

Water and Food Security: Food-water and Food Supply Value Chains

J.A. (Tony) Allan

Abstract The purpose of this chapter is to highlight the importance of food supply chains in understanding water security. Food supply chains are important because about 90 % of the water needed by an individual or a national economy is embedded in their food consumption. This water will be called food-water in this analysis. Food requires water to produce it. This water can be either green water—that is the water that is held in the soil profile after rainfall. Crops and vegetation can use this water for consumptive transpiration. Food-water can also be blue water, usually called freshwater. Such water can be diverted from rivers or pumped from groundwater. Globally, green water accounts for about 80 % of the water used for crop and livestock production. Over 20 % is blue water which is the water used consumptively in full and supplementary irrigation. The food supply chain is also important because farmers and other agents in this supply chain allocate and manage the vast volumes of water used consumptively. Farmers are helped by ag-industries which breed seeds and provide fertilizers, equipment and pesticides. All of these inputs plus science and many government subsidies have enabled farmers to increase their water productivity. Farmers manage about 90 % of the food-water resources in the food supply chain. The other 10 % of food-water is handled by corporations and other private sector entities that trade, transport, process and market food for consumers. The volumes of food-water in this non-farm part of the supply chain are therefore relatively small. (Note the analysis in this chapter does not address the water resources devoted to the production of fibre and energy. The author recognises the role of water in these economic activities but there is no space to address the nuances that these consumptive and non-consumptive demands place on the consumptive use of water.)

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1 Introduction—Hydro-system Fundamentals and Food Supply Chain Shaped Food-water Demands

There are no water wars because food wars are not judged to be necessary.

Society, politics and market players have conspired to put in place - globally and nationally - highly politicised global food regimes and food supply chains that have no reporting or accounting rules for water resources.

The purpose of the chapter is to highlight the importance of food supply chains in understanding water security. It will highlight both the politicised relationships, as well as the inescapable bond, between sustainable food security and sustainable water security. Sound food policies as well as sound water resource allocation and management will depend on the recognition of this connection.

The relationship between water and food is exceptional. No other supply chain needs or consumes a natural resource in the proportions that the world's food supply chains use water resources consumptively. The water used to produce food will in this analysis be called food-water.

Agents in the food supply chain have, since the beginning of farming about 13,000 years ago—usually unwittingly—been adapting and mainly enhancing the efficiency of the ways they mobilise the invisible rainfed green water in the root zone for food production. During all of this pre-industrial era, almost all the food-water consumed in crop transpiration was Nature's rainfed green water. Blue water—surface and groundwater—has been used in different modes of irrigated agriculture for the past five millennia. But very small volumes of blue water were consumed in irrigation until the beginning of industrialisation two centuries ago. The scale of the negative impacts on water resource ecosystems of humanity's industrial and post-industrial food supply chains has no precedent.

The analysis that follows will include the consideration of two major systems that bind together water resources and food production and consumption. First, there will be a very brief review of the significant characteristics of the hydro-systems that underpin the supply chains on which societies depend for their food security. It will be concluded that farmers are the major professionals that allocate and manage natural and engineered water resources. Secondly, there will be a very brief review of the history of global and other *food regimes* and *food supply chains*. The brief history of the world's food regimes shows that recent market volatility has exposed some dangerous features of the power asymmetries of the current global food regime. This regime emerged after the Cold War food regime of the 1950–1989 era. Thirdly, it will be shown that there exist many enduring sub-national food systems. These feed over 80 % of the world's populations (Hoekstra and Mekonnen 2012). Global food *trading* systems only ensure the food security of about 15 % of the global population (Hoekstra and Mekonnen 2012). This low proportion, however, belies its significance. The successful servicing of this international demand for traded food, driven by food consumption in water and food deficit economies, keeps the world at peace. It must be emphasised that it is normal to live in a food

deficit economy. About 160 out of 210 economies in the world exist in conditions of inescapable food deficit of which they are usually innocent. There are no water wars because food wars are not judged to be necessary (Allan 2001).

There has been a clear shift in the nature of the global food system since the 1980s as a consequence of the expanded reach of global transnational corporations based mainly in the USA and Europe. Unfortunately, this third food regime adopted the most dangerous assumption of the first and second regimes, namely that that water is a free good. A feature of the past decade has been the emergence of some East Asian corporate traders with global ambitions. These developments may signal the beginning of a fourth global food regime (Keulertz 2012a).

The commercial and communication competence of these long established and some new corporations have led to an unprecedented concentration of market power (Williams 2012). The transnational corporations in these food supply value chains—often referred to as the brands and the non-brands—operate across the world. They can operate in short sub-national supply chains. Increasingly influential, however, are the long global food supply value chains which are very well integrated into the global food regime just discussed. These major players very well understand the operation of food supply chains and have well-developed information systems which uniquely privileges them in evaluating and handling environmental and market risks. They also have established and sometimes still own elements of the banking, hedging and insurance systems that underpin the operation of the supply chains. They stand out as the players who deploy huge influence.

Knowledge is certainly power. But the corporate knowledge is not framed on reporting and accounting rules that take the value and scarcity of water into account. Society, politics and these pivotal market players have conspired to put in place—globally and nationally—highly politicised food regimes and food supply chains that have no reporting or accounting rules for water resources. Food supply chains will always be highly politicised. They need to be re-politicised in a market economy that recognises the essential securitising roles of water and ecosystems.

2 The Important Underlying Hydro-fundamentals of Water Resources and Food Systems

Society chooses to listen or not to listen to economists. It points accountants, not economists, at the operational problems of its markets when it wakes up to the dangers of exhausting a strategic input such as water or alienating a strategic input such as labour. Food-water is not yet a wake-up issue.

On the assumption that the readers of the chapter will mainly be those who produce, manufacture and consume food rather than those who work in the hydro-sciences the terms used for water will be those that have proved to be accessible to the general reader since Falkenmark introduced them in 1986. Rather than those used by hydrologists, engineers and economists who plan and install water management infrastructures.

Society's food supply chains utilise about 90 % of the water used by society (Hoekstra and Mekonnen 2012). We shall call this water *food-water*. The other approximately 10 % is used by households and industry (Hoekstra and Mekonnen 2012). We shall call this municipal water *non-food-water*. Of the massive proportion of natural green and blue water embedded in the world's food supply chains, 90 % is used in producing food and fibre on farms by farmers. Farms are clearly where improved returns to water are delivered and water ecosystems are stewarded.

There is a third type of water—desalinated or manufactured water but this water is as yet unaffordable for crop production. Manufactured water is not considered in this analysis. Nor is the recycled water available after treatment of domestic and industrial use.

The two types of natural water used by farmers are green water or blue water. Globally, green water is the most important in terms of volume. About 80 % of the food in global farming is produced with *green water* (Hoekstra and Mekonnen 2012). *Green water* is the water that—during a cropping season enabled by rainfall events—stays long enough in the root zone to meet the evaporative needs of a harvestable crop. The metrics of the volumes of water available and of water transpired are both very difficult to capture (UNEP/GRID-Arendal 2009; UNEP/GRID-Arendal 2009). Global estimates that 80 % of green water is used to produce society's food production are usually based on estimates of crop transpiration modelled from remotely sensed multispectral data (Mulligan et al. 2011; Mulligan 2013). These metrics can also be augmented with estimates based on production data.

Green water has been very important throughout the 13 millennia of humanity's crop producing history. Despite the importance of green water in determining water and food security, it is only very recently that its role has been recognised and metrics developed. Such metrics are still not included in national and international water datasets such as those of FAO, although there are moves to remedy this situation (Margat et al. 2005).

The second type of water used in crop production is *blue water*. Blue water is first, the water present in surface flows and the water found in natural and man-made reservoirs. Secondly, it is the water in groundwater aquifers. While the massive volumes of green water have always been ignored blue water has generally been recognised as a vital resource once developed—because it is evident. Blue water is tangible. It can be pumped by engineers. Economists can conceptualise values for it. But both engineers and economists have failed to introduce concepts that move society and its food-water using food supply market chains to value or price blue water. Never mind green water. Society chooses to listen or not to listen to economists. It points accountants, not economists, at the operational problems of its markets when it wakes up to the dangers of exhausting a strategic input such as water or alienating a strategic input such as labour. Food-water is not yet a wake-up issue.

Despite blue water being evident and very widely revered as a holy cultural presence, it has rarely been valued as an economic input. Its value has not figured until its availability became scarce. Unfortunately by then it cannot be valued because that water resource use has become integral to unalterable livelihoods. These livelihoods are seen by society and by society's politics as unchangeable elements of an eternally politicised food economy.

The livelihoods that blue water has enabled are embedded in political economies created in a world that preceded the triple bottom-line assumptions of *people, profit* and *planet* (Elkington 1995) highlighted by activist scientists in the 1970s and 1980s. Adding the third environmental bottom line is an elemental political challenge as it is asking society to address the second failure of capitalism. In the two centuries of industrialisation since 1800—when society was being asked to address the first failure of capitalism—slavery and getting labour wrong, unprecedented demands for water have been imposed on blue water natural water ecosystems. These new water demands were mainly a consequence of the increase in the human population from about one billion to the current seven billions.

Fortunately, these past two centuries of industrialisation have also been associated with extraordinary increases in the productivity of food-water on farms (Allan 2011). The increased returns to both blue and green water have been a consequence of farmers combining increasing volumes of diverse inputs progressively more effectively. Farmers allocate and manage water resources more than any other profession. The main message of this chapter in relation to water resources and water resource security is that we depend on farmers individually and collectively. We depend on them now and will do so increasingly in the future. How they allocate and manage water will determine first, whether there will be sustainable volumes of clean water to produce our food needs. Secondly, if society enables farmers to have viable farm livelihoods, they will in turn be able to determine whether the water ecosystem services will be well enough stewarded to ensure their long-term viability. This long-term eco-viability—dependent on society recognising the role of farmers as water managers and stewards—will determine whether we can enjoy long-term socio-economic viability.

3 The Inescapable Political Economy Contexts—Global Food Systems and Food Supply Value Chains Contexts

Human health and environmental and water ecosystem health have turned out to be very closely aligned.

Society, politics and market players have conspired to put in place - globally and nationally - highly politicised global food regimes and food supply chains that have no reporting or accounting rules for water resources.

'It's true that you cannot talk yourself out of things you've behaved yourself into' (Polman of Unilever 2011).

This section will identify the second, political economy, underlying fundamental that must be understood by society if it is to manage water resources sustainably. This second sociopolitical condition is shaped by global food regimes and by numerous other food supply value chains developed by society. Both the long supply chains of the global food regime and those of the usually much shorter sub-national food supply value chains are dynamic. They sometimes experience very volatile phases as a number of factors impact and transform global food supply chains. Such a transformation has characterised the global nature and reach of the OECD long supply chains since 1989. It is also strongly impacting some of the BRICS economies and has long impacted many other economies. It is necessary to understand global food regimes and food supply chains more generally to grasp the significance of the collectively *water resource blind* forces that determine the way farmers manage water resources and whether they can steward them sustainably.

Food regime theory was developed by Friedmann (1978), Friedmann and McMichael (1989), McMichael (2009). It explains the underlying structures of the post-1950 structure of international agriculture. The 1939–1945 wars delivered an elemental shock to all the world's nations and particularly to the powerful warring parties. An unintended outcome was a strong post-war appetite for regulation. The 'regulation of the food regime both underpinned and reflected changing balances of power among states, as well as between organised national lobbies and classes—farmers, workers, peasants—and capital' (McMichael 2009). Food regime analysis notes that the globalisation of modern agriculture first became evident with the British-led outsourcing of agricultural activities to colonies in tropical zones and then to former-colonies more generally. The first regime was associated with the wealth transferring and humanitarian disaster of the imperial tropical sugar trade of the 1750–1850 period. It was succeeded between about 1870–1930 by an era of grain and livestock production and export from settler colonies to industrialised and rapidly urbanising European communities of all classes. This model functioned to feed the prospering middle classes around Europe with basic foodstuffs and with increasingly popular exotic commodities, such as tea and coffee. Interestingly most of the corporates now prominent in current global system had established themselves by 1870. The ABCD—global grain and livestock commodity traders (Murphy et al. 2012), and two of the biggest food brands—and Nestlé and Unilever were already established by the late nineteenth century. They have been joined by a much more numerous group of long-established US corporations including, Pepsi, Coca-Cola and Kellogg since the beginning of the twentieth century.

This first modern food regime lasted until the 1930s hiatus in global politics and especially in its international and national economic systems. After the 1939–1945 wars, leadership of the global food regime passed to the USA. The outcome was a system that prioritised arrangements that promoted a US Cold War agenda and the interests of US corporations. This US-led second modern food regime re-routed surplus food from North America to strategically important allies. Unfathomable incentives and subsidies were associated with the movement of cheap food commodities to reinforce loyalty against communism (Williams 2012). At the same time, very significant advances in agronomy, seed breeding, as well as in farm

equipment, fertilizer and pesticide technologies led to the trebling of water productivity. Food commodity prices less and less reflected the costs inputs of natural resources and their misuse. These apparently economically beneficial advances were associated with the deluding mix of subsidies, such as under-priced inputs of energy and un-priced water. We are living with the impossible politics of reversing the beliefs, habits and mismanaging behaviour of the second global food regime. It put in place a toxic system made very dangerous indeed by the absence of water resources reporting and accounting systems.

The second 1950–1980 global food regime was, therefore, associated with a half century of misleading declines in global food commodity prices. The trend was everywhere welcome, especially by the poor in all types of economy. The politicians responsible for meeting the food needs of the poor were especially welcoming. The food commodity price spikes of the 1970s were, in retrospect, brief. Although one remembers as both a consumer and a scientist at the time being just as anxious then as in the middle of the current spasm of food price volatility. The outcome of the current 2008–2012 period of price volatility is hard to predict. Conditions are different from those of the 1970s. Populations and related demands have doubled and oil prices, which are the big brother of global commodity prices, are unlikely to fall to the levels of the 1980–2002 period.

The cheap food assumptions of the second food regime were doubly dangerous. First, they misled consumers and society about the real cost of food and water. Secondly, they encouraged consumers to waste food and water, as well as all the other costly inputs needed to produce food. Both rich and poor in both developing economies and in the OECD club were affected. The food choices of consumers in the rich economies especially ignored the impacts of their *wasteful* and *unhealthy* food choices on their own health and on the health of water ecosystems (SIWI and IWMI 2008). Human health and environmental and water ecosystem health have proved to be very closely aligned.

The US and European transnationals both adapted to, and were in a strong position to, promote the second regime. The process led among other things to a global agricultural division of labour with progressive commodification as part of a development strategy of Western states (McMichael 2009). At the same time, both the US and the European Union introduced a costly but in a number of ways a very efficient system of agricultural subsidies at least in protecting their markets against the perceived communist threat (Keulertz and Sojamo 2013).

The transnational corporates were also in a very favourable position when the third food regime emerged in the 1980s. This regime was initiated and enabled by what turned out to be a radical deregulating phase in the neo-liberal project driven by an influential state-market alliance of the political classes in North America and Europe. The transition was also strongly reinforced by the end of communism at the close of the 1980s. The critical dysfunctionality of this experiment was dramatically exposed in the crash and global economic hiatus of 2008. All global sectors and commodities—including the massive water consuming global food supply chains—were affected. These global food commodity markets are still experiencing price volatility that may not settle back as they did after the price spikes of the 1970s.

This powerful juggernaut—the integrated global food regime and the world’s equally formidable food supply chains—is a political economy that remains water resource blind.

The cereal traders, the ABCD corporates have been very significant actors in this third post 1980s Western-led global food system and its supply chains (Sojamo 2010; Sojamo and Larson 2012; Murphy et al. 2012). Another important feature of this third global food regime has been the emergence of a new supermarket retailer and wholesaler nexus. The very rapid expansion of this supermarket system involved an unprecedented rationalisation of the food supply chains of the third food regime. For example, the already impressive advanced weather and market information systems developed by the corporate food commodity traders were massively reinforced by the rapid evolution of computerised global data-handling across the regime.

All the corporate food chain transnationals—brand and non-brand—benefitted from this *knowledge is power* revolution. Supermarkets, particularly, found themselves in an unprecedented position of market power that had the unintended consequence of exposing them to unwelcome reputational risk. In terms of water resource management, their new position meant that they were in an unfamiliar and vulnerable position. This vulnerability was highlighted by the appearance of the water footprint metrics first developed and published by Hoekstra and Hung (2002). The prominent and very reputation conscious brands—such as Tesco, Waitrose, Marks and Spenser in the UK and WalMart in the USA—were joined by their commercial partners in the global supply chain community—Unilever, Nestlé, Coca-Cola, Pepsi, Barilla (2012), SAB-Miller, in researching and publishing on the topic of embedded water and its environmental implications (WBCSD 2006, 2007; WWF 2012). Their business leaders moved unusually rapidly (UN Global Compact’s CEO Water Mandate July 2007 (WBCSD 2006, 2007) to establish an intellectual lead as yet unmatched by the academy and the public sector. An example of the leadership being provided by the private sector is that of Jochen Zeitz who developed the *Combined financial and sustainability report of Puma* (2011).

A number of leading environmental NGOs kept pace, provided leadership and produced influential publications (WWF 2008; Waterwise 2007). The Water and Resources Action Programme (WRAP 2011) is another excellent example of how NGOs have worked with the private sector to identify the hot spots and impacts of natural resource misuse. WRAP is currently funding important research on weighted water footprints (URS 2013).

The private sector in food supply chains is always the major allocator and manager of natural resources. A complicating feature in the case of water resources is that private sector farmers in private sector food supply chains have been weak players in all three of the global food regimes. It is interesting that it is WRAP an NGO that has commissioned its *Environmental data and hotspot impact research* report (URS 2013) and not a department of state or a funded science research programme in the academy.

A leading position has been established by the transnational food corporates in the international discourse on responsible water resource use. The lead has been established with exceptional flair in a number of cases. Some CEO's of influential brands in the transnational global food regime and its food supply value chains have very effectively established themselves as lead advocates. They fluently coin persuasive ideas on stewarding water resources—'It's true that you cannot talk yourself out of things you've behaved yourself into' (Polman of Unilever 2011). 'The world is out of water already. It will not be able to grow as fast as it did in the past if we do not get a grip on the water side' (Nestlé's Brabeck-Lemanthe 2012). They and the supermarkets are constructing the priorities of the world's food supply chains. They have market power. They also have platforms in the publications of powerful ideas agencies such as McKinsey who assert that 'a complete rethink of resource management will be needed to keep pace with soaring demand as up to three billion new consumers join the world's middle classes over the next 20 years' (McKinsey 2012). At the World Economic Forum, they contribute to its agenda forums and to its declarations and publications (World Economic Forum 2011; UN Global Compact 2007). So far ahead are the leading supply chain brands in understanding the nature and challenges of water resources in the food supply chain that they can relax and wait for the academy and public sector policy-making to catch up.

With the propensity of markets to fail in environmentally challenging conditions, this asymmetric knowledge/power situation is not a promising scenario for the evolution of a secure and sustainable global food/water political economy. In a market system, *profit* will always be a tempting short-term default. The outcome for blind *people* and for the invisible *planet* is not promising in a world with unchallenged and very adept transnationals.

Meanwhile departments of state of the nations of the world and related public science and policy agencies reveal that they have not yet adopted the idea that our strategically important food-water is embedded in food supply chains. (DEFRA 2011; Australian Government 2012; Federal Ministry of Economic Cooperation and Development 2006). There is a little evidence that things may be changing at the national level. Recent studies commissioned by the US State Department note embedded water but they do not consider the political economy of food supply chains with respect to water security (Intelligence Community for the US State Department 2012). Numerous international agencies are also unaware of the role of food supply chains in water resource security (World Bank [on China] 2012; ERD [a European perspective] 2012; FAO 2013; FSDL 2012; UNESCO/UN-Water 2012; OECD 2012a, b) in their reporting on the state of the world's water resources. A number of UN/CGIAR agencies (FAO 2013; IWMI 2010; UNESCO/UN-Water 2012; World Bank 2012; OECD 2012b) have recognised that it is unavoidable that root-zone water from rainfall is an essential element of the global water budget. But they have neither devised metrics to get such water taken into account in the policy domain. Nor have they engaged with the unavoidable co-evolution that is the outcome of the encounter of such hydro-thinking and food-water allocation and

management in farming. Nor have they engaged with the political economy of the global food regime and the supply chains which ‘we have behaved ourselves into’.

4 Food-Water and the Markets of the Global Food Systems and its Food Supply Value Chains into Which We Have Behaved Ourselves

State and other food supply chain players have - understandably - preferred to align with society’s cheap food fixation rather than with food-water security and water ecosystem stewardship.

There is no appetite for reporting and accounting rules.

We have identified five key issues. First, farmers manage and potentially steward society’s food-water, that is 90 % of society’s water. Secondly, society has not provided its farmers with the necessary resources to cope with environmental and market uncertainties to enable them to enjoy secure livelihoods never mind the new responsibility of stewarding the water ecosystems on which society itself depends. Thirdly, society—as consumers and voters—have preferred the availability of cheap food to addressing the second failure of capitalism—that is, failing to adopt measures that use natural resources such as water sustainably. The first failure was getting labour wrong two centuries ago. Fourthly, state and other food supply chain players have, understandably, preferred to align with society’s cheap food fixation rather than with food-water security and water ecosystem stewardship. Fifthly, there is no appetite for reporting and accounting rules. This condition is partly because devising and installing them would be very complicated. But it is mainly because capturing the costs of food-water would impact the price of food, which is a neuralgic political issue for consumers, politicians and the food-water blind market food supply chains.

Food supply chain is an extraordinary market phenomenon. They use nearly all the water needed by society. In addition—Fig. 1 shows that—the agents in the whole supply chain—from farmers to the food commodity consumers—are all in the private sector. They produce, trade, manufacture, process, retail and consume food via private sector markets. This contrasts markedly with non-food-water services—these are the domestic and industrial water services—which are almost exclusively organised and delivered worldwide by the public sector. The UK is an exception. In Italy, privatising non-food-water services is a very highly politicised issue.

In the water intensive food supply chain, farm owning farmers and private corporations run everything from family farms to major transnational corporations that trade, manufacture and retail food. They all use accounting rules that are blind first, to the cost of food-water inputs and secondly, to the impact of farming, especially the associated misallocation and mismanagement of blue water in irrigation, on the ecosystem services of water.

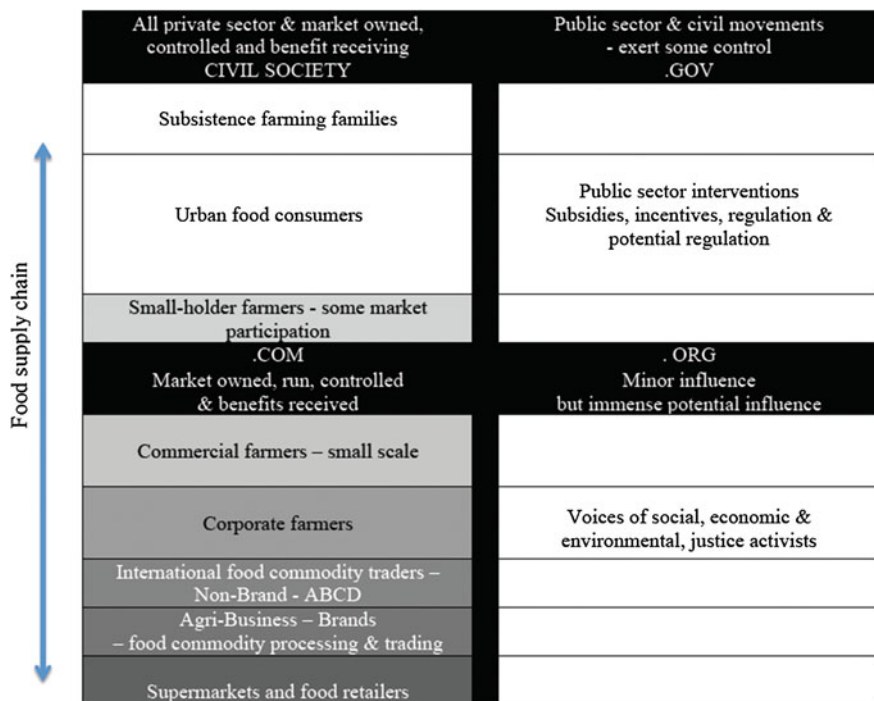


Fig. 1 An analytical structure of the agents and *social solidarities* (Douglas 1992) involved in the food supply chain, from food production by farmers to food consumption by individual consumers. The food-water in the private sector food supply chain—90 % of the water needed by an individual or economy—is allocated and managed by farmers and then supplied by agents in the private sector markets using water-value blind rules. *Source* Douglas (1992) and Allan (2013)

Figure 1 illustrates the phenomenon that this chapter has been emphasising that our very water intensive food supply chains are in the private sector. The agents who have long managed and still manage 90 % of natural green and blue water worldwide are on the left side of the diagram. They exist in civil society, first as food consumers and family farmers in the upper left solidarity and second as commercial and corporate farmers and as corporate entities in the rest of the food supply chain markets in the lower left solidarity. The players in the lower left solidarity have market power or potential market power. They can sometimes enjoy dominant roles. In contrast, farmers—the main water managers—may face impossible market conditions in dynamic circumstances that can include being driven out of business by their age, debt, pests, scarcity of affordable labour, drought, flood or negative market conditions including adverse international trade environments. All of these conditions preoccupy the farmer to the exclusion of the consideration of water resources. In the exceptional circumstances of advanced economies, crop insurance schemes have demonstrated that they can help farmers at the margin to survive. But these operational circumstances are exceptional.

States and those who make and deploy state power—in the top right solidarity—have over millennia put in place regulatory measures and incentives, tuned by very tough farm politics, that have shaped farm and agricultural policies as well environmental and trade policies. These evolving policies overlay very long-established rules of land ownership and tenure and labour rights and conditions. There is little, and usually no, appetite as yet to add to this list of regulatory measures by engaging in the toxic politics of capturing the value of water in food supply value chains.

Agricultural history is clear. Valuing an input in the food supply value chain is very challenging and involves conflictual politics by many generations over periods as long as a century. And even a century is not long enough to establish arrangements that satisfy all parties, all the time in all places. Processes of valuing labour and reforming labour rights initiated at the end of the eighteenth century took a century to put in place. It proved to be a long, ugly and sometimes violent, struggle to get markets to do the right thing by the *people* element of *people, profit and planet* triple bottom-line approach. This chapter has been about getting the market to do the right thing by the third element—the *planet*. The accounting rules in place are as yet very partial. They function to provide metrics that help the market to conjure the middle element—*profit*.

As yet the only solidarity—that in the bottom left quadrant—that has consistently promoted the value of water is the same one that rescued society from the first failure of capitalism. This solidarity is populated by civil movements, non-government organisations, trades unions and other social entities. They are inspired by environmental ethics and principles of sustainability. These organisations serve as the moral compasses of societies and of their state institutions and of their markets. A number of international NGOs have played a pivotal role in promoting the arguments presented in this chapter (WWF 2008, 2012; Waterwise 2007; Murphy et al. for Oxfam 2012; URS for WRAP 2013; Elkington 1995; World Economic Forum 2011). They have no state or market power. They can only deploy advocacy. But they have been very effective in using the language of risk. Highlighting reputational risk has been especially effective in impacting the strategic thinking of the leaders of major food manufacturing and supermarket brands in both national and global food supply value chains. The NGOs had to accept that they had no choice but to engage with the powerful private sector corporations and with private sector farmers. Unlike the academy and governments, they spotted what they needed to understand and whom to impact. They had to relate to those who both manage and misallocate water resources and potentially steward water ecosystems. They also get invited to join meetings in government departments on the rare occasions that these government agencies consider national water strategies.

Tinkering with, never mind confronting, any of the major alliances of the globalised state and market players is to engage with elemental global power relations. Big oil, big auto, big tobacco, big pharma, big armaments, big media and bi-food all have some rather evident and many more non-transparent relations with major OECD economies, with worrying asymmetric outcomes. The global food regime and food supply chains that have been highlighted in this chapter are just

another such arrangement of major significance to those responsible for other aspects of national and global security.

The experience of big oil is relevant to those of us trying to predict what will happen next in the global food system. Big oil included seven major—USA, UK and UK/Dutch—transnationals during the 1973 and 1979 oil price spikes. These major oil companies had written global energy history from the beginning of the twentieth century up to 1973. This big-oil oligopoly decreed at the beginning of the twentieth century that the world price of oil should be US\$2 per barrel; and it was so from 1900–1973 except in the exceptional circumstances of world wars. This global energy regime managed to provide the world with a further three decades of under-priced energy after 1979. Energy consumers became just as addicted to cheap energy as they had to cheap food. Both the global energy and the global food regimes had not priced in the proper cost of natural resource inputs nor of damaged ecosystems.

By the first decade of the twenty-first century, the seven major transnational oil and gas majors had merged into four and they no longer wrote the global agenda. They had lost control of the energy supply chains and no more determined the global energy regime. They also found themselves being forced to take the very technically and commercially challenging exploration concessions. They were increasingly underbid on the easy concessions by producer country companies and especially by less environmentally responsible BRICS operators. The former mighty majors were forced to pick up the high-risk and high-cost concessions. This outcome in turn involved coping with the contradiction that these contracts were usually high risk environmentally and proved to very high cost commercially.

No alternative dominant coordinated global energy power nexus such as the pre-1980 Seven Sisters big-oil regime has emerged. But it is certainly the case that the Western major oil companies have in less than three decades become a shadow of their former selves. At the same time, their essential ally the US Government is struggling to maintain its global hegemony in the oil and gas sectors. It has a motley suite of alliances with unstable Gulf oil economies and an uncertain domestic energy policy involving non-viable bio-fuels and a controversial oil-shale fracking industry.

Global food regimes have been around for much longer than the twentieth century big-oil oligopoly. Interestingly, the global food system is under-pinned by a group of staple-food suppliers that is much smaller than the current list of major oil and gas exporters. There are over twenty significant oil and gas producers accounting for most of the global oil and gas trade. In contrast, the strategically important global grain trade is dominated by only five major net-exporters of water intensive staples—the USA, Canada, Brazil, Argentina and Australia. They trade with another very small number of grain commodity traders based in the USA and France—the ABCD corporations, plus the Swiss-based Glencore, which is consolidating a number of smaller traders. They appear to operate a durable Western-based global state/market alliance. But, (Keulertz 2012c) has pointed out that there is a new acronym to consider. The long-established US-/French-aligned global ABCD phenomenon has been joined by an East Asian group of four global grain

traders that aim to serve the needs and interests of mainly Asian net-grain importers—three are based in Singapore and one in Indonesia. They are the Nows corporations—the Noble Group which grew by 25 % in 2011 (Keulertz 2012c), Olam, Wilmar and Sinar Mas. In 2011, they handled just over 20 % of the business transacted by that ABCD corporations but their trade is growing rapidly.

The global food regime could well be entering a new phase (Keulertz 2012b). The global alignments are likely to be subject to change. The ABCD traders have not yet adopted even the shared values vision of the brands such as Nestlé (Sojamo and Larson 2012). The Nows corporations have no immediate incentive to adopt water value and water ecosystem aware systems. However, Olam is setting a principled natural resource awareness pace in its operations (Olam 2012).

5 Achieving Food-water Security—Revisiting the Politicization of Food and Water Security: Concluding Comments

‘Farmers, Nature and don’t waste food.’ Japanese pre-meal vow/pledge.

Legislators have been voted in by electorates who are as water resource are illiterate as themselves. They have to engage with farm lobbies most of whose members are indebted and some suicide prone and with transnationals with powers way beyond those that they themselves possess.

The analysis has focused on the unheralded and unvalued 90 % of water embedded in the world’s food supply chains (Allan 2011; Reimer 2012). It has especially highlighted the role of farmers who manage 90 % of the food-water resources used to produce that food. It has been shown that food consumers in society and all those who operate its food supply chains have colluded in a water resource allocating and managing system, which has assumed throughout that water for food production should be free and can certainly be ignored. The other dangerous assumption that compounds the water resource catastrophes across the world is that food should be cheap. Governments want their poorest citizens to have access to cheap food. Private sector markets compete to provide it. No one—with the exception of NGO environmental and health activists and some journalists—wants to put accounting for water resource inputs and ecosystem impacts on the agenda.

The economic security of rural livelihoods associated with food production has predictably determined the nature of the political economies that provide under-priced food. Most farmers, the key water managers, are also poor. As a consequence, they cannot absorb the costs of being society’s water ecosystem stewards. Farmers need help from society to do what society requires via a transformation of global food supply chains. Food consumers in society, politicians, those who operate food supply chains and the global food regime in which they are all embedded have not yet recognised the role that must be played by farmers in

bringing about food security. That food security is totally wedded to water security is also unrecognised. The existing system is also a bag of contradictions. Beyond the farmer, the food supply chain players are fixated with their competition to provide cheap food. Cheap food can only be made available when water ecosystems are un-costed. Food consumers have yet to be persuaded of the imperatives in the Japanese prayer at the beginning of this section where both farmers and Nature are valued.

It has been shown that the analysts in government, the international agencies and the academy have been blinkered. They are still looking in the wrong place for who is capable of addressing the current water resource problems. They call on hydrologists and water resources science including specialists in water governance. Understanding water governance is very important. But it has to be a governance reform agenda that recognises private sector markets and their food supply value chains and global food systems.

The global energy supply chain has been referred to a number of times in the analysis. Like food commodities—at least in their global manifestation—oil and gas and its predecessor coal have always been explored for, sourced and marketed in private sector systems. Unlike water resources professionals, however, all those who attempted to evaluate and understand oil and gas assumed they would use data, information and analysis generated by the major transnational companies. Any international conference on energy at least until the 1990s would be mainly populated by private sector transnational professionals. The majority of contributors would be private sector specialists. Public policy-makers and the academy would always be playing catch-up and generally failing to develop national energy policies. It is apparently still the case as the UK department of state responsible for Energy and Climate Change (DECC) is currently recruiting expertise from the private sector to be able to engage in horizon scanning and scenario planning (Guardian 2012).

The contrast with the water sector is stark. Water resource professionals have been faced with the increasing hot-spot crises of water allocation and use for over three decades. But they have not in any serious way involved the major players in the private sector food supply chains. They do not relate to farmers over water despite farmers managing 90 % of society's water budget. International and other meetings on water resources and water resources security and the research that is reported still focus on water resources science supplemented by hydraulic engineering and some social science. For two decades, the economics of water and water resources governance have also figured on the agenda of such meetings. But such analysis and any related metrics have focused on underlying economic processes and on public policy and not on who is operating the big water using practices of the food supply chains. Economists do not operate food supply chains. These private sector market entities run on reporting and accounting rules installed by very highly politicised processes where economic principles are nowhere near the commanding heights of the debates. These politicised processes deliver outcomes that are the result of fiercely contended assumptions and interests that are very selective in what they prioritise (Paalberg 2010). Those engaged are elected

legislators as well as a myriad of more or less effective lobbies. Legislators have been voted in by electorates who are as water resource illiterate as themselves. They have to engage with farm lobbies many of whose members are in debt and some are suicide prone and also with transnationals with powers way beyond those that they themselves possess.

The oldest lobby in the world is the farm lobby. For millennia, farmers have always gone straight to politicians. The reporting and accounting rules that emerge from these contentious politics (Paalberg 2010) shape private sector markets including those that use 90 % of the water resources in hydro-blind food supply value chains.

Now that we can recognise that these supply chains operate in a highly politicised landscape; it is time to face the political facts of life with respect to installing secure and sustainable allocation and use of water resources. The newly emerging global food regime and the world's food supply value chains require a transition to a new political economy that has reporting and accounting rules. These rules would help ensure that farmers have viable livelihoods that in turn enable them to steward water ecosystems effectively. Water resource professionals and scientists both in the academy and government need urgently to recognise that water resource crises will be solved by farmers who have environmentally and commercially responsible contractual relations with their supply chain customers. Farmers and accountants will solve water resource allocation problems. But only if society, its food consumers as well as its global food supply chains, its legislators and its scientists can get their ideas properly aligned. This nexus needs to be revisited and differently politicised.

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The Water We Eat

Combining Virtual Water and Water Footprints

Antonelli, M.; Greco, F. (Eds.)

2015, X, 256 p. 44 illus., 41 illus. in color., Hardcover

ISBN: 978-3-319-16392-5