food safety and quality regulations) and provided a more favourable operating environment for the private sector (e.g. through protecting intellectual property). Free trade and investment agreements also started to proliferate at the regional and bilateral level (Baldwin 2006).

On the face of it, reductions in barriers to trade should increase consumer food choices and improve supply for net-food importing countries. But these structural changes raise concerns about undernutrition and excess consumption of energy dense-nutrient poor foods by altering the local availability, nutritional quality, price and social desirability of foods (Box 1) (McCorrison et al. 2013; Hawkes 2006, 2007; Rayner et al. 2007; Thow et al. 2010b; Thow and Snowdon 2010; D'Haese and Huylenbroeck 2005; Monteiro et al. 2011; Lock et al. 2009a; Stuckler and Nestle 2012). Increasingly integrated global trade networks also have the potential to spread disease if the traded commodity contains microbiological contaminants (Quested et al. 2010).

Box 1: An example of what can happen to domestic food supply as a result of trade liberalisation

The historical experience of Fiji and Samoa demonstrates that economic liberalization is associated with decreased availability of starchy staple foods and increased availability of non-traditional cereals during periods of liberalization. More recently, the opening of markets and the dumping of goods such as cheap fatty meats has further undermined domestic agriculture and contributed to import dependency, and high levels of consumption of these foods (Gittelsohn et al. 2003; Peteru 1996; Thow et al. 2011).

The increasing influence of foreign direct investment

An increasingly important aspect of trade policy has been investment liberalisation, which aims to attract investment in manufacturing, retail and advertising by international companies (Friel et al. 2013a; Labonte et al. 2009, 2011; Hawkes 2005). The link between trade, food and NCDs comes partly through the global diffusion of ultra-processed food products (Labonte et al. 2011; Monteiro and Cannon 2012) enabled by greater investment and penetration of transnational food and beverage corporations (TFBCs) into many low and middle income countries (Baker and Friel 2014). In Mexico, the North America Free Trade Agreement (NAFTA) enabled significant

US agribusiness investment across the full spectrum of the food supply chain (Clark et al. 2012), creating challenges for local agriculture production. Often what happens in these circumstances is a greater specialization of production, so changing the ability and incentive for producers to supply certain foods relative to others. The shift has affected farmgate prices (both up and down), so creating opportunities for the industries which purchase farm commodities (the food consuming industries) to substitute lower priced ingredients, thereby influencing the nutritional quality and content of foods available in the marketplace (Hawkes et al. 2012). In addition, the safety of food may be compromised if resources such as refrigeration, quality control and pasteurization are unavailable in specialized food production (Ventura da Silva 2013; Quested et al. 2010).

In addition to large agribusinesses controlling the nature of food production globally, there has been an emergence of global food manufacturers and retailers such as Unilever, Nestlé, Wal-Mart, Carrefour, and Tesco. These trans-national food and beverage corporations (TFBCs), especially the supermarkets, influence eating habits through the products they choose to sell, the retail price, and the labelling and promotion of particular goods (Dixon 2004). Increasing market penetration by TFBCs has led to a dramatic increase in the transfer of processed foods from developed to developing countries, creating national marketplaces crammed with highly processed cheap nutrient-poor foods (Hawkes 2005; Reardon et al. 2010, 2012; Baker and Friel 2014).

Recent analysis of foreign investment in countries across Asia highlights that ultra-processed food consumption in Asian middle-income countries is increasing rapidly and converging with levels consumed in high-income countries. Asian markets have become increasingly transnationalised and the market share of TFBCs in the grocery retail, manufacturing and chained food service sectors is highest in the ultra-processed food categories. The analysis also demonstrates that market concentration, whereby increasing market share and thus market power is held by a declining number of firms, is also increasing in the same sectors and food categories (Baker and Friel *under review*).

Perhaps one solution would be to require TFBCs to implement food security commitments. In all countries, FDI is subject to regulation, often in very complex ways. As FDI expands within countries, there is space when negotiating these regulatory packages to include nutrition security. Excise taxes - a normal part of any tax code - could be used to reduce demand for foods unnecessary in the basic diet of all income groups.

Food advertising

Food advertising is an important driver of food preferences and behaviours; shaping the types of foods and dietary patterns that are acceptable and desirable in different social groups. Changes in the industrialised food system have increased the ability of

the food processors and manufacturers to “add value” through product innovation and marketing, creating a market characterized by highly differentiated products targeted to individualized preferences, thus increasing the acceptability of a wider variety and quantity of food products (Hawkes et al. 2012). Marketing of unhealthy food and beverages is now widely recognised to have sufficient negative influence on food preferences, purchases and dietary intake, and therefore diet-related chronic disease risks, to warrant preventive action (Galbraith-Emami and Lobstein 2013). This evidence is particularly strong for children and young people, who are overwhelmingly exposed to marketing of energy-dense, nutrient poor foods and beverages and are uniquely vulnerable to the persuasive power of marketing (Cairns et al. 2008).

Food labelling is one way to help inform consumers about the nutritional content and healthiness of foods, and also its safety. However in 2006, when Thailand proposed, on public health grounds, the introduction of a front of pack traffic light labelling system on snack food products, many of which had been introduced into the country by US-owned TNCs (Hawkes 2005), the USA and other countries claimed that it would restrict free trade and contravened the Agreement on Technical Barriers to Trade (WTO 2007). Although no dispute ruling was ever made on this claim, the Thai government abandoned the traffic light system and implemented a monochrome Guideline Daily Amounts label (Sirikeratikul and Vasquez 2011), a decision widely regarded as ineffectual. Food labels can also impact the safety of food if the preparation, cooking and storage instructions are not clearly conveyed or understood by the consumer (Questa et al. 2010).

Price

“In 2011 international food prices spiked for the second time in 3 years, igniting concerns about a repeat of the 2008 food price crisis and its consequences for the poor” (Fig. 4) (World Bank 2012).

Several factors contribute to global and domestic food prices. Increased national pressures due to the uneven distribution of global food stocks and the accelerating demand for animal source food commodities particularly among the urban middle classes is pushing up prices. Concentrated control of the supply chain has implications for food prices and their volatility. Almost 90 % of global grain trade is controlled by four agribusinesses; these major oligopolies “provide seed, fertilizer and agrochemicals to growers, and buy agricultural outputs and store them in their own facilities. They act as landowners, cattle and poultry producers, food processors, transportation providers, biofuel producers and providers of financial services in commodity markets” (Wilson and Edwards 2008). Speculative investment in food derivatives is a relatively recent development, causing inflationary pressure, increased food demand and subsequently, inflated food prices (Pace et al. 2008). Some argue that the production of crops for biofuels is replacing production for human consumption and contributing to food price increases (Scharlemann and Laurance 2008). More recent analysis by the World Bank suggests that most of the price increases in five food commodities (maize, wheat, rice, soybeans, and palm oil) between 1997–2004 and 2005–12 is accounted for by crude oil prices (more than 50 %) (Fig. 5). Crude oil prices mattered most during the recent boom period because they experienced the largest increase (Baffes and Dennis 2013).

Food prices, and the relative retail price of different foods, are a central concern for food security because they have the strongest impact on lowest-income households, who spend a greater share of their income on food and are more price sensitive (Wall et al. 2006; Nicholls et al. 2011; Thow et al. 2010a). The 2011 food price spikes prevented an estimated 48.6 million people from escaping poverty because the poor spend large shares of their incomes on food. In many countries worldwide nutritious foods are relatively more expensive than nutrient-empty foods and their cost is rising faster than the Consumer Price Index (Harrison et al. 2007, 2010; Jones

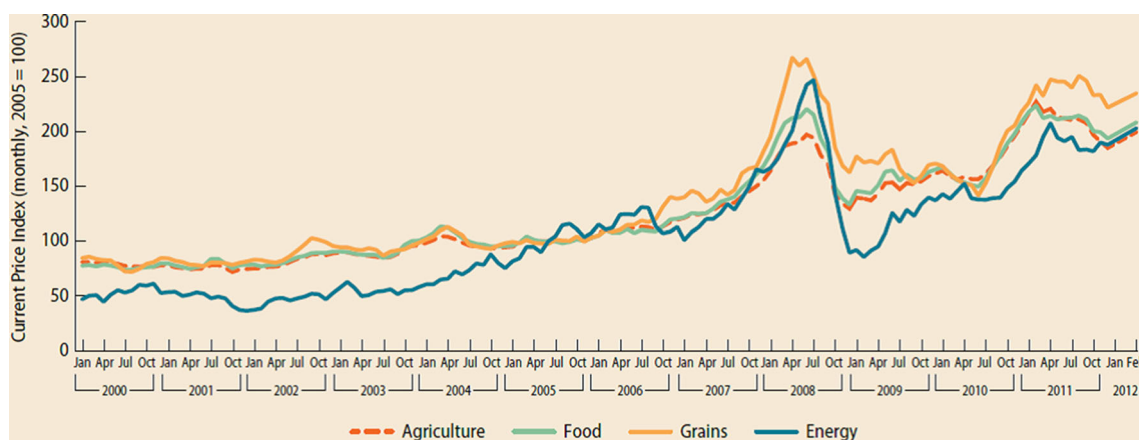


Fig. 4 Food prices since 2000. Source: (World Bank 2012). Note: The World Bank Food Price Index includes wheat, maize, rice, barley, sugar, coconut oil, soybean oil, groundnut oil, palm oil, copra, soybeans, soybean meal, orange, banana, beef, and chicken

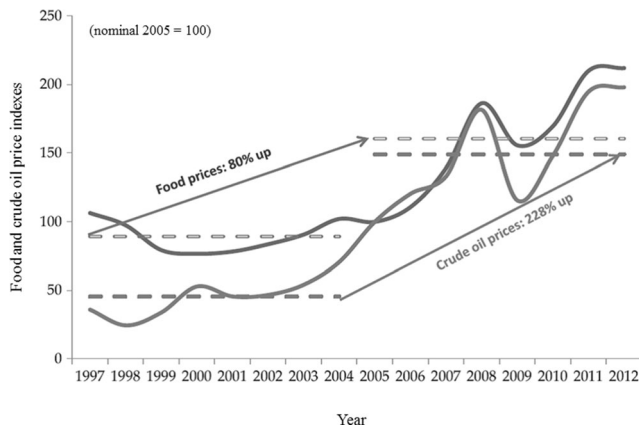


Fig. 5 Food and crude oil price indexes. *Source:* (Baffés and Dennis 2013)

et al. 2014). As incomes rise, people are more likely to consume raw agricultural products including meats, dairy, fruits and vegetables, which have a higher nutritional quality, but are also associated with a higher risk of foodborne illness (Questa et al. 2010).

A review of studies examining the impact of agricultural trade liberalisation on food security in developing countries noted that food price was one of the main issues but identified mixed results with both positive and negative impacts on food prices (McCorriston et al. 2013). Subsidies and price supports in agriculture and trade favouring specific sectors and food categories can lower the retail price of these products, altering their relative affordability (Friel et al. 2013a; Bradbear and Friel 2013). The recent attention by the Food and Agriculture Organisation to nutrition sensitive agriculture offers a counterbalance to the globalization effects. Instead of focusing exclusively on cash crops (for export markets), rural farmers are being supported to use their land to cultivate a variety of commodities, including fruits, vegetables and small livestock. This can improve household food security, nutrition and the economic status of the family and the community. Investing in home grown school feeding programmes will support smallholder farmers by giving them a guaranteed market, but also encourage the proliferation of crops and foods that will be nutritionally beneficial to children (FAO et al. 2014; FAO 2012).

Ecosystems and food security

While not the main focus of this paper, it would be remiss not to mention the natural environment when talking about issues of food security (Wahlqvist 1999; Wahlqvist et al. 2012; Friel et al. 2008, 2011; Smith and Ezzati 2005; McMichael 2005). Each stage of the food system—from production through manufacturing and processing, to retail and consumption—has the potential to be affected by and contribute towards environmental degradation (Garnett 2008, 2011; Friel 2010; Edwards et al. 2011; Costello et al. 2009). Human-induced

climate change plus other forms of environmental degradation are already affecting the functioning of the global food system, contributing to impaired quantity, quality and affordability of food in many countries but particularly countries in the tropics and sub-tropics and who are already those experiencing high levels of food insecurity (Sheeran 2008; World Bank 2010; IPCC 2014). The evidence also highlights that high levels of hunger are generally found in those countries and regions where access and property rights to land, water, and energy are limited or contested (FAO 2010).

For example, already, climate change has adversely affected food security in Pacific Island countries, through reducing both subsistence and commercial agricultural and marine production (Hoffman 2011; Friel et al. 2011; Barnett 2011; FAO 2008). As a result, climate change is likely to continue to increase local food prices, exacerbating an already heavy reliance on imported and processed foods. This also contributes to the loss of local harvesting, production and cultural knowledge and creates uncertainty around food supply. As such, populations are at additional risk of food insecurity. Failure of global processes to reach decisions on climate change mitigation and inadequate adaptation strategies means that food security will continue to be jeopardised by globally induced degradation of natural resources.

As the temperature of the planet rises there will be more climate impacts including heat stress, extreme rain and flooding events, landslides, and water scarcity, each posing risks for people, assets, economies, and ecosystems (IPCC Working Group II 2014). In particular, droughts are predicted to become more frequent and severe in many regions of the world. These cause hunger, starvation, displacement and misery; farming jobs are lost, and suicide rates can increase, especially in farmers (McMichael et al. 2008; Berry et al. 2011; IPCC 2014).

Underlying economic and social inequities and their relationship with food insecurity

In addition to the food system, there are a number of drivers of food insecurity that are located in the wider social systems. The empowerment of all social groups to achieve food security is influenced by conditions of everyday life in which people are born, live, learn, work and age. People with less money, less education, insecure working conditions and poor living conditions are more likely to experience food insecurity, and have higher levels of diet-related diseases. Of particular relevance to food security is the nature of the physical and social experiences in early life; access to and quality of education, particularly that of females; the nature of urbanisation - how cities are planned and designed plus the liveability of rural locations; the financial, psychosocial and physical conditions of working life, and the degree of social protection provided. The conditions of daily living are shaped by deeper social structures, norms and processes.

The early years

Early child development (ECD) and quality education help equip people with material security, resilience, and personal control, each an important determinant of healthy dietary choices. Disadvantage in pregnancy and in utero effects, low birth weight and improper infant feeding, and deprivation in early childhood are associated with poor nutritional status and associated health outcomes in later life. Early child development which includes not only physical and cognitive development but also social and emotional development can play an important protective role (Early Child Development Knowledge Network 2007). What children experience during the early years sets a critical foundation for their entire lifecycle— influencing basic learning, school success, economic participation, and social citizenry—all important for resilience against food insecurity in adulthood (Engle et al. 2007).

Access to quality education and health literacy are strongly associated with healthy behaviours and risk avoidance - equipping individuals with the resources needed throughout the lifecycle to achieve a secure income, provide for family, and cope with health outcomes in later life. Maternal education in particular has been shown not only to improve children's nutritional status but it also improves school attendance (Smith et al. 2003). Children from disadvantaged backgrounds are more likely to do poorly in school and drop out early - and subsequently as adults are more likely to have lower incomes, higher fertility, and be less empowered to provide good health care, nutrition, and stimulation to their own children, thus contributing to the intergenerational transmission of disadvantage (Grantham-McGregor et al. 2007). Poverty relief and income generating activities together with measures to attract quality teachers, provision of more accessible schools and classrooms, culturally relevant materials, and reduced family out of pocket expenditure on school materials are critical elements of a comprehensive strategy to make education a reality for all children (Alford and James 2007).

Money matters: issues of work and social policies

Food access is affected by both the financial cost of food and the amount of money individuals and households have to purchase food (Friel and Conlon 2004; Andreyeva et al. 2010; Lock et al. 2009b). Employment arrangements and working conditions have powerful effects on food security. In most households worldwide, work is the vehicle through which to provide the financial capability to purchase a healthy standard of living and yet there are a significant number of developing countries where large proportions of workers live below US\$1 per day (ILO 2008, 2013). These are not just developing country problems. Half of Australian households have a pre-tax income of less than \$80,000 per year. Since 1975, the wages of a (full-time non-managerial) worker in the bottom ten per

cent of income earners has risen by 15 % (\$32,000 to \$37,000). For a worker in the 90th percentile their wages have risen by 59 % (from \$65,000 to \$103,000) (Leigh 2013).

Studies have indicated that families or households who are on low incomes or are welfare-dependent find it difficult to afford a healthy diet (Kettings et al. 2009; Friel et al. 2006). In Australia, for example, compared with households on average or above-average income, low-income households spend 40 % of their income on food as opposed to the population average of 12 %, although in real terms the amount spent is less (Kettings et al. 2009). Providing a living wage that takes into account the real costs of adequate nutritious food is essential (Morris et al. 2000).

The recent global economic downturn and accompanying unemployment and falling incomes, on top of already high food prices, are increasing the pressure on poorer social groups (Brinkman et al. 2010). When household finances are under pressure, food spending is often seen as more flexible than other essential expenditure demands, such as housing and education costs, which can and often do take priority over food (Dowler 2008). Already many people living in poverty in developing countries are making changes to their diet by substituting their usual food with less expensive nutrient poor food, as well as consuming fewer meals. In the Asia Pacific region for example, many people living on less than US\$2 a day have cut out health and education and sold or eaten their livestock. Those living on less than US\$1 a day have cut out protein and vegetables from their diet (ESCAP 2009).

In addition to the direct influence of wages on the amount of money an individual or household has available for food purchasing, working conditions can shape food choices indirectly through their influence on time stress and time available for meal planning, food shopping, and preparation; their contribution to 'role overload' and work-home life spillover; as a source of stress, fatigue and dissatisfaction; and their influence over perceived self-efficacy and control (Devine et al. 2006). Inflexible job schedules, shift work, variable and non-standard work hours, working overtime and multiple jobs, lack of job security, low pay, and low status jobs all make food choices and scheduling family meal times more difficult and are associated with fewer family meals prepared or eaten at home; poorer nutritional quality of meals, and less healthy diets (Devine et al. 2006; Broom and Strazdins 2007; Roos et al. 2007; Antunes et al. 2010).

Physical environments

Local food environments - the number and mix of food retail and food service outlets located in a community; their physical proximity, walkability, and proximity to public transport options; and the range, cost, and quality of foods available - each plays an important role in food security and diet quality. The nutrition transition and associated obesity epidemic, already widespread among urban dwellers in many low and middle

income countries, is partly due to urban planning that lacks planning for public transport and ignores the need for walking, cycling and playing in the urban landscape (Smit et al. 2011). The same urban form impacts on food and nutrition security more adversely on low income groups who are more constrained by lack of transportation and lack of healthful food purchasing choices in lower-income neighbourhoods (Papas et al. 2007). Foodborne disease has also been shown to have a greater impact on low income and minority populations potentially due to poorer retail food access and food handling (Quinlan 2013). Sitting cheek-by-jowl with excess consumption among the more affluent urbanites, are slum children who have higher levels of protein energy malnutrition, vitamin A, iron anaemia and iodine deficiency disorders than their rural counterparts. The generally nutrient-poor quality of the food supply, recurrent diarrhoea due to poor environment and housing conditions, absence of adult caregivers due to employment pressures and the lack of adequate services, each serve to increase a child's risk of poor nutritional status (Ghosh and Shah 2004). The nature of the household environment is also important in shaping home cooking and eating behaviours. Availability and adequacy of space and facilities for food preparation, cooking, and storage, as well as home and kitchen layout; thermal comfort and ability to afford heating/cooling and fuel bills; sense of privacy, security and personal safety can all play a role (White 2007; Thomson et al. 2013).

Cultural and societal norms and values

The dominant social and cultural norms of a society lead to processes of socialization i.e. the transfer of attitudes, beliefs, and behaviours between and within generations, and the means by which societies shape patterns of behaviour (Boydell 2004), including the different forms of regulation that are acceptable and used. Socio-cultural norms defining what is socially acceptable, desirable and appropriate to eat and feed others (as well as when, where, and in what quantities) may be as or more important than physical environmental factors in determining food security and diet quality (Brug et al. 2008). They may include social norms around consumption of take-away, convenience and snack foods, as well as sugary beverages; meal times, occasions, and rituals; eating away from the home; openness to new foods; valuing of thrift or displays of wealth and status in food purchasing; and social acceptability (or desirability) of body fat (Thornton et al. 2014). Gender roles and norms also play significant roles in household eating practices. Although women are less likely to control household income, they are more likely to bear the responsibility for day-to-day budgeting, for food shopping and for preparation of food for the family (Blake et al. 2009; Bittman et al. 2003; Lake et al. 2006; Inglis et al. 2005).

Social norms develop in many ways. Some have argued that progress on a myriad of social problems, including food

security can be made only through a concerted effort to change social norms and that education and persuasion will ensure that certain preferences and ultimately behaviours will occur (Kinzig et al. 2013). Others have argued that government interventions are needed to change social norms in order to achieve significant behaviour modification (noting that social norms can influence or constrain what actions the government can consider). Government policies intended to alter food choices and behaviours include active norm management, changing the conditions influencing behaviours, financial interventions, and regulatory measures. Each of these policy instruments potentially influences personal and social norms in different ways and through different mechanisms. Recent work by Hawkes and colleagues suggest that understanding of learned preferences (associated with personal and social norms) is important to the understanding of how food policies work: food policies work by influencing the learning, expression, and re-evaluation of preferences, as well as by stimulating a food-systems response (Hawkes 2013).

Government, however, is only one of many parties and interests acting to influence personal and social norms. Food industry actors are increasingly influential in shaping norms; most visibly through advertising, which is widely recognised to shape food preferences, but also less obviously through the increasingly powerful position of manufacturers and retailers as cultural authorities on food, nutrition, and lifestyle (Dixon 2003). Television cooking shows can also be influential in shaping norms around shopping and cooking practices and food safety (Borda et al. 2014).

Conclusions

The accumulating international evidence highlights that the empowerment of all social groups and nations to achieve food security is influenced by conditions of everyday life – those daily social experiences; physical environments; financial resources, and material living conditions. Promoting food security also means tackling some of the fundamental political, economic and cultural influences on people's living conditions and their local food environments. Traditionally, societies have looked predominantly to the health sector to deal with its concerns about food and nutrition and diet-related health. Technical and medical solutions such as disease control and medical care are, without doubt, necessary for diseases of malnutrition but they are insufficient. Action is needed throughout the whole food system, in trade and investment arrangements; in matters of environment, income and place. Food security is therefore an issue that cuts across many policy domains including economic, social, environmental and food policies.

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