AGRICULTURE, ENVIRONMENT AND DEVELOPMENT

INTERNATIONAL PERSPECTIVES on WATER, LAND and POLITICS

Edited by

ANTONIO AUGUSTO ROSSOTTO IORIS

Agriculture, Environment and Development

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Epigraph

"…What kind of a government have you?"
"Has republicanism finally triumphed? Or have you come to a mere dictatorship, which some persons in the nineteenth century used to prophesy as the ultimate outcome of democracy? Indeed, this last question does not seem so very unreasonable, since you have turned your Parliament House into a dung-market. Or where do you house your present Parliament?"

The old man answered my smile with a hearty laugh, and said: "Well, well, dung is not the worst kind of corruption; fertility may come of that, whereas mere dearth came from the other kind, of which those wells once held the great supporters. Now, dear guest, let me tell you that our present parliament would be hard to house in one place, because the whole people is our parliament.

William Morris, "News From Nowhere" (1890)

Preface

The interconnection between economic development, agricultural production, and environmental change poses one of the most challenging questions in the world today. How can we provide enough food and properly nourish an increasingly urbanised global population, while promoting fair and sustainable development in rural and urban areas, particularly in the Global South? The answers to those problems are not trivial, but require critical and creative thinking and a move away from pre-established solutions and most of the strategies adopted during the last century. The challenge is, first and foremost, political, as it necessarily involves choices, decisions, and the redistribution of resources and opportunities. The debate on the role and the prospects of agriculture is critical, not only because of fierce disputes over land ownership, resource use, and commodity chains, but also, even more importantly, because it reveals a great deal about wider socio-economic trends and the socio-ecological safety of nations, cities, and regions. For instance, one current major controversy involves the association between mainstream food production and growing malnutrition and health problems, as well as deforestation, nature grabbing, and community impacts. The intensification of food production and commercialisation is also associated with mounting levels of obesity, bad health, environmental disruption, and food insecurity.

Unfortunately, most government reactions to those problems seem to reproduce an outdated, productivist way of thinking about development and

the environment. Public policies are largely limited by the powerful influence of global corporations, mega-supermarkets, and, increasingly, investment funds. On the other hand, it is promising that increasing numbers of authors are expressing an interest in the interdependencies between agriculture, environmental change, and development goals. In the UK, the academic community has dedicated growing attention to the socio-ecological complexity of food production systems, an idea which has received substantial support from the research councils. However, it is less common to find academics and policymakers addressing the "political nexus" between environmental change, nature-as-resource, and the contradictions of agricultural capitalism. Conventional approaches to problem-solving remain superficial in terms of connecting the politico-economic basis of agribusiness, rapid environmental change, and the joint exploitation of people and nature. This failure to consider the centrality of political dilemmas reveals a great deal about the shortcomings of Western science and the prevailing mechanisms of policymaking. It also highlights the alienation of consumers, scholars, and food producers, and how difficult it is to find viable alternatives. Therefore, the study of the food–environment–energy nexus—as well as other interconnections that are increasingly being described as "nexus" by British scholars—needs to embrace the totality of relations between sectors, themes, scales, and historical periods. It will never be possible to overcome food insufficiencies and rural poverty without confronting the hegemonic forces that persistently undervalue the socionatural whole and accumulate capital from the deliberate fragmentation of socionature.

As a contribution to filling this gap in the specialised literature, this book contains conceptual and empirical chapters that explore the interdependencies between food, development, and the environment from multiple perspectives and in multiple settings, examining both past legacies and emerging trends. The book is the outcome of a productive dialogue between British and Brazilian academics who took part in the workshop "Water as the Frontier of Agribusiness: Politico-Ecological and Socio-Economic Connections from Farms to Global Markets". The event was coordinated and chaired by José Gilberto de Souza and Antonio A.R. Ioris, and took place in March 2015 in central São Paulo, at the headquarters of the Institute of Public Policy and International Relations (IPPRI), a department of the State University of São Paulo (UNESP). It

was funded by the UK-Newton Fund (via the British Council), the São Paulo Research Foundation (FAPESP), and the UNESP, whose support is warmly acknowledged and greatly appreciated.

Overall, the various workshop activities focused on the multiple synergies between responses to food insecurity and environmental management controversies, which require profound and meaningful transformations under the hegemonic direction of rural development and wider socio-economic activities. The friendly and constructive interaction during the event led to the idea of publishing a book—immediately accepted and encouraged by the British Council—featuring the work of those participants who wanted to share their reflections and research findings. Among many other things, the authors of this book agree that important lessons can be learned from the trajectory of farmers and their associations in both Northern and Southern countries. Likewise, the trajectory of agriculture, rural development, and environmental management is an integral element of the broader search for justice and sustainability, which necessarily require novel forms of understanding common problems and the critical basis of socio-ecological transformation.

The book's content and the sequence of chapters have been chosen primarily to provide a balance between theory and empirical results, with a focus on three main world regions: Europe, India, and Brazil. The aim is not to be comprehensive or to cover all the main aspects of the academic debate (which would, in any case, be impossible in a single book), but to provide an overview of some important questions and give a flavour of the critical research being conducted in the UK and in Brazil. In the introduction, Ioris discusses the evolution of agriculture and agribusiness in the context of social and economic neoliberalisation, as well as considering economic thinking about the environment and, in particular, water. Chapter 2, by Fish and colleagues, considers the UK context as it investigates the importance of water management for agriculture and the role of integrative approaches and collaborative governance. In Chap. 3, Moragues-Faus examines Mediterranean agri-food systems and lessons from European food studies and politico-ecological perspectives. Chapter 4, by Bharucha, presents a study of water scarcity and agriculture practised in dryland areas of India, bringing together evidence from different interest groups and their search for alternatives. In Chap. 5,

Sobreiro Filho and collaborators take into account the social and political production of territories and make use of a case study from the Brazilian northeast region to discuss agrarian, labour, and environmental problems. In Chap. 6, Feliciano analyses extensive data on the environmental impacts of fruit production in Brazil and the insertion of the sector into global trade markets. Peres and Souza discuss in Chap. 7 the epistemology of water resources and offer a critique of virtual water based on a recalculation of the water balance. Empinotti, in Chap. 8, explores the introduction of a new water regulation framework in Brazil, which has many parallels with the European and international experience. Finally, in Chap. 9, Ioris returns to some of the points mentioned in the introduction and, considering the contribution of the other authors, scrutinises the current trends of agriculture and agribusiness in Brazil, with a focus on the country's main agricultural frontier area in the State of Mato Grosso.

The literature on those topics is vast, and rapidly growing, but we sincerely believe that this book offers a critical and original perspective on the politicised interface between agriculture, development, and natural resources. If nothing else, most of the material included in these chapters is presented here for the first time and, particularly in relation to the Brazilian context, will facilitate access by international readers to themes not yet adequately dealt with in published literature and still largely ignored by foreign academics. In our work, we reaffirm the importance and the contested basis of rural development, agricultural modernisation, and the transformation of nature into economic resources, which will continue to attract attention from different sectors and will require substantive improvements in public policy. These issues certainly deserve to be discussed further in universities, policymaking circles, and all sectors of civil society, and we hope to remain engaged in those debates, asking questions and learning from those affected and involved in the processes of agricultural and environmental change.

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1

Introduction: Underscoring Agribusiness Failures, Environmental Controversies, and Growing Food Uncertainties

Antonio A.R. Ioris

Contemporary Agribusiness as the Rural Expression of Neoliberalism

The different chapters of this book discuss key aspects of agricultural modernization and raise some important questions about politico-economic and socio-ecological transformations taking place in countries of both the Global North (Europe in particular) and the Global South (with specific examples from Brazil and India). Our starting point is that, because of complex socio-economic interactions, environmental pressures, and fierce disputes, agriculture and rural development are today among the most controversial areas of policymaking, planning, and lobbying. With the encroachment of contemporary capitalism upon food production and biological systems, agriculture has become increasingly associated with, and subordinate to, a globalized agroindustrial complex

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that exerts decisive influence over technology, financing, logistics, and commercialization. In general terms, a—partial and problematic—transition from agriculture to agribusiness has taken place over the last century, with the last two decades or so seeing a further transition to neoliberalized agribusiness. Consequently, the concept of agribusiness, which was originally introduced in the 1950s at the time of Fordist agriculture in the USA, has had to mutate in order to encapsulate agricultural production based on business-friendly state interventions, policy liberalization, and the dominance of transnational corporations.

It is not difficult to empirically verify that most agricultural activities today are shaped by the impact of neoliberal capitalism on production areas and on the processing and distribution of agri-food goods and the management of related services (Heasman and Lang 2004). Examples include a number of techno-economic innovations introduced by neoliberalized agribusiness sectors, for example, genetically modified organisms (GMOs), digital farming technologies, and satellite-guided machinery, as well as new production dynamics such as land and gene grabs, the privatization of common land, pervasive financialization, the decisive role of global corporations, and the creation of the World Trade Organization in 1995. These combine old and new strategies to renovate capitalism and minimize socio-ecological obstacles to economic growth. The results are intriguing, and suggest that further studies are necessary to understand the interplay between agriculture, food insecurity, and socionatural changes. On the one hand, agriculture as neoliberal agribusiness has achieved considerable results during the last three decades, in terms of additional areas under cultivation, intensification of production, and complex market integration. The aim of neoliberalized agriculture is to maximize production and profitability and suppress income gains for the labouring classes in a way that has reconstructed agriculture as a 'world farm' (McMichael 2010). On the other hand, however, these are also activities characterized by contradictions, failures, and limitations at local, national, and global scales. Never before has so much food been produced and so much space been used by farmers, but at the same time, record amounts of food are wasted every day, and a significant proportion of the global population struggles to maintain minimum levels of nutrition, while a comparable percentage suffers from the consequences of obesity (Patel 2008).

Taking into account these challenging circumstances, the main rationale for this book is that the staggering complexity of food and agriculture in the early decades of the new century can sometimes go unnoticed in a world dominated by many other urgent concerns and, more importantly, due to the false sense of security offered by intensive technologies and extensive global trade. Particularly in the North, and among high-income groups in the Global South, food is easily affordable and even taken for granted, despite the fact that food supply depends on a highly vulnerable distribution network controlled by a small number of transnational companies and supermarket chains. The following chapters will explore and discuss how the many asymmetries and uncertainties in the agri-food sector are directly and indirectly related to the instabilities of the contemporary economy, characterized by global speculation, structural inequalities, renewed forms of exploitation, and wasteful patterns of production and consumption. Ultimately, the consolidation of a global society centred on market principles has increasingly undermined individual and collective rights, and, even more importantly, subdued other socio-ecological demands. First of all, we will examine in more detail the significance and repercussions of neoliberalized agribusiness.

Studying the Transition to Neoliberal Agribusiness

Agrarian and food studies have certainly travelled a long way in the last hundred years, from a focus on rural communities around the turn of the twentieth century, via the dominance of functionalist theory and the exaltation of technological innovation in the post-war years and, eventually, to the neo-Marxism and other critical approaches introduced in the 1970s (Buttel et al. 1990). Since then, critical authors have started to question traditional scholarship—typically anchored in the supposed stability, desirability, and constant progress of capitalist society in America and beyond—with new interpretations of the rural economy, reasons for the unexpected survival of the peasantry, and the growing commodification of labour and nature. With the collapse of the Berlin Wall and consequent sociopolitical adjustments associated with a less

polarized world order, the focus of agrarian and rural studies shifted from location, context, and diversity to a range of approaches informed by behavioural research, actor–network theories, food regimes, and regulation theory (Robinson 2004). More than just a technical-economic issue, this reconfiguration of agriculture in recent decades has been described as a sociopolitical project that has come about through the struggle between social classes and different fractions of capital. An especially important part of the discussion has focused on the transition from a Fordist agriculture (focused on mass production, standardization, and higher levels of efficiency) into an alleged post-productivist and multifunctional arrangement that followed the introduction of post-Keynesian policies and the search for additional goals beyond food production (Ilbey and Bowler 1998). See more on this debate in Chap. 3.

However, post-productivist and multifunctional tendencies represent only part of the neoliberalizing pressures that have reshaped contemporary agribusiness and subjected it to the imperatives of flexible accumulation, market globalization, and the systematic concealment of class-based tensions. The intricacies of global agri-food activities today are at once product and co-producer of the dominant modernization of capitalism in accordance with the discourse and the strategies of neoliberalism. Neoliberalism is not only an economic and social phenomenon, it also constitutes an assertive programme aimed at dislodging the politico-economic approaches adopted before the 1980s (Connell and Dados 2014). It has meant an evolution from the post-war regime, which was defined by the flows of (surplus) food from the USA to its informal empire of post-colonial states (according to the strategic perimeters of the Cold War), towards agri-food liberalization via structural adjustments, lower national trade barriers, the dismantling of farm sector protections, and new intellectual property relations (McMichael 2012). In practice, neoliberal strategies have tried both to win new markets and to placate political resistance through a discourse of multiple activities, environmental responsibility, and supposed food security (Dibden et al. 2009). Neoliberalized agribusiness has also evolved through an incoherent argument about the virtues of free market transactions, while there are simultaneous calls for sustained state interventions to regulate price oscillations and eliminate overproduction.

The complexity of the neoliberal agri-food regime is particularly evident in relation to the uneven geographical development of the capitalist economy, and therefore needs to be understood in the wider context of the world ecology of capitalism (Moore 2015). The geography of neoliberalized agribusiness is characterized by a plurality of production and consumption activities, extending and connecting locales, regions, and nations. It has involved, in particular, the enforcement of free trade and other supranational agreements and the prioritization of the biotechnological production package (Pechlaner and Otero 2008). In practical terms, it is undeniable that neoliberalized agribusiness is less concerned with rural development strategies (as promoted by state agencies during most of the twentieth century) and more focused on a range of processes (rather than one isolated phenomenon with clear-cut boundaries) required for the maximization of profit and rapid capital accumulation from agri-food operations. The neoliberalization of food and agriculture has been a deliberate attempt to fix the systemic crisis of the Fordist agri-food regime without preventing the re-emergence of instability, protest, socio-ecological degradation, and, ultimately, a deficit of legitimacy (Wolf and Bonanno 2014).

It is crucial to observe that contemporary rural development and the agri-food sector have revealed, and largely depended on, the hegemony of transnational corporations, the integration of domestic production into global trade, and a number of free trade agreements. In more general terms, rural development now happens through both vertical (from rural spaces to the agri-food sector) and horizontal (rural spaces linked to other non-agricultural sectors) networks (Murdoch 2000). Yet, because of its bioeconomic properties, agricultural production cannot be integrated in the same way as the industrial sector (Goodman and Watts 1997), which means that local sociocultural factors and socio-ecological conditions remain significant despite the globalization of agribusiness. Likewise, the internationalization and networking of agri-food under the hegemonic influence of transnational corporations has not happened without resistance and reactions. Protests grow through different scales and have resulted in a variety of political, symbolic, and material consequences (Stock et al. 2014), although these have often been unreflexive and superficial (Harris 2009). The socio-ecological contradictions of

neoliberalized agribusiness are particularly noticeable in the case of contemporary Brazil and its burgeoning agribusiness-based economy. Due to sustained promotion campaigns and the emphasis placed on it by public policymaking, the term 'agribusiness' has a particular meaning in Brazil and is more widely used in common public debates than in other regions of the world. The national experience is briefly analysed in the next section, making use of a simple analytical approach, which paves the way for the subsequent chapters.

A Proposed Analytical Framework and the Unpalatable Neoliberalization of Brazilian Agribusiness

Brazil is increasingly perceived as a world agricultural powerhouse which, in principle, could have a lot to offer in terms of preventing a looming, increasingly global, food crisis. Particularly with the slowdown of Brazil's national economy since 2010 (and especially after the controversial presidential election of 2014), agribusiness is an island of prosperity and dynamism in a context of corporate losses and lack of investment. As a consequence, Brazil has been a strong advocate of free market globalization and has pushed for calculated liberalization of the global agri-food trade (Hopewell 2013). However, as in other parts of the world, neoliberalized agribusiness in Brazil has been severely criticized over its actual beneficiaries and ambiguous prospects. The sector seems to thrive on a peculiar combination of tradition and modernity, which is clearly present in the attitudes and ambivalent discourse of large landowners and allied politicians. Neoliberalized agribusiness has many new features when compared with the previous, nationalistic period of agricultural modernization in the 1960s and 1970s, but it also betrays the strong elements of social exclusion, authoritarianism, and deception that have long governed economic development in the country. The rapid advance of agribusiness towards the central and northern states of Brazil in particular has been associated with severe environmental, cultural, and socio-economic impacts, including deforestation, violence against rural workers and indigenous populations, and notable cases of state capture and corruption.

All this betrays an intrinsic opportunism and demonstrates the peculiar nature of market-friendly rationalities, shaped by the demands of transnational corporations, national politicians, and rural elites (Ioris 2015). Governments and national business associations try to depict the advance of agribusiness in Brazil as the embodiment of the most progressive elements of an emerging economy that is part of the select group of BRIC (Brazil, Russia, India, and China) countries. Nonetheless, neoliberal agribusiness essentially constitutes a late, already obsolete type of modernity that replicates many mistakes from elsewhere in the country and other parts of the world. If neoliberalized agribusiness has effectively become one of the pillars of the Brazilian economy, it has also had troubling consequences as the country has faced progressive deindustrialization and become increasingly reliant on foreign investments and imports of intermediate inputs and capital goods. All these discursive and material developments are still to be studied in depth by critical scholars, particularly in terms of connecting the specific situations of different localities and regions with broader macroeconomic trends. Challenging the rhetoric of progress and creativity, a more critical examination would question the actual contribution of agribusiness to local and regional economies and the national economy. A deeper interpretation should be able to examine the idiosyncratic, apparently paradoxical combination of small innovations and transgressions that characterizes these capitalist relations of production and reproduction. Although the sector makes use of the appealing symbolism of triumph and modernization, the evolution of agribusiness has actually served to unify the interests of rural conservative groups and reinforce processes of political hegemony and class domination.

The expansion of neoliberal agribusiness, viewed in the wider context of the politico-ecological economy of contemporary capitalism, is examined here with the assistance of an original analytical framework structured around three explanatory categories: displacement (sectoral and spatial transformations), financialization (the prioritization of financial gain over agricultural outcomes), and mystification (dissimulation of neoliberalizing trends and associated risks and disputes). This proposed analytical framework has significant implications for academic research and policymaking, especially within politico-economy and neoliberalism studies, to the extent that it encapsulates

interdependent processes that are together responsible for the revitalization of agribusiness and for the legitimization of global agri-food markets. The framework is then used to highlight the historico-geographical repercussions of neoliberalized agribusiness in Brazil, which has been a feature of conservative responses to the crisis of accumulation caused by the exhaustion of developmentalist policies and state-led entrepreneurialism.

Displacement

Displacement is the first main dimension of neoliberalized agribusiness to consider. The neoliberal model has seen the previous emphasis on rural development, job creation, and infrastructure replaced with a focus on market integration, cost reduction, efficiency gains, and technological intensification. The political strength of neoliberal agribusiness actually comes from the consolidation of new economic strategies that supplanted the developmentalist policies that were hegemonic before the 1980s. Displacement has sectoral and spatial manifestations. It occurs, for instance, due to technological developments (e.g. constant release of new agrochemicals, genetically modified seeds, and sophisticated machinery and digital equipment), inter-country trade (often at the expense of national and local food demand), and the facilitated interchangeability of different forms of capital in commodity and land markets. The affirmation of the neoliberal agri-food regime is also associated with the migration of farmers and companies to new areas and the incorporation of regions that were not previously involved in production or were beyond the reach of global markets. Although local food production still represents a significant segment of the market (particularly production involving family farmers and peasant communities), southern countries have been encouraged to expand the export of high-value foods (e.g. expensive soft fruits, out-of-season vegetables, luxury crops, etc.) to northern markets, as well as to cultivate biofuel crops under the influence, for example, of northern environmental agendas.

Displacement is particularly demonstrated by the fact that agriculture continues to be practised in the localized context of farms and regions, while management, technological developments, and trade relations

increasingly involve transnational interactions and priorities. The displacement associated with agribusiness is, thus, dialectically related to the transnationalization of the rural economy, in the sense that activities and processes are (partially) altered at local or horizontal level, only to be then (partially and problematically) integrated into globalized phenomena. Rural areas are therefore 'reproduced, and the social relations therein recomposed, by virtue of their contemporary magnetism for relocation due to the wider discontinuities of capital activity' (Cloke et al. 1990: 15). The search for efficiency and the emphasis on competitive advantages result in the dispossession of less successful smallholders by commercial smallholders and large estates that are vertically integrated into agribusiness marketing chains (Amanor 2012). At the same time, the removal of public subsidies and the dismantling of state-owned enterprises have significantly affected rural populations and increased their level of vulnerability, often prompting domestic and international migration as a negotiated response to the emerging problems (Torres and Carte 2014).

In the case of Brazil, large areas have been transformed by the advance of neoliberal agribusiness due to the intensification, and joint operation, of public and private capital investments. The country has been a supplier of foodstuffs since early colonial times, and this only increased with the conservative modernization of agriculture promoted during the dictatorship imposed by the military and conservative political elites (1964–1985). Agricultural modernization implemented by the generals happened through the aggressive expansion of credit, the integration of farming with industry, and dedicated rural development policies. Priority was then given to the Fordist expansion of production through the adoption of new technologies, fiscal incentives, and subsidized loans. The political motivation was the need to weaken the political debate about agrarian reforms and replace it with a technocratic emphasis on food production and regional development. This conservative modernization of Brazilian agriculture was based on the integration of different forms of capital into large agroindustrial chains. After achieving remarkable rates of growth in the 1960s and 1970s, the state-centralized model started to show its serious limitations when faced with the debt crisis, escalating rates of inflation and macroeconomic instability. Consequently, the Brazilian agricultural sector suffered a period of turbulence and

uncertainty from the mid-1980s onwards, aggravated by higher interest rates, a reduction in support schemes (e.g. guaranteed prices), decreased availability of bank loans, and falling land prices.

With the introduction of liberalizing reforms in 1990, conditions were again favourable for the recovery of agribusiness as a dynamic economic sector. The neoliberalization of agribusiness benefited from, and contributed to, a wider process of sectoral displacement due to an emphasis on imports of intermediate inputs and capital goods (to contain inflation and appease consumer demand) and ill-conceived deindustrialization policies. In addition, spatial displacement occurred through the migration of production to other regions and the concentration of activity in large estates with thousands, or in some cases tens of thousands, of hectares. The most emblematic experience was the conversion of millions of hectares of savannahs (*cerrado*) in the central region of the country (considered as 'spare farmland') into soybean plantations and cattle ranches in close coordination with ever-bigger agroindustries (Barretto et al. 2013). Such neoliberal 'land reform' (in effect, an anti-agrarian reform similar to the one adopted by the military governments) was based on the sacrosanct ownership of private land in the name of democratizing capitalism and, more importantly, reducing the excesses of the state. Sizeable commercial partnerships have been established between Brazil and other southern countries, China in particular, which have, to a degree, replaced the established North–South flow of agricultural goods (e.g. the export of soybean from Brazil to the European Union was particularly relevant during previous decades). Overall, neoliberalized agribusiness has not only reinforced previous developmentalist policies, but also worked through a combination of physical, social, and political shifts that has displaced, but in some cases also reaffirmed, old tendencies of agrarian capitalism and transformed Brazil into the first tropical food giant on the planet.

Financialization

The second main feature of neoliberalized agribusiness is the prominence of financialization as a decisive force behind politico-ecological changes. Financialization is a process whereby transnational corporations,

commercial elites, and financial institutions acquire ever-greater influence over rural policymaking and agricultural outcomes at the expense of the more traditional players of the previous developmentalist phase. Since the crisis of Keynesian policies (typically based on direct state entrepreneurship), agribusiness has operated through a gradual shift from the production side to the retail side and towards new mechanisms of capital circulation and accumulation. As a result, the entrenched financialization of food and farming ends up penetrating everyday life and pervading the local, regional, and global scales of interaction. This leads to adjustments not only in the productive and commercial sectors (including the role of asset management companies, private equity consortia, and other financial institutions in acquiring and managing farmland), but also along the whole agri-food supply chain, at both macro and micro levels (Burch and Lawrence 2013). In historico-geographical terms, the financialization of the agri-food sector has provided a solution to the combination of the production and plunder spheres of capitalism. Financialization is also organically associated with spatial displacement, especially considering that neoliberalized agriculture is, above all, about the redistribution of value from the under-reproduced global periphery to the overconsuming Western core (Araghi 2009).

Sharing the turbulent experience of most other Latin American countries, the Brazilian national state initiated a programme of neoliberal reforms in 1990 centred on monetary stabilization, privatization, and budget controls (Ioris and Ioris 2013). A well-crafted macroeconomic programme of inflation targeting, introduced in 1994, strengthened the national currency but had the negative effect of facilitating the importation of foreign goods and reducing the competitiveness of Brazilian agriculture. Trade imbalances, together with high interest rates, produced a circumstantial reduction in agricultural profitability, but were then considered necessary to reorganize the national economy. With significant currency devaluation in 1999 (increased in subsequent years), favourable commodity prices, and a surge in demand, Brazil was ready to return to international markets and transform its agribusiness into a highly transnationalized sector gradually becoming more dominated by large (foreign and national) capital-intensive firms. The 'end' of cheap food (demonstrated by the 2008 'food crisis' and a commodity boom between 2003

and 2011) further discouraged productive investment in industry and infrastructure in favour of speculative activities that produced a massive flow of capital into agriculture (Moore 2015).

The financialization of agribusiness and the related dependence of the Brazilian economy on the agri-food sector have continued to steadily augment over the last few years. Interestingly, in recent years, the agribusiness sector has grown less than the national economy as a whole, and its participation in the national economy actually decreased between 2007 and 2013, but its contribution to the national surplus (in dollar terms) has proved vital (Barros et al. 2014). In 2013, the trade balance result was the worst since 2000 (a reduction of 86 % in the surplus due to weakening exports of minerals and industrialized goods) with agribusiness consolidating its role as the main money-making sector of the economy. In addition, a range of novel financial instruments, such as self-financing, private banks, input supplier companies, and trading companies filled the gap created by the reduction in the federal government's conventional schemes. This is exemplified, for example, by the 2004 legislation that created the Certificates of Agribusiness Receivables (CRAs), a registered credit instrument in which a promise of future payment is linked to a debt claim.

Mystification

As discussed above, the crucial role of neoliberalized agribusiness in global trade and market speculation today has meant a decline in the relative importance of agri-food's material properties in favour of more explicit financial goals. Despite the rhetoric of food security and the major agribusiness corporations publicly claiming to 'feed the world', agribusiness is increasingly about business in and for itself, while rural development, nourishment, and food production become less important. Nevertheless, these money-making objectives are shrouded in the mist of consumer satisfaction and the discourse of lower prices, which mystify the real impacts of the neoliberalization of agribusiness. Together with its significant technological and economic components (Ioris 2012), neoliberalized agribusiness has evolved through a constant political effort to disguise and

simultaneously justify changes in the contemporary agri-food sector. Even the alleged multifunctionality of today's agriculture (i.e. a range of economic and non-economic outputs beyond traditional farming production) often serves to conceal the neoliberal features of agribusiness and mask the fact that agribusiness has not produced a new technological 'revolution' or any significant improvement in productivity or technological improvement. Entrepreneurialism and innovation discourses have even appropriated the language of food sovereignty to justify preferential treatment by governments and priority investments (Eakin et al. 2014).

In the case of Brazil, the mystification of the neoliberalization of agribusiness has followed a dynamics of continuity and change, in which practices, interpersonal relations, and political strategies have been only partially transformed. Agribusiness farmers emphasize their contribution to regional development and economic growth, but only from the perspective of an intense financialization of agriculture and calling for the removal of environmental, social, and regulatory constraints. The sector has demonstrated a competent ability to lobby and promote its interests, particularly via the Brazilian Agribusiness Association (ABAG) created in 1993. Likewise, regular technical visits to production areas coordinated by the Round Table on Responsible Soy (www.responsiblesoy.org), established in 2006, have tried to improve the image of the Brazilian agri-food sector with a colourful rhetoric of sustainability, certification, and environmental commitment. However, the rhetoric of entrepreneurialism, competence, and environmental responsibility obscures the fact that the results of agribusiness actually have more to do with the flexibilization of domestic markets and the deeper insertion of Brazil into global trade. Neoliberalized agribusiness aims to further subordinate agricultural production to the extraction of surplus value (both from labour and from more-than-human nature) as a creative phenomenon that reconfigures old agricultural practices and relaunches them in the circles of transnational capitalism.

At the same time, the mystification of the success achieved by the agribusiness sector helps to conceal internal disputes, particularly between the majority of agribusiness farmers and the stronger players (larger farmers and transnational companies). During her research in areas of agribusiness expansion, Bruno (2009) identified the construction of a

discourse around modernity, wealth creation, and the value of agribusiness (at the expense of other forms of agriculture), but behind closed doors, there are signs of disunity and often unease about the way farmers are treated by corporations, banks, and other urban sectors. Another important element of mystification is the confusion about the role of the Brazilian federal state, which has created additional space for national and international corporations, but also retained control of a myriad of mechanisms aimed at promoting agribusiness. The transformation of the state apparatus under pressures for flexible regulation and lower market constraints has led to a new pattern of socionatural interactions, increasingly characterized by associations between state agencies, financial capital, and the stronger economic sectors (Ioris 2014). Although there has been a massive increase in land prices and an intensification of market transactions, the neoliberalization of rural development since 1990 has left the national state firmly in charge of economic flexibilization. This all corroborates the claim that neoliberalized agribusiness is less focused on farm production than during the previous phases of the capitalist economy (Whatmore 1995), and more focused on the off-farm financial activities that increasingly dominate supply chains, logistics, and distribution systems coordinated and supported by the state.

To summarize this section, neoliberalized agribusiness in Brazil has unfolded in three main dimensions, namely displacement (sectoral and spatial transformations), financialization (prioritizing money-making over agricultural outcomes), and mystification (dissimulation of the neoliberalizing trends and associated risks and disputes). These three dimensions have complemented and interacted with each other across multiple geographical scales around the planet. It should be noted that this synthetic framework is not without conceptual and methodological limitations, but it should be considered a starting point for further academic investigations and a tool to foster critical thinking. The proposed analytical framework has significant implications for research in human geography, especially within politico-economy and neoliberalism studies, to the extent that it encapsulates interdependent processes that are together responsible for the revitalization of agribusiness and for the legitimization of global agrifood markets. The framework has been used to highlight the historico-geographical repercussions of neoliberalized agribusiness in Brazil, where

the neoliberalization of agribusiness has been an element of conservative responses to the crisis of accumulation caused by the exhaustion of developmental policies and state-led entrepreneurialism.

Instead of agrarian reform and local food, the hegemonic solution was to intensify and revise production procedures according to neoliberal priorities. The neoliberalization of agribusiness in Brazil followed the displacement of traditional areas and industrial sectors in favour of the export of agricultural commodities (soybeans in particular); the growing financialization of production, distribution, and consumption (articulated in particular by transnational companies and the need to generate dollars to stabilize national accounts); and numerous mystification strategies to disguise manifold socio-ecological problems. The apparent success of the neoliberalization of agribusiness betrays a clear attempt to temporarily placate the structural contradictions of capitalist agriculture while novel tensions and reactions become increasingly evident (e.g. cheap food is produced to sustain capital accumulation from agriculture and other economic sectors, but this leads to the actual blackmailing of the national economy by agri-food exports and mounting rates of environmental degradation and social conflict). Agribusiness production in Brazil has been a privileged arena for the consolidation of flexible capital accumulation approaches, while it has been significantly shaped by direct state interventions, widespread forms of violence, and the subordination of agriculture to wider, globalized politico-ecological demands.

As a final point of interest in this section, it is highly emblematic that the advancement of neoliberalized agribusiness in Brazil has had many parallels in the reform of environmental policies and regulation, which have also come under the sphere of influence of neoliberal ideologies and market globalization (Ioris 2009). New responses to environmental problems have been formulated according to the perverse agenda of 'ecological modernization', that is, the claim that existing political and administrative structures can be amended to cope with old and new problems (without considering the need for more significant and meaningful politico-economic changes). The debate on the weaknesses of environmental policies adopted in recent decades around the world is vast, but it can be briefly demonstrated by the evolution of ideas about the economic value and productive role of water, which are considered below.

Water, Environment, and Economic Development: The Missing Political Link

The allocation and use of water are among the most pressing issues in the contemporary search for better standards of living, social justice, and environmental conservation. To a large extent, this debate has evolved around the need to expand water infrastructure as a requirement for economic growth, the reversal of ecological degradation, and the enhancement of water services. During most of the twentieth century, large sums of public money were invested in water engineering, but over time, it became increasingly evident that traditional interventions were also responsible for water pollution and altered river flows, without necessarily satisfying basic public demands. Acknowledgement of the shortcomings of conventional approaches to water infrastructure has led, since the end of the 1970s, to a review of water policies and government priorities. Emerging environmental awareness and public mobilization, particularly in the political North, also added to the pressure on national governments and multilateral agencies to gradually shift from single engineering initiatives to more comprehensive responses. Informed by concepts such as 'sustainable development' and 'systemic thinking', new ways of dealing with water problems started to shape the global water agenda. Public policies have been particularly influenced by the goals of integrated water resources management (IWRM), which include the formulation of 'holistic' solutions to water management problems, the reconciliation of multiple demands, and, crucially, appreciation in the economic value of water (Mitchell 2005).

Because of this more explicit recognition of the economic value of water, calls for economic efficiency and market exposure have occupied centre stage in the agenda of water reform. This represents a move towards hybrid mechanisms of environmental governance and beyond the state/market/society divisions that allegedly caused most of the mistakes in previous decades. It is now claimed that adequate solutions to old and new management problems should include not just the direct costs related to project implementation, but also a calculation of the monetary value of water, in order to 'eliminate inefficiencies and express its full economic potential' (WAAP 2006). According to this position, 'a major

weakness of past approaches to the water sector has been the excessive reliance on overextended government agencies to manage water resources', while the new agenda calls for 'greater reliance on pricing and incentives' (World Bank 1993: 47). Therefore, the current strategy of applying market-based solutions to environmental problems is expected to foster economic rationality and promote management efficiency. Interestingly, international pressures for the adoption of market-inspired reforms have led to a homogenization of water policies around the world, despite major social, cultural, and economic differences between countries. For that reason, it is worth asking whether the ongoing reforms have actually resulted in any meaningful solutions to highly contingent and localized water problems. Considering the environmental and social statistics available in various United Nations reports and national assessments, it is evident that recent policies have largely failed to achieve environmental restoration or implement a more equitable basis for water allocation and use. Notwithstanding a change in the discourse, in the countries where the 'new management paradigm' has been applied, the outcomes of the reforms have been restricted to some bureaucratic improvements and, at best, the removal of isolated, circumstantial problems.

The Brazilian experience is a case in point of the inherent limitations of global water reforms, and this chapter intends to discuss the contradictory influences of neoclassical economics on the ongoing reorganization of water management in Brazil. With the approval of a new water law in 1997, an extensive regulatory apparatus was put in place, mostly influenced by the goals of integrated management, but so far, this has achieved only marginal results in terms of environmental restoration and conflict resolution. Although the legislation delegated to catchment committees the approval of plans and the reconciliation of spatial differences, the core element of new policies has been the expression of the monetary value of water. Despite the rhetoric of environmental sustainability, official initiatives continue to subject socionatural water systems to economic exploitation and unfair distribution of opportunities. The recent approval of hydropower projects by the national administration, for example in the Amazon region (such as in the Rivers Madeira, Tapajós, and Xingu), despite strong public opposition, illustrates the prioritizing of 'economic growth at any price'. In the same way, newly formed decision-making

forums have been dominated by the same rural oligarchies that traditionally controlled economic and social opportunities related to water use and conservation. As a result, instead of promoting a genuine change in public policies, the new approaches have largely preserved the hegemonic interests of landowners, industrialists, construction companies, and real estate investors to the detriment of ecological recovery and the majority of the population. This suggests that effective responses to water problems require a new basis for the use and conservation of water, which should be constructed according to social justice and environmental sustainability requirements, free from the pervasive influences of market rationality.

Water management has always been one of the dominant themes when economic theory is applied to the environment, including, for example, issues such as the scarcity of water stocks and the social cost of pollution. Because of its permanent circulation, water poses a unique challenge to economists, given that more than one person can appropriate the same unit of water from a common river or aquifer. Another methodological difficulty is the fact that water availability is normally concentrated in certain areas or during certain periods of time, while water usage varies according to socio-economic demands, personal preferences, and cultural values. Because of such particular properties, economic literature on the use and conservation of water is extensive and growing rapidly. As early as the eighteenth century, the founders of the discipline discussed the potential scarcity of natural resources in relation to a growing human population. For the resource economists of that period, nature contained a large reserve of raw materials freely available for human exploitation; water was seen as abundant and, consequently, there was minimal need to limit its use (Adam Smith, for example, considered water to be beyond economic value; he described it as a 'free good' and, for that reason, distinct from landed property). A few decades later, David Ricardo pointed out that if water existed in 'moderate abundance' and could be appropriated, it would then afford a rent similar to land (Ricardo 1962 [1817]).

Later, in the nineteenth century, Marxist thought provided an early critique of the worsening of environmental conditions under capitalist production (Burkett and Foster 2006), but it was the work of neoclassical economists that then achieved resonance with policymakers. For instance, J.S. Mill recommended that governments should define

property rights over natural resources—including water and forests—to secure their proper use as an 'inheritance of the human race' (Mill 1965 [1871]). The ideas of Marshall (1966 [1890]) about public amenities and his marginal theory of value inspired Pigou (1938 [1920]) to describe environmental problems as a divergence between 'marginal social net product' and 'marginal private net product'. According to the marginalist theory, those who benefit from the use of the environment should internalize the social costs (externalities) of their activities via, for example, the payment of fees and taxes. A little later, Coase (1960) submitted that government intervention was less important in ensuring the adequate use of resources, since bargaining between players constituted a more effective solution. In that case, as long as a regime of explicit ownership can be established, water allocation and pollution problems are solved rationally, as much as water can be bought and sold through the market (Ditwilier 1975).

The debate between the 'welfare theory' (after Pigou) and the 'free market theory' (after Coase) resulted in the establishment of environmental economics, a subdivision of microeconomics applied to the use and conservation of natural resources. The underlying principle behind environmental economics was the maintenance, via economic instruments, of sufficient habitat features and the observation of a 'safe minimum standard of conservation' (Ciriacy-Wantrup 1952). For example, economists can develop mathematical approaches to determine potential economic benefits and relate these to the acceptable level of impacts caused by a new hydroelectric dam (Bishop 1978). The key tenet of environmental economics is the recognition of resource scarcity and, thus, the increasing marginal utility of water. Because water is seen as a scarce resource, monetary quantification of its value becomes a prerequisite for efficiency and sustainability (Rogers et al. 2002). Monetary valuation, which has been widely used in decisions about project priorities and mitigation measures, is normally estimated in relation to parameters such as household income, real state figures, and personal preferences (Van Houtven et al. 2007). Based on monetary valuation, environmental economics nowadays includes methodologies such as supply–demand management, marginal cost pricing, valuation of water in alternative uses, and optimization models (Ward 2007).

Crucially, the rationale for environmental economics has many points of convergence with the reasoning behind neoliberal policies and, in particular, the neoliberalization of agribusiness discussed above. Environmental economists claim that valuation techniques can inform choices between numerous potential methods of improving the quantity and the reliability of water supply (Castle 1999). However, in practice, assessments informed by environmental economics have fallen short of resolving mounting impacts associated with water supply, irrigation, and hydroelectricity projects. When things go astray, environmental economists normally blame administrative inefficiencies or insufficient data to support decision-making, instead of questioning the political and structural causes of project mistakes. Piecemeal solutions are emblematically exemplified by the use of mathematical models to calculate the market price of water; these ignore the causes of scarcity and the questions of who really benefits from water use (e.g. He et al. 2007). Environmental economists' reduction of socio-economic and environmental processes to independent utility functions became a main source of criticism. In the 1960s, neoinstitutional environmental economics started to pay particular attention to processes of institutional change and transaction costs (i.e. costs incurred in dealing with human interaction). For this group of scholars, economic choices are related to a complex array of social functions and structures (termed 'institutions') raging from court decisions and informal rules to personal beliefs (Swaney 1987). It is the institutional structure of entitlements (property or liabilities) that influences the nature of the bargaining process between two or more parties, in contrast with the exogenous preferences and costless social contracting of neoclassical economics. For example, riparian institutions consolidated over time typically allow some people to use water from rivers while denying access to others, independently of the direct economic outcome of water use. Neoinstitutional economists maintain that the analysis of environmental problems should be based on interdependence rather than on externalities (cf. Paavola 2007). From an institutional perspective, instead of focusing on the efficient use of resources, solving environmental problems requires the determination of collective standards of performance that can reward individual initiative, experimentation, and efficiency (Bromley 1991).

At the end of the 1980s, a group of academics proposed a related line of investigation under the name of ecological economics. The main goal for ecological economists is to encompass production and consumption in a broader sense, moving away from the neoclassical focus on the optimal allocation of resources (Daly and Farley 2004). Ecological economics has attempted to replace the rigid mindset of environmental economics with a more plural and heuristic perspective (Gowdy and Erickson 2005). However, there remains a fundamental tension at the heart of ecological economics: on the one hand, it is committed to a conceptual pluralism; on the other hand, ecological economics is still heavily influenced by the narrow market model of thinking (Burkett 2003). The persistent reliance on market-based solutions to environmental degradation has been a systematic shortcoming of many ecological economists and betrays their frequent association with the mainstream ideas of environmental economics. By the same token, conventional neoinstitutionalists have also tended to succumb to the magnetism of environmental economics and direct their attention to the removal of institutional barriers to the 'proper' operation of market forces (e.g. Saleth and Dinar 2005).

The fundamental area in which mainstream economists fail—including not just environmental, but also many ecological and neoinstitutional authors—is in identifying the contradiction between the expansion of the market rationale and the quest for sustainable and equitable solutions to water problems. Despite their persuasive discourse on the aptness of financial incentives and economic instruments of water management, such approaches provide only a narrow and transitory answer to environmental degradation, while promoting capital accumulation at the expense of social inequalities. These economists fail to accept that market-based policies (which include both market transactions and governmental interventions that regulate the market) do not remove environmental pressures, but instead immediately transform nature conservation into an object of capital accumulation. If the exploitation of natural resources by market forces has historically been responsible for the commodification of nature, 'ecological modernization' has attempted to use the same market rationality to prevent or remedy environmental degradation. However, 'green capitalism' has ultimately produced new markets for ecological goods (e.g. pollution emissions trading and markets for ecological

services), which comprise commodities that are simultaneously excavated (in exchange-value terms) from pre-existing socionatural relations and, as part of their production, are reinserted or remain embedded in socialized nature. The 'greening' of capitalism has not changed the fact that environmental degradation continues to result from the inherent characteristics of the capitalist mode of production, such as private property, competition, the goal of producing exchange values instead of use values, the recurrent financial crisis, and the specific shaping of technology in the interests of extracting and appropriating a maximum surplus value (Liodakis 2000).

For mainstream economists, issues of power asymmetry and class, gender, and race discrimination have either been left out of the debate or contained in a secondary agenda of social compensation (epitomized by Sweden's annual World Water Week). Because of the focus on isolated elements of water systems, the prevailing school of water economics has largely ignored the power inequalities behind decision-making structures (e.g. Heinz et al. 2007) and remains silent on the fact that water management problems are profoundly influenced by cultural circumstances and political disputes. Thus, there is little consideration of social inequalities associated with the use and conservation of water, which directly depend on the incorporation of the biophysical materiality of nature into capital accumulation (Sneddon 2007), as well as on the cultural context where water is used for the production and exchange of commodities (Page 2005). The realization that the economy cannot be dissociated from natural and social survivability, nor from ethics and justice, opens a new arena for academics to engage with water management problems. The social and environmental challenges of the globalized economy require, according to Martinez-Alier (2002), a close cooperation between critical ecological economics and political ecology. Leff (1996: 146) argues that we need a 'political economy of the environment' that understands poverty, unemployment, and the destruction of natural resources as effects of given relations of production. Rather than the political neutrality advocated by mainstream economists, the starting point of the economic analysis is the fact that the use and appropriation of water describes a fundamental connection between flows of water, flows of commodities, and flows of power (Swyngedouw 2004). The task at hand is to creatively

combine a critique of the prevailing economic paradigm with the formulation of alternative models of social organization and economic production, something that Agyeman and Evans (2004) have called 'just sustainability'. In particular, critical economists cannot be unaware of the uneven balances of power that deprive certain social groups of adequate access to water and protection from environmental degradation. It is not too late to consider that 'unless analyses of development begin not with the symptoms, environmental or economic instability, but with the cause, social injustice, then no development can be sustainable' (Middleton and O'Keefe 2001: 16).

Considering the two last sections, it is possible to conclude that there are similarities between the exacerbated influence of mainstream economics over the recent reform of the water sector and experiences of agricultural modernization along the lines of the neoliberalization of state and economy. Such reforms did not happen in a vacuum, but are intimately related to the patterns of economic production and consumption promoted under economic globalization. For those who can pay, the globalized economy can provide wasteful lifestyles, which increasingly depend on large volumes of water and electricity. For the poorer strata of society, however, globalization has brought new threats to livelihoods and additional pressures over shared natural resources (Newell 2009). By and large, contemporary water policies have been limited by technocratic insistence on the internalization of costs and the optimization of resources, while social justice and collective responsibilities for the degradation of shared resources have been left out of the agenda. Prioritizing economic rationality when seeking solutions to environmental and agricultural problems only tends to perpetuate environmental exploitation and social exclusion. However, it has been mentioned elsewhere that market solutions are inadequate when it comes to dealing with stochastic and complex ecological systems, because they create a 'policy lock-in' that precludes dynamic adjustments (Bromley 2007). In other words, the priority given to the economic dimension of environmental management and agricultural production is nothing other than the mainstream political paradigm reflecting its view of itself. As Bowles (2004: 256) observes, market forces have more than just an allocative role; they also exert a disciplinary function that operates, in reality, through the asymmetric use of power.

At the same time, while acknowledging the harmful impacts of market pressures, it is also important to avoid explaining such problems as solely the result of broader economic priorities. On the contrary, there are other fundamental factors that contribute at local level to policy and management failures. As observed by Prudham (2004: 334), only the juxtaposition of the hegemonic character of market society with specific politico-ecological contradictions can 'reveal the crisis tendencies of environmental neoliberalism'. For instance, the new water regulatory regime introduced in the 1990s in Brazil attempted, but failed, to provide straightforward answers to multilayered water and environmental questions. The fundamental shortcoming of new approaches is the ideological separation between environmental degradation and social inequalities. Because of this fundamental dichotomy, policies derived from the new water legislation have neglected the social and political context where decisions are made and projects implemented (Ioris 2011). They have overlooked the crucial fact that water problems in Brazil are closely related to rural land tenure, uneven urban development, and socio-economic opportunities, issues that have mostly been excluded from the scope of the water reforms. Policy instruments of the new regime, which include user charges and flexible water regulation, were superimposed on a political system based on discriminatory practices at national and local scales. Almost all the changes are restricted to the top level of policymaking, with very limited impacts on local problems of water use and conservation. Some improvements in terms of public participation and environmental restoration do not represent a commitment by politicians or public agencies, but are convenient mechanisms for minimizing public opposition to the implementation of the new regulatory regime.

Alternatives to mainstream water and agricultural management require, first and foremost, denouncing the rationality of neoclassical economics and its commanding influence over public policies. For instance, it must be recognized that water management problems can only be resolved by bringing together local (e.g. catchment) demands and national and international resistance to the expansion of a market-based society. Alternatives to the ecological and food crisis can only emerge if anti-systemic social movements unite against the endless accumulation of capital. In other words, improvements in the agricultural and environmental sector

make no sense unless these involve a wider impact on the totality of the globalized economy and, therefore, form part of the construction of a new basis for socionatural interactions. It is also clear that there is an urgent need for dedicated and critical research on the interconnections between agriculture, natural resources, and potential future development.

In Search of Critical Thinking on Agribusiness, Environment, and Development

Among many other comparable national experiences that should be explored, Brazil represents an emblematic case of neoliberalized agriculture in need of further investigation. This is for two main reasons: first, the steady expansion of soybean and other agricultural commodities towards central savannahs and southern sections of the Amazon forest; and second, the fact that agribusiness exports are a key strategic sector of the mainstream project to integrate the country into globalized markets. Furthermore, the contentious features of agribusiness are also relevant to help understand the challenging risks and responsibilities of agriculture in the contemporary, increasingly urbanized, and technical world. Corporate, industrial-scale agribusiness practices in Brazil bring back some forgotten (or spectral) elements of capitalism, which never actually disappeared, and in which the invisible becomes visible again. This is a phenomenon of multiple dialectics that needs further theoretical, methodological, and investigative elaboration. Contemporary agribusiness is a sectoral activity carried out by a highly specialized professional category, but it has had major macroeconomic repercussions, such as the mitigation of the failures of socio-economic policies promoted by populist governments in thrall to the prevailing neoliberal paradigm. It is not only based on the long history of territorial politics introduced in the middle of the twentieth century, but also borrows and uses the most advanced technologies developed in Brazil and beyond. Agribusiness leaders claim that because of intensification and the supposed rationality of production, their activity is rescuing or ameliorating the image of development in the country, but in practice, the results continue to be short-lived and are mostly appropriated by old and new elite groups.

All those dialectical processes mean that the neoliberalization of agribusiness has been developing as a very special case in relation to the globalized food regime. Due to the scale of production and magnitude of these processes, it could be said that Brazil is creating and resiliently embarking on its own model of agriculture, that is, an authentic Brazilian agri-food regime. This idiosyncratic regime, uniquely, mixes the unfashionable practices of development as production that characterized the Fordist phase of agriculture with the highly financialized agriculture of globalized markets. One main aspect that deserves to be properly investigated is its convoluted relationship between agribusiness and the state apparatus. Given that the state receives most of the blame for the day-to-day problems of agribusiness, such as the cost and quality of transport, the lack of friendly loans or subsidies, and its inability to resolve agrarian conflicts, it is important to note that the state is the ultimate safety net, which in bad years must compensate for too much or too little rain, diseases, low prices, and so on. The activity is not without contradictions. The national agribusiness sector is professionally organized and aggressively lobbies all the agencies and layers of the state, but awareness is growing that the sector is limited when it comes to dealing with socio-ecological issues such as growing threats from insects and diseases, climate change, and land-based struggles. As much as sophisticated technology and precision machinery, agribusiness is increasingly associated with clashes with non-unionized rural workers and labourers, indigenous groups, and descendents of slaves, and the prospects are grim and likely to aggravate the level of violence.

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2

Water Governance and Agricultural Management: Collaboratively Dealing with Complex Policy Problems

Robert D. Fish, Antonio A.R. Ioris, and Nigel M. Watson

Introduction

It is not difficult to appreciate why ideas of 'integrated' and 'joined-up' planning have become key motifs of emerging approaches to the sustainable management of water and agricultural systems. Decision-makers with responsibility for this rapidly developing arena of cross-sectoral policy quite reasonably seek a future in which system interdependencies will be recognised, priorities for management assigned, and responsibilities for action borne fairly. In England, for instance, the

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government department with responsibility for sustainable rural development recently published its strategy for water (DEFRA 2008), setting out a vision that positions agricultural systems as central to the process of resolving competing issues of water supply and demand, and water quality and quantity by the year 2030. While priorities for action vary greatly according to political and material circumstances, parallel calls can be found elsewhere (Blanco 2008; Conca 2006; Faby et al. 2005; Lemos and Oliveira 2005; Swatuk 2005). Driven in part by the exigencies of an increasingly congested terrain of international agreements (such as the Convention on Biological Diversity) and laws (such as the pan-European Water Framework Directive), what holds this diversity together is the recognition that fragmented policymaking and implementation across the agricultural and water sectors continues to be a systematic and deeply institutionalised feature of natural resource management and, consequently, a major obstacle to the realisation of sustainable livelihoods and development.

Recent calls to address agriculture and water as linked policy and scientific agendas reflect, of course, the changing nature of priorities. For example, current interest in England for devising strategies that can mitigate the risks of diffuse pollution from agriculture to water is partly the consequence of a concerted effort during the 1970s and 1980s to intervene—primarily via regulation of privatised utilities—in problems of domestic, industrial, and urban water management. That is to say, as significant gains in one arena of environmental protection have been made, 'blind spots' of regulation have also been revealed. Thus, the scientific and regulatory focus of action has changed as insight and public concern have evolved. At the same time, new problems with new complexities for the water and the agriculture sectors are emerging. The aforementioned strategy for water in England published by the Department for Environment, Food and Rural Affairs (DEFRA) is governed, in large part, by wider climate change agendas, and the need to build long-term resilience among urban and rural communities through the effective management of land–water interactions. Indeed, agriculture's role in influencing the water cycle is central to discussions of how climate change risks are managed and mitigated (Thorne et al. 2007).

In recent years, bodies of work have duly emerged seeking to explain how the codependencies of land, water, and human well-being can be shaped according to the principles of sustainable development. From 'integrated water management' (e.g. Furey and Lutyens 2008) and 'integrated catchment management' (e.g. Prato and Herath 2007) to 'integrated water resources management' (e.g. Saravanan et al. 2009) and 'integrated environmental management' (e.g. Reagan 2006), this variegated literature is important not only in the way it amplifies the types of natural and social scientific research required to understand these codependencies, but also in signalling, quite clearly, the complex and changing institutional and political conditions of management. In particular, one common line of reasoning in this work is to understand processes of natural resource management as being shaped, to an increasing extent, by the principles and practices of 'governance'. This is a concept designed to point to the broadening and deepening of non-state activity in the policy process. It is closely related to wider normative debates about the need to foster more equitable, responsive, and politically engaged forms of decision-making. In this chapter, we critically inspect this idea and its implications for this special edition's specific concern with 'integrating water and agricultural management' (hitherto 'IWAM').

The text begins by considering the origins of the governance agenda, outlining its key tenets, and explaining how it is potentially taking science and policy into new conceptual and practical territory. We explain the discrepancies that surround this terrain, drawing attention to a body of work critiquing not only its empirical reality, but its underlying normative claims. Nonetheless, we argue that the regulatory thrust of the governance agenda—towards more collaborative and holistic approaches to working—is essentially well founded or at least is a step in the right direction. The chapter then considers how these concerns might best be approached as an adaptive form of environmental management, one based on a commitment to dialogue, deliberation, and negotiation among stakeholder groups with vested, often competing assessments of policy priorities. The corollary to this, we suggest, is a series of interesting questions surrounding the role and nature of research, not least the matter of how to foster effective models of cross-disciplinary working that can create the kind of evidence base required to inform adaptive policy

processes. We consequently argue that land and water governance and research have to be approached differently in the future if the process of integrating multi-sector and multi-scalar natural resource systems of management is to be realised in effective ways.

The Institutional Challenges of IWAM

The institutional basis for developing integrated approaches to water and agricultural management is complex and multifaceted. Interpreted broadly, institutional structures and processes that underpin the formation and implementation of public policy are political, legal, economic, social, and administrative, in character (Mitchell 1990; Saleth and Dinar 2005). We suggest these structures and processes present a dynamic, and often contested, context in which to gauge prospects for IWAM. The situation in England and Wales illustrates this point well. Here, many of the companies providing public water supply and sewerage services are owned and operated by multinational corporations, while the regulation of the industry involves a central government department (DEFRA), a non-departmental agency (Environment Agency), an economic regulator (Office of Water Services), and an independent monitoring body (Drinking Water Inspectorate) (Watson et al. 2009). There are also complex arrangements for environmental protection that place these institutions within wider policy networks encompassing (among others) bodies with statutory responsibility for nature conservation (such as Natural England), designated authorities for protected landscapes (such as the National Park Authority), as well as regional and local government. In all of this, important cross-sectoral linkages between the water and agricultural sectors can be identified at the level of policy design, and indeed a multitude of partnership arrangements for spatial entities such as river basins, catchments, and coastal zones are duly emerging as platforms for more integrated forms of land and water management. As elsewhere in the European Union (EU), an important case in point here would be the development of policy platforms that can respond to the emerging mandates of the Water Framework Directive. Even so, this potential for cross-sectorality belies

a deeper institutional complexity. Debates about integrated approaches to agriculture and water systems are not, of course, conducted in isolation. Priorities for both sectors are implicated in a multi-scalar and contested political economy and bear the wider institutional influence of non-governmental organisations (NGOs), professional associations, consumer groups, and, perhaps most notably in the context of agriculture, trade organisations. This means that the institutional basis of shared programmes of action *within*, as much as *between*, the water and agricultural sectors are by no means assured.

For some, overcoming this complexity is less a matter of how to foster more coordinated institutional responses to water and agricultural management, but more about fundamental changes in the way policy processes now take shape and assert influence. In particular, recent years have witnessed an emerging debate over whether we have entered an era of 'governance' (Higgins and Lawrence 2005; Hooper 2005; Bakker 2006; Warner 2007; Pahl-Wostl et al. 2008; Pahl-Wostl 2009). This is an idea used to point to a change in the relationship between the state and civil society and the way in which responsibilities for the provision of environmental quality and other public goods are thought by some to have shifted since the 1980s (Pierre 2000). Specifically, it is suggested that the historically central role of the state and its bureaucracies in activities of planning, regulation, policy implementation, monitoring, and evaluation has been recast under the ascent of more liberalised economic regimes. As a consequence, it is claimed that regulatory and institutional decision-making increasingly involves actors operating beyond the boundaries of formal government as well as traditional state-based agencies and bureaucracies. Thus, it is argued that new spaces for policymaking have emerged, which are occupied by a diverse range of self-organising actor networks, public–private partnerships, and other multiparty arrangements. In an era of governance, then, distinctions and boundaries that previously defined state–market–civil society relations are thought to have increasingly blurred (Bevir 2009).

For those interested in natural resources and the environment, the claim that we have entered an era of 'governance' brings with it a new set of challenges. As Tropp (2007) argues in the context of water management, governance-based management relies on developing more

'sociocratic' forms of knowledge and capacity development, putting the emphasis on the management of people and processes, organisational diversity, and knowledge sharing. Yet the extent to which such a transformation is possible and the degree to which governments are ready and willing to share power with non-state actors remains unclear; transformation and participation are always the object of political contestation. While in principle government departments and public authorities are now often required to interact on more equal terms with other social 'players' and alongside a host of other powerful non-state entities (Stoker 1998), the role and the influence of non-state actors in decision-making processes remains uneven and highly contested. In purely practical terms, the orchestration of multiple actors and interests and the marshalling of collective action are difficult tasks themselves. Working effectively in an era of governance means challenging entrenched attitudes and practices, overcoming organisational resistance to change, and mobilising individuals to engage with seemingly intractable, cross-sectoral environmental problems. Perhaps more critically, Petersen et al. (2009) argue that, while a governance approach favours the collective resolution of problems, it is often the state that continues to take ultimate responsibility, particularly where blame or liability cannot be established due to uncertainty, poor data, and/or lack of evidence. As a result, there is a risk that, when superficially adopted, a governance approach simply serves to renew and re-emphasise state power (and the influence of the stronger groups of interest) in environmental politics, rather than fundamentally changing the policy formulation or implementation process. Similar arguments have been made elsewhere. Writing in the context of water management and the provision of water services, Bakker (2003) explains that governance-based decision-making can amount to a process of re-regulation in which tacit state control of the allocation and management of resources remains. A related observation has been made by Ioris (2009), who demonstrates how the main policy instruments of water governance are often appropriated by the stronger stakeholder groups and, in circumstances of a weak institutional context, result in the maintenance of long-lasting management problems and associated asymmetrical power relations. As such, collective action to integrate water and agriculture within a governance framework cannot be taken

as a given or neutral procedure. Indeed, for some, governance remains a deeply problematic concept which fails to take adequate account of the politics and power relationships that exist within resource management regimes (Castro 2007; Mollinga 2008).

If there is a tendency to overlook the fact that interventions in water and land systems by different categories of stakeholders (characterised by unequal political opportunities and varied access to resources) tend to generate costs, benefits, and risks in uneven ways (Molle 2007), it is also the case that the challenges of dealing with multiple actors with competing interests and values are now exacerbated by problems of scale and spatial 'fit'. It is notable here that the catchment area or river basin is often represented as the most effective operational scale for managing land–water dynamics (cf. Oliver et al. 2009), but in institutional terms, such prescriptions are often problematic (Moss 2003). Experience in integrated catchment management has shown, for instance, that the effectiveness of catchment-scale policy interventions is frequently limited by factors such as multiple overlapping agency and organisational jurisdictions, fragmented and poorly coordinated administrative structures and processes, differences in power, unclear lines of responsibility and authority, and slow and unresponsive decision-making. It is in this vein that social scientists have argued that catchments are more than just a landscape carved by the flow of water from headwaters to the mouth, but an unstable, 'permeable', and evolving socio-ecological system (Molle 2007).

To the extent that catchment-scale planning continues to be positioned as the site where integrated governance and resource management will be realised, it remains clear that at least some of these systemic failings can only be addressed by reconciling catchment politics with the higher and lower scales of governance that produce them. That is to say, the process of joining up the governance of agriculture and water management depends as much on enhancing the vertical linkages among decision-making nodes at different spatial and institutional scales as it does on fostering closer horizontal links between the two sectors. In this sense, the drivers of change which shape these systems are effectively unbounded and operate outside and inside of the biophysical parameters of catchment systems. This seems certainly the

case when we think of water management in the context of agricultural change. The local practices of farmers are shaped by a wider political economy of agriculture which may not be necessarily in step with the goals of sustainable water management. In Europe, processes of trade liberalisation and Common Agricultural Policy (CAP) reform, for instance, are major drivers of land use change (Potter and Tilzey 2007), yet such factors are rarely, if ever, acknowledged or fully addressed within water policy. Furthermore, the water management community has a tendency to portray agriculture simply as a cause of both water quality and quantity problems while failing to acknowledge its vital role in food production and maintaining rural livelihoods.

To summarise, institutional arrangements for both water and agriculture are complex and multidimensional, encompassing networks of 'loosely coupled' state and non-state actors. For some, these arrangements characterise a transition towards more governance-based approaches to natural resource management, though empirical reality of this transition is by no means settled. As we have shown, the idea of governance is inevitably a highly contested and politicised process through which resources are allocated and benefits and costs are distributed. In such circumstances, IWAM cannot be treated as a purely technical or scientific matter. It requires the development of a process that is capable of making trade-offs among competing objectives and reconciling different values and beliefs regarding the use and management of land and water. This presents considerable challenges for many IWAM-related agendas today, not least in addressing the institutional ramifications of managing water and agricultural systems across spatial scales. From a scientific perspective, the catchment, watershed, or river basin may appear to be the most logical scale for the integration of water management and agriculture (Newson 2008). Nevertheless, many of the market and institutional processes that drive and regulate both water management and agriculture operate at entirely different scales. As such, IWAM requires an approach to governance that is capable of working both inside and outside the frame of catchment management and is able to deal with the dynamic relationships between water and agricultural systems. The question of how these challenges might be addressed within a governance framework for IWAM is examined in the following section.

Towards Alternative Models of Governance

One of the central social science challenges to emerge from these complexities is the identification of approaches to governance which can satisfactorily cope with unbounded system interconnections. This would be relatively easy if it were simply a matter of constraining uncertainty and complexity by cumulatively investing in more sophisticated scientific research. However, such an approach overlooks important philosophical arguments about the limits of knowledge in a complex and rapidly changing world. As the scale of the unit of analysis is expanded from a single farm up to an entire catchment area and beyond, an increasing number of systems, interactions, feedback, and non-linearities are brought in to play. This results in a step change in the nature of the uncertainty that has to be confronted, moving from 'risk' where prediction is possible through to 'ignorance' and even situations of 'indeterminacy', where understandings of system boundaries and interactions are defied because they are in constant flux (Wynne 1992). In the absence of certainty, it is inevitable that issues such as managing the effects of agriculture on nutrient pollution or flood risk or agricultural demand for water tend to be highly controversial. Indeed, recognising the boundaries of what it is possible to know in a limited period of time and reaching consensus when data and evidence are lacking are indicative of the fundamental challenges associated with IWAM. It is clear that governance models with the capacity to cope with these sorts of 'messy' or 'turbulent' conditions must be created (Trist 1980). Conventional models that emphasise rational-comprehensive and technocratic styles of policymaking dominated by government bureaucracies are unlikely to be a good match in these circumstances.

In recent years, more collaborative forms of governance have started to emerge in a variety of different spatial and environmental contexts in response to the perceived deficiencies of technical knowledge and, we contend, have great potential for dealing with the challenges of IWAM (Wondolleck and Yafee 2000; Armitage et al. 2008). Drawing on theoretical arguments concerning communicative rationality, discourse, and policy dialogue (Habermas 1981; Innes and Booher 1999), collaboration is posited as a highly interactive and adaptive process that is capable of

transforming social relations by creating new knowledge networks among interdependent actors and interests. This can include interests with little or no prior experience of each other because they operate in socially and organisationally separate domains at entirely different spatial scales, or those who have been historically engaged in competition or conflict over underlying institutional, commercial, or cultural priorities. In this vein, Dengler (2007) demonstrates how different organisations and groups, while invested with different degrees of power, can work together to achieve agreed policy outcomes, and advocates a regime of governance based on sharing expertise between complementary organisations, so called 'knowledge-based' governance.

Conventional styles of policymaking have certainly involved interactions across institutional and social boundaries, often in the form of cooperative agreements and efforts to coordinate policies and practices. However, these are relatively short-term arrangements designed to allow each party to pursue separate goals and objectives under stable policy conditions. In these circumstances, government agencies often remain in control of the decision-making process with limited accountability. Collaborative governance, in contrast, involves a more sophisticated, emergent, and enduring form of interaction in which two or more groups pool understanding and/or tangible resources to address a set of problems which neither could solve alone (after Gray 1985). It is a process in which organisations and groups are required to re-examine basic assumptions, beliefs, attitudes, and values through iterative cycles of knowledge exchange, dialogue, deliberation, and negotiation. It is suggested that through this process, joint understandings and commitments for action begin to emerge (Watson 2007).

In practical terms, collaboration involves a number of phases (Fig. 2.1), as well as opportunities and constraints which are shaped by prevailing economic, social, political, and environmental conditions (Watson 2004). Often, collaboration is initiated as a result of several factors, such as a perceived environmental threat or crisis, a new legal mandate, or the availability of financial incentives. When an initial commitment to collaboration has been made, a 'problem-setting' phase occurs in which groups with legitimate stakes are identified and the nature of the joint problem or issue they face is articulated (Gray 1989; McCann 1993). As

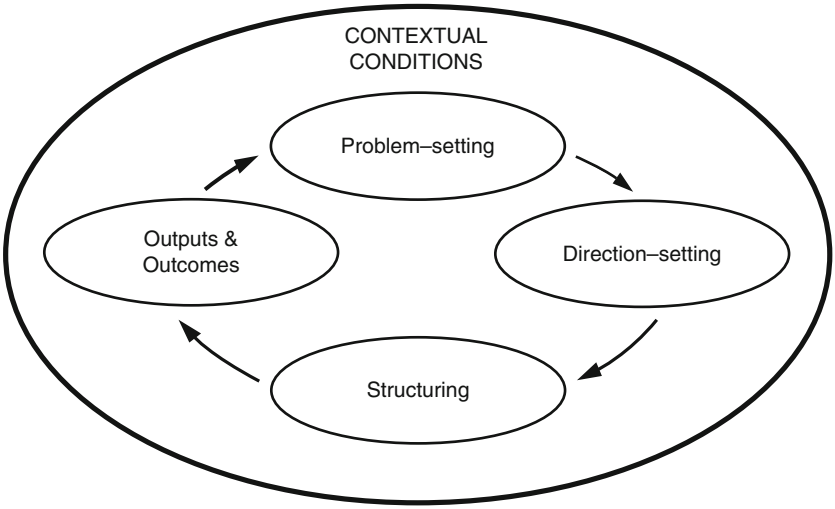

Fig. 2.1 Conceptual framework for collaborative governance

a result, stakeholders begin to appreciate their interdependence and the need to act together. In the subsequent 'direction-setting' phase, participating organisations focus on desirable future conditions as well as the underlying values, beliefs, and principles that will guide them towards their joint ambitions and aspirations. This tends to be followed by a 'structuring phase' in which specific goals and objectives are established, programmes of activity are designed, and roles and responsibilities are assigned to the various participating organisations and groups. Although some commentators regard this to be the end of the process, others have argued that collaboration should generate outputs, such as policies and programmes (Selin and Chavez 1995), which must be implemented in order for measurable outcomes to be realised.

While it is convenient to conceptualise collaboration as a well-defined process, in practice, some of the phases may occur simultaneously and several cycles may be required over time before satisfactory results are achieved. In other cases, changes in knowledge or circumstances may require the participants to return to one or more of the earlier phases of activity in order to redefine problems, objectives, or working arrangements.

According to Innes and Booher (2003), this sort of collaborative approach is not just a method for solving complex problems in the existing policy system, but crucially is a way of establishing new networks through which capabilities can be developed and sustained. Effective collaboration can be identified from four immediate or first-order results: reciprocity, relationships, learning, and creativity. Collaborative dialogue can lead to the establishment of reciprocal relationships among the participants as they begin to appreciate their interdependence. A reciprocal agreement might involve compromises among the participants but it can also lead to a situation where one group is able to take action at little or no extra cost which may have benefits for others. Such situations arise when there is a strong sense of purpose and a commitment to a common vision of a future that is more desirable than present-day conditions. It is important to realise that reciprocity is not a predetermined or straightforward attribute of the interplay among stakeholders, but is a constructed quality that helps groups to do joint work and to build trust. That is why successful collaboration also builds relationships and social capital based on mutual understanding and respect. It is precisely these kinds of enduring human and interorganisational resources that enable collaborative governance to cope with uncertainty, changing conditions, contested knowledge, and conflict, conditions which are closely associated with the objectives of the IWAM agenda. A further result of collaboration is collective learning. Participants not only learn about the problem at hand and how scientists and lay groups understand it, but also typically learn about the values and norms of the other interests and actors involved. More fundamentally, engagement in collaboration can eventually lead to deep 'double-loop learning', whereby the values, beliefs, and norms of a participating group are transformed (Argyris and Schön 1978; Pahl-Wostl 2002, 2009). Problem-framings, aims, objectives, and strategies may be adjusted on the basis of the shared understanding that emerges from collaboration. Finally, one of the greatest virtues of collaboration is that it encourages out-of-the-box thinking and creativity. Potential strategies and solutions which might otherwise be dismissed as irrelevant or poorly informed are likely to receive more considered and careful attention in an environment where alternative

views and perspectives are valued and respected. Ultimately, effective collaboration can lead to system adaptations because of the shared identities, meanings, heuristic principles, and innovations that it creates. It is precisely these kinds of system adaptations that are needed in order to bring about the integration of water and agriculture.

It should be noted that this analysis is not designed to imply that collaboration is unproblematic. Indeed, one of the main challenges of this approach to governance and problem-solving is to maintain trust and commitment to shared long-term goals when obstacles are encountered and when evidence of progress is only weak. Potential benefits as well as challenges and risks associated with collaborative approaches to the governance of land and water are summarised in Table 2.1.

Table 2.1 Potential benefits, challenges, and risks of collaboration

Benefits	Challenges and risks
Improved personal, social, and interorganisational relations	Increased transaction costs due to the number of actors involved and the added complexity of decision-making
Access to alternative sources and forms of scientific and lay knowledge	'Capture' or diversion of the process due to asymmetrical power relations among the participants
Deep learning, leading to the exploration of underlying values, assumptions, attitudes, and expectations	Potential 'implementation gaps' arising from difficulties in translating agreed plans into polices, projects, and actions
Reframing of complex issues and questions, leading to enhanced problem-solving capacity	Failure to broker agreement in the face of uncertainty, limited data, or contested knowledge
Legitimisation of decisions through consensual decision-making	Maintaining trust among organisations with different cultures, norms, and practices
Commitment to long-term goals and future visions	Ensuring the benefits and costs of collaboration are fairly distributed among the participants
Leverage of additional financial, technical, administrative, and political resources	Maintaining commitment to long-term goals when evidence of progress may be limited
Reallocation of roles and responsibilities according to organisational capacities and skills	

Perhaps most significantly, the obstacles of making a full transition from old systems of governing and policymaking to a new ethic and regime of collaborative governance should not be underestimated. Other models of policymaking, which rely more on political influence, technocratic tools, and bureaucratic structures, are deeply embedded in the institutional systems of agriculture and water and will not easily be removed or reformed. At the individual level, personnel involved in either sector may inadvertently preserve values and practices that reflect centralised, unresponsive modes of governance when trying to achieve collaboration. What this implies is that the future development of IWAM governance is likely to be hesitant and contested because the process of implementation brings together different perspectives, values, norms, and customs. Much will rest on the level of political and scientific support given to the process of integrating water and agriculture and the ability of government ministers and civil servants as well as non-governmental stakeholders to push through institutional reforms aimed at improving genuine collaboration.

Ultimately, a viable approach to governance for agriculture and water systems must be capable of integrating multiple voices and reconciling competing interests. Dealing with complexity and uncertainty requires innovative strategies to the relations among social groups and between society and the state apparatus which can foster constructive and enduring collaboration. This means that governance is not just about changing the format of policymaking or management activities, but also about a profound shift in terms of commitment to working together to understand, and constructively resolve, shared problems. Collaboration creates some of the conditions upon which legitimate actions depend even in the face of uncertainty and political and socio-economic differences among groups or spatial areas. It is the most appropriate model for achieving this change because of its commitment to dialogue, deliberation, and negotiation. By enabling reciprocal agreements, establishing enduring institutional and social relationships, promoting learning, and encouraging creativity, collaborative governance has the potential to produce the kinds of transformations which IWAM is seeking to achieve.

Integrating the 'Social' and 'Natural' in Land–Water Research

In the same way that integration challenges current thinking about governance and policymaking, it raises equally fundamental questions about how academic research should be organised and conducted. As clients of this new policy agenda, single-discipline researchers with historically little reason (or perhaps inclination) to share the same intellectual space must now navigate a stable pathway through a fundamental and seemingly intractable set of issues regarding how scientists—as a diverse community of social and natural science researchers—describe and construct the realities of water and land management, acquire and marshal knowledge for the purposes of closer integration, and judge the efficacy of our interventions. These are just some of the questions that characterise the problem of creating and operating within integrated research 'platforms' (Warner 2007). For some, this might imply a compromise and dilution of standard disciplinary pathways to knowledge and understanding, the idea that integrated thinking lies at the 'shallow end' of water research. For others, progress towards the application of these policy goals is not only producing novel theoretical constructs in the arena of land–water research but also driving the formation of new study areas that do not respect neat disciplinary boundaries (see Lane et al. 2006). At the same time, the outputs of joined-up research on agri-water systems from research must reflect the needs of policy and practice if there is to be any real prospect of making new knowledge relevant and 'useful'.

Given the simultaneously human and non-human complexion of land–water systems, it is perhaps not surprising that collaboration across the social and natural sciences is regarded as a necessary, and underpinning, facet of integrated land–water policy. One of the common presumptions behind this view is that we can create holistic understandings of land–water systems rather like fitting together a jigsaw puzzle, with cognate specialisms and expertise adding up to a complete picture. In essence, the logic is that the natural and social sciences, by their very nature, are concerned with different parts of a connected reality: the natural sciences accounting for the environmental manifestations of human

and non-human processes, the social sciences for the economic, social, political, and cultural relations that condition and give rise to them. In other words, the rationale behind this 'additive' world view rests on the notion that the social and natural sciences are compatible with each other because they prioritise different thematic areas in the study of land–water interactions. By working collectively, it is argued, social and natural science researchers are therefore able to make up for disciplinary deficiencies and forge innovative approaches to complex questions.

Holistic scientific working involving the meshing together of different types of preoccupations and expertise is a fundamentally attractive idea, yet two key challenges emerge with it. The first of these challenges concerns the need to reconcile the prevalent divergence between natural and social science research. That is to say, an important precondition of joined-up approaches *between* the natural and social sciences is to foster coherent conceptual and methodological narratives *within* them. In the natural sciences, this problem has been addressed by Haygarth et al. (2005), who, specifically in the case of phosphorus research, draw attention to the different cognate specialisms underpinning this field of inquiry and highlight the kind of challenges (and possibilities) arising for the research community when seeking to create collaborative and mutually reinforcing agendas in the context of contrasting methodological logics. An equivalent analysis of the social sciences shows that economics, political science, geography, psychology, anthropology, sociology, and planning, to name but a few, all have something of value to offer to the IWAM debate. While cross-fertilisation of ideas (and careers) among these fields makes it difficult to appreciate how exactly each has added to the understanding of water management and agriculture, it is certainty the case that this community has produced a rich mix of research priorities and fostered varied pathways to an understanding of the relations between society and nature (Haberl et al. 2006; Waterton et al. 2006; Dixon and Sharp 2007; Giller et al. 2008; Jansen 2009).

Given this, some of the principal cross-disciplinary preoccupations of social science approaches are depicted in Fig. 2.2, which highlights three arenas of inquiry around which it seeks to understand the politics of land–water management: structural trends, capacities to act, and institutional complexity. Each of these cognate areas of inquiry provides the

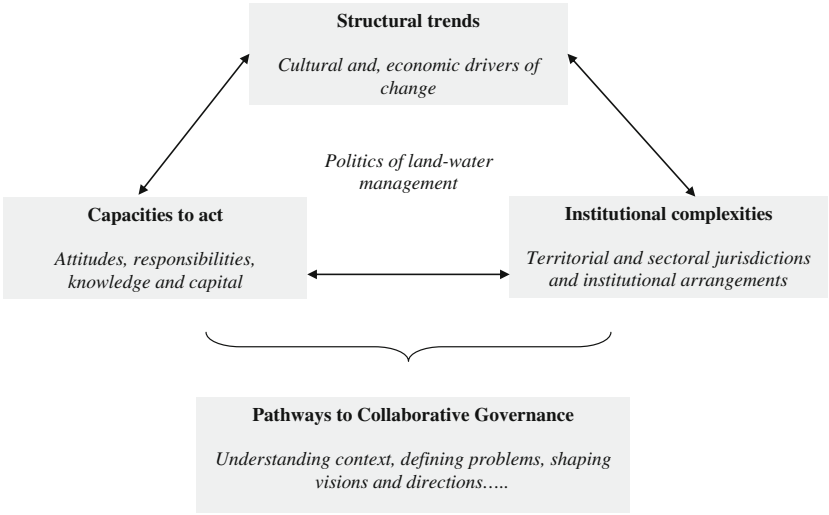

Fig. 2.2 The thematic scope of social science research in IWAM

analytical insights necessary to promote effective pathways to collaborative governance. Thus, sites of inquiry shift from studies of 'capacity' in which the concern is to unpack how attitudes, responsibilities, knowledge, and capital come to shape the behaviour of individuals and groups, through to an account of the territorial and sectoral jurisdictions that influence frameworks of interventions across multiple scales, and finally into the analysis of 'structural trends'—cultural and economic—that dictate wider terms in which inclinations and capacities to act take shape. What this implies is that IWAM-related research must seek to understand how these domains interact to produce barriers and opportunities for effective action, the first and necessary step in the collaborative process.

The second key challenge concerns the development of approaches to joint working that have the potential to *transform*, rather than simply *reaffirm*, segmented ways of researching land–water problems. In its most reductive form, holistic thinking is conflated with the idea of *multidisciplinarity*: in essence, the provision of a sequence of distinct, neatly bounded disciplinary perspectives around a given research problem (Tress and Tress 2001). According to this logic, communities of research find common cause in a particular aspect of land–water systems

(diffuse pollution, flood risk, or drought, for example), but since priorities are shaped by different kinds of issue, standard disciplinary pathways to knowledge remain largely intact. In effect, the research problem is itself divided up according to the particular theoretical, methodological, and empirical perspectives favoured by the participating disciplines. It is almost inevitable that such an approach will lead to answers that are specific to the different elements under study and that understanding the research problem as a whole can remain elusive. As such, the idea of a holistic, transdisciplinary or even post-disciplinary approach to land–water systems remains at best a distant aspiration of the research process, and at worse, a cover for a 'business as usual' discipline-bound approach to problem-framing and investigation. Despite a stronger emphasis on the need for interdisciplinary research agendas, and the incorporation of non-academic expertise, it is still the case that universities and research councils in general continue to assess the quality of academic work in terms of relevance to single disciplines. This is a major disincentive for the kind of innovation and collaborative working that is required to develop and deliver integrated strategies for water and agriculture.

One unfortunate consequence for IWAM of simplistic *interdisciplinary* thinking is that it tends to reinforce certain caricatures of what the social and natural sciences are perceived to do, and leads to deeply problematic and unreflexive views of the power we should (or should not) then invest in social and natural science judgement. In a disciplinary world, it is not unusual, for instance, for social scientists to be derogatively consigned to a rather nebulous world of conjecture and interpretation, the implication being that, not only do they have little meaningful effect on material processes and outcomes, but they also engage in a kind of obfuscatory relativism that serves to stall expedient forms of action. Accordingly, abstracted from the messy social relations and politics of the human world, the natural sciences can duly carry on with the business of 'evidence gathering', revealing the deeper 'objective' truths behind appropriate policy action.

In contrast, ideas of *interdisciplinarity* and *transdisciplinarity* offer more expansive and proactive interpretations of holistic working. In the former case, models of working proceed and carry with them an underlying aspiration for synthesis (Fish et al. 2008). Problems are defined collaboratively

from the outset of research, while methodological frameworks are designed to synthesise findings at strategic points in the research process. Transdisciplinarity working, in turn, implies progression to a vision of holistic research involving, as Harvey (2006: 332) has put it in the context of rural economy and land use, 'unification of the involved disciplines at the paradigmatic (metaphysical) level'. In these circumstances, common vocabularies of problem-framing may begin to emerge among ostensibly different kinds of land–water researchers, methodological pathways to knowledge associated with one disciplinary area begin to find expression and application in others—often transforming them in the process—while underlying assumptions concerning the basis of disciplinary authority begin to dissipate. Importantly, a common characteristic of transdisciplinarity is its tendency to collapse neat distinctions between scholarly and non-scholarly communities of expertise, a characteristic which resonates well with the ambitions, logic, and ethic of IWAM.

In the same way that IWAM governance cannot be treated as an additive processes in which two policy arenas are simply joined together, IWAM research demands a more sophisticated, collaborative, and beyond-disciplinary approach. At the present time, most IWAM research appears to be characterised by either single discipline or multidisciplinary work within the natural or social sciences. Research which seeks to transcend the conventional natural/social divide in land and water research is a very recent development which requires a significant 'upfront' investment of time and trust in order to develop common definitions, conceptual models, methods, and working languages (Bracken and Oughton 2006). However, scale dependencies, system interactions and adaptations, risk, and uncertainty are all concepts which are recognised and have currency in the natural and social sciences and therefore have great potential as the basis of a common language for transdisciplinary IWAM research.

Conclusions: Moving IWAM Forward

IWAM has emerged as a new policy agenda from a variety of different debates about rural resource management, including diffuse and point-source pollution, flood risk, water conservation, drought management, and

sustainable farming and food systems. While a broad range of policy fields and research disciplines related to land and water have switched on to the idea of joined-up ways of working, the underpinning concept of *integration* is used in a variety of ways and has not received sufficient careful consideration. Indeed, much of the debate about IWAM to date has been concerned with the scientific, technical, and economic dimensions of land and water. While such debates are necessary for the development of effective policy tools and instruments, other fundamental and equally important questions related to the integration of policymaking for agriculture and water, and the role of science in that process, demand much closer research attention.

IWAM is not just about the connection of two very different policy areas (agriculture and water) at a single (catchment) scale. Both agriculture and water management are complex multilayered socio-biophysical systems, and neither are neatly delineated nor organised to fit hydrologic boundaries defined solely by river catchment areas or river basins. As a consequence, a superficial 'additive' approach to integration is not viable for IWAM because it fails to take adequate account of the complex, multidimensional, and uncertain nature of the systems which policymakers and researchers are attempting to merge. To use a simply analogy, the integration of agriculture and water management is not like a jigsaw puzzle with a relatively small number of large pieces which simply have to be put together in the right order to create a complete picture. Rather, it is more like a puzzle in which the sizes and shapes of a large number of pieces are constantly changing, producing different patterns and configurations over time. Clearly, this sort of task requires a much more sophisticated and creative approach to both policy and research.

In a policy environment characterised by complex, evolving systems and interactions, pervasive uncertainty, and contested knowledge claims, the difficult task of jointly managing water and agriculture cannot be achieved by government departments or public agencies acting in isolation, no matter how large or powerful they might be. Clearly, such organisations have legal responsibilities for land and water and are likely to play key roles, but the IWAM policy process itself must be based on a new system of multiparty and multilevel governance that not only operates within catchments but is also linked to higher and lower levels of

governance and private decision-making. Collaborative governance, we contend, provides the kind of response repertoire that is required to begin coping more effectively with complexity and uncertainty, to realign agriculture and water in the context of rural space, and to achieve the ambitious policy goals of IWAM. One of the implications is that those who are involved in the development and application of IWAM policy need a clear understanding of the different phases in a collaborative process; the kinds of organisational, management, and research skills that it demands; the potential pitfalls and recovery strategies; and the kinds of outputs which can be expected to lead to positive outcomes in the long term.

The IWAM agenda also has major implications for the ways in which research on agriculture and water is practised. Future IWAM research needs to be transdisciplinary and synthetic, rather than simply multidisciplinary and additive, if it is to yield worthwhile knowledge regarding systemic interactions across multiple scales. As such, a common language is required to enable researchers from very different disciplinary backgrounds in the natural and social sciences to understand each other in order to develop shared problem definitions and make use of combined methodologies. Concepts such as 'complexity', 'interdependence', and 'uncertainty' could provide very useful starting points. Such terms might have different meanings to different research communities, but nevertheless provide some common ground for the development of a dialogue about how IWAM can be understood and further developed.

One of the potential dangers in advocating both collaborative governance and transdisciplinary research for IWAM is that the two activities become distanced from one another when in fact what is needed is an arrangement whereby policy and research are mutually reinforcing. Once again, notions such as 'complexity' and 'uncertainty' are readily recognised by both the policy and research communities and could provide the necessary bridges between them. In particular, approaches such as Adaptive Environmental Management (AEM) have been specifically designed to combine policymaking and research in highly complex, dynamic, and uncertain environments (Holling 1978; McLain and Lee 1996). The underlying principle of AEM is that policies inevitably have to be designed on the basis of incomplete scientific understanding, and therefore should be treated as trial-and-error experiments which are adapted

over time on the basis of feedback from scientific monitoring and evaluation. In effect, AEM brings together policymakers and researchers in a collaborative governance environment where complexity and uncertainty are openly acknowledged and addressed. Given the nature of the scientific and policy challenges associated with the integration of agriculture and water management, it is precisely this sort of proactive, experimental, and collaborative approach that needs to be developed for the future.

At the present time, IWAM represents a long-term goal or aspiration that has yet to be fully translated into an operational strategy for dealing with water and agriculture in a holistic or interconnected fashion. Any future strategy must be capable of maintaining food production systems without compromising the long-term viability of water and ecological systems. In addressing agriculture and water in a combined way, IWAM must include a range of stakeholders who are unlikely to have interacted closely with each other in the past. As such, IWAM requires particular effort in developing mutual understanding, negotiation, and cooperation so that political, organisational, and disciplinary differences and conflicting interests can be overcome. Ultimately, success will depend on the development of transparent and legitimate channels of dialogue and collaboration that connect the local, catchment, national, and international scales of governance and research on agriculture and water.

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3

Revisiting Food Studies from a Political Ecology Perspective: Lessons from Mediterranean Agri-Food Systems

Ana Moragues-Faus

Introduction

In the collective imagination, Mediterranean agri-food systems are based on small farms that expand through high nature value (HNV) landscapes, where farmers use traditional and culturally specific practices to produce foodstuffs that are recognized globally as part of the famous Mediterranean diet. However, the actual dynamics of the Mediterranean agri-food system reveal a much more complex and diverse reality, with distinct socionatural configurations—from highly intensive vegetable production to extensive cereal farms—which do not fit the stereotype and are seldom analysed in an integrated fashion (see Ortiz-Miranda et al. 2013). Not only are these historical socio-ecological systems being bypassed, but Mediterranean dynamics have struggled to fit into European agrarian change and rural development paradigms developed in the Anglo-Saxon tradition (which

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are the main influence behind European Union policies). This difficulty has prompted an image of 'delay' in Mediterranean countries, either in adopting productivist pathways (e.g. increasing the size of agricultural holdings) or in developing an internal market for organic products or urban food policies.

In this chapter, I want to discuss how the European food studies scholarship has bypassed distinct political ecologies, and propose new ways to integrate the diverse socionatural configurations that constitute current European agri-food systems. For this purpose, first, I introduce political ecology (PE) as a critical tool that combines elements of ecological and political economy and its usefulness to study agri-food systems. Second, I present a sequence of theoretical debates on agrarian change, rural development, and associated criticisms, ranging from more classical conceptualizations—such as the modernization paradigm—to more recent theoretical formulations such as the bio- and eco-economy models. This analysis is followed by an account of how PE as well as the Mediterranean academia can contribute to developing a more comprehensive and critical approach to understanding European agrarian change dynamics in order to ultimately inform more inclusive rural development policies and projects. The third section presents the emergence of urban food strategies (UFS) and uses PE coordinates to point out challenges in urban food policies in the pursuit of more sustainable and just food futures as well as discuss Mediterranean specificities. Finally, the conclusions highlight some of the main elements to develop a PE of Mediterranean agri-food systems.

Political Ecology: A Critical Community of Practice Striving for New Spaces of Possibility

The term 'political ecology' embraces a range of definitions, dating back to the 1970s, to explain environmental degradation as a consequence of corporate and state mismanagement (Cockburn and Ridgeway 1979). This term emerges in part as a challenge to apolitical accounts of

environmental crisis and ecological change that ignore the influence of political-economic forces, and calls for an explicit unveiling of normative goals that embed assumptions and explanations around human–nature relations (Robbins 2012). Following Bryant and Bailey (1997), the basic premise of PE research is that ecological conditions and their modifications are the result of a political process. This assumption can be further divided into three key elements: costs and benefits derived from ecosystem management and environmental changes are unequally distributed, how this distribution can reinforce or reduce existing social and economic inequalities, and how this in turn alters power relations among actors (Bryant and Bailey 1997).

PE research links processes occurring on different scales—from the individual actions of peasants selecting seeds to multilateral trade agreements—integrating different levels of decision-making to reveal winners and losers, costs and benefits, and their implications in power distribution. PE not only jumps between scales, but also combines different disciplines, or as Bryant and Bailey (1997) put it, disciplinary transgressions. This has led to a very fertile field, undeniably characterized by an enormous theoretical and empirical heterogeneity, under the banner of PE, which inevitably also challenges the field's coherence (Blaikie 2008). Furthermore, Robbins (2012) suggests that PE cannot be encapsulated as a method or a theory—since it mobilizes concepts from broader schools of thought, rather, he proposes we describe PE as a community of practice that fosters a global conversation between academics and practitioners. Following Robbins (2012), the PE studies are characterized by the following four main elements:

- *Track winners and losers*: Environmental changes, by and large, have unequal consequences for different communities or groups. PE narratives explore the historical process through which winners and losers of environmental transformations are created, including the institutional, social, economic, and power relations that operate on different scales and even geographies. One example is the use of pesticides in farming, which, as Galt (2008) shows, is influenced by a mixture of socio-economic characteristics of the farm household, political-economy relations in the food chain, and agro-ecological relations. The global

governance of food export and pesticide regulation puts producers in the developing farming countries and their domestic market at a higher health risk than northern consumers (Galt 2009). However, winners and losers are not only restricted to individuals or communities. Non-humans, that is, the environment itself, can also suffer injustices. The recent book *The Political Ecology of Meat* (Emel and Neo 2015) analyses the root of socio-economic marginalization in political-economic institutions of animals that are converted into meat by looking at how power structures and knowledge of the global meat trade are reproduced, as well as the socionatural implications of meat production and consumption.

- *Narrate using human–non-human dialectics*: From a dialectical position, things are not discrete but interrelated; they have a history and an external connection with other things; they are in constant interaction and transformation, that is, in a state of ongoing becoming. The dialectical approach in PE leads to understanding how things and relations change by becoming entangled with one another, rather than how individual variables can explain phenomena in a straightforward way. For example, Goodman (2004) explores the dialectical relationship between the material aspects of fair trade and the meaningful constructions of ethical products. This dialectical relationship between materiality and meaning unveils limitations of fair trade networks, including the potential to exclude most vulnerable producers who cannot comply with quality standards from reaching outlets for middle-class knowledgeable northern consumers (Ortiz-Miranda and Moragues-Faus 2014).
- *Start from or end in contradiction*: Robbins also highlights that many PE texts start their enquiry from or end their analysis in a socio-ecological contradiction, which fosters critical scrutiny of taken-for-granted approaches or ideas. One example is Guthman's (2004) analysis of organic agriculture in the USA, which reveals that rather than creating fairer, more sustainable, and interconnected food systems, the organic ideology contributes to capitalist development and labour exploitation. By exposing these paradoxes, PE contributes to the understanding of unjust and unsustainable socionatural mechanisms.

- *Simultaneously make claims about the state of nature and claims about claims about the state of nature*: PE aims to understand environmental change; on the one hand describing transformations in the physical world (e.g. development of genetically modified organisms [GMOs]), while on the other, the meanings and discourses attached, representing and shaping those changes (e.g. supporters of GMOs vs. anti-GMOs). This tension is also linked to different epistemological positions; realist in the first case and constructivist in the second. However, this juxtaposition can be extremely fertile in understanding the ecological and political process that ultimately leads to specific socionatural configurations. The case of GMOs is particularly interesting since there are biophysical processes involved at the same time as a contentious debate on knowledge creation and the politics of science, which ultimately constitute a key element in the discussion and regulatory outcomes (Lawhon and Murphy 2012).

Finally, it is important to mention the long tradition of PE as a critique of wider environmental management and natural resources use and allocation, which exposes the crucial role of power relations in shaping socionatural relations that reproduce inequality and injustice. Nonetheless, as Walker (2006) states, critique is not sufficient; political ecologists should also engage in envisioning and nurturing more sustainable and just futures, creating the grounds for new spaces of possibility to emerge (Cornwell 2012; Gibson-Graham 2006).

Revisiting Agrarian Change and Rural Development Paradigms Under a Political Ecology of Mediterranean Agri-Food Systems

This section presents a short overview of the rural development and agrarian change paradigms that have dominated debates in the European context. This critical review points out how these dominant European approaches have surpassed Mediterranean PEs and how the integration of socionatural sensibilities and histories as well as a better focus on power relations could enrich these conceptualizations.

Modernization or Marginalization: Intensify, Get Larger, or Get Out

The study of rural and agricultural change has been characterized by a long series of exchanges, in many cases between 'competing paradigms' that have led to conceptual transitions. From the 1950s until the late 1980s, agricultural restructuring and science was pervaded by a productivist ethos. This productivist regime expanded through most developed countries, defined as process of farm modernization aiming to increase food production through 'intensive, industrially driven and expansionist agriculture with state support based primarily on output and increased productivity' (Lowe et al. 1993: 221). According to Friedmann and McMichael (1989), this period responds to the productivism agricultural regime or intensive food regime, and was fuelled by a devastated Europe after the Second World War when different mechanisms were set up to foster domestic food production in order to assure food security (Lowe et al. 1993; Marsden et al. 1993). These circumstances coincided with what has been conceptualized as a Fordist mode of regulation, where state intervention in the agricultural sector was conceived as part of a larger social contract between capital and labour (Potter and Tilzey 2005). Therefore, in areas where agriculture was unable to intensify or use economies of scale in order to respond to the agrarian cost-price squeeze (by enlarging holdings, increasing inputs and technology, etc.), farms became increasingly dependent on state support, and were also pushed to abandon commercial agriculture if they were not able to compete under the productivist rationale (Marsden et al. 1993; Van der Ploeg and Renting 2000). The productivist paradigm's message was also delivered through policy instruments such as subsidies telling farmers to intensify, *get larger, or get out* (Lang 1999). The productivist regime was further reinforced by the role of agricultural economists in shaping *scientific spheres* and mainly analysing rural areas and agrarian change through the lens of modernization (Newby 1982).

In the mid-1980s, there was a political crisis within the productivist paradigm, related to the increase of production and its associated budgetary policy problems in the European Union, a rise of public health and environmental concerns associated with intensive agriculture

(e.g. bovine spongiform encephalopathy [BSE]), and international market tensions due to state intervention (Lowe et al. 1990; Patterson 1997). Furthermore, Potter and Tilzey (2005) also identify a transition in this period from a Fordist mode of regulation to the progressive incorporation of corporativist interests in the design of policies, configuring a new phase of corporativist political productivism. Significant mismatches between actual agricultural dynamics and the interpretation of agrarian problems and solutions through a productivist lens fostered changes in academic and political spheres, since the 'modernize or disappear' message inherent to the productivist paradigm was obscuring a much more complex farming reality.

Some examples of this diversity and complexity came from the Mediterranean. For instance, Fabiani and Scarano (1995) argued, based on census data from 1990, that there was a more complex structure in Italian agriculture, which would be better explained by a continuum rather than a polarization of extremes. According to these authors, this agricultural holding differentiation would respond to the plurality of functions performed by diverse types of farms (i.e. residential function, disengagement for retiring farms, income complement under several forms of pluriactivity), including an adaptation of agriculture to the broader Italian diversified model of territorial development. Greece also provides an interesting example, given its 'problematic' agricultural structure under the lens of modernization, characterized by a marked territorial duality between littoral and plain agriculture, and farming on mountains and islands. Greek academics (e.g. Beopoulos and Damianakos 1997; Damianakos 1997) call for a more pluralistic understanding of farming strategies, including the coexistence in the same holding of distinct relations of production, the increase of pluriactivity of farm families, the importance of social bonds (i.e. family, relatives), and the role of rural–urban linkages. Therefore, the multiple transformation processes of Greek agriculture included the preservation of some specific features intimately conditioned by its social structure and territorial context that made it difficult to comply with simplistic modernization ideals.

These contributions, only briefly reviewed here, show the need for a more place-based, critical, and historical approach to understanding

agrarian change dynamics, focusing on socionatural relations in order to understand farmers' strategies and landscape changes. However, a close relative of PE, political economy, took centre stage in the study of agrarian change throughout the 1990s, emphasizing the importance of state and policies, and macroeconomic factors of decision-making processes and focusing on food production and global market regimes (Marsden et al. 1993; Wilson 2001).

Productivism Versus Post-productivism

Despite its non-agricultural origins (Tovey 2001), post-productivism became a key term in the agrarian domain since its emergence in the 1990s as an attempt to capture the crisis in agrarian policies and the incorporation of wider health, environmental, and rural development concerns into the agricultural agenda (Walford 2003; Ward 1993). This term also aimed to capture the cost-price squeeze faced by farmers as a result of modernization and the overall productivist model (Evans et al. 2002). These concerns were manifested in new rules and regulations in the agricultural sector, what Marsden et al. (2001) called a bureaucratic hygienic mode of regulation, referring to the constraint of traditional and ecological practices by new health and safety norms that ultimately constituted a barrier for small producers to access markets. An important part of environmental regulation in particular conceives nature as a consumable good to be enjoyed by urban dwellers, while agriculture is seen as a 'dirty business' that needs to be monitored (Marsden 2003).

The productivist/post-productivist debate (already briefly discussed in Chap. 1) gathered attention in academic and political spheres in Europe and particularly the UK. The emergence of post-productivism as a term to explain new agrarian dynamics led to redefine productivism as the opposite to post-productivism; that is to say, if productivism was characterized by intensification, specialization, and concentration, post-productivism was defined by extensification, dispersion, and diversification (Ilbery and Bowler 1998). This dualism sparked a heated debate not only on the actual reach of the phenomenon but also on the usefulness

of the concept itself. This included new empirical evidence on the vitality of productivism practices in the European countryside together with a limited spread of post-productivist activities. For example, Walford (2003) demonstrates an increasing share of agricultural production provided by large farms and a continued adoption of mechanization and automation processes in the UK agricultural sector. Several studies also showed that changes derived from the participation in agri-environmental schemes, quality production, or organic agriculture did not imply a major change in farmers' practices and behaviours; in fact, in many cases, the participation in these initiatives involved using productivist practices (Evans et al. 2002).

As before, this evidence demonstrated the coexistence of different farm pathways within the European countryside (Walford 2003), as well as the need to incorporate agency, actor-oriented, and behavioural analysis in post-productivist studies in order to tackle grass-roots dynamics. Another fallacy of the productivism and post-productivism conceptualization is its UK-centrism, and the failure to discuss whether the concept has wider applicability within Europe and beyond (Wilson 2001). Mediterranean dynamics in particular have been mostly ignored in this debate by British and Northern European scholars. For instance, Hoggart and Paniagua challenged the actual extent and depth of changes occurring in the so-called post-productivist British countryside, calling for a more critical and stronger theoretical evaluation of rural change (Hoggart and Paniagua 2001a). In their analysis, they also tackled the Spanish case (Hoggart and Paniagua 2001b), not finding any signs of diversification, professionalization, or environmentalism in the agrarian sector, which led them to deny any sign of post-productivism as well as reinforce their critique to this approach.

In fact, the post-productivist/productivist question is a clear example of an over-celebratory analysis of a specific type of agrarian dynamics. A more critical approach, able to unveil the power relations that configure specific socionatural spaces, would have been instrumental to a better understanding of the different PEs emerging in a society where quality and environmental values were highly valued but operating in a wider productivist regime.

Beyond Dualisms: Multifunctionality and the New Rural Development Paradigm

This dualistic debate between productivism and post-productivism was interrupted by the formulation of a third paradigm, strongly linked to the rise of multifunctionality as a conceptual, practical, and political device (Marsden et al. 2001; Van der Ploeg et al. 2000). Breaking the deadlock, Marsden (2003) identified three distinct models shaping changes in rural areas and agriculture. These models constituted expressions of specific socio-economic dynamics and involved political and scientific conceptualizations where the relationship between society and nature is a defining element. The first of these three models is the *agro-industrial model*, strongly linked to the productivist agricultural regime described above and therefore underpinned by modernization theory, in which intensification and economies of scale in agriculture constitute the development pathway. Second, the *post-productivist model* includes aspects related to the *countryside consumption model* or the *bureaucratic hygienic model* (Marsden et al. 2001). According to Marsden (2003), this model does not imply a break with the agro-industrial dynamics, but rather a continuity and attempt to correct some perceived deficiencies. As the same author recently put it, this model implied a compromise '*whereby environmental protection*, *amenity pressures*, *as well as food production demands on agricultural land could be assuaged by increasingly cheap imports of both temperate and exotic foodstuffs*' (Marsden 2012: 1). And finally, there is the *new rural development model*, defined as a real shift from previous dynamics where farmers squeezed by low revenues mobilize new sources of income to set up different rural development practices in order to maintain farming activity, and thus constitute multifunctional livelihood strategies (Kinsella et al. 2000; Van der Ploeg et al. 2000).

This new rural development model was mainly based on a new agricultural model that drew on the multifunctionality of agriculture. The concept of multifunctionality emerged earlier (in 1993) in the European Council for Agriculture. Its aim was to harmonize European legislation and ground the notion of sustainable agriculture (Marsden and Sonnino 2008). Other authors point out that this was a social welfare justification for state assistance through the Common Agricultural Policy (Potter and

Tilzey 2005). The multifunctionality of agriculture has received much attention from academics and policymakers, mostly in the European context and related with the political construct of the European model of agriculture, despite its contested nature (Buller 2001). In fact, assumptions such as 'all agriculture is multifunctional' have raised the need to clarify debates through more complex conceptualizations such as the distinction between weak and strong multifunctionality (Wilson 2007, 2008) or to distinguish how different rural/agrarian development models use the concept of multifunctionality (Marsden and Sonnino 2008).

This new rural development model included different farming strategies that were grouped into three processes: deepening, broadening, and re-grounding (Van der Ploeg and Roep 2003). This framework led to a rethinking of diversification and pluriactivity phenomena, from marginalized practices to key strategies to build up new consumption–production relationships and how this benefited rural communities (Kinsella et al. 2000; Ventura and Milone 2000). The new approach reveals a conceptual paradox, showing that specific processes conceived as 'backwards' under a productivist lens are actually supporting long-term farmers' livelihoods as well as generating positive environmental externalities and contributing to the social fabric (Moragues-Faus 2014). This new multifunctional approach fuelled an important body of work on how these three processes unfold in different European countries (Van der Ploeg and Renting 2000). In particular, the study of deepening processes, mostly in the form of establishing short food supply chains and constructing quality food products, has gained broad recognition. In fact, research on short food supply chains and/or alternative food networks has developed into a very prolific area of study (see recent reviews by Goodman et al. 2012; Tregear 2011). Some authors state that this model may owe its origins to those regions that other development logics have largely 'bypassed' (Marsden 2003), areas that traditionally were termed 'peripheral rural regions' and thought of as lagging behind. Mediterranean agricultural landscapes in particular have been considered an example for some of these processes based on producing high-quality foodstuffs and diversified incomes.

Despite the broad acceptance of this new model in academic spheres, many of these contributions have received criticism from different fronts. Conceptually, several authors point out the benign view and

normative assumptions underlying some of the formulations of this new paradigm, being 'aligned with an idealised vision of a rural Europe of resourceful yeoman farmers and the era of high farming' (Goodman 2004: 8). Goodman (2004) also acknowledges an insufficiently developed method to assess the impact of these new rural development practices, in particular the incorporation of elements such as equity and power distribution that resonate in the PE agenda. Several authors are concerned about the lack of critical analysis of some food initiatives; for example, assuming that organic is good when the labour conditions of the farmers are not assessed, or that local is good when it might be reproducing relations of domination (Allen and Guthman 2006; DuPuis and Goodman 2005; Guthman 2008; Sayer 2001). Furthermore, many of the empirical studies underpinning these theoretical contributions have generally focused on individual niche initiatives, such as the development of quality products, agri-tourism, or pluriactivity farms that stand out for their exemplifying nature rather than demonstrating a wide dissemination of these practices. The attempt to measure the spread and impact of initiatives under the new rural development paradigm throughout Europe using statistical data (Van der Ploeg and Roep 2003) resulted in using proxies to measure the spread of this model such as the number of farmers involved in protected designations of origin (PDOs), which might occlude dynamics operating under productivist or post-productivist logics.

However, these processes and initiatives in many cases combine characteristics of different models, creating hybrid practices (Sonnino and Marsden 2006). For example, some Italian farmers merge industrial and artisanal modes of production under PDOs (Trabalzi 2007) or the case of Greece, where there is a lack of farming-based activities on agritourism initiatives (Kizos and Iosifides 2007). Another example is pluriactivity, an old strategy that has been relabelled under this paradigm. Pluriactive farmers might operate under productivism logic—developing non-agricultural tasks as a transition to abandoning agriculture—or these practices could be an innovative response to maintaining agricultural production, expressing hybridity and continuity of some processes. As a consequence, critics have disputed this paradigm as a new phenomenon—as they did with post-productivism conceptualizations (Goodman 2004).

New Concepts or Old Dualisms?

The debate on rural development and agrarian change has recently been embedded in wider debates about the sustainability of the food system and food security, reconnecting food production and consumption spheres (Sonnino et al. 2014). The expansion of the topic is inevitably related to what has been labelled as the 'new food equation' (Morgan and Sonnino 2010), characterized by the increase of food insecurity, including hunger, as well as diet-related diseases; the recognition of food security as a national security issue; the effect of climate change in agro-food systems and vice versa; and the growing incidence of land conflicts around the globe. These processes are accompanied by the recognition of the multifunctional character of food by different stakeholders, from policymakers to civil society organizations, and therefore its strategic value in resolving a range of problems, from environmental impacts to public health costs (Morgan and Sonnino 2010). These new dynamics have inevitably fuelled new and more profound debates about the role agriculture plays in contemporary society, considering not only productivity but also how to 'optimize across a far more complex landscape of production, rural development, environmental, social justice and food consumption' (Pretty et al. 2010: 220).

Nevertheless, despite the complexity that characterizes the current situation, most practical and political solutions, as well as theoretical contributions, have revolved around two opposite narratives that reproduce the old dichotomies discussed above. These narratives have been given different labels such as the productivity (or efficiency) and sufficiency narratives (Freibauer et al. 2011; Huber 2000), the productivist and demand-led approaches (Sonnino et al. 2014), or the bioeconomy and eco-economy paradigms (Kitchen and Marsden 2009). This last case is particularly instrumental in exploring the reproduction of old dichotomies. Horlings and Marsden (2011) use the concept of ecological modernization as an overarching theoretical concept underpinning both narratives and models: the bioeconomy and the eco-economy. Ecological modernization involves a positive framing of the relationship between ecology, society, and economic development, involving '*a gradual re-embedding of ecology in the institutions of economy, creating the spaces for an*

ecological as well as economic rationality' (Marsden 2004: 3). In a similar way to the conceptual development of multifunctionality and sustainability, there has been a distinction between the weak and the strong strands of ecological modernization. Scholars relate weak ecological modernization to a corporativist interpretation based on the economization of nature through elitist decision-making structures. Meanwhile, strong ecological modernization relates to changes towards sustainable production and consumption patterns through further democratization, redistribution, and consideration of social justice issues (Gibbs 2000; Hajer 1996).

Horlings et al. (2010) identify the bioeconomy and eco-economy paradigms as examples of weak and strong ecological modernization, respectively. The bioeconomy paradigm refers to 'those economic activities that capture latent value in biological processes and renewable bio-resources to produce improved health and sustainable growth and development' (Horlings et al. 2010: 7). The dominant narrative under the bioeconomy paradigm is a new politico-economic strategy operating globally to sustain capital accumulation through nature's modification and commoditization at different levels (Birch et al. 2010; Kitchen and Marsden 2011). This paradigm shares principles with the productivity or efficiency narrative as described above, which relies on scientific advances to face food insecurity and environmental challenges, mostly through technologies that boost productivity while addressing resource constraints and reducing negative environmental impacts (Freibauer et al. 2011).

Contrastingly, the eco-economy paradigm is presented as an alternative paradigm cutting across production and also consumption spheres. It is defined as a set of complex networks of viable economic activities that utilize the varied environmental resources in more sustainable ways, providing cumulative net benefits that add value to rural and regional spaces in both ecological and economic ways (Horlings and Marsden 2011; Kitchen and Marsden 2009). Unlike the previous paradigm, the eco-economy paradigm stresses place-based constructions of economic relations and, at the same time, emphasizes 'the recalibration of micro-behaviour and practices that, added together, can potentially realign production-consumption chains and capture local and regional value between rural and urban spaces' (Horlings et al. 2010: 8). This model is clearly aligned with the sufficiency narrative, which envisages a response

to the new food equation through scientific advances applied to food production, mainly through behavioural and structural changes in food systems that transform current production and consumption practices (Freibauer et al. 2011).

This example of the eco-economy/bioeconomy paradigm shows that despite broadening the focus to the entire food system and the increasing type and number of participants in these debates, paradigms not only maintain the dualism and stagnation of former conceptualizations (see Marsden 2012 on differences [specifically Table 1]), but also tend to reproduce mainly their basic elements. In the case of the eco-economy paradigm, its defining characteristics and innovations proposed are, by and large, related to the processes of deepening, broadening, and re-grounding the sustainable rural development paradigm (see Kitchen and Marsden 2009 for an adaptation of the framework) and also closely linked to the different dimensions identified under the 'rural web' (Horlings and Marsden 2011; Marsden 2010). Similarly, the bioeconomy principles basically reproduce the logics of productivism, placing the increase of productivity as the main solution and overall aim of economic (and agricultural) development. This polarization once more leads to simplifications of reality and also acts as a heuristic device (Tscharntke et al. 2012), since most farmers' strategies lie somewhere between the extremes, as many contributions on agrarian change in Mediterranean countries show (e.g. Kizos and Iosifides 2007; Moragues-Faus 2014).

Contributing to Rural/Agrarian Development Paradigms from a Political Ecology Perspective: Lessons from Mediterranean Agri-Food Systems

PE approaches, as well as the Mediterranean scholarship, can contribute to developing a more comprehensive and critical approach to understanding European agrarian change dynamics in order to inform more inclusive rural development discourses, projects, and policies. Below, I point out key elements to advance in this agenda related to key PE tools as described above and current agricultural dynamics in Mediterranean Europe (see compilation by Ortiz-Miranda et al. 2013).

First, it is paramount to *develop a critical approach in order to understand socionatural configurations of agrarian change.* The literature shows a tension between understanding the dynamics of agrarian change and formulating a sustainable rural development model that will deliver economic, social, and environmental benefits across Europe. PE prompts us to develop a robust critique and understanding of the power relations at play that shape specific environmental and socio-economic configurations, as well as to understand who wins and who loses throughout these processes of change. European agri-food studies will benefit from separating this critical analysis of the state of the art from more normative views, which although necessary (see below), might obscure the dynamics at play. A clear example comes from Laurent's (2013) magnificent explanation of how multifunctional agriculture discourses in France hide the appalling working conditions of the migrant workers who are essential to make these farms economically viable. Similarly, Arnalte-Alegre and Ortiz-Miranda (2013) reveal how the development of PDO labels has contributed to a further intensification of agriculture. It is paramount to *make these paradoxes and contradictions visible* because they are key to shaping and transforming agri-food systems. This will also entail unpacking the idea of yeoman farmer, as Goodman (2004) puts it, to include immigrants, food-chain workers, women, part-time farmers, rich and poor consumers, and other relevant agents in the study of food systems.

Second, we need to acknowledge *place-based socio-natures as key agents* configuring agri-food systems and rural spaces. By and large, in European circles, Mediterranean landscapes are envisaged as a set of small farms enclosed in HNV spaces producing high-quality food products that are recognized globally as part of the famous Mediterranean diet, which also constitutes an invaluable cultural asset. However, while this constructed image is true for some specific agro-ecosystems (e.g. mountain olive oil production) (Moragues-Faus and Sonnino 2012), it hides a much more complex and diverse set of processes in those 'ideal landscapes' such as the importance of pensions in keeping agriculture viable in some areas (Moragues-Faus 2014) or the increasing rate of land abandonment (Aldanondo Ochoa and Casanovas Oliva 2009), as well as failing to account for socio-ecological systems such as extensive grain monocultures or intensive organic vegetable production in greenhouses, for example, in

Almeria, the so-called sea of plastic (*mar de plástico*) (Galdeano-Gómez et al. 2011). Consequently, specific socionatural configurations and their evolution over time are key to understanding the agri-food system and acknowledging its territorial embeddedness and associated interdependencies in social, cultural, environmental, and economic terms in order to formulate interventions towards more sustainable and just futures.

Curiously enough, despite the studies and data that challenge the widespread diversification and other related activities in Mediterranean Europe (Arnalte-Alegre and Ortiz-Miranda 2013), the Mediterranean stereotype has been championed in rural development paradigms as an example of post-productivism, multifunctional agriculture, and/or rural development success. This contradiction shows not only the importance of developing empirically grounded studies, but also the need to be critical about *how not only* discourses but also theoretical contributions are built. *PE calls for a critical account of the production of knowledge*, raising awareness of existing interests and how knowledge can also constitute a tool for exclusion and domination (Forsyth 2003). For example, most paradigms on rural development and agrarian change have been developed (and inspired) in an Anglo-Saxon context (and language), from productivist and modernization approaches to the eco-economy. My contention, therefore, is not only about the need for integration of other perspectives and socio-ecological systems, but also the need to raise awareness that the framings attached to these paradigms are conditioning our views on particular agri-food systems. This is clearly illustrated under the lens of modernization, where small family farms in the Mediterranean region were seen as backwards in the 'development' process. This notion of delay led to the design of agricultural and rural policies oriented towards reducing the structural gap with Northern European countries, that is, increasing the size of holdings to the detriment of other policy goals, namely environmental ones (Paniagua 2001). However, this also applies to the multifunctional approach that celebrates the production of high-quality foodstuffs despite creating markets only for middle- or high-income families. Of course, these framings have misguided not only academics but also policymakers in the context of the Common Agricultural Policy (Moragues-Faus et al. 2013).

Finally, developing place-based critical accounts of agricultural dynamics and the process of knowledge creation is a first step towards

comprehending current processes. However, the *PE community of practice is committed to understanding the world in order to change it*. In this regard, unveiling the relations of production behind particular foodstuffs is not enough; it is important to engage in new inclusive conversations that create spaces of possibility for new socionatural configurations. These spaces should take into account the production and reproduction of inequalities between people and places, and aim to formulate rural development models that challenge these inequalities.

Reframing Urban Food Strategies to Build More Inclusive Critical Food Geographies

Cities are beginning to rise in the Global North and the Global South as key food policy actors are expanding food studies from their sole focus on agriculture and rural development to embrace consumption and urban areas. In the last decade, there has been a growing number of contributions under the banner of urban food or food planning (e.g. International Planning Studies Special issue 2009; Maxwell 1999; Pothukuchi and Kaufman 1999; Viljoen and Wiskerke 2012). This broadening in focus calls for spatial and food-chain integration as well as a holistic approach to sustainability, including the environment, health, economics, social justice, quality, pleasure, culture, and so on. This section explores the emergence of UFS in the Global North, reflecting and presenting results from my participation in the community of practice on UFS of the European project FOODLINKS (Moragues-Faus et al. 2013). PE coordinates are instrumental in pointing out challenges faced by UFS when building more sustainable and just food futures, and discussing Mediterranean specificities.

Urban Food Strategies: Connecting Scales and Sectors

More than 70 % of Europeans live in urban areas, a number that is likely to increase in the forthcoming years (UNFPA 2008). Recent food crises, particularly the food price hikes of 2007–2008, have shown the

vulnerabilities of the food system, exposing the socio-economic and environmental deficiencies of an unsustainable food system. For example, FAO (2009) reports that around 43 million people are at risk of food poverty in Europe, while obesity and other diet-related diseases are on the rise, generating economic costs of more than $560 billion in the USA (Kenkel and Manning 1999). Environmental impacts of the food system are also staggering, with food system emissions contributing to 19–29 % of global greenhouse gas emissions (Vermeulen et al. 2012) and food waste per capita reaching around 100 kg per year in Europe (FAO 2013). Food constitutes a vehicle to integrate these social, economic, and environmental concerns, as well as to reconnect different geographies, sectors, and scales.

The local or city context is gaining recognition as a political sphere where municipal action is sometimes more feasible than broader changes to national or international policies (Moragues-Faus and Morgan 2015). Food planning, for instance, is a clear example of how cities can provide more space for growing food, develop new food markets, or limit fast food outlets near schools (see more examples in Moragues-Faus et al. 2013). Furthermore, the challenges and potential solutions that cities face are mediated by the historical configuration of specific socio-ecological relations that shape each urban space. Consequently, UFS take different forms around the globe. For example, London as a capital city needs to acknowledge the cultural richness of its food system and deliver good food for this diverse population accordingly. In the case of Malmö in Sweden, the industrial past of the city constrains the development of organic agriculture in some areas, or requires innovative solutions in order to develop urban food-growing projects. Nevertheless, the awareness of the local context should not prevent cities from cooperating with different scales and territories, allowing a trans-local movement to emerge (Moragues-Faus and Morgan 2015).

Transforming the food system also requires a holistic vision that integrates both horizontal and vertical dimensions. The vertical dimension of the food system includes all the activities involved in the food chain: production, transformation, transport, distribution, storage, consumption, waste management, and recycling. The horizontal dimension refers to all areas that shape or are shaped by our food system: well-being, health, social justice, economic development, education, environment, and so

on. Finally, this holistic system calls for an integration of the different actors that play a role in the food system, by incorporating voices from civil society organizations, local administration, public institutions, and other private and public stakeholders that operate in the food chain, such as producers, businesses, markets, distribution companies, restaurants, caterers, schools, and so on. A good starting point from which to identify these dimensions and actors is a food audit, as conducted by Bristol Food Council in 2011, entitled *Who Feeds Bristol* (more information in Carey 2013), which revealed the strengths, weaknesses, and challenges that this UK city faces to transform its food system. For example, the report shows the loss of fertile soil around the city, the decrease in the number of independent shops that sell fresh fruit and vegetables in favour of supermarkets, and the difficulties faced by the wholesale market that constitutes a key piece of infrastructure in the local food system.

Developing a place-based diagnosis helps to identify key areas of intervention. After an analysis of different UFS in the community of practice of the FOODLINKS project, we identified seven thematic fields where food can have an impact in cities (Moragues-Faus et al. 2013):

- Improving *health and well-being* through good, nutritious, and healthy food adapted to local and traditional diets.
- Improving *environmental c*onditions, for example, reducing CO_2 emissions, being more energy efficient, reducing food miles, promoting organic and agro-ecological production, and preserving green and agricultural spaces.
- Enhancing *economic and community development* based on a vibrant local and green economy, for example, by supporting local growers, retailers, and markets; improving local infrastructure; and generating employment opportunities.
- Preserving *social and cultural* assets by supporting resilient, close-knit communities and food-friendly neighbourhoods, for example, by celebrating and promoting local food culture and by creating collective spaces such as buying groups, collective kitchens, or public food banks.
- Focussing on *food security and social justice*, improving access to affordable, healthy, and culturally diverse food, as well as promoting fairness in the food chain.

- Prioritizing *learning and empowerment* processes, creating participatory spaces for decision-making, as well as sharing knowledge and raising awareness of the food system.
- Fostering positive synergies between *urban and rural* areas through food.

New Urban Food Politics: The Emergence of Spaces of Deliberation

Following PE thinking, in order to transform the food system, it is paramount to change current power configurations, by necessity, including new opinions and more voices in the process. Notwithstanding, the innovative role of cities as new food policy actors has also involved the creation of new spaces of deliberation and participation, consisting of alliances between local social movements and municipalities (see Moragues-Faus and Morgan 2015). In each city, this inherently political process has developed differently, leading to distinct configurations and results. By and large, the aim is to invite all interested stakeholders and those directly involved in the local food system: civil society organizations, local administration, other public bodies, and the private sector. This group of stakeholders might be very diverse, since the inclusion of new topics in UFS beyond agricultural production has attracted new partners who were formerly excluded from these conversations, such as public health officials or planning departments. The final structure of these new 'spaces of deliberation' can take a number of different institutional forms, including Food Policy Councils (e.g. North America or Canada [Blay-Palmer 2009; Schiff 2008]), Food Boards (e.g. London [Reynolds 2009]), Food Partnerships (e.g. Brighton), Secretariats (e.g. Belo Horizonte, Brazil), or the like (discussed in Moragues-Faus et al. 2013).

These new spaces of deliberation can be originated and driven by civil society organizations or by local authorities, creating opportunities to coordinate ongoing activities and foster new conversations and partnerships. However, the main aim of these spaces is to develop or modify policies at the local level (Harper et al. 2009). In principle, these spaces have a more strategic character and the development of new projects or

activities is developed by specific organizations or actors. However, in order to modify food politics, it is essential to create new participation mechanisms with local dwellers. For example, some cities hold annual conferences, send weekly newsletters, hold training workshops and events, and so on. Nevertheless, there are concerns about whether these new food conversations are truly inclusive.

Urban Food Strategies and Political Ecology: Lessons for Mediterranean Urban Food Systems

More and more municipalities are developing food strategies, calling for a holistic view of the food system and creating new spaces for dialogue and deliberation between civil society organizations, private actors, and public institutions. In the UK, there are 40 cities that are part of the Sustainable Food Cities Network, and in the USA, there are around 200 food policy councils. This urban food movement offers new practical and political directions to build a more sustainable food system. However, there are risks and challenges that need to be considered in order to modify inequality flows. Mobilizing PE as an overall framework, and using insights from an analysis of Spanish cases under food sovereignty approaches (see Emaus Fundación Social 2011; Moragues-Faus 2015), there are three main elements to be considered:

- *The cost of building alliances*: Despite the importance of debating and engaging with different organizations, there can be costs associated with establishing collaborations with stakeholders that are not 'natural' allies. While in places like the UK, the food movement and civil society organizations in general have a long tradition of partnership with public and even private institutions, this is not necessarily the case in other countries, such as Spain, where campaigning, and in some cases confrontation, has been the main strategy. This change towards more cooperation between the public sector and civil society casts doubts about whether some organizations are winning influence and power by associating with some local authorities and other institutions or if they are compromising their creativity and radicalism. In the UK, the

institutionalization process of some organizations has made up for a shrinking local state, and even substituted delivery of some services (Deas 2012; Lewis 2005). This 'hollowing out' of the state is also manifested through the increasing importance of food banks in the UK and their legitimization as a key mechanism to solve food poverty. In places like Spain, civil society has generally remained outside of the public institutions, but recent political movements and parties (e.g. Podemos, Guanyem-Barcelona en Comú) are establishing new relationships with organizations, and activists are taking part in new political parties and also creating spaces through which civil society can channel its demands.

- *New flows or new inequalities*: In some instances, the promotion of local, artisanal, and organic products leads to generating economic activities and spaces that exclude a large part of the population, mainly lower-income families. The literature on the local trap—or the risks of conflating local with good and sustainable—is an excellent example of how local food discourses and associated practices can be rooted in neoliberal principles, or neglect environmental impacts not only on a local but also on a regional or global scale (Born and Purcell 2006; Guthman 2008). In the previous section, we showed some examples of how organic food or other high-quality products can conceal exploitative means of production. In the case of cities, food can constitute a tool to gentrify spaces, ultimately creating new, exclusive environments accessible only to those with enough economic, social, and cultural resources. Furthermore, cities are rapidly gaining economic and political centrality, which posits questions in terms of spatial inequalities between cities and hinterlands or rural areas. It is paramount therefore to consider who is winning and who is losing with the establishment of these activities, who is included/excluded, and how new socionatural configurations stemming from changes in the food system are transforming the endowments of different groups. In places like Spain, the consumption of organic products is relatively low, and the 'eat local' discourse has had a more limited impact on purchasing habits. This represents an opportunity to develop initiatives that deliver the benefits associated with local and organic foods (Sonnino 2010) and also to promote social justice and redress inequalities.

- *More democracy or new elites*: The new spaces of deliberation described above are at risk of being co-opted by old or new elites, since they have the economic, social, and cultural assets to access this type of spaces. As one activist from the city of Malmo puts it: 'I think it will be very good to have a more formal space, and give people the opportunity to have their say about what developments they need. But the problem is that the people that are in the most difficult situation, say single mums or incoming immigrants, would probably never come to those meetings' (see more in Moragues-Faus and Morgan 2015). Consequently, these new spaces need to ensure they are promoting and facilitating the participation of new voices, assuming that integrating new, and usually politically marginalized, actors is not resolved by just offering an open space.

Conclusions

This chapter presented an account on how Mediterranean PEs have been surpassed in the food studies literature, mainly in terms of rural development approaches but potentially in new urban food debates. The analysis of these gaps using a PE framework allows to point out how the integration of socionatural sensibilities and histories, as well as a better focus on power relations, could enrich agri-food systems and rural development conceptualizations.

In the case of agrarian change and rural development approaches, it is paramount to develop a critical approach in order to understand socionatural configurations of agrarian change, distinguishing between a deep understanding of the dynamics at play and the formulation of normative rural development models. This means that it is vital to uncover paradoxes and contradictions between these normative models and the unsustainable or unjust processes they might be concealing. This includes also a critical analysis of processes of knowledge/theory building that frame the identification of problems and solutions and, consequently, policy recommendations. Furthermore, Mediterranean studies show the need to acknowledge place-based socio-natures as key agents in configuring agri-food systems and rural spaces. Nevertheless, unveiling the relations of production behind particular foodstuffs is not enough; it is also

important to engage in new inclusive conversations that create spaces of possibility for new socionatural configurations to emerge.

The emergence of cities as food policy actors also offers an opportunity to redress agrarian/rural stereotypes of food studies, by helping to develop analytical frameworks to studying urban food that are more sensitive to specific socionatural configurations as well as geographical specificities. This chapter has discussed how the field of urban food is evolving, relying heavily on US and UK experiences. When analysing this new field under PE premises, three key challenges emerge. The first one brings to the forefront the role of the state and the risks and benefits of establishing partnerships between public institutions and civil society organizations. We need to assess potential institutionalization processes or shrinking of states in contrast with different place-based traditions of civil society involvement. The second challenge relates to how food can be used to create more inclusive spaces as well as exclusive spaces, and therefore points out the need to consider winners and losers when redefining food (socionatural) configurations. Finally, the focus on who is included and who is excluded should also extend to how power relations are modified by these new spaces of deliberation and beyond them, in order to build a more democratic food system.

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4

On the Climate of Scarcity and Crisis in the Rainfed Drylands of India

Zareen P. Bharucha

Introduction[1]

This chapter discusses the prevailing paradigm governing agricultural land and water management in the rainfed drylands of India. It aims to nuance an existing narrative that tightly intertwines agrarian distress in these landscapes with primarily climatic factors—specifically low or

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diminishing rainfall. In doing so, it contributes to opening up what has become a rather narrow conversation that informs a limited set of technical strategies. The central thesis of the chapter is that climate-driven distress is less of a threat (though by no means an insubstantial one) than overuse or unequal allocation of limited water resources. By extension, sustainable land and water management require much more than the provision of more irrigation.

Though these themes are discussed here with reference to empirical material drawn from India, they are applicable globally, given that around 40 % of the terrestrial surface is classified as 'dryland'. These landscapes are distinguished by various degrees of 'water limitation', where average rainfall is lower than potential moisture loss through transpiration or evaporation. Depending on the degree of water limitation, drylands may be classified as dry sub-humid, semi-arid, arid, or hyper-arid. Each sub-type is characterized by ecosystems configured to particular levels of productivity determined largely by moisture availability. The drylands have tremendous significance for human development and global social-ecological well-being. Some two billion people live and work in these landscapes globally, 90 % of them in developing countries. Around one billion of these people practise agriculture in dryland areas. A significant proportion of these rely primarily on rainfall—rather than on built irrigation infrastructures—for their supply of water; around a quarter of the world's drylands are devoted to rainfed agriculture. Historically, for such communities, the relative water limitation inherent in dryland ecosystems has not constrained the existence of vibrant agricultural livelihoods. A great variety of adaptations and management practices have allowed dryland communities to contend with the risks of relatively low or erratic precipitation, high temperatures, and relatively marginal soils that accompany land-based living in these landscapes. These communities have shown that careful management of blue and green water, soil health, and vegetation results in remarkably productive dryland landscapes around the world.

However, rainfed drylands are now at the forefront of a number of social-ecological crises, bearing much of the global burden of hunger, thirst, and poverty. Land-based livelihoods in such contexts are severely constrained by degradation. It is estimated that between 10 % (United

Nations 2011) and 25 % (Wiesmeier 2015) of the world's drylands have already been degraded—experiencing some combination of groundwater decline, soil erosion, and de-vegetation sufficiently severe to impair productivity and livelihoods (United Nations 2011). Degradation in the drylands also imposes a significant human cost. Some 1.5 billion people are thought to be affected (UNCCD 2011), with poverty acting as both outcome and driver of land degradation and limiting the nutritional security of people working in these agricultural landscapes.

The urgency of these challenges is brought into sharp relief by climate change, which will intensify the pressures already experienced by agricultural communities in the drylands. At the same time, an urbanizing and increasingly affluent world will drive bigger demand for food, fibre, fuel, and feed crops. Agricultural communities in the drylands will need to play their role in meeting these global challenges of food and energy security, biodiversity conservation, and climate regulation. It is now clear that these challenges are generated by particular social and economic responses to dryland landscapes, rather than by the intrinsic biophysical characteristics of the ecosystems themselves. Drylands have often suffered from endemic lack of policy support and chronic under-investment (Barrow 2014) as well as inappropriate resource management. Unsuitable land use, competing demands on resources, and the breakdown of traditional resource management institutions have exacerbated the social-ecological pressures facing land-based communities in the drylands.

Building social-ecological resilience in rainfed drylands will mean confronting the paradigms, policies, and processes which have thus far singularly failed to advance sustainable, viable, and vibrant land-based living in drylands. Already, tensions between resource availability and seemingly inexorable increases in demand are giving new life to long-standing debates on dryland management around the role of climate versus human activities (e.g. Akhtar-Schuster et al. 2000), the complex influence of poverty on degradation (e.g. Mortimore and Harris 2005; Mortimore 2005), and (though perhaps less so) the nature of the demands social groups make of the land. These conversations will have wide relevance beyond the 'small, poor farmers' who have thus far been at the forefront of concerns about degradation, poverty, and dryland agriculture. For example, as this chapter is being composed in November 2015, drought

in California is forcing regulators, farmers, residents, and consumers around the world to confront the complex collision of climatic factors (either periodic El Niño or emerging global climate change), resource waste, global high-value agricultural commodities, and competition between agricultural and non-agricultural water use.

This analysis draws on a long tradition of critical scholarship within the environmental social sciences, particularly political ecology, to explore the dynamics of social-ecological vulnerability, rural development, and resource governance in dryland agricultural landscapes. Specifically, I intend to discuss the case of smallholder agriculture in the Indian rainfed drylands—an exemplar case of dryland sustainability challenges—to show how continuing social-ecological vulnerability here is generated, in part, because of an incomplete diagnosis of the complex problems of water scarcity and agrarian distress, which in turn generates limited technocentric solutions and perverse unintended impacts.

My starting point is a set of three 'received wisdoms' concerning water and dryland agriculture: first, that 'water *scarcity* is the predominant feature of drylands' (United Nations 2011: 30, emphasis added); second, that this scarcity is the predominant driver of agrarian distress; and third, that scarcity is best alleviated by increasing the supply of irrigation. The aim of this chapter is to critically interrogate these established, self-reinforcing wisdoms by referencing empirical material from the Indian case. I show how policy, development practice, and even popular media commonly trace direct links between relatively limited rainfall, water scarcity, and social-ecological distress. Low rainfall figures are pitted against growing demands so that scarcity becomes naturalized. The overriding imagery is of parched landscapes that lie at the mercy of the rain, unable to provide enough for local food security, let alone attain enough productivity for agricultural commodity markets. These widespread visions and the prescriptions that follow are simple and compelling. The practical agenda that follows is also clear: a foremost task for development practitioners is to tackle the availability of water in the landscape. Again with reference to India, I show that the resulting governance regimes are quite technocentric in nature and have limited potential to address the real and complex concerns of people living and working in water-limited landscapes. Please, also refer to Chap. 5 for drylands in Brazil.

This exercise does not diminish the real and lived material experience of scarcity in the drylands. Nor is it the intention to discount the value of managing supply. Instead, the point is to contribute to a growing body of literature that calls into question the hegemony of the 'scarcity discourse' (Mahayni 2013; Mehta 2010). Evidence from a range of perspectives is converging to show that the 'scare' of scarcity (Mehta 2010) is neither an accurate nor a particularly helpful way to approach water-limited landscapes. Interrogating the nature, dynamics, and implications of a scarcity discourse in water management uncovers new spaces within which to recast old problems and challenge accepted ways of approaching them (Lankford 2005). Whereas the received wisdom paints a relatively generalized picture of climate-induced distress, more nuanced perspectives show that resilience or vulnerability is generated by many factors in addition to climate and is, in fact, amenable to management. Dryland communities, policymakers, and resource managers all have agency, actively mediating the 'resource environment' through their decisions. The macro- and micro-politics of allocation generate or alleviate scarcities by governing access and the uses to which *limited*—rather than 'scarce'—resources are put. Uncovering these dynamics reveals practical options for management and is thus a highly pragmatic exercise at a time of widespread alarm about planetary limits (cf. Rockström et al. 2009; Steffen et al. 2015).

In what follows, I touch on these points with reference to India, with a focus on the state of Maharashtra, a particularly significant site within which to interrogate the dynamics of water scarcity, agrarian distress, and water governance in rainfed dryland landscapes. The chapter first outlines the material scope of dryland rainfed agriculture in India and the discursive environment which has come to characterize responses to it. I then show how both conventional management responses and seemingly radical alternatives are bound up in a paradigm where naturalized scarcity is the central problematic and increased water supply is the dominant response. I outline emerging evidence showing that management interventions embedded in this paradigm generate perverse social-ecological outcomes. This evidence is then discussed in the light of a brief review of scholarship which finesses the links between climate, scarcity, and agrarian distress. The chapter concludes with reflections on the key lessons learned.

A Climate of Crisis in the Indian Drylands

Indian agriculture—and by extension India's economy and social infrastructure—is fundamentally and perhaps uniquely dependent on the 'remarkable stability' of the seasonal Asian monsoon (Turner 2013). Every summer, a reversal of winds brings rain-bearing clouds from the southwest Indian Ocean. These sweep northwards across the Indian landmass, bringing 80 % of the rainfall that falls over the subcontinent. A warm, wet season of four months ensues, during which farmers plant the main (*kharif*) crop (June to September). Untimely, inadequate, or excessive rains disrupt food production, commodity prices, the availability of drinking water, and (given India's significant dependence on hydropower) electricity generation. These disruptions cascade across both rural and urban India. The centrality of the monsoon has meant that the rains are the focus of both celebration and anxiety. In Indian cultural iconography and everyday social experience, timely and adequate rain means life, fertility, and hope. Dry spells, droughts, or floods mean ruination and despair on a colossal scale.

Yet, India leads the world in the prevalence of rainfed agriculture, measured by both area and value of produce (Rao et al. 2015). Approximately 90 % of India's cropland is located within the 'water-limited tropics' (Milesi et al. 2010). Though some 80 % of the freshwater abstracted in India is used for irrigation (Shah 2013), rainfed agriculture of various types constitute between 60 % and 70 % of India's cultivated land. Rainfed systems produce around 40 % of India's food and support around 40 % of the national population. Important food and commercial crops depend fundamentally on rainfed systems, which produce 44 % of India's rice, 87 % of its coarse cereals, 85 % of food legumes, 72 % of oilseeds, 65 % of cotton, and 90 % of minor millets (Rao et al. 2015). Thus, rainfed systems are critical for India's food and livelihood security.

As in the rest of the world, these landscapes are in the midst of a human-made crisis. Land degradation, poverty, and hunger loosely overlap in the Indian drylands (Reddy and Reddy 2002), with some 30 % of the population in India's degraded semi-arid watersheds living below the poverty line (Ryan and Spencer 2001). The extent of total degraded land

is judged to be between 75.5 and 103 million hectares, most of which is to be found in semi-arid and arid areas (Ravindra 2007). Soil loss costs the equivalent of around 10 % of India's annual agricultural production (Babu and Dhyani 2005), and in rainfed areas cultivating major cereal, oilseed, and pulse crops, water erosion causes losses valued at around US$2.51 billion (Sharda et al. 2010: 79). Rainfed systems show large yield gaps relative to irrigated systems (Rao et al. 2015). Yet, the importance of these regions is only set to grow: some 40 % of India's net sown area would be totally rainfed even if the country's irrigation potential were completely fulfilled (Rao et al. 2015) (as discussed subsequently, this is not necessarily a desirable objective from a social and environmental perspective). While India is currently self-sufficient in the production of major food crops, improving the viability of dryland agriculture is a key concern for alleviating the hunger and poverty that are particularly concentrated in rainfed dryland landscapes.

Over time, the overarching metanarrative describing the challenges faced by the rainfed drylands has drawn relatively simple causal links between climate and water scarcity and between this scarcity and the unfolding agrarian crises in these landscapes. In this conception, climate—and rainfall in particular—occupies a particularly central position in the discourse, practice, and policy of Indian water governance. This centrality is especially evident in discourses and policies focused on the drylands. A small indicative selection covering materials presented by government actors (points 1–3) and scholarship (points 4 and 5) is presented in Box 4.1.

Box 4.1 Selection of narratives on rainfed drylands and their management in India

1. 'Rainfall and snowfall are the ultimate sources of water for meeting needs of drinking, irrigation, groundwater recharging (sic), rainfed agriculture, and environmental flows, flood and farm income securities…The implications of abnormal monsoon were more devastating in dryland agriculture without ground water utilities' Government of India (2013: 29).

2. 'An insight into the rainfed regions reveals a grim picture of poverty, water scarcity, rapid depletion of the ground water table and fragile ecosystems' Government of India (2011: 4).

3. '…stopping farmer's suicides is the biggest challenge before the government and to meet it, we have undertaken a flagship programme… which aims at making 5000 state villages permanently water-scarcity free. If this succeeds, it will mark an end to farmer's woes. [Existing initiatives to relieve agrarian distress] cost crores[a] [which] went down the drain as [they] did not try to go to the root of the problem, which was inadequacy of irrigation': Maharashtra Chief Minister Devendra Fadnavis announcing the new rural development scheme in the state of Maharashtra (Deccan Herald 2015).

4. 'The fragile regions such as the Indian dry tropical areas have several nature-induced risks and vulnerabilities. Their specific features…such as a high degree of fragility, marginality, diversity and limited accessibility (when compared to prime land areas of the country) generate the circumstances that keep them poor and contribute to their low productivity…' Jodha et al. (2012: 3).

5. 'Rain-fed areas are confronted with the intrinsic problem of degradation of land and water…A vast proportion of rain-fed areas faces arid and semi-arid type of situations and receive scanty rains for nearly 50–55 days during monsoons, which is grossly insufficient to meet the year-round water requirement' Joshi et al. (2011: 224).

[a]One crore = 10 million in the Indian numbering system.

Source: Various sources.

As this small sample of comments illustrates, the prevailing discursive environment *causally* ties together climate, water, and agrarian distress in the rainfed drylands, which are viewed as 'fragile', 'intrinsically' prone to 'nature-induced risks', poverty, and marginality, particularly when 'compared to the prime land areas of the country'. Vulnerability is thus 'naturalized': understood to be primarily an outcome of biophysical factors—precipitation, aridity, and 'fragile ecosystems'. In this discourse, the line connecting these 'nature-induced' factors with hunger and poverty is straight, and it is short.

How does this discursive context play out in the policy and practice of water governance in the drylands, and with what impacts? To fully explore this question, it is first necessary to take a detour, briefly tracing the dominant features of water management for agriculture in India.

The Waterscapes of Indian Agriculture

Historically, the seasonality and intermittency of the Indian monsoon has not acted as the primary barrier to dryland agricultural communities in India. Farmers in these landscapes have enjoyed a rich legacy of successful water governance dating back to antiquity. An array of techniques, technologies, and practices has built on the seasonality of the rainfall to build stable and remarkably productive agricultural communities (see Agarwal and Narain 1997, for a seminal chronicling of traditional management techniques from across India). Technologies and practices show a great variety of forms, including capturing rainwater falling on open community lands (e.g. via structures called *kundis*[2]); harvesting flood water from streams and rivers; building embankments, gullies, and check dams to control soil erosion and improve percolation; and maintaining community tanks and shared wells to provide water for drinking and irrigation. Strategies have thus incorporated elements that, variously, increase storage, configure the flow of blue water (surface or ground), and manage green water through, for example, improving soil quality and biomass content. Crucially, these historical, communal arrangements have incorporated a number of governance practices focused on risk management, resource sharing, and long-term maintenance. For example, in the arid northern state of Rajasthan, groups come together to construct temporary dams called *hembars* over seasonal streams, from which water is channelled into users' fields. Construction is a group activity led by experienced local farmers, who manage both the physical infrastructure and the cropping pattern of beneficiaries—selection of crops, the area allowed to be irrigated, and the frequency of irrigation are the same for all members, irrespective of the size of their lands. To enforce the principle of equal entitlement to water for all members, tail-end farmers who may receive comparatively less water are encouraged to enter into crop-sharing arrangements with head-end farmers.

This body of knowledge and practice unfortunately entered into a long period of decline during the last decades of the colonial period and then

[2] *Kundis* consist of an artificially created circular microcatchment. Rainwater drains from this catchment into a covered well.

immediately following Indian Independence in 1947. The new Indian state was faced with a large agrarian population experiencing severe problems of food insecurity and poverty, driven in no small part by the dismantling of traditional resource management institutions set up during the colonial period and accompanying changes in socio-economic relations (Davis 2000; Jodha 1995). For the new Indian state, there was a general consensus that agricultural intensification was urgently required to deal with these challenges. In response, the thrust of water and agricultural policy shifted overwhelmingly towards increasing the availability of surface and groundwater irrigation, particularly in areas favourable for agricultural intensification. In the northern Indian states—the heartlands of the Indian Green Revolution—farmers received free electricity to pump groundwater, improved seeds, subsidized inputs, and minimum support prices. Output soared, and to commentators, this suggested 'the power of the new technology to liberate the fortunes of Indian agriculture from *the vagaries of the monsoon*' (Frankel 1971: 8, emphasis added). Groundwater abstraction rose phenomenally, with landowners given full rights to abstract water from aquifers on their land. High rates of abstraction continue to the present, with most groundwater abstraction controlled by individual landowners (Cullet 2014). The Green Revolution states of northern India are now perhaps 'the most heavily irrigated region in the world' (Tiwari et al. 2009: 1). Surveying aquifers in the states of Rajasthan, Punjab, and Haryana, Rodell et al. (2009) found that over a six-year period between 2002 and 2008, groundwater depletion in these states was approximately 109 km^3 of water—equivalent to around double the capacity of India's largest surface-water reservoir. Crucially, the last authors state that 'annual rainfall was close to normal throughout the period', as were other hydrological features such as soil moisture, surface flows, runoff, and biomass, suggesting that 'consumption…for irrigation and other anthropogenic uses is likely to be the main cause' of depletion (p. 999). Placing groundwater loss in the region in a global perspective, Tiwari et al. (2009: 1) state that 'this is probably the largest rate of groundwater loss in any comparable-sized region on Earth'.

In addition to increased groundwater abstraction, the Green Revolution was also accompanied by huge increases in surface-water

irrigation capacity through the implementation of minor irrigation works as well as large river-based infrastructure projects. From the second half of the twentieth century, India embarked on a programme of dam building that now places it third globally in numbers of large dams completed—some 5000 to date, with another 345 still under construction (National Register of Large Dams, n.d.). Drawing on British colonial legacies of building permanent headworks and elaborate diversion systems, 'irrigation was transformed from a seasonal to a perennial possibility' (D'Souza 2008). Accompanying hydraulic interventions was the systematic dismantling of long-standing traditions and institutions of water governance, and 'having thereby relentlessly extinguished other ways, techniques, arrangements, traditions and cultures for managing and conserving water in India, the large dam is still always pursued as the TINA (there is no alternative) option' (D'Souza 2008). At the same time, for policymakers, increasing irrigation potential represents a highly visible and politically expedient way in which to be seen to be doing something about agricultural productivity and for 'the national good'.

These modes of water management impose heavy social-ecological costs. An estimated 40 million citizens have been directly displaced by large dams in India, 'with possibly a mere tiny fraction of this huge number of oustees having managed anywhere near meaningful resettlement' (D'Souza 2008). Irrigated lands are now experiencing declining productivity. Around a million hectares of agricultural land in northwest India are affected by irrigation-induced salinization, caused by the application of poor-quality groundwater (Datta and de Jong 2002). In the state of Haryana, waterlogging and salinity cause losses estimated at US$37 million annually (ibid.). Datta and de Jong conclude their analysis with an observation that foregrounds the policy and economic drivers of degradation: '…*intensification* per se *is not the root cause of land degradation*, *but rather the policy environment that encouraged inappropriate land use and injudicious input use*, *especially excessive irrigation. Trade policies*, *output price policies and input subsidies all have contributed to the degradation of agricultural land*' (p. 223). In other words, the prevailing political economies and ecologies of land use have driven unsustainable overconsumption and degradation.

Perhaps most perverse has been the singular failure of irrigation projects to actually meet their own objectives. Analysing official data from the Union Ministry of Agriculture, Thakkar (2010) finds that between 1991 and 2007, some Rs. 142,000 *crores* (approximately US$ 21.4 billion) were spent on major irrigation projects with the stated objective of increasing canal irrigation. Yet, 'the official data shows that this whole expenditure…has not led to the addition of a single hectare in the net irrigated area by canals in the country for the whole of this fifteen year period' (ibid.). It is also clear that where irrigation potential has been created, it may not necessarily alleviate agrarian distress: water is appropriated largely by the powerful, articulate, and privileged farmers who are able to cultivate profitable water-intensive crops. This dynamics is well demonstrated in the state of Maharashtra, which has more large dams than any other state in India, but where the overwhelming majority of irrigation is appropriated by the vastly lucrative sugarcane crop, which is only grown on some 4 % of the state's agricultural land.

Finally, once established, projects do not necessarily provide water for long: siltation and lack of proper repair and maintenance have cut deeply into the storage and distribution capacity of existing irrigation infrastructure. Investment in creating new storage is not matched by the availability of funds to maintain it. A World Bank report, for example, finds that some Rs. 17,000 *crores* (just over US$ 250 million) are required *annually* for the upkeep of India's irrigation infrastructure, but less than 10 % of this amount is actually available (World Bank 2005) and even less is likely to be spent effectively (Thakkar 2010).

This irrigation-intensive model of agricultural intensification continues to this day, as does the long-standing neglect of rainfed areas. Landscapes without recourse to built irrigation infrastructures were relatively neglected during the Green Revolution, as evidenced by disproportionate discrepancies in dedicated investment and systematic planning relative to irrigated areas. Up to the late 1980s for example—during the height of the Green Revolution—investment in irrigation and flood control was *22 times* that dedicated to soil and water conservation in the non-irrigated zones (Vaidyanathan 1994). Until as late as 1985, rainfed zones were 'unrecognized in mainstream planning', and their first inclusion in the national planning process (during the Seventh Five Year

Plan period from 1985 to 1990) was accompanied by the admission that 'decades of neglect had led to dryland areas being caught in a vicious circle of high risk, low investment, poor technology and low production' (Chhotray 2011: 56). Yet, lethargy continues, as does a discursive environment naturalizing the problems of drylands. Though India's current (12th) Five Year Plan (2012–2017) provides for a National Programme on Rainfed Farming (NPRF), three years into the five-year plan period, the programme is yet to be implemented because of a lack of capacity to work at the local level in rainfed regions, which are considered by the policymakers themselves as 'resource-poor, unpredictable and diverse' (interviews with representatives from the Department of Agriculture and Cooperation, quoted in IIED 2015: 2).

It is against this background that scholarship and popular advocacy have called for alternative approaches to water and land management in the rainfed drylands. Mindful of the social-ecological perversities generated by top-down and technocentric models in irrigated landscapes, advocates have called for alternatives which are participatory, decentralized, and 'integrated' and which build local communities and ecologies. In regions with no access to centralized irrigation infrastructures, participatory watershed development (WSD) has evolved into the most widespread such alternative, and is now India's foremost strategy for (linked) dryland management and rural development. WSD projects have become an essential feature of the waterscape of the rural drylands, aiming to build social-ecological resilience and rejuvenate agricultural incomes that have until now lagged far behind those of farmers in irrigated regions. Projects, whether funded and implemented by either state or non-state development agencies, focus on single or small groups of villages which may be grouped together as a microcatchment. Within these boundaries, agencies work with local communities to implement soil conservation and rainwater harvesting, recharge aquifers, add vegetation, and set up community groups for resource management.

This approach largely mirrors the basic tenets of an integrated water resource management (IWRM) approach and crafts a 'complementarity between conservation and productivity objectives' (Kerr 2001: 1387). It represents a practical acknowledgement of the now well-recognized links between social and environmental well-being. As such, WSD has

been viewed as a strong countercurrent to the 'big project' mania that otherwise dominates Indian water governance, and as a departure from single-focus projects that restrict themselves to the provision of water for irrigation to the exclusion of other aspects of water use and management. Watershed projects also incorporate a long-term vision of stewardship. After the completion of five-year projects, the aim is that any water management structures that are built will be managed by local communities with dedicated bank accounts and management groups supporting this objective. Women's groups and small savings societies are set up during the project, and these are designed to continue after its completion with a view to encourage livelihood diversification. The autonomy of local communities is foregrounded, at least in theory, in stark contrast to the encounters between local communities and large irrigation infrastructures. Crucially, watershed projects are meant to offer a wider array of options than simply increasing the supply of blue water. Instead, there is a provision for 'dry issues' (Rockström et al. 2010) such as preventing soil erosion, improving soil quality, and adding biomass and organic matter. The potential for increased flows of green water is thus implicit in the practice of WSD, as is the recognition that low productivity in dryland landscapes is not exclusively a function of irrigation, but instead, can be improved by enhancing soil moisture, soil quality, soil organic content (SOC), and vegetation (Srinivasarao et al. 2014).

In summary, then, conventional approaches to increasing water supply have generated a number of social-ecological perversities which WSD, as a seemingly radical alternative, seeks to avoid. In what follows, I unpack this contention by exploring the long-term performance of watershed projects and tracing the dominant ideologies informing practice on the ground.

Unpacking Alternatives

WSD has enabled some remarkable transformations in rainfed dryland landscapes. A number of pioneering cases, notably the villages of Ralegaon Siddhi and Hivre Bazar in the state of Maharashtra, are lauded worldwide as exemplars of participatory, decentralized, and 'integrated'

resource stewardship. Yet, over time, it is becoming clear that the transformations seen in these seminal cases are not mirrored in more general practice. The evidence base is limited. Comparative and longitudinal analyses are rare, with most evaluations cast in the relatively instrumental idiom of rural development indicators, assessing changes in crop productivity and farmers' incomes mainly in the short-term following projects. Perhaps understandably, success is more visible than general outcomes—and failure is barely visible at all. Available empirical evidence highlights a significant gap between the potential and the reality of the watershed programme. Outcomes are found to be patchy, varying from 'the spectacular' to the 'once good but now not very good' (Samuel et al. 2007: 71). To explain this patchiness, early evaluations of WSD projects focused primarily on the social dynamics of project design and implementation. These cited factors such as lack of a proper participatory process, inequitable distribution of costs and benefits, and socio-cultural, institutional, and administrative barriers to sustained community engagement (see, among others, Bouma et al. 2007; Joshi et al. 2004; Kerr et al. 2000; Mishra 2010; Phadke 2013; Samuel et al. 2007, 2009; Sharma 2003).

Giving due credence to these factors, an emerging stream of scholarship nevertheless calls for a more fundamental critique. Scholarship in this stream interrogates the foundational premises shaping projects and their outcomes. Specifically, emerging evidence suggests that gaps between promise and reality may derive from the fact that watershed projects might be operating within the same *milieu* as that which governs Indian water management more generally. That is, watershed practice may be manifesting the dominant 'common sense', linking water scarcity directly with lack of rainfall, and centralizing the singular aim of water provision in response. Researchers have pointed out, for example, that programmes have relied on a number of 'myths' about water, rainfall, and climate—one being that rainfall has been progressively declining and that this underlies water scarcity (Batchelor et al. 2003). The Drought-Prone Areas Programme (DPAP)—a key initiative for WSD—for example, aimed to 'drought-proof' the rainfed drylands, and is premised on the need to minimize 'the adverse effects of drought on the production of crops and livestock and productivity of land, water and human resources' (Singh and Ballabh 2008: 162). In other words, the central problematic

was considered to be a question of rainfall and aridity. Finally, Calder (2005) highlights how incorrect assumptions about land–water interactions have underpinned the Indian WSD programme and resulted in *increased* groundwater abstraction and *reduced* access to common-property water resources for poor people, among other negative social-ecological externalities. For these scholars then, WSD practice is not simply suboptimal because of improper implementation. Instead, improper diagnosis of the problem drives the gap between promise and reality.

Further evidence along these lines is provided by recent research on the long-term outcomes of WSD in the state of Maharashtra (Bharucha et al. 2014). Interviews with farmers showed that they overwhelmingly thought of declining rainfall as the chief driver of water scarcity and agrarian distress, despite the fact that aggregate rainfall had not shown significant declines over a 100-year period (ibid.). Qualitative narratives also show that farmers may simply be viewing projects as avenues for the provision of irrigation rather than as a multifaceted and multipronged strategy to institute broad-ranging management across the social-ecological system. For example, some ten years after the completion of projects, beneficiaries described how '[t]here used to be only 50 wells in the village. Now there are 400! If previously 50 wells were being used for 400 acres, now one well is used for one acre! *This is an improvement*, *isn't it*?' (Bharucha et al. 2014, emphasis added). Well-digging is regarded as a non-negotiable, practical necessity, as exemplified by the following excerpt from a focus group (Box 4.2) in the study site.

Box 4.2 Focus group narratives on well-digging following watershed development (WSD)

Farmer 1: Suppose that today, I require some water. I have a shortage of water in the well for my fields. I do not have enough to drink. Then, I will immediately dig a bore well. [If] I have money with me, I will dig a bore[well].

Farmer 2: It's not just that. It's not just money. Suppose you take a bore[well] [*referring to focus group participant*]. Then [even] if I don't have enough money, even if I don't have anything—I will dig a bore[well]. I will do anything, I will take a loan, but I will dig a bore[well].

Source: Bharucha et al. (2014).

Other evaluations have found that following WSD, farmers may have been increasing the abstraction of groundwater based on erroneous beliefs about the potential of soil and water conservation to recharge aquifers. Samuel et al. (2007), for example, found that in recent years, farmers may have been tapping groundwater too deeply for it to be recharged by rainfall, thus weakening claims that WSD is driving a resurgence of rural prosperity via sustainable improvements to irrigation. There is also indication that farmers switch from traditional 'dry' crops such as millets and sorghum to relatively water-intensive crops following WSD, a transition that is then locked into place, as the switch to high-value cultivation costs money, making it prohibitive to switch back to dry crops offering relatively low returns (Bouma et al. 2007). In the state of Maharashtra, ten years after the completion of watershed projects, farmers almost unanimously reported the decline or cessation of the cultivation of 'dry' crops such as horse gram (*Macrotyloma uniflorum*) and moth bean (*Vigna aconitifolia*) (Bharucha et al. 2014). Thus, rather than WSD being used to strengthen the resilience of rainfed cultivation, it is instead acting as a catalyst for the transition to a relatively high-input regime of irrigated, commercial cultivation. Interviews with farmers revealed that this change is overwhelmingly framed with reference to the climate. That is, farmers state that traditional 'dry' crops can no longer be grown because there is not enough rainfall to do so. Yet, both horse gram and moth bean possess immense adaptability to conditions of poor soil and low rainfall; traits that have ensured their place as traditional staple crops in dryland India (Brink and Belay 2006; Gadgil and Guha 1992; Nene 2006). In further conversation, it became clear that farmers were in fact simply turning away from rainfed cultivation altogether, viewing it as a negative choice rather than as a regime to be strengthened by WSD. Instead, they described how WSD had provided greater access to irrigation, allowing them to cultivate more irrigated and lucrative crops: '[W]e do not have to grow crops which are wholly dependent on the rainfall' (Bharucha et al. 2014: 9). For these farmers then, WSD is viewed as a means to increasing the availability of water for irrigation, as a catalyst away from rainfed cultivation and as a means to intensify cultivation of relatively lucrative crops.

What does this mean for the social-ecological resilience of rainfed dryland communities? Are farmers who have used WSD to intensify

cultivation more or less vulnerable than before? Conversations around these themes are notably absent in the scholarly literature, which largely neglects to collect systematic accounts of the lived experience of 'project beneficiaries' over time. For interviewees in Maharashtra, the increased abstraction of groundwater for farming has not necessarily alleviated the *experience* of water scarcity and there is still a dominant perception that rainfall remains the ultimate arbiter of water availability (Box 4.3), even as well-digging and the intensification of irrigation continue apace (Bharucha et al. 2014).

Box 4.3 Farmers' narratives on water scarcity, rainfall, and watershed development (WSD)

'In the end, what ultimately determines a farm's viability is rain. WSD cannot buffer against major changes in climate. The WSD advantage so far is only that there is a slight increase in water and therefore slight shortages can be buffered'.

'In dry regions, there is no alternative except for it to rain. Suppose it were a place serviced by a canal. Even if it didn't rain, they could release water from a dam, then people could carry on. There is nothing like this here'.

Source: Bharucha et al. (2014).

Taken together, these narratives suggest a process in which the attribution of deepening scarcity to rainfall goes hand in hand with—or even enables—the continuing unsustainable abstraction of groundwater. Tellingly, groundwater abstraction and the intensification of irrigation are both strictly regulated in the seminal WSD cases on which the contemporary programme is based. Grassroots community work in Ralegaon Siddhi, for example, has included long-term rules limiting the cultivation of water-intensive sugarcane and the sinking of deep bore wells. By contrast, on-the-ground experience in contemporary projects tends to show the process moving in exactly the opposite direction: WSD becomes a means by which individual farmers justify increased abstraction of groundwater, though these claims do not necessarily hold in the light of what is known about the links between water conservation and aquifer recharge (cf. Samuel et al. 2007).

We are thus faced with a situation in which both conventional water management and well-regarded, 'integrated' alternatives are bound together by a metanarrative wherein the problem is viewed as climate-driven scarcity and the solution is almost always to increase water supply. Perverse impacts follow from both. Whereas these have been comprehensively chronicled with regard to large dam and canal projects, emerging scholarship on the unintended outcomes generated by alternatives is only just developing. What evidence that does exist highlights the need for a critical rethink of the assumed links between climate, scarcity, and agrarian distress. A multidisciplinary body of literature critically analyses agrarian distress, land degradation, and the impacts of drought as complex multicausal phenomena rather than as singular outcomes of inadequate rainfall. Empirical work finessing this nexus of issues loosens the links between climate, scarcity, and distress that are so tightly woven together in the 'accepted' reality of water and land management. It is impossible to provide a comprehensive review of this literature in the space of a single chapter; what follows is simply a brief overview of some of its key themes and insights. These open up new spaces and potentials for effective water governance that contributes to social-ecological resilience.

The first vein comes from critical accounts of environmental and economic history. These have nuanced our understanding of the links between drought, agrarian distress, and famine by highlighting the influence of particular political and economic configurations that either amplify social-ecological vulnerability or block communities' abilities to adapt to the vagaries of climate. The seminal work of Mike Davis comprehensively and powerfully illustrates the specific influence of national and international economic policy in driving agrarian distress during the nineteenth-century El Niño (Davis 2000). For Davis, neither the fact that rainfall was insufficient nor Malthusian explanations of population growth driving famine adequately explain the scale of damage and degree of suffering experienced around the world during the nineteenth century. Instead, the incorporation of peasant agronomies into global commodity chains, the dismantling of traditional systems of crisis management (e.g. locally controlled grain stores), high unemployment, and high prices all combined to 'turn drought into famine' on a catastrophic scale. Davis quotes the Famine Commissions which found that 'supplies of food were

at all times sufficient, and it cannot be too frequently repeated that severe privation was chiefly due to the dearth of employment in agriculture [arising from the drought]' (in Davis 2002: 161).

Scholars focusing on India were particularly exercised by these questions following the central Indian drought of 1972. Oughton (1982) shows how human suffering associated with the drought was not exclusively the result of inadequate rainfall. Instead, agrarian distress was generated by the combined impacts of the relatively low spread of irrigation, the adoption of water-intensive cash crops in surrounding districts rather than of cereals, and a poor public food distribution system that did not effectively distribute aid. Examining the causes of increased vulnerability to drought in India, Kumar (1988: 1) begins by noting that 'despite no changes in rainfall patterns, there is evidence that droughts have been causing successively larger variations in employment and rural incomes'. He proceeds to highlight the macroeconomic factors that underlie drought vulnerability and concludes that interregional inequality needs to be directly addressed through 'a much larger effective level of public investment in agriculture—with particular emphasis on the poorer rainfed regions' (p. 30).

In a different vein, the role of water-intensive crops is critically examined in the context of contemporary struggles over water and sustainable dryland livelihoods. For example, commenting on agrarian distress in the state of Maharashtra, the South Asia Network on Dams, Rivers and People (SANDRP 2015) discusses the case of sugarcane cultivation in the district of Marathwada. SANDRP acknowledges that the region is water-limited and even 'drought prone', but questions why, nevertheless, 'in 2013, Marathwada grew over 2 *lakh*[3] hectares of sugarcane and is now crushing the cane in its 61 sugar factories using thousands of *lakhs* of water every day'. In another report on the perverse juxtaposition of water-guzzling crops in water-limited landscapes, SANDRP describes how, in the district of Solapur, '[i]n 2012–13, a year that was called a drought year, worse than (the) 1972 drought, Solapur added 4 new sugar factories' (SANDRP 2013: 2). Following SANDRP, then, we may say that while limited rainfall is a

[3] 1 *lakh* = 100,000 in the Indian numbering system.

key driver of water-limited landscapes, it is water-intensive cropping patterns that push the boundaries between water limitation and water scarcity. At landscape and catchment level, the appropriation of water by sugarcane farmers and politically powerful sugar producers directly affects water for drinking or for the cultivation of other crops. In Solapur, 'sugarcane and "tanker fed" villages co-exist' (SANDRP 2013: 6)—that is, water for drinking and household use is provided by a state-run tanker service, while local supplies of water are diverted to sugarcane cultivation. These cropping patterns impact both food and water security. In Marathwada, water shortages have driven so-called cattle camps—the distress sale of cattle by farmers unable to support them through a dry period. A recent interview with a researcher-activist on Indian water management highlighted '*possibly one of the most tragic ironies of Maharashtra today*: [*that*] *the cattle are fed with sugarcane fodder*'. The same activist also highlighted how grassroots agitations for drinking water coincide with the continued use of water for sugarcane cultivation and crushing:

> *While he* [activist Prabhakar Deshmukh] *was sitting on a fast for drinking water, sugarcane factories in his own village, 3 sugar factories, one of them belonged to Pawar, were actually crushing sugarcane using nearly 6* lakh *liters of water per day. So we are not talking only about water for livelihood security. We are talking about drinking water security, water as a fundamental right to life, which is also sabotaged by sugarcane. And it's not a one-off case. It is a recurrent example…* (Interview with researcher-activist on Indian water management, January 2015)

Commenting on the links between the local elite, sugarcane cultivation, and agrarian distress in the dryland district of Marathwada, an article in the newspaper *Economic Times* observes:

> *Sugarcane cultivation and sugar industries have for decades received privileged treatment, thanks to the factories being either owned or controlled by the state's politicians. In 2012–13, Marathwada added 20 sugar factories even as villages were supplied drinking water through tankers. Today, there are around 11* lakh *hectares under sugarcane and 205 sugar factories in the state, of which 70 are in Marathwada alone.* (Mohan 2015)

A third stream of critical insight is generated by political ecologies of water management and agrarian change. Mehta (2001) developed a seminal political ecology of water allocation in the dryland landscapes of India, revealing how narratives of water scarcity dominate both the politics and the everyday lived experience of people in the semi-arid Kutch region of Gujarat. She shows how these narratives are used to justify centralized irrigation infrastructures—in this case the Sardar Sarovar Dam—which will supposedly alleviate scarcity by increasing the supply of irrigation. Mehta carefully unpacks these narratives to reveal how the spectre of '*dwindling rainfall and increasing droughts…can also be "manufactured" in such a way to serve the interests of powerful actors…*(*These*) *popular perceptions of scarcity*, *as represented in the mass media and by politicians and advocates of the water question*, *have naturalized scarcity in Kutch*' (p. 2026). For those holding this view, 'there is unambiguous consensus…that climate change, independent of human intervention, exacerbates the problems of water scarcity' (p. 2029). Yet, as Mehta shows, there have been no significant changes in rainfall that might explain these popular perceptions. Long-term analysis of rainfall patterns reveals that rainfall has always been variable, and no statistically significant reductions are yet discernible. Instead, as Mehta reveals, water use has increased significantly, driven by rising demand from a growing population and the intensification of agriculture. Farmers have increased the number and depth of bore wells, and de-vegetation has led to increased soil erosion and reduced aquifer recharge. Thus, the spectre of agrarian distress is a powerful tool with which to justify dam building and other measures focused on the narrow goal of increasing water availability. The same dynamics are discerned in the state of Maharashtra, where observers highlight how the construction of large irrigation infrastructures

> *…is an enterprise between businesses and politicians* (*that*) *has nothing to do with water availability especially for the poor. Examples where the poor got water from a dam are very*, *very rare. They do exist*, *I don't say that they don't exist at all. But if you compare them with the number of dams that we have*, *and the slogans that we've been giving for the past 50 years*, *it doesn't hold ground at all.* (Interview with researcher-activist on Indian water management, January 2015)

The establishment of these infrastructures dovetails with the 'lock in' of a relatively water-intensive agricultural commodity complex which, over time, has actively impeded resilience by displacing drought-adapted crops and established livelihoods. In Maharashtra, traditionally prosperous oilseed-dominant agroecosystems have flourished within water-limited conditions. Yet at present: '*[O]f the 16,000 ha expected of oilseed, only 2000 ha are actually cultivated. So much oilseed has just not been planted. Instead, they are cultivating sugarcane because of the sort of security that the sugar factories give them. There is no such security when it comes to oilseed*' (interview with researcher-activist on Indian water management, January 2015).

Finally, new evidence on the sustainable intensification of agriculture shows the remarkable outcomes that can be achieved in rainfed dryland landscapes where green water, soil health, and biodiversity are well managed by local communities themselves. Rainfed dryland communities which have focused on 'dry' issues (Rockström et al. 2010) have seen huge increases in productivity and resilience. The Sahel provides a particularly powerful example. Here, some three million hectares of previously degraded land have been improved through a combination of soil conservation and the cultivation of some 120 million trees. In the mid-1980s, restrictive policies prohibited farmers from managing trees on their own lands; this was accompanied by creeping land degradation. The relaxation of these policies, coupled with the promotion of agroforestry, has seen farmers actively managing so-called fertilizer trees on their lands (Pretty and Bharucha 2014; Pretty et al. 2011). Farmers plant nitrogen-fixing species (e.g. *Faidherbia albida*) on and around cereal fields, and community groups have implemented small-scale water harvesting to capture rainwater and improve soil moisture. A stream of positive externalities has emerged, including aquifer recharge, improved soil health, and improved availability of firewood fodder and other non-timber products. In all, the 'Green Wall of the Sahel' has resulted in substantial increases in food production—some 500,000 additional tonnes of food per year (Reij et al. 2009). Similarly, in Malawi, Tanzania, Mozambique, Cameroon, and Zambia, cereal production has increased from five tonnes to eight tonnes over a five-year period (Asaah et al. 2011; Ajayi et al. 2011; Pretty et al. 2011). While the long-term outcomes and political ecologies of these schemes need to be explored in further detail, these examples nevertheless

do show the potential of interventions which do not focus solely on increasing water supply. Instead, strategies for sustainable intensification in drylands can generate significant improvements through the management of soil, green water, and vegetation.

In summary, these different streams of scholarship open up the conversation about climate, scarcity, and rainfed agriculture. They show that vulnerability is not as tightly bound to the climate, and specifically to declining rainfall, as the dominant narrative in India suggests. There is much potential for an 'opening up' of land and water management beyond simple technical measures to increase water availability. Perhaps ironically, the importance of this 'opening up' will only *increase* as climate change advances and climatic pressures become increasingly immediate. As this occurs, it will be ever more important for rainfed farmers to have a well-developed and diverse suite of options to maintain all-round social-ecological resilience.

Going Forward

This chapter discussed the prevailing paradigm governing land and water management in the rainfed drylands of India. Assumptions of naturalized scarcity as the primary driver of agrarian distress have coloured both conventional and well-regarded alternatives such as WSD. Though integrated, community-scale management was initially meant to strengthen rainfed cultivation, evidence on its outcomes and critical analysis of stakeholders' narratives show that WSD is embedded within the very same paradigm as conventional 'business as usual' irrigation management in India. Across both irrigated and rainfed landscapes, the prevailing vision valorizes water availability as the primary criterion of water management, increasing supply of blue water to cultivate relatively water-intensive and lucrative crops. For farmers working in rainfed landscapes, however, this does not enable resilience over time. Instead, short-term spikes in productivity and incomes precede the return of a narrative of water scarcity (Bharucha et al. 2014). The continued attribution of these outcomes to rainfall means that potentially useful management measures, such as introducing rules on cropping patterns and limiting well-digging, are not implemented.

At the time of writing, the state of Maharashtra is once again faced with the prospect of dry spells affecting the rainfed cotton crop. It has been reported that the government is considering employing a private agency to undertake cloud-seeding to encourage rainfall (Economic Times 2015). So, both the spectre of scarcity and the supposed saviours of increased rainfall (or more blue water) are still powerfully in play. With increased concern about global climate change, the intensity and variability of the Indian monsoon are both likely to be exacerbated, as are regional disparities between water-abundant and drier areas (Roy 2006). It would be easy to conclude that while the impact of climatic factors has thus far been overstated, it should now be at the front and centre of the conversation. And yet, it is quite clear that dryland communities are 'double-exposed'—vulnerable on two fronts, to both climate change and the imperatives of capricious markets (O'Brien et al. 2004). The received wisdom is that both can be navigated if we simply increase the amount of water available. However, efforts to do so have not only failed to alleviate agrarian distress, but also introduced a whole array of social-ecological perversities that increase vulnerability to climate change when it does occur.

The streams of evidence and critical scholarship that have only just been briefly summarized in this chapter converge to reveal very real opportunities for a genuine transformation towards sustainability and resilience. These bodies of scholarship widen the space between climatic 'givens' and outcomes on the ground. In doing so, they reveal the wide array of strategies that may be employed to build social and natural capital over and above the provision of increased water for irrigation. It is time to recommit to forms of governance that build on the long-standing competencies of agricultural communities, and employ them to build resilient rainfed agriculture, rather than chasing the mirage of superabundant water in dryland landscapes.

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5

Water, Land, Socioterritorial Movements, Labour, and Capital: Territorial Disputes and Conflictuality in Brazil

José Sobreiro Filho, Bernardo M. Fernandes, and Tassio B. Cunha

Introduction

This chapter is the result of a collective effort by a group of geographers in which we propose a territorialized reading of certain complex questions related to water, land, socioterritorial movements, capital, and labour in contemporary Brazil. Our starting point is that an understanding of territorial issues is fundamental as part of an integrated approach to sectoral issues, and that we need to understand territory as being something more than just the ground surface of an area of land. Territory is more than surface; people are also territories. We make reference to actions that produce social relations and, in that sense, create territories. People create territories as much as territories create people. Territories and people are therefore inseparable. We emphasize the complexity of socioterritorial relations, and argue

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that a territorialized understanding is essential when analysing disputes over natural resources and the processes that produce new territories. Territorial disputes are key when considering power relations through a typology of territories, meaning that a multidimensional analysis is required; in a one-dimensional examination of a territory as simply an area of land, these realities are likely to be overlooked.

As a result, water, land, labour, capital, and social movements are fundamental aspects of territory, which must be considered if we are to understand the conflicts involved in territorial disputes and territorial development models in both the countryside and urban areas. Understanding these issues is essential when considering how spaces are created within society and examining how different models of production express antagonistic or converging class interests. Failure to consider the reality of these conflicts limits our understanding of geographical and historical processes.

The chapter is organized as follows: first, we undertake a multi-scale reading of territories as a whole that allows us to identify power relations which are often obscured when the concept of "territory" is only considered in terms of the biophysics of the earth's surface. Next, we discuss water-related conflict across Brazil and the formation of the Brazilian Movement of Dam-Affected People (MAB). Finally, we assess the concept of "agro-hydro-business" (*agrohidronegócio*), applying our analysis to the case of a project to transfer water from the São Francisco River in Brazil's Northeast Region.

Territorial Disputes and Conflictualities

The term "territory" is most often used to refer to the land surface of a country, or part thereof. However, this understanding of territory as simply state land can limit our understanding of the multidimensional, multi-scalar, and diverse nature of a given territory. With this in mind, Fernandes (2009) presents a typology of territories which aims to move beyond a vision of the governance of space and the separation between subject and space. According to this analysis, territory is produced or created by the actions or relationships of those who inhabit the territory.

As the subjects shape the territory, they are also shaped by the territory. Governments create the first territory within a state, which is the space of governance in which people live. Many scholars stop at this point, not venturing to further explore the concept of territory (Fernandes 2013).

We propose an exploration of the various territories that exist within the first territory or space of governance. In this chapter, we consider water to be one of these territories, in addition to the land, its inhabitants, labour, and capital. Because subjects, relationships, spaces, and territories are undividable, they are multidimensional and multi-scalar; all are territory relations and subjects. Fixed and fluid territories are produced within the first territory and can be called second and third territories, respectively. Other properties of the nature of territory are materiality and immateriality; ideas, concepts, theories, ideologies, and energies are immaterial territories. Social relationships produce territories and territoriality, and these relationships in turn may also be defined by how territories are used. But productive relationships within territories may also destroy and reconstruct territories in a process of territorial dispute, generating conflict. These processes are called Territorialization, De-territorialization, and Re-territorialization, or the acronym "TDR" (Fernandes 2009).

The production of new territories is the result of relationships of power. New territories are produced when subjects intentionally seek to reproduce a certain social relationship. The intentionality determines the use of the territory, that is, its territoriality. Each institution, including the state, capital, and the labour force, produces its own territory. In this chapter, we analyse the territorial disputes between different social groups and organizations over land, water, and labour, whose availability are essential conditions for life. Land and water become territories when a particular group or class appropriates these resources and either restricts access to them or allows others to use them. In this case, land refers to any type of property, either public or private, and is a fixed, or second, territory. A river, on the other hand, would be a fluid, or third, territory.

However, it is essential to understand that, like nature and society or subject and space, land and water cannot be dichotomized. Social movements are themselves socioterritorial interactions that only exist because space and subject are inseparable. These movements are institutions of

organized society in which members participate in meetings with other institutions in order to claim their rights, their land, and their water, such as in meetings with governments, businesses, and so on. Social movements exist within specific territories, produced by territorialized cultures and economies as forms of spatial management. State and capital also constitute institutions of the management of various territories. These forms of management produce and are produced by economic development models that are at the service of different social classes. The capitalist development model, for instance, excludes the working class and rural workers, or subordinates these groups to the politico-economic priorities of the dominant classes. As a result, in territories shaped by rural workers, relationships with capitalist corporations are usually avoided so that the processes of exclusion and subordination can be minimized.

Different models of economic development compete for state and national territory, as discussed later in this chapter in relation to several ongoing processes in Brazil, namely the MAB, agro-hydro-business, and the São Francisco River water transfer project. The first is a rural workers' movement and the second is an amalgamation of capitalist corporations with state support, which has turned land, water, and people into a business. Through these examples, we will show how territorial disputes and development models produce permanent conflicts, because they promote de-territorialization and re-territorialization: a clear example of territorial disputes.

A territory can contain conflicts because it is a power space. Like land, water, and the people who rely on these resources, models of economic development are also territories. When agro-hydro-business appropriates territories, it creates its territoriality through the expropriation of other non-capitalist social relations, such as those involving rural workers, indigenous groups, and Afro-descendants. This set of permanent conflicts produces a process we call conflictuality, which shapes conflicts over land, water, labour, methods of production, and class perspectives on the use of territories.

Such a multidimensional perspective allows us to visualize the scales and types of conflicting territories. It helps to overcome the narrow modern–backwards binary through consideration of the fact that every social relationship has its own time and space and thus produces its own reality. Therefore, it is not possible to compare the territories of agribusiness with

those of rural workers using elements of one or the other. Each territory is produced by different social relationships, and each social relationship produces a different territory. At the centre of this analysis is labour, which is the main social driving force in the production of territories. Labour, exploited by capital, created and recreated in territories, is a producer of wealth, and wealth is concentrated within corporations. Likewise, unemployment and the conditions for expropriation are generated by capital and form socio-spatial and socioterritorial movements. Alienated labour produces socio-spatial movements, bearing in mind that employed workers produce and reproduce within the territory of capital; therefore, they do not produce their own territories as small farmers and indigenous groups do, but produce and reproduce capitalist territories. The reactions of employees may produce spaces or territories of resistance within capital's private properties, although these do not constitute their own territory. This is the example of Brazilian Unified Workers Confederation (CUT), the main trade union movement in the country, which represents exploited labour and promotes resistance to capital. As a socio-spatial movement, it produces various resistance territories or spaces, defending workers' rights. It is important to clarify that workers can create spaces or resistance territories within the territory of capital or the government, that is, within the second or first territory, when they strike, picket the workplace, or use strategies such as work to rule to reduce yield.

These concepts should help us better understand the processes shaping the Brazilian countryside, where territories are increasingly subject to disputes between multinational corporations and different types of farmers, triggering the counteroffensive of socio-spatial and socioterritorial movements such as trade unions and rural workers' organizations. This idea is important in the next two parts of the text. The typology of territory, conflictuality, and territorial disputes can only be fully understood in the context of class struggle and through a critical analysis of the hegemonic model of economic development. This perspective challenges the common view of subaltern classes as passive to the initiatives of capital as all the examples studied in this chapter involve resistance to capital or government policies. Workers and small farmers strive for their own spaces and territories, proposing new models where they can act as protagonists.

The Struggle for Water and the Movement of Dam-Affected People

The Movement of Dam-Affected People (MAB) was founded in response to the established Brazilian energy generation model with the aim of creating spaces for struggle and resistance (MAB 2011). It has principally been associated with conflicts generated by the implementation of mega-projects, such as the Itaipu Hydroelectric Plant (a binational project between Brazil and Paraguay), which displaced thousands of families in eight districts in the far west of Paraná State in the 1970s (Fernandes 2000: 65). First reactions to this project came in the form of the Earth and Justice Movement, with support from the Pastoral Land Commission (CPT), a branch of the Catholic Church based in the Uruguay River Basin in the southern States of Santa Catarina and Rio Grande do Sul. This movement played an important role in the initial formation of the MAB. The next step was the creation of the Regional Commission of People Affected by Dams, which territorialized the struggle and extended it to Itaparica in northeastern Brazil,[1] specifically in response to the building of the Moxotó and Sobradinho dams in the 1970s, with support from the Middle San Francisco Trade Union Hub.[2] In the following decade, the movement was territorialized in Pará, encompassing the struggle and resistance against the Dams and expropriations along the Tocantins River and the formation of the Movement of those Displaced by the Tucuruí Dam and the Commission of People Affected by the Tucuruí Dam (CAHTU). In the south, the struggles continued with other territorialized movements, such as the campaign against the power plants of Itá on the Uruguay River and Machadinho on the Pelotas River on the border of the States of Rio Grande do Sul and Santa Catarina.

These conflicts were directly related to the national and international energy crises that followed the oil crisis of 1973. According to Foschiera (2009), the installation of low-cost hydroelectric power—

[1] Itaparica is located between the States of Bahia and Pernambuco in the São Francisco basin.

[2] The Middle San Francisco Trade Union Hub was the main inter-union organization that arranged rural workers of many municipalities of the Meddle São Francisco and the Land Pastoral Commission (CPT) in the 1970s and 1980s.

low-cost in relation to the amount of energy generated—financed by the Brazilian government (usually with the assistance of foreign loans) aimed to provide the country with the infrastructure needed to achieve its capitalist goals, such as producing metal. However, while these projects were cheap in monetary terms, more than one million people were negatively affected by the dams. As a result, the dam projects provoked numerous reactions and territorialized struggles that emerged simultaneously with other socioterritorial movements in the country, such as the Landless Workers Movement (MST), which was officially established in 1984, although it had existed unofficially since 1979 (Fernandes 2000).

Socioterritorial movements such as the MST and the CUT had their roots in the political uprisings that took place during Brazil's military dictatorship (1964–1985). This is also the case of the MAB, which came into existence during this period, even though it was not officially established until 1991. Foschiera (2009) explains that the first National Conference of Workers Affected by Dams took place in 1989, and it was there that the decision was taken to build an organization on a national scale. It was not until 1991 that this organization was officially established; the first National Congress of People Affected by Dams[3] was held in Brasilia on 12–14 March of that year.[4] At this first meeting, the group discussed the large-scale dams being built and the impacts of their construction on local areas and populations. The MAB Congress took place during a period of democratic advances in Brazil, following the establishment of the Federal Constitution of 1988, which had made it easier for the government to make policy decisions and enact changes. However, the land question remained one of the greatest constitutional problems for the working classes, and government policy remained repressive, with calls for change restricted to the socioterritorial combative movements.

[3] According to *A Enchente do Uruguai* [The Flood of Uruguay], the Congress was attended by over 200 participants from different entities, including representatives of the Brazilian Social Democracy Party (PSDB), Workers' Party (PT), Brazilian Socialist Party (PSB), Communist Party of Brazil (PC do B), and Democratic Labour Party (PDT). The Brazilian Democratic Movement Party (PMDB) sent a letter of solidarity.

[4] It was also decided that the 14th of March would be marked annually as the National Day of Action Against Dams.

Moreover, following the election of a new government in 1990 with a clear neoliberal manifesto, Brazilian markets were opened to imports and privatization. The government maintained strong ties with large estate owners, who tended to be hostile to agrarian reform policies, resulting in an environment hostile to family agriculture. This marked a new chapter in the struggle for land in Brazil, leading the movement to intensify its protests and calls for the mobilization of affected people. The book *A Enchente do Uruguai* [The Flood of Uruguay] presents an analysis of the Congress in the context of this process and the resulting space of political socialization. According to the book, the following demands were put forward during the Congress:

- Agriculture policy: crop markets with guaranteed minimum prices, agricultural insurance, and special credit guarantees for small and medium farmers;
- Droughts: emergency credit for farmers affected by droughts, release of blocked funds without adjustment and extension of financing, as well as the expansion of the Feaper insurance programme;
- Agrarian reform problems: settlement of 5000 families until 1991, resettlement of families living in tent camps, credit channels, and technical assistance for those already resettled;
- Health and social security: observation of constitutional retirement rights for rural workers, regularization of the social security system;
- Energy policy: participation of the working class in energy policymaking, resumption of negotiations on dams constructions and the related projects, suspension of work on the Machadinho dam and of the sale of local land, release of public funds blocked by the Collor government (1990–1992);
- Education: an end to discrimination against women in textbooks and classrooms, education focused on rural areas, resources for education in tent camps and rural settlements, integrated education centres (CIEPS) in rural areas.

At the end of the Congress, these demands and a transcript of the discussion that took place were published as the *Letter from Brasília*. The publication of the letter was a historical milestone as it was the first

document to unify the voices of the collective struggle and to express these voices as a list of social demands, pointing to future prospects and helping to forge the identity of the MAB. It was a milestone in the process of territorialized struggles in Brazil, and a precursor to the general list of demands still used today by the MAB (1991: 8):

- Immediate fulfilment of agreements reached between the MAB and the energy sector, aimed at remedying the situation of those affected by dam construction;
- Prioritizing resources from the electricity sector to solve the serious social and environmental problems arising from the construction and operation of dams;
- New dam projects only to be implemented where definitive solutions to any resulting social and environmental problems have been agreed;
- An end to privatization of state-owned power companies, which belong to the Brazilian people;
- Reform of current energy policies with the participation of those affected and wider society;
- Reform of irrigation policy and public irrigation projects, which should aim to benefit rural workers;
- Full respect for the territorial rights of indigenous peoples and immediate demarcation of indigenous lands and the lands of *quilombo* communities (descendants of African slaves), and wider agrarian reform.

Although these demands have not been met, the fact that an organized movement exists, that the struggle has been acknowledged and the problems have been explicitly questioned, represents a major achievement during this period and an important milestone in the historic process of socioterritorial struggles in Brazil. The MAB is also significant for the fact that it addresses major environmental issues as well as the struggle for land, attempting to challenge the destructive agenda of capitalist organizations and protesting against the state's prioritization of development projects at the expense of grassroots interests, traditions, and cultures. The creation of the MAB enabled various groups to organize themselves into a unified movement, allowing them to intensify their fight and gain visibility both nationally and internationally.

The emergence of the MAB was also important in terms of reinforcing the struggle of other socioterritorial movements against capitalist agendas and, above all, demonstrating the need for real energy democratization. The unified struggle has been grounded in the fact that, historically, the affected populations had virtually no say in decisions relating to national energy initiatives, especially with regard to large projects. As part of its fight for re-territorialization, the MBA brought together struggles over energy territory, land territory, and water territory, as well as other forms of resistance against corporations; it has now been established that these struggles are inseparable. MAB fights made explicit the multidimensionality of territorial developments and the class differences between rural workers and capitalist interests. Thus, the MAB plays a key role in the struggle for water, which, as well as the struggle for land, is a historic fight in Brazil.

Data on water conflicts in Brazil between the years 2002 and 2014 are presented in Fig. 5.1. Such conflicts result from clashes of interest between rural workers, large-scale farmers, and capitalist corporations, and also relate to the appropriation of dams and lagoons by powerful private interests, resulting in socio-ecological tensions such as water pollution, the threat of expropriation, limits on access to fresh water, displacement and/or inadequate resettlement of rural workers, destruction of historical and cultural interests, and poaching, among others. The data used to produce this diagram were systematized and digitally stored by CPT and are presented in the publication *Conflitos no Campo Brasil* [Conflicts in the Brazilian Countryside] (CPT 2014).

This map shows that conflicts over water take place all over the country, in all states; just like the struggle for land, the struggle for water is a national issue. The struggles for land, water, and energy, and also education, health, housing, and infrastructure, are territorial struggles that comprise a search for a development model that is not limited to the interests of capital, but prioritizes the needs and interests of the population. While capitalist interests need to control and exclude in order to grow, ordinary Brazilians put demands for social inclusion at the centre of development.

It is clear that the people affected by development are reacting, as shown by the increasing number of demonstrations organized by the MAB, illustrated in Fig. 5.2. This graph shows that people are willing to

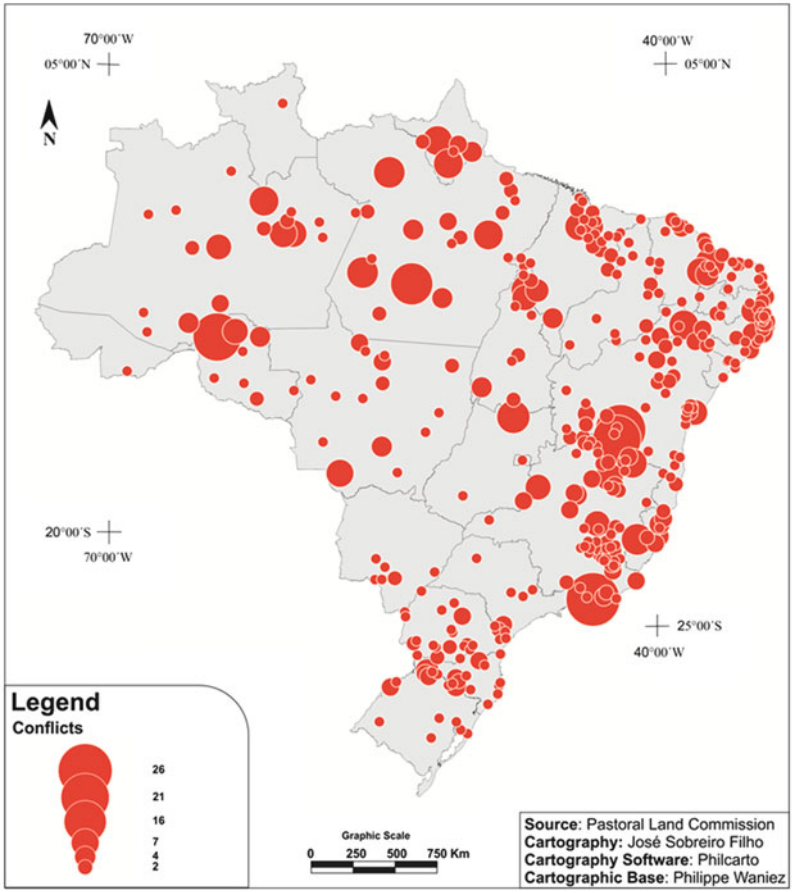

Fig. 5.1 Brazil—water conflicts 2002–2014 (number of conflicts by municipalities)

take action and get involved in mobilization, expressing their political, religious, and ideological beliefs by demonstrating in various different ways, including marches and camps, public hearings, occupations and blockades, building sieges, picketing of bank branches and other public and private buildings and spaces, congregation in public spaces, hunger strikes and fasts, manifestoes, processions, vigils, pamphlets, collective hikes, and even group hugs in symbolic locations.

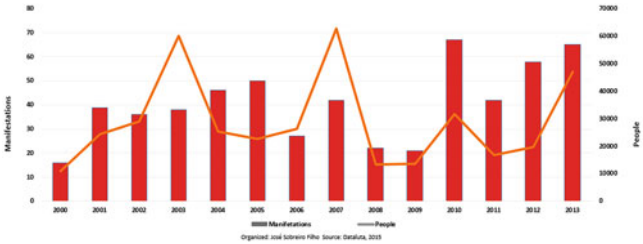

Fig. 5.2 Brazil—movement of dam-affected people—individual or shared manifestations 2003–2013

The MAB is the result of different conflictualities, trajectories, traditions, and regional specificities coming together. It is a national movement that brings together various practices and strategies, encompassing multiple cultures, political values, and realities. As pointed out by Vainer (2002), there are common denominators that dialectically reflect the existence of a collective drive, building an identity around the phrase "*I am someone who was assaulted*". Various contexts and ways of life are united by this shared experience, including farmers, fishermen, riverbank residents, urban dwellers, and so on. This unified and unifying fight, whose motto is "water for life and not for death", is also expressed in interactions between the MAB and other socioterritorial movements,[5] especially those involving farmers and smallholders (Table 5.1).

Diversity is a key feature of the MAB, be it cultural, political, or socioterritorial, dialectically transcending and articulating scales. In addition, a reality that is multi- and trans-scalar is not restricted to the MAB, but permeates various movements operating at national and international level, such as the MST, the MPA (Small-scale Farmers Movement), the MNCI (National Indigenous Campesino Movement, Argentina), Via Campesina, and so on. These are movements that maintain links with other forms of mobilization and that are diverse because they emerged from different political uprisings in different spaces. Understanding local conditions, circumstances, and socioterritorial relations is fundamental to an understanding of each specific experience, but in addition, these struggles cannot be understood without considering the historical context and the prerogatives

[5] On socioterritorial movements, see Sobreiro Filho (2013).

Table 5.1 Occupation of individual or shared properties by MAB (Movimento dos Atingidos por Barragens) - Movement of People Affected by Dams and MST (Movimento dos Trabalhadores Rurais Sem Terra) - Landless Workers' Movement - MMA (Movimento das Mulheres Agricultoras) - Women Farmers' Movement (2001–2014)

State	Municipality	Site name	Families	Socioterritorial movement	Date of the occupation
RS (Rio Grande do Sul State)	Júlio de Castilhos	Fazenda Bom Retiro	1100	MAB	27/03/2001
SC (Santa Catarina State)	Ponte Serrada	Fazenda Três Barras	20	MST/MAB/MMA	15/01/2003
MT (Mato Grosso State)	Acorizal	Gleba Espinheiro/Acamp. Chico Mendes/Itambaracá	350	MAB	05/08/2003
PR (Paraná State)	Candói	Fazenda Campo Real	650	MST/MAB	01/08/2004
CE (Ceará State)	Potiretama	Fazenda Várzea Grande	120	MST/MAB	20/05/2006
MG (Minas Gerais State)	Governador Valadares	Usina de Baguari	26	MAB	13/03/2007
PB (Paraíba State)	Itatuba	Faz. Mascadi/Barragem Acauã	100	MAB	07/05/2009
SC (Santa Catarina State)	Cerro Negro	Acampamento Terra Nova	120	MAB/MST	06/06/2011
TO (Tocantins State)	Aliança do Tocantins	Fazenda da Aliança	100	MAB/MST	07/03/2013
RS (Rio Grande do Sul State)	Passo Fundo	Fazenda de Dal Agnol	300	MST/MAB	28/04/2014
RS (Rio Grande do Sul State)	Cruz Alta	Fazenda da Varig	100	MAB/MST	28/04/2014
RS (Rio Grande do Sul State)	Capão do Leão	Fazenda da Palma	200	MST/MAB	05/08/2014
RS (Rio Grande do Sul State)	Esmeralda	Fazenda Agência	110	MST/MAB	05/08/2014
RS (Rio Grande do Sul State)	Charqueadas	Horto Florestal da Companhia Estadual de Distribuição de Energia Elétrica do RS (CEEE)	520	MST/MAB	05/08/2014
RS (Rio Grande do Sul State)	Pelotas	Fazenda Palma	90	MST/MAB	28/04/2014

Note: Dataluta is a database set up in 1998 by NERA/UNESP (Núcleo de Estudos, Pesquisas e Projetos de Reforma Agrária/ Universidade Estadual de São Paulo) - Nucleus for Studies, Research and Projects on Agrarian Reform/State University of São Paulo (Presidente Prudente campus) and collects data referring to land struggles in Brazil.
Source: Dataluta (Land Struggle Database), 2015.

of the class struggle. It is important to understand that these movements are not monolithic phenomena, but are diverse and also subject to both internal and external pressures from the interaction of political forces at all levels and scales. But, first and foremost, it is a matter of class.

Land–Water–Labour, "Agro-hydro-business", and Water Transfer from the São Francisco River

In this section, we analyse the project to transfer water from the São Francisco River to other areas in the Northeast Region of Brazil from a perspective of territorial overlap in terms of land, water, and labour issues. The project involves the construction of two large-scale channels for transferring water to dry basins in semi-arid inland areas.[6] Our analysis focuses on one of the fundamental rules of the capitalist mode of production, which is that capital should generate more capital through the exploitation of surplus labour (through the extraction of surplus value and the production and movement of goods). Our starting point is the idea that capital is "value in movement" and capital accumulation is the process by which value multiplication occurs. This can also happen through the private appropriation and economic exploitation of water (Ioris 2010).

In our discussion, the concepts of territory and agro-hydro-business are key to enabling us to understand socioterritorial disputes and forms of resistance. These concepts can help us recognize the social dynamics, contradictions, and conflicts of a capitalist society. Territory is perceived through power relations between individuals who are interconnected by various types of material and symbolic relationships. The conquest and control of territory is directly related to who has control of natural resources and workers, as demanded by a capitalist economy.

[6] This region is characterized by low rainfall rates, which, together with intensive land and water management, contribute to high levels of labour exploitation and expropriation of the poor groups in the area. This process of socionatural exploitation was established centuries ago through political alliances between the state apparatus and large landholders. These relationships have been reconfigured in recent decades, with the high levels of capital injection from the export of tropical fruits and the building of public dams and irrigation canals.

This territorial reading allows us to better comprehend the interventions of the Brazilian federal state (particularly in the States of Ceará, Rio Grande do Norte, Paraíba, and Pernambuco[7]), capital dependency relations, the legacy of established social groups, and the use of natural resources. The exploitation of labour and ecological degradation, and its association with poor health among workers, are central to understanding the effects of land concentration, levels of which are very high in the territory affected by the water transfer project. In this context, the concept of agro-hydro-business is crucial for studying the range of events involved and deconstructing the economic structures and politico-cultural rhetoric promoted by agribusiness.

Considering that Brazil's development has relied on the exploitation of natural resources such as water, soil, and biodiversity (a fundamental element of national history), together with the exploitation of labour in the process of capital accumulation and value multiplication, we argue in favour of a critical investigation of conflicts, coalitions, class alliances, and, consequently, the (re)formulation of territories (Ioris 2005; Almeida 2010). The steps of this examination, in addition to the analysis of water transfer from the São Francisco River under the logic imposed by capital, which does not consider human needs, reveal how agro-hydro-business demands coordinated control of land, water, and labour.

In addition, our research focuses on the regime of land use and speculation, which is linked to varied land management approaches related to market pressures and developmental priorities, manifested in the commoditization of significant social and ecological features in recent decades. In an effort to unpack the circumstantial and structural barriers that have led to significant multidimensional and trans-scalar changes in the Northeast Region, we need to consider international interconnections,[8] given that local particularities contain and express global realities (Brandão 2010).

[7] States (or provinces) that will be beneficiaries of the water transfer from the São Francisco River.

[8] According to Brandão (2010), the appropriation and expropriation of abundant territorial resources and permanent primitive accumulation are fundamental elements in Brazilian history. The fact that Brazil's national territory is both vast and heterogeneous has allowed the national elites who control it to subordinate the general population. The country's territory has been turned

Our analysis starts with an historical overview, which is needed to introduce dynamic elements of the region associated with the agricultural configuration and the various forms of state intervention that follow the capitalist order, in which the natural design of the region influences the appropriation of nature and associated territorial management mechanisms. Implementing the water transfer project required a detailed knowledge of local soils, climate, terrain, vegetation, and water, and of the regional, national, and global political-economic framework. However, in addition to this, the project was driven by class interests and controlled by formal and informal rules ultimately aimed at the expansion and consolidation of capital in the Northeast Region.

It was in 2007, during the second term of President Lula's administration, that work on the project started, 160 years after Brazilian Emperor Peter II's manifesto announced the possibility of transferring the waters of the São Francisco River. The official argument in favour of the project focused on water shortages in the region, promising to "quench the thirst" of 12 million living in drought-prone areas and with limited access to surface and groundwater. Key factors influencing the project, according to the Institute for Applied Economic Research (IPEA) (2011), included:

- The Northeast Region has only 3 % of national water resources but 28 % of the population;
- Water is also concentrated in some parts of the region and the São Francisco River contains 70 % of regional stocks;
- Significant disparity in demographic density in the water-receiving areas (to the north of the São Francisco Basin) with 50 inhabitants/km^2, compared with only 10 inhabitants/km^2 in the source areas;
- A disparity in water use: 400 m^3/inhabitant/year in the water-receiving areas (below the threshold of 1500 m^3/inhabitant/year recommended by the United Nations), compared with 10,000 m^3/inhabitant/year in the source areas;

into a mere operational base and platform for capital circulation, as well as a locus of human and environmental predation.

- Most existing dams and storage facilities built on intermittent rivers and/or aquifers with significant limitations in terms of water quality or quantity;
- The water transfer project would only abstract 26.4 m^3/s from the São Francisco River, representing only 1.4 % of firm water flow at the Sobradinho Dam (1850 m^3/s).

The data demonstrate the extent of water scarcity in this region, and, in theory, explain the need to transfer water from a more abundant area. This is a matter of human survival, since without water there is no life. In fact, however, human supply, the goal touted by the state and regional oligarchies, does not seem to be the main objective of the project. Notwithstanding the climatic vagaries of this semi-arid part of Brazil, high levels of land concentration and patriarchal policies at various scales were also important factors in terms of population expulsion, especially in times of prolonged droughts. This explains why the semi-arid region's population has been the main migratory group in the history of the country. Since the beginning of colonization, populations who, through no fault of their own, lacked access to water and land, have had to migrate to sites with greater abundance and more favourable social perspectives. Despite the fact that the semi-arid region is the most densely populated semi-arid region in the world, and also the most humid, the social vulnerability of the population has always been profoundly linked to the quality and quantity of available water, both of which have been adversely affected by high levels of land concentration and precarious labour conditions.

Brazilian state rhetoric has been consistent with a scenario constructed by policies that have aimed to bolster regional oligarchies with infrastructural investments allowing for control of water bodies, concatenated with Brazil's land concentration, which has been high for centuries. The crucial proposal we want to examine is that state discourse is not consistent with the concrete reality on the ground, taking into account that the São Francisco River project follows the same pattern of political alliances between state and capital and regional oligarchies that has prevailed in Brazil for the last five centuries. The water demands proposed in the project are for the public supply of urban centres, and particularly for

irrigation and supply to industrial parks that will benefit powerful groups. This fundamental distortion can be seen from the following observations:

- There is a direct relationship between the interests of those involved in the water transfer project and the agenda of some members of the rural committee in the Brazilian National Congress (i.e. deputies and senators representing regional oligarchies, particularly those who own vast tracts of land in areas that will be benefit from the transfer of water) according to mapping presented by Costa (2012). The rural committee has agreed on the allocation of funding to build several channels that will receive irrigation water from the São Francisco River, including the Cinturão das Águas in Ceará (R$ 6.8 billion), the Acauã–Araçagi channel in Paraíba (US$ 933 million), the irrigation perimeter of the Santa Cruz dam in Rio Grande do Norte (US$ 145 million), as well as from existing channels (such as the *Trabalhador* [Labourer] Canal in Ceará and Várzeas de Souza in Paraíba).[9]
- The promotion of industrial parks is another stated purpose of the water transfer project. The Industrial and Port Complex of Pecém, in the metropolitan region of Fortaleza, is an example. It will benefit from the increased volumes of water to be moved through the Trabalhador Canal, which is already in operation.
- Policies to address water scarcity in the semi-arid region, particularly in rural areas, are restricted to emergency measures, such as the use of water tanks and the promotion of so-called small hydro-social technologies, such as the construction of water cisterns, underground dams, desalination plants, wells, fountains, and so on. Consequently, for family farmers, demand continues to exceed supply, and the situation leaves these farmers prey to populist policies, precarious working conditions, disease, forced migration, and so on.
- Even with its low rainfall levels and climatic irregularities, water availability in the semi-arid part of the Northeast Region is adequate to meet urban public supply demand (ANA 2012; IPEA 2011);

[9] Through these channels, the transfer of water could feed irrigation perimeters (14 in the States of Ceará, 5 in Rio Grande do Norte, 3 Paraíba, and 4 in Pernambuco), which is likely to merely (re) produce social inequalities, poisoning/killing workers (see note 11, below) and affecting their living conditions, while facilitating the expansion of capitalist relations.

nonetheless, public policies have systematically focused on large hydraulic infrastructure and neglected alternatives; that is, the demands of capital have been prioritized.

- With all these territorial rearrangements involving agricultural and hydrological issues, the São Francisco River water transfer project appears to be at risk, especially from the drastic decrease in river flows over the last three years. The minimum firm flow of the river, according to the Environmental Impact Assessment (EIA), at the withdrawal sites was calculated as 1800 m^3/s downstream from the Sobradinho dam. However, this flow has decreased by 50 % to 900 m^3/s following long droughts, river basin degradation, and over-abstraction by irrigation.[10]

The above are examples of how regional agrarian oligarchies seek to monopolize control of waters and lands as a strategy for holding onto power. This strategy has been directly linked with alliances and pressures on the state apparatus, as the financier and executor of numerous water projects. In the Brazilian semi-arid region, alliances between large landowners and the state have played an important role in the formation of alliances with big agribusiness, especially in public irrigation projects that provide water to areas producing mainly for the foreign market. In these areas, an agro-export structure has gradually become consolidated, where increasing the price of rural property allows land rent to be added to the circulation of more significant capital. In this process, control of water is crucial in terms of consolidating political power and facilitating capital accumulation. The closer properties are to the agribusiness infrastructure, the higher their market value and the greater the rent exploitation of their land. Higher valuations are thus related to positions in the sociotechnical territory, and favourable locations ensure a faster monetary return, either from speculation or production.

[10] The Urucuia aquifer, located in the middle portion of the basin, is considered the "lungs of the São Francisco River", especially during the dry season (from April to September) and is the source of a large portion of the river's flow. However, the doctoral research project entitled "From Hidden to Visible: Earth-Water-Work and Agro-hydro-business Territorial Conglomerates in Western Bahia" (Cunha 2013), identified about 1000 central pivots and 2.5 million hectares of cultivated land in aquifer recharge areas. This means that the production structure based on large-scale agribusiness has contributed significantly to reducing the flow in the São Francisco River.

There is a clear and long-established class alliance underpinning this supposedly "modern" productive structure. Perhaps one of the novel aspects of agribusiness in the São Francisco Basin is the influence of the global financial system. In this current phase of capitalism, the agriculture practised in the territories of agro-hydro-business is dominated by this class alliance between large corporations, land owners, the state, and capital. Crucially, agribusiness corporations[11] control inputs, machinery, the seed trade, and bank credit, while landowners speculate or use their land for production. A study carried out by the National Secretariat of the MST, using information published in the magazine *Exame* (2013), revealed that the 50 largest agribusiness companies accounted for 70 % of Brazil's agricultural gross domestic product (GDP) (R$ 600 billion).

The agrarian social structure, while contributing directly to production and lucrative financial results, has also led to socio-environmental degradation due to the lack of regulation of how large-scale landowners control labour and natural resources (water and soil are the most important strategically). Agribusiness players always try to expand profit through various mechanisms in parallel with the downward trend of the use value of goods so as to encourage the production cycle and increase profit rates. With this in mind, it is possible to better understand the configuration of large capitalist enterprises in Brazil's rural sector, whether in terms of technical or social relationships (Delgado 2012; Antunes 1999).

At the same time, the Brazilian government has chosen primary commodities as its main export sector in an attempt to expand the country's presence in foreign markets, and has privileged its economic, strategic, and logistical interests, resulting in exclusionary policies that have amplified social inequalities, property concentration, and income and power asymmetries at various scales (Thomaz 2008). With growing socio-environmental impacts affecting the majority of the working class, control of land, water, and labour by capital is a central aspect of territorial dynamics in the areas of influence of the São Francisco River water transfer project.[12]

[11] The ten largest agribusiness corporations in operation in Brazil are: JBS, Raízen (Cosan e Shell), Cosan, Bunge, BRF, Cargill, Marfrig, Nestlé, Copersucar, and Louis Dreyfuss.

[12] Raquel Rigotto, medicine professor at the Federal University of Ceará, has conducted research in the State of Ceará on irrigation perimeters that receive water from the São Francisco water transfer

The official rhetoric that agribusiness is the fundamental driving force of national exports, responsible for contributing massively to the Brazilian trade balance, says nothing about the conflicts and exploitative scenarios in areas that will receive water from the São Francisco River, where slave-like[13] labour, disputes over water and land, exposure of workers to toxic substances, water pollution, and serious river degradation are rife (Lima 2006; Rigotto 2013). Furthermore, the consequences of the project will not only affect the areas where it is directly focused; they are also likely to affect a range of territories, threatening long-established interactions between human beings and the rest of nature. Evidences of that are the excessive use of water for irrigation, production of soft fruits for export, and contamination by pesticides and chemical fertilizers, among others.

These critical reflections are based on the analytical link between agrarian questions, labour struggles, and water disputes involving the expansion of productive forces and conditions. Land grabbing by foreign businesses is another element of this process, and has led to a significant change in the meaning of production relations as it deepens capitalist control of rural properties, water stocks, and the workforce. According to the National Secretariat of the MST, foreign companies already control about 60 % of Brazilian agricultural GDP. The foundations of agrarian policies in the Northeast Region and in the rest of Brazil are directly associated with the requirements of large transnational conglomerates at the expense of feasible alternatives for the emancipation of local workers. Large water infrastructure, as exemplified by the water transfer project, basically exists to strengthen the mechanisms of private capital accumulation (Thomaz 2012).

Conflicts over water, land, and labour are inherent in the progress of capital, particularly in the activities of the export-oriented economic model, based on widespread commodification and a progressive control of territories and the production chain. This is something that intensifies

project that has detected significant poisoning of workers by chemical fertilizers and pesticides. The researcher identifies severe threats to the health and life of these workers, including carcinoma, genetic disorders, and acute contamination, among others.

[13] There are circumstances that, according to the Brazilian Penal Code, bear a resemblance to slavery situations, given serious human degradation, violation of basic rights, unacceptable health and live risks, long working days, forced work due to debts, and so on.

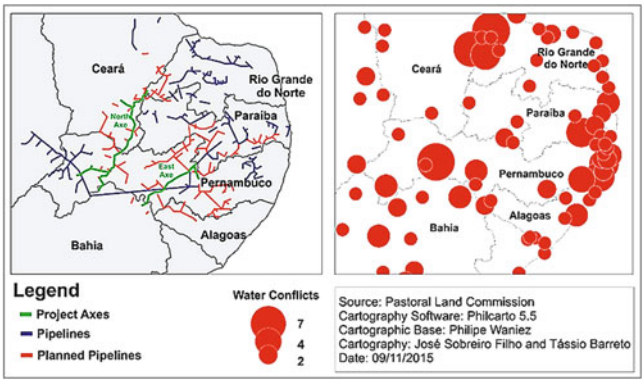

Fig. 5.3 Project axes, pipelines, and water conflicts 2002–2014

over time, with increasing contributions from new and more damaging elements. Slave labour, intense conflicts, and even murder have become part of the daily lives of people in the semi-arid region, both established groups and newcomers who came to the region to participate in the construction of irrigation perimeters[14] (see Fig. 5.3).

The struggles for control of land and water are inextricably linked. These are natural goods needed for the practices of everyday life, but transformed into resources by economic demands. Since water is increasingly understood as a commodity, it becomes a tool for value promotion and the protagonist of the advance of capital in the countryside, directly or indirectly, whatever the activity. This cyclical dynamics, fuelled in large part by the exploitation of unpaid labour, is intrinsic to the survival of capital. A comparison between the two most recent sets of figures shows an increase in conflicts over water, especially in areas of progress or capital consolidation in the Brazilian northeast. In the semi-arid areas that will be affected by the São Francisco River project, but also in more humid coastal zones, water control demonstrates elements of the prevailing socio-economic model.

[14] According to the CPT, the main organization in charge of collecting conflict data, there has been a growing number of incidents over the last decade, especially in the territories of primary commodity exports, including agribusiness, hydropower sites, roads and railways, mining, and so on.

We conclude this section by stating that we are not opposed to traditional interventions such as water diversion, especially for regions with negative water balance, limited water reserves, and high rates of evapotranspiration (which favours salinization). However, what we advocate are genuine changes in policymaking in the pursuit of decentralization, with more democratic and less bureaucratic forms of management, which would treat nature and territory as common goods. This would represent a possible way forward based on water as a substantial element for life and a protagonist in issues of land and agriculture. We also propose an alternative path of development in which social movements are understood as central institutions for building and managing these changes, prioritizing human and non-human nature rather than capital accumulation.

Conclusions

In this chapter, we briefly reflected on different types of territory and presented a critical interpretation going beyond the perspective of understanding territory as synonymous with power on a given piece of the earth's surface. We presented a territorial reading of land and water from the perspective of disputes over different development models and explored the territories produced by different social relations. This highlighted the multiple dimensions associated with the conceptualization of water as a disputed territory. The chapter included a historical overview of the formation of the MAB and the various conflicts over water in Brazil, focusing on the complex and conflictive process associated with the transfer of water from the São Francisco River, occurring alongside the advancement of national and international agro-hydro-business.

Moreover, based on the evidence and empirical data presented above, we aimed to move the debate beyond superficial readings of the historical issue of water and land in Brazil. Discussing the territorial advances of capital supported by the Brazilian government, we see that examination of conflicts is essential if we are to understand the uneven balance of power between socioterritorial movements and agro-hydro-business, as well as the contradictions generated by the latter. Struggles and resistance on the ground, such as resistance by the MAB, are an important process

of contestation and socioterritorial dispute, and exemplify the contest for popular participation in state actions, fighting for the recognition of the rights and interests of those affected by state projects. The emergence of the MAB as a national organization is a milestone not only in terms of denouncing conflict and providing a voice of resistance for the people affected by agro-hydro-business, but also in how it has taken the first steps in terms of public policy proposals and challenging the state. The logic of this approach, based on a reading of the conflict, is also intended to deconstruct the actions of the state, removing obstacles to clarity and working to eliminate conflicts and social, economic, cultural, environmental, and political problems, as well as the exploitation of state facilities and public policy by agro-hydro-business. The São Francisco River project is an emblematic example of this conflictive process promoted by agro-hydro-business in Brazil because it is characterized by public policies misrepresented by the state as "social development", while its main purpose is in fact to serve the interests of capital. Incidentally, the discourse against the simplification of "social development" reveals the profusion of conflicts, the precariousness of labour relations, environmental degradation, the expropriation of rural worker, the appropriation of land and water by oligarchs, and so on.

In conclusion, water, land, socioterritorial movements, labour, and capital are important components of the current conflictuality in Brazil, generated by the dispute between different models of territorialized economic development. This multidimensional reading, multi-scale and diverse on the concept of territory, also allows us to scale up the conflicts and unpack the rationales behind existing territorial disputes. Moreover, we believe that a key contribution of this text is to foster debate and new reflections and dialogues on conflictualities and territorial disputes, and also to promote a critical use of the concept of territory in geography and other sciences.

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6

Environmental Impacts of Fruit Production in Brazil

Diana M.S. Feliciano

Introduction[1]

Over the last 20 years, production of fresh fruits, both in crude and processed form, has increased significantly around the world (Fig. 6.1).[2] Rising incomes and growing consumer interest in product variety, freshness, convenience, and year-round availability are among the main reasons for this increased demand (Diop and Jaffee 2005). Fruits and vegetables are rich sources of micronutrients, needed by children for optimal growth and development. Most national and international dietary guidelines are in agreement that consumption of fresh fruits and vegetables is

[1] The author thanks Maggie Gill and Antonio Ioris for their insightful comments and suggestions to previous versions of this chapter.

[2] Ruel et al. (2004) define fruits as the sweet, fleshly, edible parts of plants that contain the seed(s), excluding non-sweet examples such as zucchini, tomatoes, peppers, and peas.

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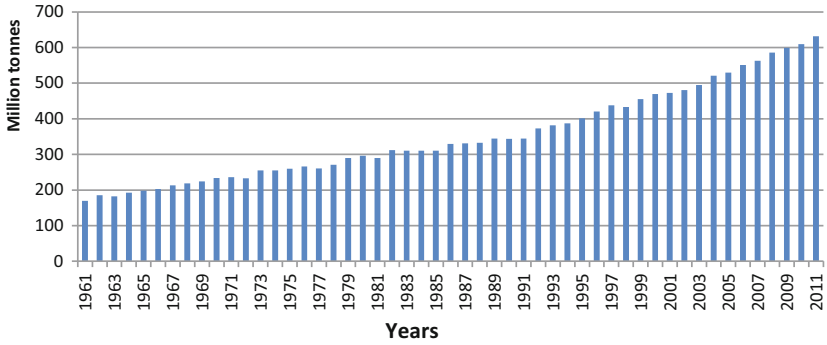

Fig. 6.1 World fruit production between 1961 and 2011 (FAOSTAT)

a healthy food choice and yet needs to be increased. The World Health Organization (WHO) recommends a minimum daily intake of 400 grams of fruits and vegetables, especially for children, and many countries have programmes to promote consumption (FAO/WHO 2004).

Several initiatives have recognized the importance of the consumption of fruits and vegetables in avoiding micronutrient deficiencies. One of these is the Global Fruit and Vegetable for Health Initiative (PROFAV/PROFEL), launched by the Food and Agriculture Organization (FAO) and WHO, in 2003. This was followed by the Framework for Action in 2004, the objective of which was to guide the development of cost-effective interventions to promote adequate consumption of fruits and vegetables for health at national or sub-national level (FAO/WHO 2004). However, according to Ruel et al. (2004), families around the world still tend to spend a relatively low percentage of their food budget on fruits and vegetables (between 4 % and 16 %).

In addition to increasing demand, the Organisation for Economic Co-operation and Development (OECD) (1996) cites several reasons for the expansion of the global fruit trade, namely: (1) efforts by developing countries to increase the value of their exports after a fall in production of tropical commodities during the 1980s; (2) increases in trade liberalization; (3) diversification of production in response to agricultural policy reform, reductions in subsidies, and increases in fruit supply in both the Northern and Southern Hemispheres; and (4) technical progress in storage and transport. On the other hand, even though some national governments around

the globe have incorporated the concepts of sustainability, climate change adaptation, and social participation into their policies, these aspects are frequently not implemented due to the pressure for economic growth (Ioris 2011). Therefore, the expansion in fruit production and the increased contribution of fruits to international trade can lead to social and environmental overexploitation in producing countries. According to Basset-Mens et al. (2014), fruits, as well as other foods produced and traded globally, are increasingly coming under scrutiny because of their environmental impacts. For example, it can limit access to water resources, cause food insecurity in producing regions, or force small-scale producers out of business. Other effects of increased fruit production include soil erosion; the introduction of genetically modified organisms, which are not always accepted by the society; monoculture expansion; and control of production by multinationals focused on supplying goods to developed countries.

Given the fact that, according to FAOSTAT (the database made available by the Statistics Division of the FAO), Brazil is the third largest producer of fruits in the world and the lead supplier of concentrated orange juice (85 % of total world exports), it is important to conduct an initial analysis as to how the environment has been affected to further identify potential negative social effects. This industry is of growing importance for the Brazilian economy, with an export value of around US$ three billion in 2012 (data from FAOSTAT). Brazil has indeed great potential for food production given its size, the diversity of its climatic conditions, and the strategic seasonal timing of its harvests. The existence of different climates within the country means that both tropical and temperate fruit types can be produced, and allows for year-round fruit production (Faveret Filho et al. n.d.). Temperate fruits are harvested at different times of year from the harvest period in the Northern Hemisphere, thus presenting an opportunity to sell the Brazilian production in these markets. Of all the regions in Brazil, the State of São Paulo is the main fruit producer, responsible for 43 % of total fruit production in the country. The European Union is the largest market for Brazilian fruits, importing 70 % of the total amount of fruits exported. About half of the exports go directly to the Netherlands before being distributed to other countries in the European Union, such as the UK, Germany, Belgium, France, Italy, Portugal, and Spain (Faveret Filho et al. n.d.).

The objective of this chapter is to analyse the impacts of increasing fruit production on Brazil's natural resources (water and land in particular) and its contribution to climate change. It aims at improving the understanding on how the demand for food production in Europe can displace environmental impacts to other countries, using Brazil as a case study.

This analysis will follow the 'nexus' approach,[3] which is essential when looking for solutions to optimize interdependencies and support the equitable and sustainable allocation of resources in a context of increasing competition in the water, energy, and food sectors. Because issues in the water, energy, and food sectors are often treated in isolation by regional and national government institutions, the 'nexus' approach can better help stakeholders to identify and understand the risks to food, energy, and water security.

Fruit Production in Brazil

Fruit production has been increasing rapidly in Brazil since 1961 (Fig. 6.2). The main fruits produced in 2013 were oranges, bananas, and pineapple (Fig. 6.3).

Diop and Jaffee (2005) examined the factors responsible for the initial growth and subsequent maturation in production levels for some of the developing world's leading producers of fresh and processed fruits, including Brazil. These authors found that the initial increase in production occurred during a period of stable macroeconomic conditions which created a favourable environment for investment. In addition to this, the modernization of Brazilian agriculture and the technical progress in storage and transport also contributed to the increase in production. Important initial catalysts for export growth included sudden shortfalls (demand greater than supply) in major overseas markets,

[3] The 'nexus' is an increasingly recognized concept and is about how and where the food, water, and energy systems intersect. Because actions related to one system can impact one or both of the other systems, it is necessary to take a nexus approach. Underlying the nexus approach is the understanding of the interdependencies among these three systems and how to ensure food, water, and energy security for an ever-growing population.

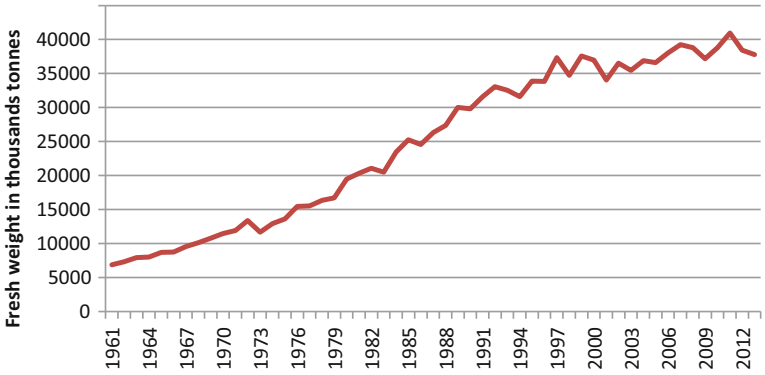

Fig. 6.2 Fruit production (excluding melons) in Brazil between 1961 and 2013 (*Source*: FAOSTAT)

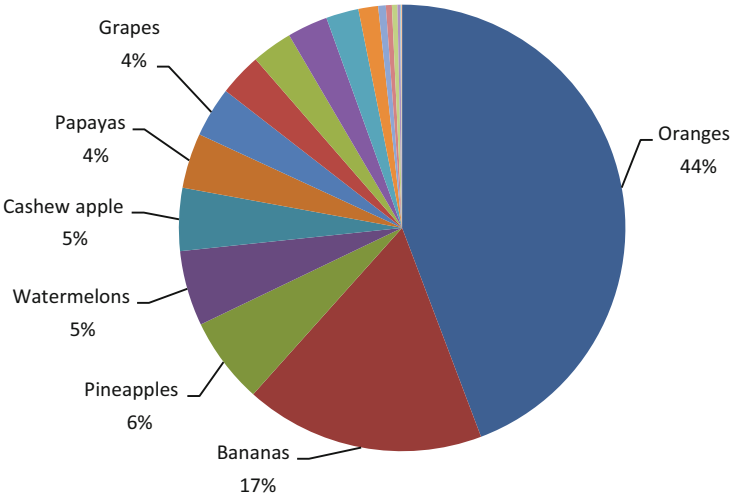

Fig. 6.3 Fruits produced in Brazil in 2013 (%) (*Source*: FAOSTAT)

new foreign direct investment and strategic partnerships, and improvements in international logistics capacity. International technical and marketing partnerships also provided a vehicle for the transfer of technology, for new market penetration, and for creating an identity for the products being exported.

About 80 % of Brazil's oranges are grown in what is known as the 'citrus belt', covering some regions of São Paulo State and part of the *Triangulo Mineiro* (Mineiro Triangle, in the State of Minas Gerais). In general terms, around 30 % of national production is consumed internally, while 70 % is turned into juice for export (Bellingieri et al. 2012). In 2012, 86 % of the oranges produced in São Paulo were destined for the juice processing industry, with only 14 % destined for fresh consumption (Neves 2010). Brazil is the world's largest juice exporter, controlling 85 % of the global market, with 70 % of juice exports from Brazil destined for Europe (Neves 2010). In 2010, the citrus production chain generated 230,000 jobs in the country, with around 77,000 directly linked to the cultivation of oranges and 7000 linked to the orange juice processing industry (Neves 2010). The 'citrus agribusiness complex', implemented in the 1960s and 1970s, forced all aspects of the orange production industry (from production to processing) to become interdependent, especially in the case of frozen concentrated orange juice (FCOJ), where decisions about volume, quality, and fruit origin affect all stages of the production process (Borges 2004).

Using the variable fruit supply from the food balance sheets of FAOSTAT as a proxy for fruits consumed, it is possible to observe

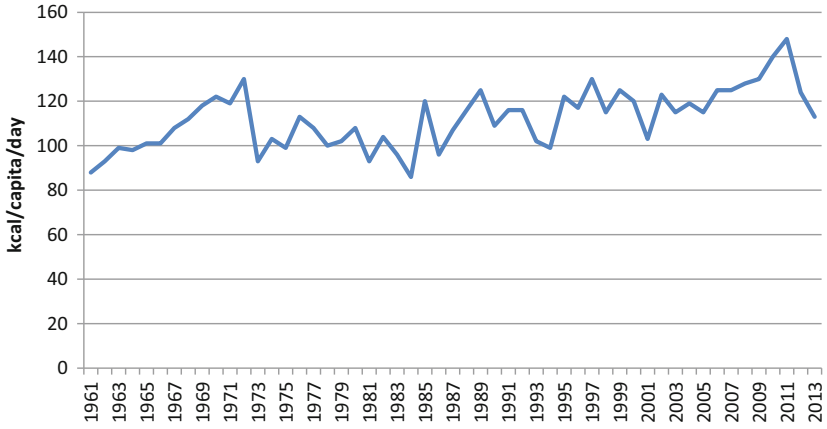

Fig. 6.4 Fruit supply in Brazil between 1961 and 2013 in kcal per capita per day (*Source*: FAOSTAT)

Table 6.1 Main fruits consumed in Brazil

Brazilian origin	Other origin	Unknown origin
Pineapple (2nd), Guava (7th) Passion fruit (12th)	Avocado (1st), Banana (3rd), Persimmon (4th), Fig (6th), Orange (8th), Lemon (9th), Papaya (10th), Quince (13th), Apple (14th), Watermelon (15th), Melon (16th), Pear (17th), Peach (17th), Tangerine (19th), Grapes (20th)	Bahia coconut (5th)

Source: Sustainable Planet

only a slight increase in terms of kilocalories (kcal) per capita per day since 1961 (Fig. 6.4). It should be noted that food supply is the total quantity of foodstuffs produced in a country (minus waste on the farm and during distribution and processing), added to the total quantity imported, and adjusted for any change in stocks that may have occurred since the beginning of the reference period. Per capita food supply is then obtained by dividing the resulting quantity by the related data on population. Data on per capita food supplies are expressed in terms of quantity.

According to Sustainable Planet,[4] of the 20 main fruits consumed in Brazil, only three are Brazilian in origin (i.e. were already in Brazil before European colonization), which means that the country has probably a reduced biological diversity of those plant species. Table 6.1 presents the main fruits consumed in Brazil according to their place of origin and importance in daily consumption.

Brazil also exports much of the fruits consumed in Europe and the USA (see Box 6.1). Fruit exports from Brazil can be divided into processed (coconuts, oranges, tangerines, mandarins, clementines, satsumas, lemons and limes, grapefruit, pears, quinces, cherries) and unprocessed fruits (orange juice, dried figs, canned pineapple, cooked fruits, sugar-preserved fruits, concentrated juice). Fruit exports by Brazil increased continuously between 1962 and 2007, with a slight decrease between 2007 and 2011 (Fig. 6.5). The main fruit items exported are 'processed fruits' (single strength and concentrated juice) and the main

[4] www.planetasustentavel.com.br

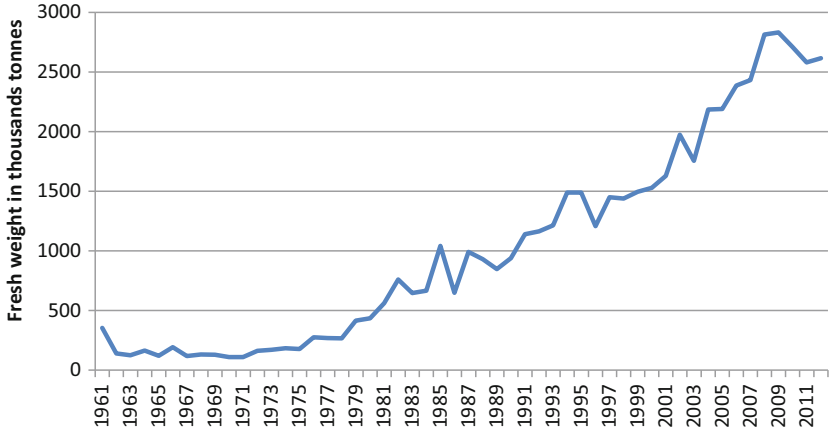

Fig. 6.5 Fruit exports (processed and unprocessed) between 1961 and 2012 in thousand tonnes (*Source*: FAOSTAT)

unprocessed fruits exported are melon, mangoes, mangosteens and guavas, bananas, and oranges. According to Coltro et al. (2009), the majority of the oranges produced in Brazil (70 %) are processed into FCOJ by large processing companies. The FCOJ produced is mainly exported to Europe (70 %) and the USA (15 %) (Neves 2010). This makes Brazil the world's largest producer and exporter of FCOJ. Brazilian orange production accounts for half the world's supply of orange juice and 80 % of the juice traded on the international market (Coltro et al. 2009).

Box 6.1 Brazil in the world market for orange juice

The world market for orange juice used to be a duopolistic market structure, with only two players, the USA (mainly Florida) and Brazil, which supplied around 85 % of the world market. Over 95 % of Brazil's production was exported, whereas more than 95 % of US orange juice was consumed domestically. Of the US imports of concentrated orange juice, some 90 % came from Brazil. Imported orange juice was mixed with US juice to improve its colour and make up for seasonal shortfalls in supply. In the early 1990s, Brazilian producers began to invest directly in the

Florida industry, acquiring as much as 40 % of the Florida processing industry. The US presence in Brazil's citrus industry started in the 1960s, when winter freezes prompted US growers to look to Brazil for planting (Thunder Lake Management 2002 cited by Diop and Jaffee 2005). According to Neves (2010), 35 European juice packing companies buy 80 % of the juice exported from Brazil, while in the USA, the four biggest companies dominate 75 % of the market. Juice packing companies prefer to pack juice that provides a higher profit margin, which means they bargain to lower the prices of the raw material (concentrated juice). Therefore, the higher the price of orange juice, the more it will lose market share to other juices such as apple, pear, peach, and so on (Bellingiere et al. 2012).

Environmental Impacts

In this study, five components of the Rockström et al.'s (2009) planetary boundaries framework were considered (climate change, the nitrogen [N] and phosphorus [P] cycles, global freshwater use, and land use) to investigate the environmental impacts of fruit production in Brazil. Waste production and energy use were also considered since the relatively short shelf-life of fresh fruits exacerbates the impact of fruit production on water, land, energy, and climate change. The planetary boundaries framework (Rockström et al. 2009) defines the safe operating space for humanity with respect to the Earth system and its biophysical subsystems (or processes), namely, climate change, biodiversity loss, the N and P cycles, stratospheric ozone depletion, ocean acidification, global freshwater use, land use, atmospheric aerosol loading, and chemical pollution.

Freshwater Use

According to Mekonnen and Hoekstra (2011), Brazil is the country with the fourth-highest water footprint (482 Gm^3/y) after China (1207 Gm^3/y), India (1182 Gm^3/y), and the USA (1053 Gm^3/y). In addition, the catchment of the Parana River, which is the second-longest

Table 6.2 Water footprint for different unprocessed and processed fruit items (average world data)

Unprocessed fruit	Total water (m^3 $tonne^{-1}$)	Green (m^3 $tonne^{-1}$)	Blue (m^3 $tonne^{-1}$)	Grey (m^3 $tonne^{-1}$)
Figs	3350	1527	1595	228
Grapes	2400	n.a.	n.a.	n.a.
Plums	2180	1570	188	422
Mango, guava	1800	1314	360	124
Apricot	1287	694	502	92
Pear	922	645	94	183
Peach	910	583	188	139
Apple	822	561	133	127
Banana	790	660	97	33
Tangerines, mandarins, clementine	748	479	118	152
Lemons, limes	642	432	152	58
Orange	560	401	110	49
Grapefruit	506	367	85	54
Papaya	460	399	40	21
Pineapple	255	215	9	31
Watermelon	235	147	25	63
Processed fruit	**Total water** (m^3 $tonne^{-1}$)	**Green** (m^3 $tonne^{-1}$)	**Blue** (m^3 $tonne^{-1}$)	**Grey** (m^3 $tonne^{-1}$)
Apple, dried	6847	4678	1111	1058
Grapes, dried	2433	1700	386	347
Pineapple juice	1273	1075	45	153
Apple juice	1141	780	185	176
Orange juice	1000	729	199	90
Grape wines, sparkling	869	607	138	124
Grapefruit juice	675	490	114	71

Source: Mekonnen and Hoekstra (2011)

river in South America (obviously, after the Amazon) and includes most of the State of São Paulo, is the fifth-highest river catchment in water footprint after the Mississippi, Ganges, Yangtze, and Indus. The average water footprint per tonne of primary crop differs significantly between crops and across production regions. Global average water footprints of selected fruits and their derived products were assessed by Mekonnen and Hoekstra (2011) and are presented in Table 6.2. The water footprint per tonne (m^3 $tonne^{-1}$) is the sum of the **green**, **blue**, and **grey** water footprints. The **blue** water footprint refers to the volume of surface and

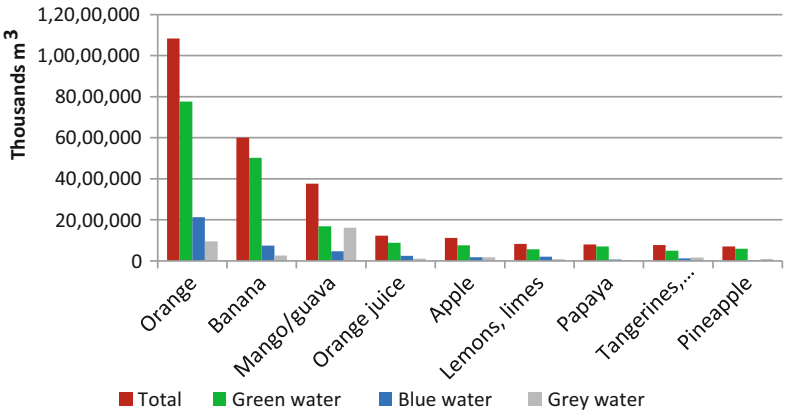

Fig. 6.6 Water footprints due to fruit production in Brazil in 2013 (in thousand m³) (*Source*: Own calculations)

groundwater consumed (evaporated) as a result of the production of a good, the **green** water footprint refers to the rainwater consumed, and the **grey** water footprint of a product refers to the volume of freshwater that is required to assimilate the load of pollutants based on existing environment water quality standards (Hoekstra and Chapagain 2007). The water footprint by fruit type is obtained by multiplying the sum of the water footprints for each water type by the amount (in tonnes) of each fruit type produced in Brazil (Fig. 6.6).

As shown in Fig. 6.6, the production of oranges (fresh fruits produced in tonnes) contributed the most for water footprint in 2013, followed by the production of bananas.

Although the total water footprint for pineapple is low when compared with the water footprint of oranges, the production of this item is increasing fast in the past 30 years (Fig. 6.7). Therefore, if this rate of production is maintained, there will be a significant impact on freshwater resources. According to Neves (2010), demand for irrigation has been increasing significantly since the 1990s. Data from the FAOSTAT database confirm that the area of agricultural land under irrigation has doubled in Brazil between 1990 (~1 % of total agricultural land) and 2013 (~2 % of total agricultural land).

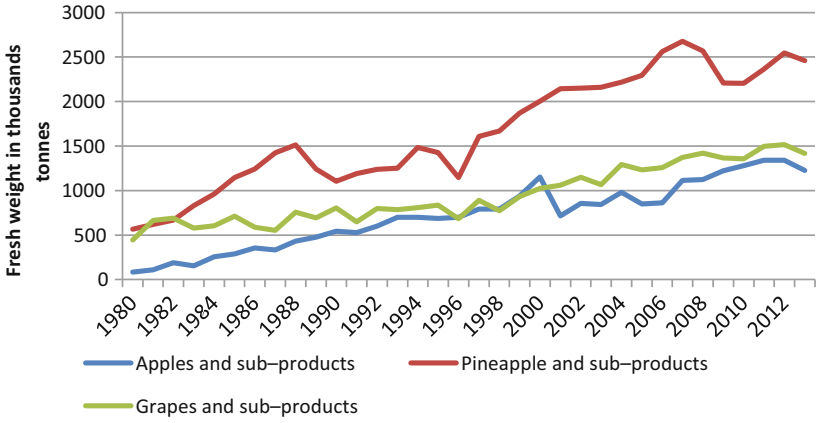

Fig. 6.7 Production of apples, pineapple, grapes, and their sub-products between 1980 and 2013 (*Source*: FAOSAT)

Freshwater Eutrophication

Eutrophication is the response of the ecosystem to the addition of natural or artificial substances such as phosphates to freshwater systems. A negative effect of this response includes hypoxia, which is the depletion of oxygen in the water, causing the death of fish and other aquatic animals. Fruit production can contribute to eutrophication through the application of phosphates, nitrates, and potash in mineral fertilizer. The International Fertilizer Industry Association provides activity data on N, phosphate (P_2O_5), and potash (K_2O) application in mineral fertilizer in Brazilian fruit production in 2011. According to the International Fertilizer Industry Association website,[5] in 2011, 157,000 tonnes of N were applied to fruit production areas in Brazil (International Fertilizer Industry Association), as well as 88,000 tonnes of phosphate and 152,000 tonnes of potash (Fig. 6.8).

From Table 6.2, it can be seen that mango and guava production and apple drying are major contributors to the grey water footprint (volume of freshwater that is required to assimilate the load of pollutants based on existing environment water quality standards). According to FAOSTAT,

[5] http://knoema.com/IFAFUBC2013/fertilizer-use-by-crop-2013

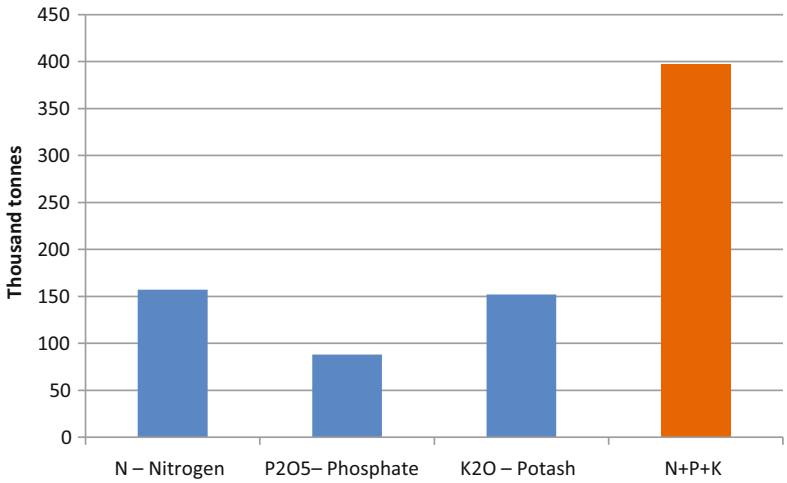

Fig. 6.8 Fertilizer applied in fruit production in Brazil in 2011

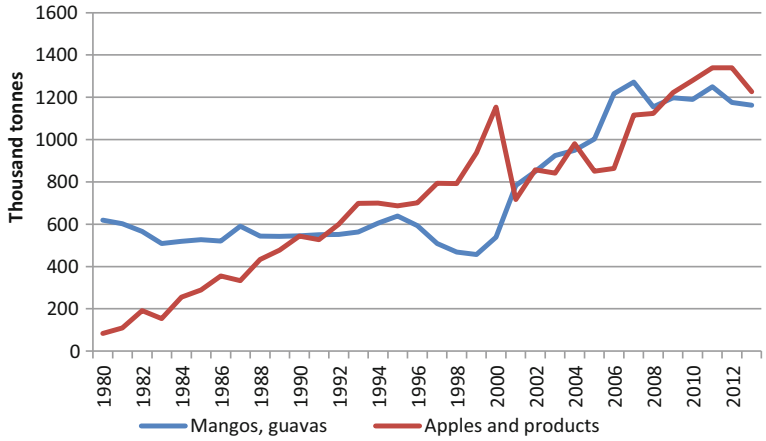

Fig. 6.9 Production of mangos, guavas, and apples and their sub-products in Brazil between 1961 and 2013 in thousand tonnes (*Source*: FAOSTAT)

production of mangos, guavas, and apples and their sub-products has been sharply increasing since the 1980s (Fig. 6.9). If these rates are maintained, fruit production is likely to become a contributor to freshwater pollution and potentially, eutrophication, which in turn can increase

greenhouse gas (GHG) emissions. According to Abe et al. (2008), more eutrophic reservoirs have higher diffusive fluxes of GHG when compared with less eutrophic reservoirs.

Greenhouse Gas (GHG) Emissions

The main sources of GHG emissions in fruit production prior to the farm gate are associated with mineral N and manure application to soils, cultivation of organic soils, decomposition and burning of crop residues, and energy used in fruit production. The main source of statistics used in our discussion, FAOSTAT, presents emissions data for each source type, but does not disaggregate the data by type of agricultural product, only providing the total for crop production (Fig. 6.10). The application of N causes direct and indirect nitrous oxide (N_2O) emissions, as the availability of N influences nitrification and denitrification reactions. N_2O is a powerful GHG with a global warming potential of 298 (1 tonne of N_2O corresponds to 298 tonnes of carbon dioxide [CO_2] equivalent) over a 100-year period.

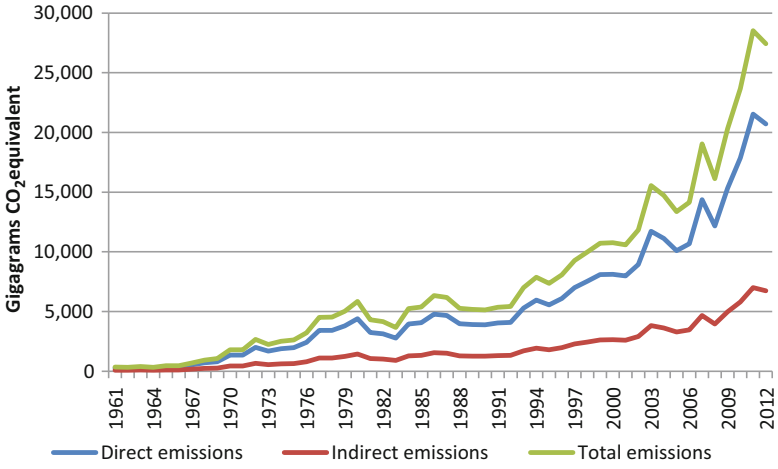

Fig. 6.10 Greenhouse gas emissions from synthetic fertilizer application in Brazil between 1961 and 2012 in gigagrams of CO_2 equivalent (*Source*: FAOSTAT)

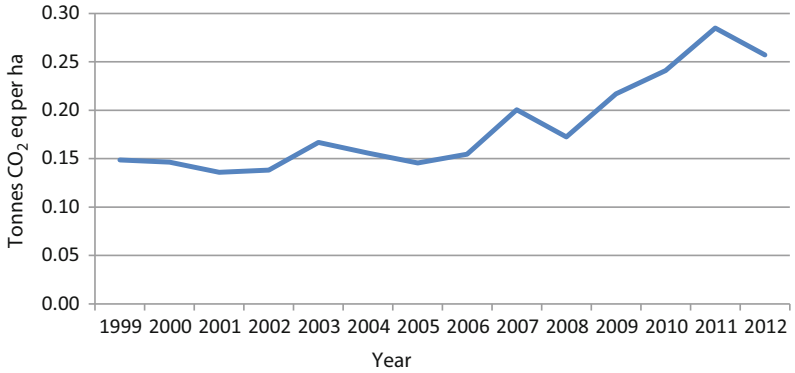

Fig. 6.11 Greenhouse gas emissions from the application of synthetic fertilizer in Brazil per hectare of area harvested in tonnes of CO_2 equivalent per hectare (*Source*: FAOSTAT)

Note that FAOSTAT calculates emissions from synthetic fertilizer in crop production using data from the Fertilizer Archive dataset (1961–2001) and calculated data (2002–2050), but does not disaggregate the data by crop type. According to these estimates, total GHG emissions from synthetic fertilizer application have been increasing rapidly since 2003, and the prediction for 2030 and 2050 is a continuation of this rapid rate of increase (Fig. 6.10).

The increase in GHG emissions in agriculture is not only caused by an increase in the production area as total emissions from synthetic fertilizer application per hectare of crop produced has also increased in the past ten years, suggesting the amount of synthetic fertilizer applied per hectare has increased (Fig. 6.11).

GHG emissions due to the application of synthetic fertilizer in Brazilian fruit production were estimated in terms of tonnes of CO_2 equivalent emitted per kilogram of fertilizer applied. GHG emissions caused by synthetic (N) fertilizer application can be estimated by using Tier 1 methods[6] from the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories. According to the

[6]Tier 1 methods are actual emission estimation methods, often based on default activity data where better data are not available.

International Fertilizer Industry Association website,[7] 157,000 tonnes of N were applied in fruit-producing areas of Brazil in 2011; using IPCC equations (see Eggleston et al. 2006) to estimate direct and indirect emissions from N application, the result obtained is 974 thousand tonnes (~1 gigagram) of CO_2 equivalent emitted in fruit production in 2011. To add to CO_2 emissions from fertilizer application, there are the emissions due to the production of synthetic fertilizer and transportation of this same fertilizer. The world factor of GHG emissions for the production of fertilizers is 2.72 kg CO_2equivalent/kg for ammonium nitrate (35 % N) and 1.38 kg CO_2 equivalent/kg for urea (46.4 % N). Therefore, an application of 157,000 tonnes of N would produce more 0.47–1.2 gigagrams[8] of CO_2 equivalent due to fertilizer production.

Agricultural Land Use

Data for the amount of land (in hectares) used in fruit production in Brazil are provided by the FAOSTAT database. If all crops are considered, fruit production in 2013 (including melon and citrus) occupied a total area of 3,211,755 hectares, making fruits the third most extensive crop type in Brazil after oil crops and cereals/coarse grains.[9] Orange production occupies the largest area for fruit production (~700,000 in 2013), followed by cashew apples (~600,000) and bananas (~500,000) (Fig. 6.12).

Looking at data for the period 1961–2013, large increases in cultivated area can be seen for oranges and cashew apples, with a slight decrease for oranges after the year 2000 (Fig. 6.13). This decrease in the area harvested of oranges must have been due to a decline in world demand for orange juice and a consequent loss of market share in the juice market (Neves 2010). This author identified the three main reasons for the fall in demand for orange juice as: (1) growth in consumption in emerging countries, where consumers buy cheaper drinks such as soft drinks and nectars,

[7] http://knoema.com/IFAFUBC2013/fertilizer-use-by-crop-2013

[8] (100 %*157,000 tonnes/35 %)*2.72.

[9] Coarse grains generally refer to cereal grains other than wheat and rice—in the OECD countries, those used primarily for animal feed or brewing (*source*: https://stats.oecd.org/glossary/detail.asp?ID=369).

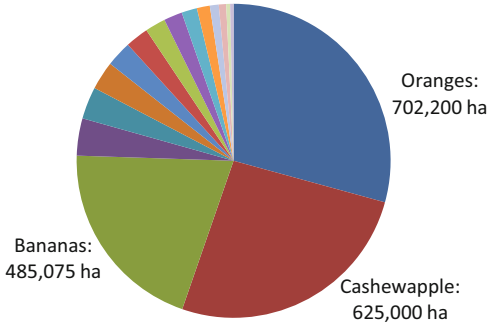

Fig. 6.12 Area of land used to produce fruits in Brazil in 2013 in hectares (*Source*: FAOSTAT)

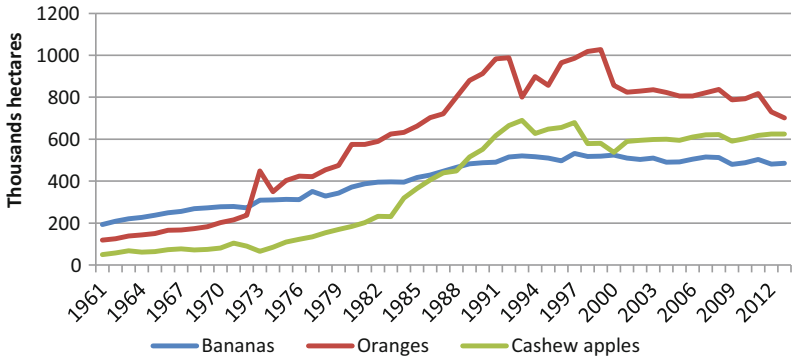

Fig. 6.13 Area harvested for bananas, oranges, and cashew apples in Brazil between 1961 and 2012 in thousand hectares (*Source*: FAOSTAT)

which have a lower juice content; (2) increase in the diversification of fruit flavours in some important consumer countries, with orange becoming less popular; and (3) increased consumer preference for low-calorie drinks.

Pesticide Application

According to FAOSTAT, pesticides include insecticides, herbicides, fungicides, and others (such as growth regulators). The active ingredient is the chemical element or the micro-organism that kills or eliminates

Table 6.3 Harmful effects of pesticides in the environment

Impact	Explanation
Environmental impact	Pesticides contaminate the soil, water, turf, and other vegetation. In addition to killing insects or weeds, pesticides can be toxic to other animals such as birds and fish, beneficial insects (e.g. bees), and non-target plants.
Surface water contamination	Pesticides can reach surface water through runoff after application to plants and soil.
Groundwater contamination	Once groundwater is polluted with toxic chemicals, it may take many years for the contamination to dissipate or be cleaned up.
Soil contamination	Pesticides and the products of their breakdown are retained by soils to different degrees depending on the properties of the soil and the pesticide. The most important variables in soil are soil type, organic matter content, CEC (cation exchange capacity), and pH.
Effect on soil fertility	Heavy treatment of soil with pesticides can cause the decline of beneficial soil microorganisms. Plants depend on a variety of soil microorganisms for transforming atmospheric nitrogen into nitrates; herbicides can disrupt this process.
Contamination of air, soil, and non-target vegetation	Pesticide sprays can directly reach non-target vegetation, or can run off or volatilize from the treated area to contaminate air, soil, and non-target plants. In addition to killing non-target plants outright, pesticide exposure can cause sub-lethal effects on plants.
Non-target organisms	Pesticides can harm beneficial soil microorganisms and insects, non-target plants, fish, birds, and other wildlife. Herbicides, for example, are toxic to fish and can have devastating effects on aquatic plants. On land, herbicides are toxic to several insects, including bees, which are crucial for agricultural pollination.

Source: Aktar et al. (2009)

the pest, fungus, or weed. Although pesticides are applied in smaller amounts than fertilizers and soil correctors, their degree of environmental persistence is much higher (Aktar et al. 2009). There are several impacts of pesticide application in crop production and these are categorized and described in Table 6.3.

According to Rigotto et al. (2014), the Brazilian pesticide market increased by 190 %, more than the double of world pesticide market, which increased by 95 % between 1992 and 2012. Brazil has overtaken

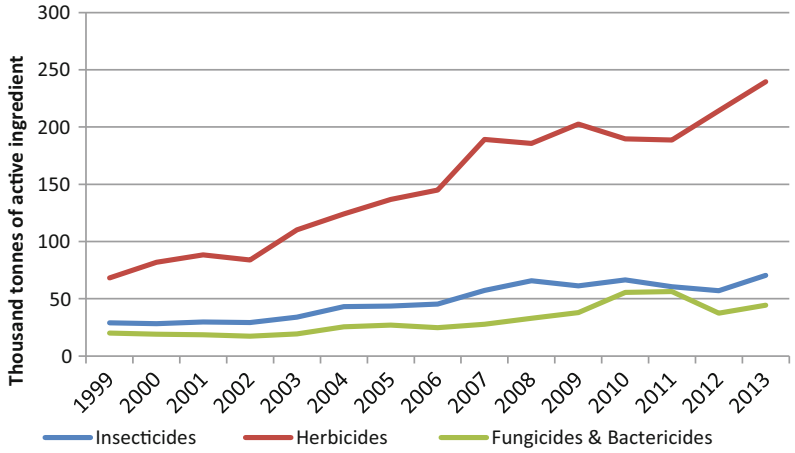

Fig. 6.14 Use of insecticides, herbicides, and fungicides/bactericides in Brazil between 1999 and 2013 (*Source*: FAOSTAT)

the USA to become the most important centre for the global trade of pesticides. Data published by the ANVISA website,[10] shows that 80 % of the pesticides used in Brazil are applied in the production of soya, corn, cotton, and sugar cane. The remaining pesticides are applied in the production of other crops, including vegetables and fruits, especially strawberries, papaya, figs, grapes, pear, peaches, and melon. A cancer report released by INCA (Cancer National Institute José Alencar Gomes da Silva) reveals that in 2009, Brazil was the major consumer of pesticides, with an average consumption of 5.2 kg of pesticide per capita (INCA 2015). FAOSTAT data show the use of insecticides, herbicides, and fungicides/bactericides in Brazil between 1999 and 2013 (Fig. 6.14). It is notable that the use of herbicides increased dramatically over the period 1999–2013, surpassing the use of insecticides and of fungicides and bactericides.

Figure 6.15 shows the average use of pesticides in permanent crops on arable land using FAOSTAT data. The graph demonstrates that in 1991, there were around 0.4 thousand tonnes of active ingredient (the key component of pesticides) per 1000 hectares of cropland, while this

[10] http://portal.anvisa.gov.br/wps/portal/anvisa/home

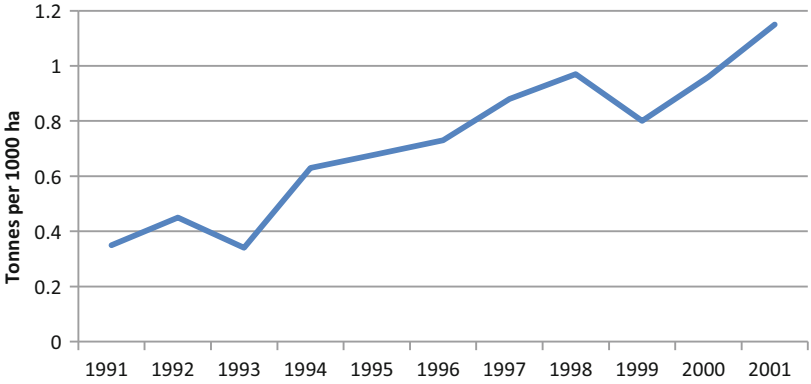

Fig. 6.15 Pesticides used in permanent crops on arable land in Brazil between 1991 and 2001 (*Source*: FAOSTAT)

had tripled to around 1.2 thousand tonnes per 1000 hectares by 2002. The Brazilian Association for Fertilizer Dissemination (ANDA) website[11] reports an application of 10.5 litres of pesticide per hectare in 2002 and 12.0 litres in 2011.

According to Coltro et al. (2009), the current technology available for orange growing in tropical regions is intensive in its use of pesticides to control pests and diseases. There are at least four main diseases responsible for increasing average tree mortality from 4.5 % to 7.3 %. These diseases and their consequences are presented in Table 6.4. According to Neves (2010), this has made oranges the second most intensive crop in terms of pesticides use. In 2003, outbreaks of greening and citrus variegated chlorosis (CVC) alone increased the use of insecticides by about 600 % (Neves 2010).

Coltro et al. (2009) found that for every 1000 tonnes of oranges produced, about 2.75 kg of pesticides are applied. Using this value, pesticide use during the period 1991–2013 can be plotted. The graph in Fig. 6.16 shows that the total amount of pesticides applied in Brazilian orange production in 2013 was around 50,000 kilograms. It also shows a decrease in 2001 with a constant use (in thousand kg) until 2013, this coinciding with a decrease in the area harvested for oranges in 2001.

[11] http://www.anda.org.br/index.php?mpg=01.01.00andver=ing

Table 6.4 The main diseases in orange production and their consequences

Disease	Damage	Region affected and time
Citrus canker	Disease of bacterial origin causing leaves to fall prematurely	Outbreak in 1990 in the State of São Paulo
Citrus variegated chlorosis	Affects the vascular system of trees, reducing fruits to the size of a golf ball	The most severe consequences so far have been seen in the north and northeast of the State of São Paulo in 1987
Sudden death	Affects the vascular system of trees and can kill the tree in 12 months	Mineiro Triangle (*Triângulo Mineiro* in 2001)
Citrus greening	Disease of baterial origin that caused the yellowing of the veins and adjacent tissues, followed by splotchy mottling of the entire leaf, premature defoliation, dieback of twigs, decay of feeder rootlets and lateral roots, and decline in vigour of the orange trees	Spreading in the State of São Paulo since 2004

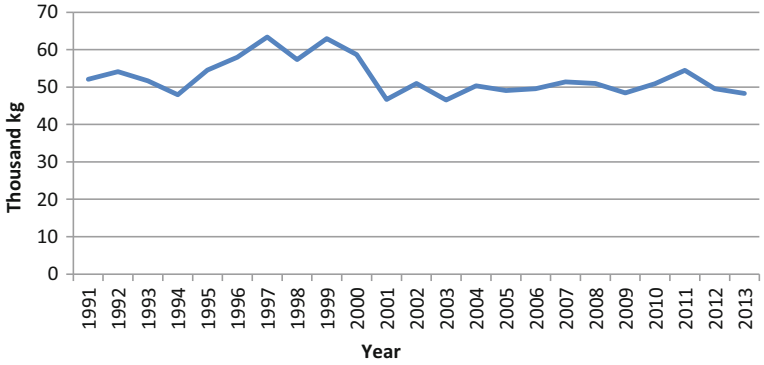

Fig. 6.16 Pesticide use in Brazilian orange production between 1991 and 2013 (*Source*: FAOSTAT)

Food Waste

Globally, a significant proportion of food produced is wasted during the production, transport, processing, storage, retail, and household consumption stages (FAO 2011, 2013; WRAP 2013). It is estimated that

between 30 % and 50 % of the world's food supply (1.2–2 billion tonnes) is wasted and sent to landfills or composting facilities before reaching the consumer (FAO 2011). Parfitt et al. (2010) found that losses are much higher for perishable foods across both industrialized and developing economies. As fresh fruits are perishable, an increase in production is likely to have an impact in food waste produced. FAOSTAT records the amount of each commodity lost through wastage during the year at all stages between production and household consumption, that is, storage and transportation. Quantities lost during the transformation of primary commodities into processed products are taken into account in the assessment of respective extraction and conversion rates. FAOSTAT excludes losses occurring before and during harvest and waste from both edible and inedible parts of the commodity occurring in the household. Waste is often estimated as a fixed percentage of availability, the latter being defined as production plus imports plus stock withdrawals. Data from FAOSTAT show that in 2013, in Brazil, 10 % of orange production was wasted, as well as 15 % of banana production. According to FAOSTAT, losses tend to be more severe in countries where agricultural products reach consumers in urban areas after passing through several marketing stages. In fact, one of the major causes of food waste in some developing countries is the lack of adequate marketing systems and organization.

Overall, this section described the impact the production of fruits has on different components of the natural environment. Table 6.5 summarizes the main findings regarding the impacts of fruit production on the environment for the period 1961–2013 using data provided by FAOSTAT and incorporated in several of the previous figures. Environmental impacts over the last few decades were used to estimate potential future problems.

Discussion

The international trade in fruits has grown rapidly since the mid-1980s. The potential for fruit production in Brazil is considerable and fruit production increased dramatically between 1961 and 2013. Since fresh fruits have a high-income elasticity, the growth of purchasing power among

Table 6.5 Environmental impacts studied and associated indicators for Brazil

Impact	Indicator	Time period
Freshwater use	Water footprint: total of ~10,000,000 thousand m^3 in orange production (Fig. 6.6)	2013
	Irrigation: evidence of an increase in irrigated area (Neves 2010)	1990–2013
	Production of water footprint–intensive fruits: increase in the production of fruits with high water footprint (Fig. 6.7)	1980–2013
Freshwater eutrophication	Application of nitrogen (N), phosphate (P), and potash (K) in fruit production: total of ~400,000 tonnes of NPK (Fig. 6.8)	2011
	Production of fruits with high grey water footprint (mangos, guavas, apples): Increasing trend (Fig. 6.9)	1980–2013
Greenhouse gas (GHG) emissions	Emissions from synthetic fertilizer in crop production: Increasing trend (Fig. 6.10)	1990–2013
	Synthetic fertilizer application per hectare in crop production: sharp increase between 2008 and 2011 (Fig. 6.11)	1999–2013
	GHG emissions from synthetic fertilizer application in fruit production: total of ~1 gigagram	2011
Land use requirements	Area of fruit production: total of 3,211,755 ha (Fig. 6.12)	2013
	Area of banana production: increasing trend between 1961 and 2012	1961–2012
	Area of orange production: decreasing trend between 2000 and 2012 (Fig. 6.13)	
Chemicals used—pesticides and herbicides	Herbicide use in agriculture: increasing trend between 1999 and 2013 (Fig. 6.14)	1999–2013
	Use of pesticides in agriculture (tonnes per thousand ha): sharp increasing trend (Fig. 6.15)	1991–2001
	Pesticide use in orange production: ~50,000 kg (constant value apart from the period 1994–2000, when it reaches ~60,000 kg) (Fig. 6.16)	1991–2013
Food waste	Waste in orange and banana production: 10 % of crop produced is wasted (bananas) and 15 % of the crop produced is wasted (oranges)	1961–2012

the population of Brazil is reflected in an increase in domestic supply and consumption (see Fig. 6.4). However, this increase might be smaller than expected if the percentage of household food budgets allocated to fruits and vegetables in Brazil is the same as assumed globally (4–16 % according to Ruel et al. 2004). Faveret Filho et al. (n.d.) showed that the domestic market is the main destination for the fruits produced in Brazil. The increase in the commercialization of fruits has brought several advantages to the Brazilian economy, such as employment and income, with positive socio-economic consequences (Faveret Filho et al. n.d.). But there are also examples of negative socio-economic effects such as the exclusion of small-scale producers from orange production (Bellingieri et al. 2012) and increased dependency on external inputs, which are less accessible to small producers, specifically those with precarious land ownership. Small-scale farmers have traditionally played a major role in the production of fresh fruits and vegetables, but their role in producing goods for export may be limited as they need assistance in adapting to policies, institutions, and infrastructure to take advantage of this increasing trend.

This chapter has specifically focused on the impacts of fruit production on the environment as a basis for further discussion on how these impacts can affect livelihoods. The framework chosen to begin the analysis is that already used by Gill et al. (2015). This is an earth system framework based on planetary boundaries (Rockström et al. 2009), which are human-determined values of the control variable set as a 'safe' distance from a dangerous level or from its global threshold. Beyond these boundaries, the hypothesis is that development will no longer be sustainable. The planetary boundaries approach focuses on the biophysical processes of the earth system that determine the self-regulating capacity of the planet. From the nine boundaries proposed by Rockström et al. (2009), this chapter focused only on the influence of fruit production on climate change, P and N cycles, freshwater use, and changes in land use. It is considered that these influences are aggravated by food waste and energy consumption, so attention was drawn to these processes. The influence of fruit production in the remaining earth systems (ocean acidification, stratospheric ozone depletion, atmospheric aerosol loading, rate of biodiversity loss, chemical pollution) was not analysed in this chapter. The thresholds for Brazil were not analysed either, but the available literature allows for some informed

commentary. Further analysis would be essential in order to assess the sustainability of fruit production in Brazil and to identify more sustainable practices, if required. Some governments, for example, the UK government, have been encouraging the food and drink industry to use resources more sustainably (DEFRA 2015). This chapter aimed also to arrive at an understanding of some of the trade-offs between fruit production and environmental services in Brazil. In a context of increasing competition for resources in the water, energy, and food sectors, it is important to understand the existing synergies and trade-offs, as these are key to the well-being and economic development of nations. Assessments related to the environmental impacts of an expansion in fruit production in Brazil have already been undertaken by several authors (e.g. Coltro et al. 2009—orange; Basset-Mens et al. 2014—mango).

There is no baseline to compare these values with, or threshold to determine whether fruit production in Brazil is unsustainable, but data presented in Table 6.5 show that fruit production has been putting pressure on water resources through increased freshwater use, freshwater eutrophication, use of pesticides, and waste production. Fruit production is also contributing to pressure on land use and likely to aggravate the problem of GHG emissions.

In particular, incremental production of fruits with a high water footprint (e.g. apples, grapes) will contribute to increasing the pressure on water resources. Brazil's potential increased participation in the international fruit market will contribute to the problem of large exports of virtual water. Virtual water is defined as the total volume of water needed to produce and process a commodity or service. The external water footprint is the total amount of virtual water used in other countries which is imported when goods produced in those countries are imported. To the UK alone, Brazil exports 4441 million m^3 of water embedded in products such as beef, soybeans, coffee, poultry, livestock, maize, rapeseed, wheat, pigs, milk, and sunflower oil. Because Brazil is the world's lead supplier of concentrated orange juice, the country's fruit sector is also an important exporter of virtual water. An increase in the consumption of exotic fruits such as mangoes and guavas in Europe and the USA also exacerbates the problem of virtual water as these fruits have a large water footprint (see Table 6.2), compared with other exotic fruits such as pineapple and

papaya. Tucci (2009) believes that water, embedded in food production, will become an important commodity in the world market. This will mean that some countries will export water, while other countries will import water. Under climate change, or changes in the demand from other water uses, water can become a scarce good, so a mechanism of exclusion for embedded water might be implemented (e.g. price) with consequences to food prices.

In the case of fruits, water footprint is, in general, much lower than those of other products exported by Brazil, such as beef (15,400 litres of water per kilogram produced) or coffee (18,900 litres of water per kilogram produced) (see Mekonnen and Hoekstra 2011). However, it is important to take into account the impact of food production on water in order to engage decision-makers in developing and implementing plausible actions that will result in positive long-term outcomes both on the environment and on the economic sustainability of the Brazilian fruit sector.

The development of fruit production in Brazil has taken place with the help of irrigation, which is highly dependent on groundwater abstraction and rainfall. In Brazil, groundwater abstraction is not monitored or licensed and is exposed to unsustainable management, with withdrawals exceeding the rate of recharge. According to de Souza (2015), every ten years, the depth of artesian wells, which is a main source of water for agricultural production in some regions, increase by 50 metres. On the other hand, rainfall shortages, like the one that occurred in the São Paulo region in 2014–2015, are likely to threaten crop productivity in the future, especially for crops dependent on irrigation such as fruits and vegetables. Therefore, increased production of fruits that require large amounts of water to grow might not be sustainable in a scenario of increasing droughts. Some studies already show a gradual increase in the average temperatures, reduced rainfall in the northern region of São Paulo, and long periods of drought (Neves 2010; De Souza 2015). To maintain production levels, water may be transported from places where it is available, putting pressure on water resources in other Brazilian catchments or regions and increasing GHG emissions associated with pumping and transportation.

Fortunately, there are some practices which can reduce the water used in agricultural production, for example, implementing more water-efficient systems. These measures should take into consideration not only water

conservation benefits and implementation costs but also other factors such as energy dependency and GHG emissions. According to Maraseni et al. (2014), analysis of the trade-offs between water efficiency and energy use in irrigated agriculture is critical to ensure that the economic efficiency of agricultural production is maintained; these authors stress that both mitigation and adaptation aspects must be evaluated. A large proportion of the water demand could also potentially be met by changing consumer behaviour and reducing food waste. Increases in production will certainly be important to the Brazilian economy in the future, but the growth will be constrained by the finite resources provided by the earth's land, oceans, and atmosphere (Godfray et al. 2010). According to FAOSTAT, about a third of all food produced is lost or wasted. The increasing distances between the points of production and consumption contribute to increasing food waste along the supply chain, especially in the case of highly perishable products such as fruits. Therefore, with the potential increase in Brazil's participation in the international fruit trade, an increase in waste is anticipated. There are significant potential savings to be made in terms of water, energy, money, and reduced GHG emissions from cutting food waste with reasonable investment and effort. Regarding the use of pesticides, this could also potentially be reduced, as Faveret Filho et al. (n.d) report an excessive amount of pesticide use in Brazilian agriculture, including fruit production. The overuse of chemical pesticides in developing countries has resulted in a series of codes in some countries to promote ethical production systems. However, the associated compliance costs of these regulatory steps may impact negatively on small-scale farmers, who have limited access to information about the codes and standards required (Ouma and Whitfield 2012).

Dietary changes also could have an indirect impact on Brazilian water systems since the volume of freshwater that is used to produce food varies according to the food types produced (Hoekstra and Hung 2002). However, this would depend on whether the change is related to imported food or domestically grown food.

Changes in the types of fruits produced could also have a significant impact on GHG emissions (Smith et al. 2013) since there are fruits with higher carbon footprint than others. Governments have the potential to incentivize the production of fruits that require fewer inputs to reduce

the impact on water and land resources and reduce GHG emissions through the rewarding of farmers for the provision of ecosystem services and health benefits. Native tropical fruit species may be more environmentally friendly and often have great potential as sources of dietary vitamins, minerals, and energy.

Conclusion

This analysis using mainly data published by FAOSTAT found that fruit production in Brazil has a major impact on the environment, especially on water resources. The framework used was an initial step in identifying ways to make the fruit production sector in Brazil more sustainable. It was not possible to determine whether this impact is beyond the tipping point or threshold as defined in the planetary boundaries framework for Brazil. Having said that, this analysis was the first step in raising questions and suggesting directions for future research, for example, what are the risks for fruit production due to climate change, how can agro-ecology techniques contribute to the resilience of the crops, and what are the ecosystem services associated to different fruit production systems. Fruits and vegetables have received insufficient research and development attention from the international community, but the high demand and high value of the products should trigger increased investment in this sector. In Brazil, the excessive use of pesticides and the high water footprint of some fruits are certainly the major environmental impacts to tackle first.

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7

Water Incorporated in Agricultural Production: Water Balance Considerations

Renato de Toledo Peres and José Gilberto de Souza

Introduction and Overview

The international market for food and non-food agricultural products is growing rapidly, as is the concentration of production that takes place at sectoral level due to merger and acquisition processes and the consolidation of spatial monopolies due to regional productive specialization, company consolidation, and intense competition patterns. These processes have a particularly great impact on the primary sectors of the economy, contributing to what is called the commoditization of agriculture, and in this respect, Brazil stands as a unique example. Big corporations aim to achieve the highest possible productivity in order to maximize profits. To this end, water, one of the most basic resources in agricultural production, is exploited to the extreme. An example of this is the use of deepwater aquifers as a major source of

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water for irrigation. These sources of water, which should be prioritized as strategic reserves, have often shown signs of depletion and scarcity in various key intensive farming areas of Brazil. The dynamics of water exploitation in such cases is what links the two processes examined in this text. First, the authors examine the effective use of resources in irrigated production from free or confined aquifers. Second, the study examines production standards arising from the concept of virtual water export and the use of green, blue, and grey water types. Demand for all these types of water is established in production processes, but there is also an effective extraction of the physical water reserves for incorporation into agricultural products, which we call consumptive use, and, consequently, for the material export of water. These two processes—namely consumptive and non-consumptive uses of water—play an important role in the hydrological cycle and need to be reflected in a new water balance model.

Setting the Scene

In the last two decades, Brazil has been setting records for production and export of grains, soybean in particular. Meanwhile, products derived from sugar cane, fruits, and other agricultural activities have also become very important both nationally and in foreign markets. For many, these developments are a positive sign for the economy and an indication that economic growth has resumed after the turbulence of the 1980s and early 1990s. A surplus in the trade balance and an increase in the national minimum wage are two positive effects observed during this period, which seem to confirm the "evolution" of Brazilian agriculture. The country is increasingly specializing in the production of primary goods, such as the commodities mentioned above, while the formation of competitive regions shows the dynamic expansion of agriculture (Frederico 2012). However, there are also production costs and negative externalities that are not always incorporated or analysed in relation to the supposedly positive outcomes of contemporary agriculture in the country. One of these externalities is the increased use of water, an issue which is not unrelated to the recent crisis in Brazil's urban water supply, as in the case of São Paulo.

Before anything else, it is essential to revisit our conceptualization and interpretation of the basic properties of water. According to Latour (1994

[1991]), water constitutes a hybrid: when analysing issues around water, it is necessary to consider the inseparability of nature and society, that is, take into account natural and environmental aspects, whether physical, chemical, or biological, as well as human and social aspects, whether economic, technological, or political. In this sense, water is a complete hybrid according to Latour's theory of hybrids, and all these aspects must be considered if an appropriate understanding of water management problems is to be reached (Swyngedouw 2004; Ioris 2013).

Water has important physical features, such as temperature, transparency, and physical state (solid—ice or snow, liquid, or gas—water vapour and air humidity). Its chemical characteristics include its composition (H_2O) and the presence or absence of contaminants (heavy metals, nitrates, etc.). Also important are the biological characteristics of water, because in addition to being fundamental to life on Earth, water is part of the composition of every living being and every source of food (Berg et al. 2014). When it comes to human aspects, water is significant in every sphere of human interaction, whether social, economic, political, cultural, or environmental (Silva et al. 2012). More recently, water has started to become the subject of geopolitical conflicts in countries where its scarcity is already at a more advanced stage and there is limited willingness to resolve disputes through negotiation and compromise (Souza 2015).

Based on the above, the text is organized as follows. The first part deals with concepts related to water, whether natural, economic, or social. Then, we present the concept of virtual water (Hoekstra and Hung 2002), to be able, later, to bring forth the idea of physical water we are proposing. This latter one took us to the measurements of exported volumes of physical water from Brazil, linked, at last, to the water balance considerations.

Water Resources, or Simply Water?

As a central element[1] on Earth, occupying almost three quarters of the planet's surface, water is an object of analysis in various sciences. To physicists, it is a liquid at room temperature, colourless (slightly bluish), odourless, and tasteless (when pure), which, under "normal pressure"

[1] Note that for chemistry, water cannot be called an *element*, because it is a compound.

(1 atm), solidifies at 0 °C and evaporates at 100 °C. To chemists, it is a compound formed from two hydrogen atoms attached to an oxygen atom with the chemical formula H_2O, and is known as the "universal solvent" as it has the physicochemical property of dissolving many other chemicals. In the biological sciences, water is important because our bodies (and those of other living beings) are mainly composed of water, and "dehydration" is a condition that can lead to death (Berg et al. 2014). The importance of water is even more comprehensive when it comes to the applied sciences, most of all in hydrology (etymologically "water study"), considered by Chow (1959) as a science that analyses the water in all its chemical, physical, and biological forms, as well as the interface of those different forms with human life.

Meanwhile, the social sciences deal with understanding various different representations and symbolisms related to the concept and the experience of water use. Roberto Malvezzi, a former national coordinator of the Pastoral Land Commission (CPT—*Comissão Pastoral da Terra*), argues that we are facing a new paradigm in approaching an issue that demands a conceptual revision: it is necessary to make a distinction between water resources and water:

> Water is in nature and this is prior to all forms of life. But it is also a fundamental part of life, making up 70% of the human body, for example. So we have to include in the debate on water an ethical principle, which recognizes its natural and biological value, its social value—a population without water can have no peace—cultural and religious. So do not just think of its multiple uses for power generation, irrigation, navigation. We have to speak in multiple values as well. (Carta Maior 2005)

For instance, Swyngedouw (2004) uses the example of water to demonstrate the process of "Competitive Construction of Spatial Scales", in the cases of Ecuador (the city of Guayaquil) and Spain (in its modernization process), and considers water resources as "starting points for reconstruction and theorizing of the political-ecological scale process". For him, water pervades all realities, spaces, and imaginable scales in the world. It is biological, physical, chemical, social, economic, and political at the same time. By his turn, Ioris (2013: 3) highlights the theoretical and academic building of a true "geography of water":

> The geography of water is based on the recognition that there is a permanent and dialectical interaction between human activity and the environment. Water is essential in countless natural processes and at the same time is an integral part of social relationships. You cannot separate the movement of water from human interference, nor ignore the hydrological conditions of communities and civilizations. Therefore, there is an interdependent relationship between society and water resources, creating a cycle that, rather than being purely hydrological, is fundamentally hydrosocial.

But in legal terms, the concept of "water resources" may have a missing significance of social, regional, or natural specificities. According to Pereira Jr. (2004: 3):

> The renewable portion of the Earth's fresh water is about 40,000 km^3 per year, corresponding to the difference between atmospheric precipitations and water evaporation on the surface of the continents. Not all of this volume, however, can be harnessed by man. Nearly two-thirds returns quickly to waterways and oceans, after heavy rains. The rest is absorbed by the ground, permeating its surface layers to be stored in underground aquifers, which, in turn, will be the main sources of hydration for the waterways during droughts. The relatively stable portion of the water supply is therefore just under 14,000 km^3 per year. This portion of fresh water available to mankind in the current technological stage and at suitable costs with its various uses is what is called the water resource.

Importantly, this concept is legally accepted and has therefore served as a normative basis for Brazil's entire system of social organization and environmental regulation (Pereira 2004). The last author points out, among other characteristics of water resources use in Brazil, the poor distribution of stocks, showing that despite being the country with the largest "endogenous" water production, it ranks only 23rd in the world in terms of per capita availability. This misallocation is even more evident when analysed regionally. The North and Centre-west Regions have 2–11 times as much water available compared with the national average, while the Northeast and Southeast Regions have only about 10 % of the total.

We can infer, then, that water is much more than a resource. The word "resource" has connotations of merchandize and consumer goods, and treats water as an object of economic value, which some scholars

have proposed. The great social risk inherent in this approach is the pricing and commoditization of water. Water would become, according to this model, a commodity available only to those who can pay, changing its status from a human right to a tradable commodity (a perspective favoured by certain large corporations, which defend privatization and aim to limit access to water):

> In the opinion of Peter Brabeck, president of Nestlé, water should be treated like any other food and have a market value established by the law of supply and demand. (Portal Metrópole 2015)

This market model that large corporations seek to establish is a concrete expression of the idea that water is not only a necessity for human consumption, but can also be understood as a resource for productive input and basis for capital accumulation. However, such attitude can be a source of conflict between states, societies, and corporations. In Brazil, the dominance of such ideas in the logic of production (Souza 2014) links the commodification of water directly to the issue of land grabbing, that is, water problems are also an element of agrarian disputes; according to the CPT, conflicts over water in the country increased by 26 % in 2014 compared with the previous year, with 127 conflicts affecting around 42,800 people (CPT 2014). The water thus proves far beyond a "water" resource because it is, above all, a natural and social good, and therefore a human right. It would be incorrect to characterize the water only as an economic resource, and analyses in this regard are being made, such as the concept of "virtual water", as discussed below.

Questioning Virtual Water

In 2002, Hoekstra proposed the concept of a "water footprint", an allusion to what was already known as an ecological footprint, only in this case referring to the volume of water used in the entire production chain for any given agricultural or industrial product. (Also refer to Chap. 6 for more details on water footprint). This water can be said to be "virtually" exported or imported by a country. According to Hoekstra and Hung

(2002), the water involved in the production of a kilogram of beef, for example, is about 15,000 litres, which includes consumption during all stages of the production process, from raw materials to intermediate and final products.

To describe the composition of "virtual" water, water is classified into three different types: blue (superficial or underground water, that is, rivers, lakes, or aquifers), green (soil moisture), and grey (pure water required to "decontaminate" or dilute the contamination of natural water reserves that may occur during the production process) (Hoekstra 2011). This classification forms the basis of the calculation of water used in the international trade of agricultural products, showing that agro-export countries like Brazil have a vocation for virtual water export due to the country's self-sufficiency in terms of water resources. Along the same lines, Hoekstra and Hung (2002) suggest that countries with a water deficit do not normally produce goods that require large amounts of virtual water, and are more likely to import this type of product.

However, we favour a rather more critical approach to this concept, which includes the following:

1. Questioning the general view that declaring a country to be "water scarce" or "water self-sufficient" should involve regional analysis of water resources, and consideration of the different existing morphoclimatic fields in the country and the different ways water is used (Souza 2015);
2. Quantifying the volume of water "physically" incorporated into the agricultural products exported by our country (Souza et al. 2010);
3. Re-evaluating the analysis of how much water is required to produce various agricultural products, through water balance considerations.

At the next three subsections, we are going to clarify these three critics above.

1. *Differences Between Brazilian Morphoclimatic Fields*

The first critique of Hoekstra's proposition is certainly very acute. Known for its continental dimensions, Brazil has more than one

morphoclimatic domain, with certain water systems and soil conditions that mean it cannot be declared a country where water is "plentiful" throughout (Ab'Saber 1977). This fact alone would be enough to challenge Hoekstra's suggestion that the country has a productive vocation. However, the availability of groundwater resources must also be evaluated since aquifers have a clearance rate which can vary from short term (less than a year) to long term, or even geological timescales in the case of deeper aquifers, which may require thousands of years for replenishment (Gastmans et al. 2013). Brazilian agricultural production in some regions, such as those that are semi-arid, depends largely on irrigation. So, in addition to climatic differences, hydrogeological differences are important variables.

2. *Volume of Physical Water*

"Physical" water in an agricultural product may refer to one of three types of water: "*humidity or moisture*", "*from photosynthesis*", and "*from fermentation*". First, the actual water present in an agricultural product in its known form is H_2O itself (humidity). In some products, such as orange juice, which is a major export product for Brazil, the proportion of moisture may reach 95 % (NEPA 2011); that is, almost the entire exported product is water. In other products, such as soybeans, water content is lower, reaching only 14 % (Souza et al. 2010).

In the latter case, the second concept of physical water becomes more important. This is water *from photosynthesis*, which is the water incorporated into the product during the genesis of the plant, whereby nature transforms the water absorbed from the soil by the plant's roots into organic matter present in the plant, whether mono-, di-, or polysaccharides, or vegetable protein. We estimate that almost 60 % of the material in dry (dehydrated) plant material also comes from water, not only in known liquid form (H_2O), but also in the form of atoms that come from broken-down water molecules in, for example, glucose, and are then incorporated into other molecules, as exemplified by the chemical equation of photosynthesis:

$6H_2O + 6CO_2 \rightarrow C_6H_{12}O_6 + 6O_2$ (in the presence of light and chlorophyll)

Taking this into account, the moisture content of soybeans would increase from a maximum of 14 % to about 65 % of incorporated water, depending on the type of bean. In some specific cases, such as sugar cane and its derivatives (e.g. refined sugar and ethanol), a third concept of physical water appears. During the production of ethanol, sucrose becomes ethyl alcohol via the process of *fermentation*. During this process, the glucose molecule is broken down, producing ethanol and carbon dioxide: $C_6H_{12}O_6 \rightarrow 2C_2H_6O + 2CO_2$ (Berg et al. 2014). As water molecules were required to obtain glucose, in the process of photosynthesis, and as there is a loss of carbon dioxide to the atmosphere, ethanol production requires about 117 grams of water to obtain 100 grams of ethanol. It means that the volume of water used in ethanol production is higher than the volume of ethanol itself, which means that the volume of water in ethanol exceeds the actual volume of ethanol.

Peres (2012) estimated the incorporated volumes of physical water in the orange juice, sugar, and alcohol exported by Brazil in 2008 and 2011. The study relied on data from the Unicamp Table of Food Composition, or TACO for short (NEPA 2011), sugar and ethanol export data from the Brazilian Sugarcane Industry Association (UNICA), and orange juice export data from the National Association of Citrus Exporters (CitrusBR). In addition, according to the Nucleus of Studies and Researches of Food (NEPA) data (2011), confirmed in laboratory tests, Peres (2012) concluded that an orange (varying depending on type) is made up of about 90 % humidity and about 10 % carbohydrates and fibre. Of these, about 60 % may be considered water, originating from photosynthesis.

However, according to CitrusBR, it is not the fruit *in natura* that is exported. According to NEPA data (2011), the chemical composition of the juice is very similar to that of the fruit: approximately 91 % moisture and about 9 % carbohydrates (also varying according to the type of orange), or 96.4 % incorporated water. According to CitrusBR (2015), whose figures are established for frozen concentrated orange juice (FCOJ), this type of juice is concentrated on average 5.5 times for export. So, this type of juice has 5.5 times more carbohydrates in place of moisture, meaning that the proportion in this variant is 50.5 % moisture and 49.5 % carbohydrates. As 60 % of carbohydrates are considered to be water altered by photosynthesis, the final incorporated water content of FCOJ is approximately 80 %.

Based on these data, it was concluded that over four years (2008–2011), Brazil physically exported 1,809,044 m^3 of water, that is, 1.8 billion litres, only in FCOJ (including the moisture content of the product itself and water incorporated from photosynthesis). Over the same period, Brazil's exports of NFC (not from concentrate) orange juice comprised a volume of 3,669,943 m^3 of incorporated water, or roughly 3.7 billion litres. It is important to consider that sales of this form of orange juice are growing.

As regards the export of physical water incorporated into the sub-products of sugar cane, it appears that for sugar, which has about 60 % water absorbed by photosynthesis, a volume of 58,274,005 m^3, or almost 58.3 billion litres, of water was exported over the same period (2008–2011). In the case of ethanol, which is considered to contain approximately 117 % incorporated water, a volume of 14,391,066 m^3 of water, or almost 14.4 billion litres, was exported over the same period. So, just from these four products, 78,144,048 m^3 of physically incorporated water was exported over four years, an annual average of 19.5 billion litres.

3. *Considerations for Water Balance*

Water vulnerability, observed in several regions of Brazil and the world, is measured in terms of water balance. Initially proposed by Thornthwaite and Mather (1955), this tool is still widely used. Assessment is based on figures for soil moisture variation, taking into account rainfall measurements, evapotranspiration, and run-off, all of which cause increases or decreases in moisture in the soil being studied. However, with advances in well drilling technologies, water withdrawal from aquifers has become common practice in agribusiness and other production activities. For this reason, it is now necessary to consider new water entering the system (such as a watershed) as a variable.

The traditional water balance formula is as follows (Thornthwaite and Mather 1955):

$$\Delta S = P - ETR - R - I$$

where:

ΔS = soil moisture variation

P = precipitation

ETR = evapotranspiration (actual)

R = run-off
I = infiltration

It is noteworthy that this balance model (traditional) does not consider aquifer water withdrawal as an input source in the system, nor does it consider the "virtual" or physical water that would be "exported" (system output). For this reason, it is proposed that these two variables should be included in the model in order to provide a more complete analysis of water availability and vulnerability, as follows: one variable to address the lack of information with regard to the exploitation of water from aquifers, which we will call irrigated water (iW); and the other to consider the volume of water that effectively leaves the basin in question in the form of physical water (phW). The latter is also referred to as consumptive use. It is important to note that, at the moment, we do not have a way to measure virtual water as it does not represent a consistent volume within the water balance equation. It is, however, important in other studies in which the determination of "grey" water is of utmost relevance due to the problems observed today with groundwater contamination from pesticides, industrial waste, and other contaminants such as the "vinasse" or "slop" from the "fertirrigation" of sugar cane (Souza and Peres 2012).

This gives us a new water balance formula, with the two new proposed variables added to the model:

$$\Delta S = P + iW - ETR - R - I - phW$$

where:

iW = ground water from irrigation
phW = physical water consumption incorporated into the product

Beyond Those Shortcomings

The importance of knowing the actual volume of irrigated water and consumptive use (physical water) is to determine with a reasonable degree of accuracy the volume of physical water incorporation in agricultural production compared with the volume of groundwater withdrawal. This information will allow us to determine which of two possible causes is responsible for the depletion of aquifers. The first, more optimistic,

scenario would be that the proportion of consumptive use is low compared with the consumption of irrigated water. In this case, the depletion of aquifers could be explained by evapotranspiration and losses and/or waste during the production process. High evapotranspiration is not problematic since this water returns to nature through the natural hydrological cycle and will eventually contribute to refilling the aquifers (although sometimes very slowly). In addition, this evapotranspiration is a normal feature of the regional climate. In the case of loss or waste of water during production processes, a proposed analysis would use applied technology to accurately compare producers' water use and determine which irrigation methods use water most efficiently, as exemplified in the study of spray irrigation versus drip irrigation. As a result, improvements could be achieved with some investment.

The second, more pessimistic, scenario would involve a high proportion of consumptive water use from aquifers, meaning that agricultural production relies directly on water from groundwater sources. This would reveal that current methods of agricultural production exploit all available sources of water indiscriminately, using non-renewable assets for the purposes of profit-making. Eventually, the likely results of this scenario would be a trail of destruction in the natural environment, ultimately leaving families without water and food, undermining the economy, and even causing political conflict, as noted at the beginning of this chapter.

It is too early to talk about exact percentage values that would determine a "high" or "low" proportion, but comparative studies can be made between products that deplete aquifers and those that preserve them, giving a real sense of a limit to how much agricultural productivity can be increased, which is vital in the case of a country where agriculture is fundamental to the economy.

One proposal to ease this *hydrosocial* impasse regarding restrictive or conservative measures would be to impose restrictive measures that would effectively prohibit the use of certain aquifers in regions of the country where percentages of irrigated water incorporation are high. In areas where the situation is less critical, measures such as taxation and environmental services could help to reduce production losses,

always bearing in mind the risk of pricing and commoditization of water as a natural resource.

Final Considerations

As seen above, volumes of physical water incorporation are high in some of the major Brazilian export products, which are fundamental to the country's economy. Where high-humidity products such as orange juice can contain up to 95 % water, and even low-humidity plant-based products such as refined sugar can contain over 60 % water, questions about the physical and virtual export of water and its effects on water balance are of vital national importance.

Some studies that are taking place in the state of São Paulo (Brazil) suggest that the use of water and methods of land use in monoculture production of, for example, sugar cane, orange, soybeans, and other agricultural commodities can produce long-term average moisture reduction processes in soil and lead to desertification or *sandification*. This phenomenon occurs when soil moisture shows a trend towards reduction as a result of agricultural production without proper conservation management. Factors that cause desertification include: the removal of natural vegetation (woods and forests), particularly in groundwater recharge areas; a "splash" effect leading to soil sealing (where rainwater generates soil compaction); erosion from rainfall with increased run-off, especially under extreme weather conditions; and pesticide use, leading to the elimination of micro-organisms and ants, which are essential for aeration and soil nutrition.

These factors have been identified as the main causes of desertification in regions which are not prone to desertification under normal climatic conditions but where agricultural monocultures can trigger this phenomenon. In addition, there is concern for the output of families who traditionally used the land in these areas for polycultural farming, often subsistence, with demand for physical and virtual water compatible with minimal environmental impacts, as the advance of agribusiness has led companies to invest in these productive lands.

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8

Politics of Scale and Water Governance in the Upper Xingu River Basin, Brazil

Vanessa L. Empinotti

Introduction

The Amazon region poses a great challenge for the water resources management regime in Brazil. Its large area, widely dispersed population, and the small number of economic activities based in the region's river basins have hampered the implementation of decentralized and participatory institutional structures as defined in Brazil's Water Law 9433, approved in 1997. The lack of spaces for negotiation, combined with rising demand for water and energy, has led to serious conflict, as was recently the case with the Belo Monte Dam, under construction along the lower Xingu River. The growing demand for water and energy has led to conflict and distress, while state authorities and the agriculture sector have focused their attention on land tenure and deforestation, leaving water management and access as a secondary issue. However, while

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water is not explicitly on the agenda, it is water availability that allows intensive food production in the region to expand. So, how are formal water institutions reaching the local and municipal scale? Who are the groups involved? How are their strategies influencing water access and environmental conservation in the region?

This chapter briefly investigates the ways in which water issues have been discussed and negotiated in the region, informed by results from an empirical study conducted in the municipality of Canarana on the Upper Xingu River Basin in the state of Mato Grosso, Brazil's main soybean production region. In the specific case of the Upper Xingu region, industrial-scale agriculture in the form of soybean and corn (maize) production has grown exponentially since 1990, which has changed farming practices, local leadership structures, and the relationships involved in land use and land allocation. These are all significant issues that deserve proper consideration (Durigan et al. 2013; Le Tourneau et al. 2013; Vanwey et al. 2013), and the situation exemplifies how water security in the region is under significant pressure due to these multiple uses of water, raising serious questions about the mechanisms of water access in the area. Since the adoption of the 1997 Water Law, governance has become a key component of water resources management in Brazil. Participatory institutions have been created, and decision-making must now involve various sectors of society in addition to public agencies.

The inclusion of these new participants in decision-making has made the process more dynamic, reflecting the various challenges and structures present at different times. At the same time, water influences the transformation of the economic and social landscape through the complex relationships between human beings, economic practices, and cultural factors that make water resources so socially significant and thus influence governance practices (see, among others, Swyngedouw 1997, 1999; Swyngedouw et al. 2002; Prudham 2003). Changes in water management strategies lead to the emergence of new issues that redefine how water and its use are understood by various social groups, and can also lead to changes in institutional arrangements and power flows as these respond to the dynamic appropriation and understanding of water (Empinotti and Jacobi 2012). Therefore, it is important to understand the range and complexity of social actors and their multiple

strategies in order to propose new mechanisms for considering such dynamics. An important consequence of this consideration is that water governance processes and instruments established in law should be adjusted and re-created where necessary depending on the specific local and regional context.

The purpose of this chapter is to map and understand existing institutional arrangements in order to identify power structures and the main approaches of decision-makers to managing water resources in the Upper Xingu region. The text is organized into four sections. The first offers a theoretical discussion that relates water governance to the politics of scale in order to help provide an understanding of how tensions between environmental and production issues lead to new institutional arrangements between different scales, thus redefining water resources issues in the region. I start by explaining how formal institutions are present at state level, describing the main players in the region and examining the politics of scale currently in place. In the following two sections, institutional arrangements in the region are discussed, with an analysis of how these arrangements activate different scales of social action. I explore the reasons for such arrangements and examine the case study in the Upper Xingu region, detailing the region's particularities and specificities. I then discuss how water management has been influenced indirectly by programs and partnerships that have focused primarily on forestry recovery. The chapter concludes with an analysis of the role of nongovernmental organizations (NGOs), farmers, and municipal agencies as major stakeholders in water governance practices and the consequences of actions whose ultimate aim is the recovery of native vegetation.

Politics of Scale and the Practices of Water Governance

The introduction of governance to the management of nature reflects a new model of political practices, which emerged in a specific sociopolitical context as a result of the interaction of various social actors trying to secure results beyond conventional state interventions. Centralized state control was broken up, and a new form of interorganizational coordination was

adopted that was based on self-governing networks rather than following established hierarchies or market forces (Kooiman 1993; Rhodes 1997). When applied to environmental management, the environmental governance agenda creates, often controversially, conditions for the establishment of new institutional spaces where the public and private sectors can interact, and technicians can interact with users. *Governance*, a more inclusive term than *government*, refers to the socially acceptable implementation of public policies which amplifies the relationship between society, the state, markets, lawmakers, and policymakers, and deals with all the government actions associated with well-being and quality of life that ultimately lead to better environmental health.

This implies the establishment of a system of rules, norms, and behaviors that reflects the values and worldviews of those affected by this institutional framework. The construction of this system is a participatory process, and, above all, one of shared learning (Empinotti and Jacobi 2012). At territorial level, governance is coordinated through partnerships, coalitions, and alliances between different actors in collective initiatives, with the ultimate aim of promoting the interaction of government representatives with other social actors. Because individual actors, public or private, have neither the full knowledge nor access to all the information needed to solve complex, dynamic, and diversified problems, conventional responses under the rigid intervention of the state tend to fail in situations that require them to deal with multiple interdependencies; this demonstrates the need for strong ties between the private sector, social organizations, and all spheres of public administration.

As a result, the challenges of environmental governance are related to this ability to bring together different social actors with different perspectives for meaningful negotiation, leading to strategies and solutions to complex dilemmas such as how to guarantee water security and environmental conservation. As these are fundamentally environmental issues, the understanding of governance practices should not be restricted to the network of water users, but should also include large technological systems and socionatural processes affected by socioeconomic and political pressures (Bakker 2010). In the process of water governance, it is essential to recognize how the flows of power and water are interconnected, transforming society and the environment together. More than ever, the transformation of cultural practices

and the (socionatural) landscape is mediated by institutional arrangements, and an integrated vision of the relationships involved is more likely to promote new managerial approaches that recognize the degree of complexity and the politico-ecological tensions involved.

When analyzed from the perspective of political ecology, the study of water governance recognizes that access to water is not merely a result of capital accumulation and the purchase of material goods, but rather of how people are able to increase their access through their engagement with other actors or affiliations, or through participation in institutions, and how their relationships are governed by the logics of the state, market, and civil society (Berry 1989; Bebbington 1999; Leach and Mearns 1999; Ribot and Peluso 2003). When considering the mechanisms that control access to natural resources, and the institutions that influence these processes, we find not only obstacles but also new possibilities for understanding how interactions between old and new players, combined with institutional practices, allow certain groups to access resources while denying these resources to others (Coles and Wallace 2005; Empinotti 2011). Access to water resources depends on institutional arrangements that ultimately reflect the social structures present in each region and sociocultural context.

The study of institutional relations and their consequences also requires a reflection on the scales at which these processes occur. With the inclusion of concepts such as decentralization and participation in water management practices influenced by the neoliberal management of nature (Himley 2008; Cohen and Davidson 2011), the scale of analysis has usually been the watershed or river basin. In the Brazilian context, the watershed has been identified as the basic planning unit, as stipulated in the text of Law 9433. We could say that this legal provision reflects the emergence and consolidation of the international perspective on integrated water resources management (IWRM), which has been a key component of the water resources management reform proposed by multilateral agencies like the World Bank since the 1990s (Jacobi et al. 2014). At the same time, the Brazilian Constitution of 1988 formally established a system of decentralized state management and created new participatory spaces in an attempt to respond to social demands for democracy. In the context of the new constitution, and under pressure from multilateral

agencies such as the World Bank, the river basin became the main planning unit and a space for the exercise of participatory democracy through river basin councils and committees in Brazil (Warner 2007).

On the other hand, in recent years, it has been argued that the scale where water governance practices occur transcends the physical and hydrological borders of the river basins (Budds and Hinojosa 2012; Warner et al. 2008; Lebel et al. 2005). Despite the decentralization of decision-making to the river basin scale, laws and regulations are normally defined in other spheres of negotiation such as the national scale; likewise, productive sectors, such as mining, tend to access water from various different river basins, and effluents can also be discharged beyond the original watershed (Budds and Hinojosa 2012; Warner et al. 2008). In addition, the recognition of virtual water flows that occur via the export and import of consumer goods has contributed to the realization that water resources issues have global relevance (Allan 1998; Sojamo et al. 2012). The analysis of the role of private actors, such as agribusiness companies, along with international NGOs and development agencies, has revealed the influence of these actors in the space of global water governance as they attempt to define practices and set up new monitoring thresholds, which are required to improve water use efficiency in various production processes and to better determine which water users are responsible for water shortages (Sojamo and Larson 2012; Daniel and Sojamo 2012; Empinotti and Jacobi 2013). It is possible to identify new networks and actors who, through their production and consumption practices, have expanded access and allocation strategies and tried to improve water management in and beyond the basin scale.

The relationships between different geographical scales change over time as power dynamics alter, and water governance practices provide more scope than traditional authority structures for interactions between actors from different geographical scales. It is also possible to observe how water resources issues connect actors from different scales and how, as a result, new spaces for negotiation are created across the established scales. These dynamics reflect an understanding of scales as socially constructed, the joint result of social and environmental relations. The configuration of scales is adjusted when the flows of power change, reducing the importance and influence of some geographical scales while strengthening

others (Cox 1998; Marston 2000). At the same time, these new configurations can create dynamic scalar policies, namely the emergence of new relationships, practices, and processes that evolve through different combinations of scales and that are transformed over time (MacKinnon 2011; McCarthy 2005). Such dynamics are part of governance practices, given that decision-makers activate the networks that allow scales to be transcended (Himley 2008).

Consequently, the existing hierarchy of scales may come under pressure as a result of new approaches to water governance and the range of new relationships centered on the management of water resources. There are many factors that influence the scaling of water governance beyond the hydrological scale, as in the case of irrigation schemes; these factors include historical practices and relationships governing access to water, such as tensions between urban and rural areas, and social structures organized in response to the multiple pressures limiting access to this natural resource (Perreault 2015). It is from this critical perspective that we will examine a case where converging scales of water governance have been constructed in the Upper Xingu River Basin, one of Brazil's main agricultural frontier regions. As management processes and social relations are scaled in different ways, these reveal how power is shared unevenly between social actors and the consequent repercussions in terms of water allocation and use.

The Upper Xingu as a New Stage for Environmental Governance Practices

The transformation of the Upper Xingu region, in the state of Mato Grosso, into one of Brazil's main production areas for agricultural commodities began in the 1950s with the implementation of a series of agrarian reform and rural settlement projects (Barrozo 2010). These programs had their heyday in the 1970s and 1980s with the mass migration of subsistence farmers from southern Brazil, as well as the establishment of large agricultural companies (entitled to receive generous government subsidies). (See more on Mato Grosso's agricultural development in Chap. 9). The colonization processes that followed the modernization development approach assumed that small farms (land areas smaller

than two hectares) were not appropriate for modern agriculture, mainly due to the production scale necessary for this practice. Because of that, the Brazilian State promoted the occupation of indigenous land in Mato Grosso, which was regarded as empty space by Brazilian institutions at the time,[1] to allow for property areas of medium to large size (Ianni 1979). This process led to a radical transformation of the local and regional landscape due to high rates of deforestation and the introduction of crops (initially rice), beef cattle production, and, finally, the intensification of soybean and corn plantation farms (Ianni 1979; Empinotti 2015).

Consequently, new groups of landowners emerged in the region as ascendant small-scale farmers and entrepreneurial farmers. Coming mainly from the south of Brazil, these ascendant farmers were able to buy areas between 200 and 400 hectares through private colonization programs (Jepson 2006). Between 1970 and 1990, 35 private enterprises organized 104 settlement projects and colonized 3.9 million hectares of land in Mato Grosso alone (Jepson 2006). Such transformations frequently led to social conflicts in the region as a result of violence against rural laborers and traditional and indigenous communities, as well as state corruption (Barrozo 2010). This trend toward production and market intensification has increased over the past two decades with a worldwide growth in demand for soybeans, particularly and increasingly from China (Hetch and Mann 2008). At the same time, the diversification of agricultural activities in the region has created new urban centers, as well as an increasingly diverse labor market and an expanding service sector. Today, 70 % of the gross domestic product (GDP) of the state of Mato Grosso, where the Upper Xingu region is located, comes from agricultural activities (IBGE 2012).

It is probable that such changes in economic practices in the region are exerting influence on local leaders and their agendas, and on institutional arrangements (which are often informal), resulting in significant impacts on the appropriation and use of natural resources, where the main goal is to intensify food production and commodities exports. In the state

[1] There is an extensive body of literature discussing the impact of land colonization processes in the Amazon region, as well as the specific impact on indigenous populations (Lévi-Strauss 1971; Villas-Bôas and Villas-Bôas 1994; Harres and Joanoni Neto 2009).

of Mato Grosso, currently the main area of agribusiness expansion in Brazil, neoliberal principles are shaping agricultural practices as well as the landscape. Recognizing this fact means acknowledging the key role played by such principles in the Brazilian political and economic context, as the Brazilian government and the country's business associations regard agribusiness practices as one of the most progressive elements of the emerging economy represented by the BRICS (Brazil, Russia, India, China, and South Africa) countries (Ioris 2015).

Environmental issues were not a major consideration for most farmers until the 2000s, when monitoring of deforestation in the Amazon region was intensified (Macedo et al. 2012), and water issues have tended to be even lower on the agenda. Even though the state of Mato Grosso is a net exporter of water to other parts of Brazil because of its agricultural activities and the presence of large water bodies, including the headwaters of major rivers such as the Xingu, Paraguay, and Tapajós, water system management has barely been implemented in the state (Mato Grosso 2009). The state apparatus in Mato Grosso has taken little action to reform water resources management beyond the preparation of guiding documents and the creation of a participatory collegiate. According to technical staff at the Secretariat of the Environment, interviewed for the purpose of our research, this situation reflects a general lack of interest in the water resources management agenda and its legal framework; in the environmental realm, attention tends to be focused more on the problem of deforestation. As an agricultural frontier area, the Upper Xingu region has undergone high rates of deforestation over the last four decades as intensive agricultural production has been introduced (Galford et al. 2010; Macedo et al. 2012), and there is growing pressure from both national and international groups to reduce deforestation and prioritize the recovery of native vegetation, as defined by the Brazilian Forest Code.[2]

Thus, as the state responds to external pressures when determining its priorities for action, the water resources agenda is regarded as secondary. Furthermore, in a state where more than 50 % of GDP comes from

[2] Since 1965, the Forest Code (Law 4771) has determined the amount of native vegetation to be preserved in rural private properties in Brazil. In 2012, because of the high levels of controversy involved and under pressure from the rural sector, two new versions of the Forest Code were aproved in the same year (Laws 12651 and 12727).

agriculture, the Secretariat of the Environment and its areas of responsibility occupy a relatively marginal position in the public administration structure, as reflected in the limited resources and insufficient numbers of qualified staff allocated to the department. The water resources agenda receives more attention in areas where there are conflicts over water access, as in some western areas of the state; according to water regulators, it is demands for intervention, from municipal government for example, that direct implementation and regulation of state and national water resources policy in Mato Grosso. This weak water governance by state agencies in Mato Grosso reflects the influence of the prevailing neoliberal agribusiness model in the region.

In his provocative article, Ioris (2015) argues that the transformation of Mato Grosso by agribusiness practices is an example of a case in which capitalist institutions are undergoing renovation processes but without dismissing the reproduction of old practices. In this context, market roles prevail over the commons and any other reference that goes against modernization and liberalization. Assuming such an analysis, we would expect that private sector interest and civil society organizations would prevail over state actors. In a neoliberal context, governance would be understood as a tool to promote efficiency over state practices and the control of costs as part of the decentralization of decision-making processes and the weakening of state influence. In this regard, it is expected that water management practices in Mato Grosso will indicate a new trend in which flows of power will mainly be influenced by traders, farmers, and their associations. Under this type of governance, state agencies are weak actors and the prevailing agenda is centered on the market and its established actors, as discussed in the following sections.

Water Management in the Upper Xingu: The Role of State Agencies

Until 1997, water in Brazil was managed by the federal government as a technocratic and centralized matter in which the main goal was energy production. Following the approval of Water Law 9433, the approach changed, part of a wave of institutional water reforms happening all over

Latin America and in other parts of the world (Jacobi et al. 2014). The law decentralized decision-making processes, created participatory institutions responsible for managing water, and recognized water's multiple uses. Water was now considered a public good, but one with economic value, and in order to guarantee the availability and quality of water, the law created management tools such as water rights, bulk water pricing, water plans, and an information system. From 1997 onward, every state in the country was responsible for creating its own state law, mirroring the federal one (Abers and Keck 2013). This innovative approach allowed for the participation of civil society organizations and users who, together with state agencies, formed water councils and watershed committees responsible for mediating conflicts, creating norms and regulations, defining the bulk price of water, and approving the water management plan, a document to advise the state on actions and practices. The Brazilian Water Law is one of the most advanced in the world, and became a reference for other Latin American countries (Jacobi et al. 2014).

However, despite its commitment to participatory democracy practices, the new Water Law also has limitations. Even though it recognizes multiple water uses, it does not incorporate the importance of land use and its impact on water availability and quality. Also, by considering watersheds as planning units, it created new territories that do not follow political and social boundaries. People are brought together through identifying common problems and solutions to these problems, and this does not necessarily occur in one particular watershed. Also, the law does not recognize the different nuances of watersheds that cover mainly urban areas compared with those that are predominantly rural. Such spaces will have totally different political and economic dynamics, as well as their own particular problems that demand specific tools and management practices. Finally, the costs of bringing together watershed committee members are high, particularly in watersheds covering large areas with low population density and few economic activities, such as those in central and northern parts of the country.

Mato Grosso exemplifies the difficulties faced in implementing the Water Law in Brazil. The water resources management framework in the state is one of the weakest in Brazil (ANA 2012). Although Law 9945 (the State Law on Water Resources), which enshrined the Water

Law in state legislation, was approved in 1997, the implementation of management tools has been remarkably slow. Mato Grosso's first State Water Resources Plan was only introduced in 2009, and out of its 27 water planning and management units, only two have basin committees (Sepotuba and Covapé). The State Water Resources Council was created, through Decree 2707, in 2010, a further example of how long it has taken for comprehensive control of water resources management to be implemented in Mato Grosso.

However, it is also important to acknowledge that the reasons for this go beyond the difficulties in adjusting such a model to the Amazon context. State practices and presence in the region also contributed to this result. In the specific case of the Upper Xingu watershed, the absence of any basin committee or significant discussion of new management tools reflects the limited state governmental presence in the region. Currently, the nearest office of the Secretariat of the Environment is located in the municipality of Barra do Garças, which is located 326 km from Canarana, in the Tocantins and Araguaia basin (ANA 2009). The main access route to the east side is national motorway BR-158, which connects Altamira in Pará to Santana do Livramento in Rio Grande do Sul, crossing the area between the Xingu and Tocantins and Araguaia river basins. This corridor is now known as the 'Valley of the Forgotten' due to the lack of attention paid to it by state and federal governments over the last 20 years. As a result, infrastructure in the area tends to be inadequate, land disputes are poorly mediated, laws are not adequately enforced, and businesses have been able to take over the land belonging to indigenous groups and small-scale farmers with few consequences.

The region's relative isolation and the lack of state government presence reflect the initial role of federal agencies in the organization of the territory since the 1950s, as discussed above. Starting in the late 1970s, federal agencies such as INCRA (the National Institute for Colonization and Agrarian Reform) coordinated settlement projects in parts of the region. In addition, the creation of the Xingu National Park in 1961created a significant role for FUNAI (the National Indian Foundation). More recently, because the region is a strategic area for the country in terms of water resources and energy generation, the Civil Cabinet at the Ministry of the Environment prepared a Sustainable Regional Development Plan

(PDRS) in 2009 (Federal Decree 7340), which aims to promote public policies aimed at improving quality of life for the area's inhabitants.

The Brazilian Constitution of 1988 stipulates that the federal government and its agencies are responsible for the country's rural areas. As most of Mato Grosso is rural, federal agencies have a major institutional role in the state, and the relationship between national and municipal bodies is key to achieving transformation in the region. In practice, however, although the federal bureaucratic scale has decisive influence, federal agencies do not have a major physical presence in the state; their influence is mainly exerted through regulations, programs, and incentive policies, while meetings between the key social actors normally take place in Brasília rather than in Mato Grosso itself.

In 2010, in response to the slow implementation of the National Water Resources Policy in the northern region of Brazil, the National Water Agency (ANA) published the Strategic Plan for Water Resources in the Amazon Basin and Right Riverbank Tributaries, covering 2.55 million km^2 in the states of Mato Grosso, Amazonas, Rondônia, Pará, and Acre (ANA 2009). Despite the Water Law's stipulation that individual basin committees are responsible for preparing and implementing plans for their own basins, this plan was drawn up almost exclusively by the ANA, with limited input from civil society representatives, users, and the states concerned. The justification for such an initiative was the need for a document to guide water management in the region given the strategic importance of water resources and because Mato Grosso has a high concentration of areas that are home to indigenous peoples, as well as being an agricultural frontier region and one with great potential for hydroelectricity generation (ANA 2009).

The area that includes the municipalities of Canarana, Água Boa, and Querência, where the empirical part of our study was conducted, does not yet have a basin committee, and the state and federal government agencies responsible for water regulation do not have a presence in the region. The area exemplifies the dynamics of landscape transformation and appropriation of natural resources as a result of agricultural frontier expansion and the modernization process (Empinotti 2015). As well as being one of Brazil's major soybean production areas, the municipalities contain the headwaters of the Xingu River and several of its tributaries.

Despite this, the debate on water resources has tended to be less of a priority in the area compared with pressing demands for better roads and production logistics and the question of how to deal with high rates of legal and illegal deforestation. Thus, without the participation and commitment of federal agencies such as the ANA and the Environment Ministry, institutions and water management tools have not yet been created in the Upper Xingu, leaving space for other social actors to lead this process and interpret water governance practices in their own way.

What is revealed here goes beyond the discussion of whether the Water Law is being implemented in Mato Grosso or not. What we can observe is that the weak presence of state agencies leading the implementation of formal institutional water arrangements has led to the birth of an endogenous water agenda. Such dynamics have promoted new alliances and networks that reflect new scales of action as well as the ways in which social actors and market forces understand and treat water issues. Finally, the history of the region and the absence of state agencies, the pioneering practices of land occupation and use, the presence of inequality, and the disregard for land rights, combined with pressure from environmentalists in the region, have created a unique context for understanding how water governance practices appear. The questions explored below will help us understand the dynamics present in water governance practices where state representatives are overpowered by private sector agents and civil society organizations.

How the Practice of Water Governance Has Evolved in the Upper Xingu: The Role of Global and Local Social Actors

The limited presence of state and federal management agencies in the Upper Xingu region has allowed a range of other actors to create environmental governance processes in the region. Environmental NGOs, both national and international, have played an important role, with their actions directed mainly toward ensuring that agricultural businesses comply with legal specifications. The purpose of some of these NGOs, such as the Earth Innovation Institute and the Earth Alliance, is to create

conditions for sustainable commodity production, including the adaptation of production practices so that market certification can be obtained. Such initiatives are usually aimed at medium and large-scale landowners and commodity exporters, and have encouraged many such businesses to implement sustainable farming practices, creating conditions that could, in principle, reconcile agricultural production and high-tech agriculture with environmental preservation. The main strategy at local level is to develop farmers' technical capacities and to ensure that the relevant legislation on land use and access to natural resources is respected. In the case of the North American organization The Nature Conservancy (TNC), which has been very active in Mato Grosso, the intention has been to work together with the municipal authorities in support of the Rural Environmental Cadastre (CAR), as stipulated in the new Forest Code, thereby contributing to data collection and to the production of a national database which will eventually facilitate the monitoring of native vegetation, as stipulated in the law, and inform the application of penalties and sanctions.

The Brazilian NGOs in the region have tended to work independently, but their projects have much in common with the agenda of the international NGOs in that that they also promote the implementation and strengthening of environmental protection measures included in laws such as the Forest Code. They normally work in partnership with local governments and their agriculture departments. Two major programs were the Y Ikatu Xingu[3] campaign and the Xingu Seeds Network, both led by the Instituto Socioambiental (ISA) [Socio-environmental Institute]. The goal of the campaign was to work toward the recovery and protection of springs and headwaters in the Xingu River. The strategy involved creating spaces for dialog between farmers from different production scales, leaders of indigenous groups, environmentalists, and representatives of government agencies and civil society. Action was focused on forest restoration, agroforestry education, and territorial planning and management. Apart from the ISA, partners in this initiative included the Union of Lucas do Rio Verde Rural Workers (STR—LRV), the Mato Grosso Forum for

[3] The expression *Y Ikatu Xingu*, in the kamayurá language (one of the many languages spoken in the National Park), means 'save the good waters of Xingu'.

Environment and Development (FORMAD), the Life Centre Institute (LCI), and the Amazon Institute of Environmental Research (IPAM). An important outcome of the campaign was the creation of the consortium Forest Governance of the Xingu Headwaters, funded by the European Community, which was intended to stimulate environmental initiatives and promote agroforestry systems in the region. The initiatives have developed programs that work with indigenous communities to restore springs on farms and to produce seeds and tree seedlings to be used in the restoration of riparian forests, as stipulated in the 2012 Forest Code.

It is possible to identify two typical characteristics of this emerging environmental governance in the region: first, that it is conducted by NGOs, which have become mediators between local farmers and international networks working together to promote sustainability. However, it is important to note that the NGOs do not directly use water resources laws as guidance when planning their activities and projects. Consequently, improved access to water and improved water quality are simply extra benefits resulting from the protection of river headwaters and riparian forests, as required by the Forest Code. In addition, NGOs do not usually invoke or discuss the importance of creating participatory forums where decisions on water resources management can be taken in the presence of representatives from different sections of society, and they do not officially endorse the strategies for water allocation and management included in the legislation, such as water use charges (i.e. the principle of 'the user [or polluter] pays').

Second, because of the prominence of NGOs in the Upper Xingu, the role of state representatives as social actors in governance processes is very limited. In the current context, the rules for water resources management and their formal instruments were introduced through federal and state policies and legislation, while locally, the preservation of headwaters and riparian vegetation are led by national and international civil society organizations. State agencies are mainly present at the municipal level through partnerships with local governments and their agriculture departments, which act as interlocutors between local farmers, indigenous peoples, traditional communities, and national and international NGOs. The dynamics of scale operate in the consolidation and reinforcement of common agendas, which translate into actions at international, national,

and local levels. Therefore, governance occurs at various scales, while the role of the state is most evident at the national scale through the intervention of federal regulatory agencies. The impact of the federal state in rural areas follows this dynamic scaling. In practice, the actions of the state are not having an impact on the stakeholders who manage and use water on a daily basis; that is, the institutional arrangements that would support these practices and rules are not being translated into tangible results.

At the same time, federal and state agencies use watershed boundaries to determine management units, while NGOs define their territory of action from the perspective of rivers, riverbeds, and headwaters, and also take into account the social and physical transformation of the landscape due to the deforestation and the expansion of agriculture. Such a dynamics reflects the fact that the water management agenda is directly associated with changes in land use, given that variations in the quality and quantity of water in water bodies are a consequence of changes in landscape and land use. This basic understanding has not guided Brazilian legislation on water resources, which, while considering the river basin as a management unit, has developed its instruments and regulations based on practices that only focus on river flows, water quality, and water withdrawn. The participation of farmers' organizations in water governance is still in its early stages. For these groups, problems with water represent a direct threat to their agricultural production activities, even though these same problems are themselves likely to be a consequence of intensive farming practices, which have a major impact on the quantity and quality of water available in the region. But these groups focus mainly on actions that can help farmers to comply with current laws, since failure to do this can lead to sanctions such as suspension of incentives or access to credit, or even rejection of farmers' goods on international markets.

It should also be noted that farmers are largely unaware of the water management system proposed by the Water Law, and as a result, they often simply have no opinion about it. On the other hand, the Brazilian NGOs that work in the region acknowledge the water management system; they even participate as members in other regions, but do not see themselves as the ones pushing for it in the Upper Xingu River Basin. Such realities expose the different ways in which these organizations define water issues, going beyond water quality and quantity to deal with

how water is integrated into land use practices. They also reveal a limitation of the Water Law: it does not offer spaces for negotiation in which environmental problems can be fully discussed while considering the social actors' interests and concerns. The lack of trust in state agencies and the state's history of corruption and human rights violations push such organizations to create different paths in order to avoid the influence of the established power structures. Finally, international NGOs and traders are committed to market rules and strategies that guarantee the trading capacity of commodities from Mato Grosso. It is not the Brazilian Water Law that pushes for their action and commitment, but rather market opportunities.

Conclusions

In areas where the formal institutional arrangement proposed by Law 9433 has not been consolidated, as in the case of the Upper Xingu, it is interesting to observe how actions across different scales exert direct and indirect influence on the management of water resources. There are several important conclusions to be drawn from this situation. The territory of action is determined depending on the factors that unite the actors involved, in this case farmers, local governments, and national and international NGOs. These groups have been motivated to act by changes to agricultural production practices in accordance with legal and/or environmental parameters, such as the Forest Code, whereby the recovery and care of permanent protected areas contributes to the maintenance of water availability and water quality in the region. Therefore, the river basin can be formally considered to be the unit of action and management at local and regional level, but the actors involved tend to be located in other countries, which adds a global component to local action, taking it beyond the physical boundaries of the basin. Consumption and production networks are the main determinants in the construction of scales within which various practices influence water availability and quality. These facts corroborate the understanding that social and economic factors can challenge the biophysical boundaries of the watershed as a planning unit (Ferreyra et al. 2008; Cohen and Davidson 2011). At the same

time, socio-ecological dynamics in the region provide the opportunity to study the adoption of novel water governance practices at scales where the state is less influential and private agents and NGOs become the main protagonists.

It is also crucial to observe that because of the absence of formal water governance arrangements, the water resources agenda in the region is guided by pressure on land use, the opening of new production areas, and the resulting deforestation and disregard for the preservation parameters of native vegetation. This means that water governance is linked to issues of land use, as well as to the growing involvement of new actors with roles related to water allocation, use, and management. The scale of action has not followed formal regulations, but has instead created a new rationale, which should be regarded as a reference for thinking about such practices in the agricultural frontier context. Finally, where the fact that a region is an agricultural frontier is a defining factor in how it functions, the agribusiness sector tends to be the most influential, although global environmental networks are also prominent. Putting their agendas into practice leads to biophysical and political landscape transformations in addition to the attempts to promote water governance practices. In this case, water governance aims to regularize agricultural activities and their certification, ensuring that agribusiness commits to finding a balance between optimal production and environmental conservation, which will ultimately lead to better conservation practices and the protection of water bodies in the region.

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9

Controversial Frontiers of Agricultural Development and Environmental Change

Antonio A.R. Ioris

Introduction

As discussed in detail in the other chapters in this book, although agricultural production has increased considerably in absolute terms since the post-World War II years, various problems continue to affect the agriculture industry's image worldwide. These problems include a lack of access to affordable, nutritious food in many countries; the impacts of agrochemicals on communities and ecosystems; and the enormous concentration of power held by a small number of mega-supermarkets and agri-food corporations to control food production, distribution, and consumption. There is a growing understanding today that the increasing industrialization of agriculture represents an important chapter, perhaps the most important, in the renovation of the global capitalist economy (Busch and Bain 2004) and, in particular, the transition to

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post-Fordist modes of production under the sphere of influence of globalization and neoliberalism (McMichael 2009). If neoliberalism—as a complex, inherently variegated ideology of critical importance across scales and regions (MacArtney 2009)—comprises beliefs and practices centred on the idea that market efficiency is the best mechanism for regulating socio-economic relations and renovating politico-economic strategies (Schmalz and Ebenau 2012), agro-neoliberalism is a highly idiosyncratic phenomenon that combines free-market pressures and flexibilization approaches with renewed forms of protectionism, trade barriers, and labour movement restrictions (Potter and Tilzey 2005). Agro-neoliberalism is essentially a politicized ideology that ultimately deepens the contradictions of capitalism across time and space (Araghi 2003), such as the disturbing contrast between southern areas of production (and environmental degradation) and northern spaces of consumption (and capital accumulation).

The complex role of agriculture in the expansion of industrial and post-industrial societies has been a favourite research topic for scholars interested in the patterns and perspectives of present-day neoliberal capitalism. This chapter offers further critical investigation into the overall trends of agrarian neoliberalism and the persistence of its political means and ideological mechanisms alongside forces of change. The chapter's departure point is that neoliberalized agriculture entails processes ranging from adjustments to small-scale farming and local economies to the escalation of agro-industrial production, the monopolization of trade (upstream and downstream to the farm gate and the household), the widespread financialization of agriculture (including future markets and agriculture derivatives), and the subjugation of public policies to strong market pressures (Clapp and Fuchs 2009). As a result, contemporary agri-food systems are increasingly tending to focus on short-term economic gains and the legitimization of political hegemonies at the expense of issues of nourishment and health (Goodman and Watts 1997). Particularly in Latin America, agribusiness has become the embodiment of aggressive processes of commodity export, land concentration or re-concentration, marginalization, and proletarianization (Murray 2006). Various types of power work together in the region, from instrumental and discursive rationality to structural manifestations

of political control deciding what is produced and what sort of food is consumed (Newell 2009).

The focus of the present analysis is on the modernization and intensification of agribusiness in Brazil, as an entry point into the politicized geographies of globalized agri-food and into the complexity of agro-neoliberalism at national and subnational levels. Because of new production areas and growing productivity, Brazil has consolidated its position as a global leader, and even as a 'model' of commercial, integrated crop production (Collier 2008). Unlike other economic sectors (such as industrial production and the retail market), agribusiness is considered an island of prosperity and economic dynamism, and is currently claimed to be the 'main business of Brazil' (Furtado 2002: 203). It should be noted that, due to promotional campaigns and assertive public policies, the term 'agribusiness' has a particularly positive, and strategic, meaning in Brazil, where it is commonly used in reference to large plantation farms (and, to a lesser extent, in reference to food processing and trading companies typically found in the USA). More importantly, although the expansion of agribusiness has proved to be central to Brazil's participation in globalized markets, the expansion of agribusiness has revealed a peculiar amalgamation of tradition and (conservative) modernity, evolving through new social orders and old political structures and vividly present in the practices of influential landowners and in the discourse of their representatives in the National Congress (Bruno 2009).

What follows in the next pages is a space-sensitive assessment and theorization of social relations and socio-economic trends across different scales, which, according to Callinicos (2007), should concentrate on the main dimensions of power, especially economic activity, ideologies, and various patterns of political domination. Another main objective here is to discuss the emblematic situation of the State of Mato Grosso, in the Centre-West region, which since the 1990s has become one of the main hubs of agro-neoliberalism in the world; more than ten million hectares of soybean, cotton, and maize have replaced massive areas previously covered by *cerrado* [savannah] and forest ecosystems. From being a region with relatively low levels of isolated economic activity, Mato Grosso is now at the core of national economic life and plays a key role in Brazilian exports and global agri-food markets (the state is responsible for

around 10 % of global soybean production, for example). Nonetheless, although Mato Grosso has been transformed by the expansion and gradual consolidation of agribusiness in recent decades, it remains a material and symbolic agricultural frontier. Also, while new agricultural areas are currently developing in other Brazilian states, planned improvements in transportation and logistics (jointly by public and private companies) are likely to trigger new rounds of socio-spatial transformation.

The discussion is based on three fieldwork campaigns conducted between 2013 and 2015, which comprised repeated visits to cropping areas, private companies, research centres (such as Embrapa), indigenous and subsistence farming communities, attendance at public meetings, and 21 interviews carried out in the States of São Paulo, Rio Grande do Sul, and, particularly, Mato Grosso (in the municipalities of Cuiabá, Rondonópolis, Sinop, Cláudia, Porto dos Gaúchos, Lucas do Rio Verde, and Sorriso). The research strategy consisted of an 'embedded case study', which started by considering subunits of social action; these were then scaled up to identify common patterns in larger geographical spheres. With the help of local academics at the universities UFMT (Federal University of Mato Grosso) and UNEMAT (State University of Mato Grosso), interviewees and informants were identified, initial contacts were set up, and the research then followed a snowball approach. Based on preliminary information, a database was developed to guide further interviews, documentation analysis, and the collection of background information. With the mapping of sectors and organizations, their discourse, and stated aims, it was possible to compare intra- and inter-group differences and the range of alliances or disputes (ranging from those strongly against to others fiercely in favour of the prevailing agri-food system). Semi-structured interviews were complemented with analysis of documents, statistics, websites, leaflets, presentations, and newspaper articles found in university libraries and in the archives of public agencies and private entities. Interviews and other qualitative material were transcribed, coded, and assessed in Portuguese; only the extracts reproduced in this chapter were translated into English.

Empirical results, as analysed below, principally show some fundamental contradictions and signs of exhaustion in Brazilian agro-neoliberalism, despite its current status as a dominant ideology. While the neoliberal agribusiness sector has succeeded in crafting a positive

image of technological and economic success, the federal government and the wider business community have become highly dependent on the export of primary commodities (to safeguard the national currency and avoid trade deficits, for example). The economic hypertrophy of agribusiness in Brazil has also resulted in a situation where rural leaders are disproportionately influential in politics, particularly in the National Congress and the Ministry of Agriculture, where they attempt to advance conservative agendas and secure further concessions from the government. Agro-neoliberalism evolves not only through attempts to influence the government, but also through further modification to the structure and rationale of the state. As part of this turbulent and controversial process, new production areas are being incorporated with the employment of old and new practices of socio-environmental management and political legitimization. It is particularly in agricultural frontier areas, such as Mato Grosso, that the philosophy of agro-neoliberalism is used to combine populist and developmentalist traditions in order to disguise mounting impacts and inequalities. Ironically, when facing criticism from other social forces in the country, the agribusiness sector reacts with a pre-established rhetoric of heroism and entrepreneurialism that, in the end, serves the corporations and national politicians more than the farmers themselves. It is similar to what happened with small producers in the USA, who were once considered the backbone of democracy but are no longer at the heart of US politics. It is to the contentious ongoing experience in South America that we now turn.

Brazil and the Realization of Agro-neoliberalism

Brazilian agriculture has evolved, since colonial times, through the association of export crops and subsistence farming, as a political compromise dominated by powerful rural elites in strong alliance with the apparatus of the state (Oliveira 2007). By the first decades of the last century, modern production technologies were already being systematically transferred from the Global North (the main agriculture colleges and research centres were established during this period), without altering the overall balance of agrarian power between large-scale and subsistence

farmers. Agricultural modernization and rural development received a new stimulus during the 21-year military dictatorship (1964–1985), with the incorporation of different forms of capital, new methods of production, and the formation of agro-industrial chains (Gonçalves Neto 1997). Priority was given by the authoritarian governments of the time to national developmentalist policies inspired by Keynesian ideas (Graziano da Silva 1988); these involved the adoption of fiscal incentives, subsidized credit, and efficiency measures, and the integration of farming and industry (Delgado 2012). Crop production was promoted by the federal government throughout the country, along with related processes of land cover and socio-ecological change (Oliveira and Stédile 2005), as an 'anti-agrarian' reform that further concentrated land ownership and reinforced old agrarian trends along the lines described by Araghi (2009) as 'accumulation by displacement', predicated on the dispossession of small farmers and encroachment on natural vegetation.

After achieving remarkable rates of production growth in the 1970s, the state-centralized mode of agricultural intensification started to show serious limitations, particularly as Brazil was suffering from a public debt crisis, escalating rates of inflation, and macroeconomic instability. The Brazilian agriculture sector went through a period of turbulence and uncertainty beginning in the mid-1980s due to the reduction of support schemes (e.g. guaranteed prices), significantly higher interest rates, and a paucity of bank loans. That prompted the transition to what is described by Campanhola and Graziano da Silva (2000) as a 'new rural model', characterized by higher levels of agro-industrial integration, more direct intervention from large corporations (including production funding), and multipurpose agriculture technologies. This new model was directly associated with neoliberal reforms to the state and economy during the 1990s. Inflation reduction and macroeconomic stabilization policies—known as the Real Plan, launched in 1994 and maintained by President Cardoso (1995–2002)—strengthened the national currency, the real (R$), and facilitated agro-industrial imports, while creating circumstantial barriers to the export of Brazilian goods for most of the decade (Ioris and Ioris 2013). A serious trade imbalance, together with higher interest rates, led to a temporary reduction in agricultural profitability and a lowering of land prices; nonetheless, it also paved the

way for the advancement of agro-neoliberalism as an alternative strategy for the revitalization of national agriculture. Production of crops for export was also encouraged by more favourable exchange rates following the 1999 devaluation of the Brazilian currency (Siqueira 2004) and by extraordinarily favourable commodity prices in global markets during the early 2000s (Richards et al. 2012). The results were highly positive and Brazilian agribusiness accounts now for approximately 25 % of gross domestic product (GDP), 35 % of exports, and 40 % of national jobs in the country (MAPA 2012).

The speedy recovery of Brazilian agriculture, following neoliberalizing priorities, was enabled by a combination of public and private measures (Petras and Veltmeyer 2003). The state remained firmly in charge of rural development (Schneider 2010), but at the same time forged close partnerships with an ever-stronger private agribusiness sector. Since that time, both transnational (Monsanto, ADM, Bunge, Cargill, Dreyfus, etc.) and new national corporations (Amaggi, BR Foods, JBS, Marfrig, etc.) have played an increasingly decisive role in terms of policy planning and efforts to grow business. Under the populist, neo-developmentalist administrations of Presidents Lula and Dilma since 2003, agro-neoliberalism became more deeply entrenched and was enhanced by supplementary rural credit offered by official banks (with annual interest rates of around 5 %, significantly lower than the standard rates offered by commercial banks). As a somewhat surprising, but integral, element of agro-neoliberalism, public credit increased from R$ 15 billion per year in the 1990s to R$ 136 billion in 2013 and R$ 156 billion in 2014 (O Estado de São Paulo 2014). However, a significant proportion of rural credit has also been provided by transnational corporations and by a massive increase in bank-like transactions. Since the early 2000s, various new financial instruments have been available, such as self-financing, financial cooperatives, input supplier companies, and trading companies, filling the gap created by the inadequacies of previous federal government–administered schemes (Serigati 2013). A notable example of the widespread financialization of neoliberalized agriculture was the 2004 legislation that created the Agribusiness Receivables Certificate (CRA), among other titles traded on the São Paulo stock exchange. The CRA is a registered credit instrument which links a promise of future payment

in cash to the debt claim issued by the securitization company (MAPA 2010). By 2013, the amount of traded CRAs reached R$ 1.2 billion (around US$ 550 million), but this is expected to expand 30 times more over the next few years (Isto É Dinheiro 2013).

The increased financialization of crop production and distribution affected not only the relations of production, but directly transformed the nature and destination of what is produced. Government investments in agriculture-related infrastructure and technological development have become more selective, targeting primarily biofuel and export commodities (Bernardes 1996). Related to policy adjustments, there has been a partial replacement of the previous North–South trade priority (especially with the European Union) with a growing South–South interconnection, particularly between Brazil and Asia (FIESP 2008). In particular, commercial exchanges between Brazil and China reached US$ 77 billion in 2011 (Brazil exported goods worth US$ 44.3 billion and imported goods worth US$ 32.8 billion), with agriculture-based exchanges growing from US$ 1.7 billion in 2003 to US$ 14.6 billion in 2011, according to the Ministry of Agriculture, Livestock and Food Supply (MAPA) (2012). *The Economist* (2010) even considers Brazil the first tropical food giant, mainly because of the influence of Chinese demand. Soybean is by far the most important agricultural commodity in Brazil and the 'soybean complex' accounts for 80 % of agricultural exports to China. Soybean is not only an emblematic symbol of Brazilian agro-neoliberal modernity and of the success of production reorganization; soybean production also involves significant geopolitical repercussions in terms of Brazil's influence, especially in Africa and South America (Oliveira 2015).

Despite positive results in terms of increased production, financing, and commercialization, however, the success of agribusiness has left the country dangerously over-reliant on primary commodities and on the appetites of distant markets. On the one hand, Brazil has become the main global exporter of soybean (contributing 44 million of the 105.1 million tons traded in 2013) and the soybean complex continues to expand unabated (8.2 % in 2011–2012 and 18.5 % in 2012–2013, when it accounted for almost US$ 31 billion of export revenues, according to CEPEA 2014). On the other hand, the Brazilian economy has faced progressive deindustrialization, increased dependence on foreign investments, and rising imports of intermediate inputs and capital goods.

From 2004 to 2013, manufacturing dropped from 55.0 % to 38.4 % of GDP, while primary production increased from 29.5 % to 46.7 % (MDIC 2013). Between 2000 and 2010, export earnings from primary goods increased from 25 % to 45 %, while those from manufactured goods declined from 56 % to 43 % (Delgado 2012). After the 2008 global financial crisis, the dependence of the Brazilian economy on the success of agribusiness extended even further as the export of agricultural commodities became the 'green anchor' of the economy (Acselrad 2012). Between 2012 and 2013, national exports fell by 0.2 %, but agribusiness exports increased by 4.3 %; in the same period, national imports increased by 7.4 % and agribusiness imports increased only by 4.0 % (CONAB 2014). In 2014, the trade balance showed the worst performance since 1998 (a deficit of US$ 4.036 billion in 2014, according to the Ministry of Development, Industry and Foreign Trade [MDIC] database), with agribusiness appearing as one of the few sectors with positive foreign exchange results.

It can be seen in Table 9.1 that, while agribusiness grew proportionally less than the national economy, and its percentage contribution to the national economy actually decreased between 2007 and 2013, its contribution to the national surplus (in dollar terms) was critical. Agricultural exports in 2013 reached a value of US$ 99.97 billion (4.3 % more than the previous year) with a net surplus (i.e. minus imports) of US$ 82.91 billion (including US$ 30.96 billion from soybean exports alone); forecasts for the next few years indicate a continuing increase along the same lines (Agroanalysis 2014). Because the overall surplus of Brazilian trade was only US$ 2.2 billion, without the contribution of the agribusiness sector, the country would have faced a serious and embarrassing defi-

Table 9.1 Agribusiness and the Brazilian economy (2007–2013)

	2007	2013
GDP Brazil (R$)	3.58 trillion	4.49 trillion
GDP agribusiness sector (R$)	833.6 billion	1.02 trillion
Participation of agribusiness in the Brazilian GDP (%)	23.30	22.80
National trade surplus (US$)	40.0 billion	2.2 billion
Agribusiness trade surplus (US$)	49.7 billion	82.9 billion

Data consolidated from various bulletins of CEPEA (Centre for Advanced Studies on Applied Economics), at the University of São Paulo)/SECEX (Brazilian Foreign Trade Secretariat)/Agroanalysis (monthly economic magazine)

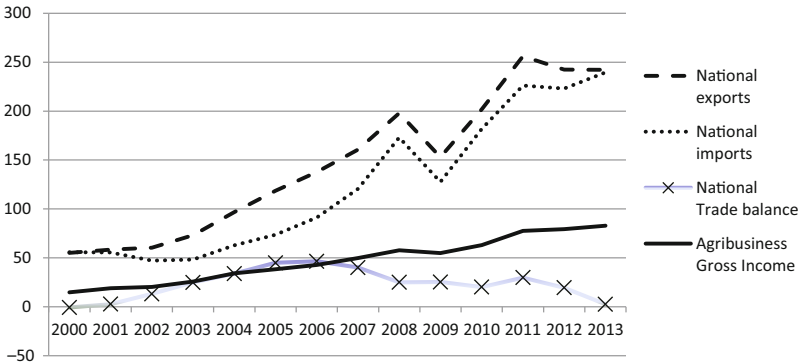

Fig. 9.1 Brazil's trade balance and the contribution of agribusiness (in billions of dollars) (*Data Sources*: CONAB/MAPA/Ministry of Development)

cit. The help of agribusiness was even more impressive due to a decline of 7.5 % in the average price of commodities on international markets between 2012 and 2013 (Barros et al. 2014).

Figure 9.1 illustrates the fact that, while the difference between export and import values is dwindling in Brazil and even tending towards a negative result, the surplus (gross income, i.e. total exports minus total imports) produced by the agribusiness sector is positive and constantly growing. One of the most perverse consequences of the steady expansion of agribusiness surpluses is that the activity of the contemporary Brazilian state, which combines neoliberalizing priorities with elements of populism and neo-Keynesianism, itself depends on agriculture to help manage the monumental public debt (around US$ 1 trillion in 2015) and to sustain politically relevant welfare-related programmes (such as the important cash transfer scheme known as *Bolsa Família* or family allowance).

Furthermore, the positive economic results produced by agribusiness have served to unify the interests of rural conservative groups and renew processes of political hegemony and class domination (Bruno 2009). It was highly symbolic of the political influence of agribusiness that President Lula started his first term in office with the 'Zero Hunger' programme and ended his second mandate openly defending the sector and making significant concessions on environmental legislation (Canal Rural 2009). Because of its political significance, the agribusiness sector has actively managed to protect its interests, especially with an organized and prominent presence

in the National Congress, where around one third of the senators and deputies belong to, or support, the Parliamentary Farming and Cattle Raising Front [*Frente Parlamentar da Agropecuária*—FPA]. An important initiative of the FPA is the determined attempt to remove any environmental and social regulation that could prevent the expansion of production. The number of FPA parliamentarians actually increased following the 2014 general election. They are led by the hard-line Senator Katia Abreu, president of the National Agriculture Confederation (Ms Abreu was re-elected in 2014 and became Secretary of State of Agriculture in the second Dilma government from January 2015 until May 2016 when the Brazilian Senate voted to remove the president from power).[1]

Agribusiness is often seen by other groups as a debt-prone sector, with high environmental costs and unable to overcome production obstacles in a fair manner (Silva and Mello 2009). There are growing tensions between global commodity chains led by Brazilian agribusinesses and social, grassroots movements that call for corporate responsibility, environmental protection, quality food, and labour rights (Wilkinson 2011). However, due to the vital role played by agribusiness in maintaining macroeconomic stability, and thanks to the political legitimization of populist governments, the sector has managed to secure increasing regulatory concessions (such as more flexible labour and forestry legislation) and its political capital has served to mitigate bad publicity generated by environmental impacts and the regressive social agenda advanced by representatives of agribusiness. Systematic campaigns orchestrated by representative entities (for instance, the Brazilian Agribusiness Association, the Brazilian Confederation of Agriculture and Livestock, and the Federation of Industries of the State of São Paulo) have tried to counter the prevalent image of large-scale farmers as perpetrators of injustice against small-scale farmers and indigenous groups and as major contributors to environmental damage in old and new production areas. The following interview extract illustrates this attempt to reinforce the economic relevance of agriculture and argue that the social and environmental costs are justified:

[1] Senator Kátia Abreu repeatedly stated that environmental conservation aggravates the food crisis and that, consequently, climate change deserves much less attention from government and society alike (*The Guardian* 2014).

> Agribusiness is the main sector for FIESP [Federation of Industries of the State of São Paulo], it is associated with the largest proportion of industries. And Brazil is number one in global agriculture. Of course, we are a bit concerned about the 'soyification' of Brazilian agribusiness, another problem that we can't deny…and also the reduction of the industrial component of the rest of the economy. But in any case, we are really satisfied with the prices in the global markets and with the introduction of more reasonable environmental legislation in recent years, particularly the new Forest Code. (…) The main challenge now is to improve logistics, roads, ports, railways, etc. (Interview with a manger of the rural division of FIESP, São Paulo, April 2014)

Brazilian agro-neoliberalism has evolved through an intricate process of economic gain and aggressive modernization intermingled with systematic attempts to conceal strategic alliances between populist authorities and market-friendly ideologies. The sector has maintained steady rates of expansion not only due to constant technological improvements (e.g. new agrochemicals, genetically modified seeds, and more sophisticated machinery and digital equipment), but also because of further land grabbing and incursion into new production areas (Borras et al. 2012). The end result is a paradoxical combination of circumstantial profitability and positive results with mounting socio-ecological risks and power concentrated in the hands of corporations and rural political leaders. The Brazilian region where the controversies related to agro-neoliberalism are most evident is the State of Mato Grosso in the Centre-West region, where more than half the economy is now based on agribusiness (IMEA 2014) and where the value of exports jumped from US$ 254 million to US$ 8.5 billion between 1990 and 2009 (Pereira 2012). The intensification of agriculture in the state since the 1990s has revealed an idiosyncratic fusion of old habits and new, market-centred approaches, employed by the agribusiness sector in an attempt to consolidate the agriculture frontier (initially opened in the 1970s). Mier y Terán (Mier 2014) rightly points out that agribusiness in Mato Grosso was never a uniform phenomenon, but has been shaped by local particularities because of the heterogeneity of migrants, farming practices, market oscillation, and ecological specificities. During our research, it was possible to verify that agro-neoliberalism is being applied in the

localized context of farms and regions, but management, technologies, and trade relations increasingly happen in accordance with globalized, transnational interactions and priorities. However, what is still missing in most available publications is an examination of the interconnected driving forces at this uneven agribusiness frontier (Ioris 2015); the goal of the next section is to provide such an examination.

Mato Grosso: The Core Area of Brazilian Agro-Neoliberalism

> Men had greedily fitted across this vastness but found nothing to root them. (…)
> A man's name did not last long in the Mato Grosso.
> John Updike, *Brazil* (1994)

The reconfiguration of the patterns of agricultural production in Mato Grosso constitutes an emblematic example of the articulation of public and private agendas that shape agro-neoliberalism. The State of Mato Grosso (henceforth 'MT'), in the hinterland of Brazil, is one of the most active areas of agricultural production for export in the world today, representing the culmination of the rural frontier fostered by the government over the past few decades. Since the post-World War II years, MT's state government has been selling large plots of relatively cheap land (typically around 200,000 hectares) in order to secure revenues to run the public sector and to compensate for the limited financial support received from the federal authorities (Moreno 2007). The agrarian transition took a new turn during the military dictatorship, which intensified the occupation of new areas in MT through the construction of roads (e.g. the motorways BR-163 and BR-364), warehouses, and other related infrastructure. Direct federal interventions prompted a number of colonization projects in the 1970s and 1980s, which attracted thousands of small famers and landless labourers from the south and northeast of Brazil. The areas used for colonization were previously held as semi-collective property by subsistence farmers or occupied by nomadic indigenous tribes. Yet, the official discourse defined these locations as 'no man's land' or

'empty—territory' waiting to be explored. In many cases, common land was grabbed using false documents, with the assistance of corrupt civil servants and allied political leaders (Souza 2013).

Despite the enthusiasm of the newcomers, the first two decades of the new agriculture frontier could be hardly considered a success. On the contrary, farmers struggled to produce due to the lack of adapted technology, insufficient preparation for different agro-ecological conditions, difficulty selling their products, and erratic government support (Barrozo 2010). Technical and socio-ecological barriers faced by the new farmers coincided with the national economic crisis of the 1980s, when the government ran out of cash and defaulted on its payments. Many had to leave MT, either returning to their original home states or moving further into the Amazon region. The late 1980s and early 1990s was a period fraught with turbulence and uncertainty about the future of the agriculture frontier. Crucially, it was through the reinvention of the agriculture frontier along the lines of agro-neoliberalism that production managed to recover and ended up expanding at an unanticipated pace. Figure 9.2 shows, for instance, that MT has been the main producer of soybean in Brazil since 1999. Interestingly, the relentless increase of soybean production in MT was initially underestimated in most public and private projections, which did not anticipate the measures taken to overcome technical, economic, and sociopolitical difficulties (Warnken 2000).

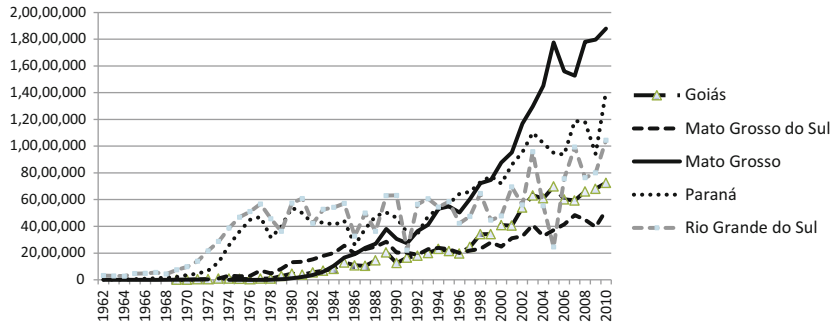

Fig. 9.2 Annual soybean production (tons) in the main Brazilian states (*Data source*: IPEA)

The celebrated success of agricultural recovery in MT is the result of a lucky convergence of political determination in the farming sector, the renewed interest of transnational corporations in the region, favourable commodity prices, and, critically, the growing macroeconomic importance of crop exports for the balance of trade. Agribusiness farmers in MT have been eager to capitalize on their success and quick to describe their activity as the 'Brazil that is doing well' (*Brazil que dá certo*), an idea that has been reinforced by government rhetoric and mass media coverage. Expressions such as the 'Brazil that is doing well' end up working as a totalizing narrative that is repeatedly used by politicians and agribusiness groups even to explain such phenomena as the surprising victories of the small football team Luverdense, from the MT city of Lucas do Rio Verde, in a national football championship in 2013 (Terra 2013). According to the state association of crop producers, in 'Mato Grosso, soybeans are synonymous with technology. Mato Grosso producers are renowned for using the most up-to-date technology, from planting to harvesting crops' (Aprosoja-MT n.d.: 22).[2] And, as claimed by ABAG (Brazilian Agribusiness Association), 'soybean production was born modern' and it is a good example of the best the country can offer (Furtado 2002: 135). Also during one of our fieldwork studies (June 2014), the most influential Brazilian magazine, *Veja*, was conducting a countrywide trip to visit the locations identified as undisputed examples of economic achievement, which necessarily included agribusiness clusters in MT.[3]

An intriguing dimension of the ideological construct of the success of agro-neoliberalism is a tendency to systematically blame the government for both large and small adversities. Despite the fact that agribusiness is deep in the pockets of transnational corporations—which finance production and acquire most of the goods produced—farmers paradoxically call on the state to correct market failures and, in bad years, to provide bailout funds (Peine 2010). In a context of strong agro-neoliberalism, farmers tend to easily accept the legitimacy of corporations and focus their criticism on the state for excessive social and environmental regula-

[2] Aprosoja-MT was established in 2005 at a moment when the costs of production had temporarily increased and farmers were dealing with losses caused by climatic adversities.

[3] More information, maps, and pictures of the VEJA expedition at http://veja.abril.com.br/tema/expedicao-veja

tion or for its inability to understand their needs (cf. FAMATO 2014). A large-scale farmer (in the municipality of Sorriso, Dec. 2014) argued in an interview that he has 'a good interaction with the "*tradings*" [transnational corporations, or TNCs], they help with inputs and in some years with credit, but it is expense. But we lack viable options, we can't really diversify. (…) In the end, the government is always guilty, because they pay little attention to our problems'. Related to that, agribusiness farmers have repeatedly attacked the federal government for insufficient investment in roads and, in particular, exerted pressure for privatization. As a result, 851 kilometres of the federal motorway BR-163 (which crosses the main production areas in MT) were transferred to a private operator (Odebrecht) in 2013, following the public–private collaborative strategy of President Dilma's administration.

Nonetheless, although farmers frequently complain about the price of transporting grains to the international ports in the southeast of Brazil (around R$ 330 or US$ 140/ton), high transportation costs have not affected profitability or the perennial search for new, more distant production areas.[4] One main reason for this is that logistical difficulties have been overcome with inexpensive land (at least during the colonization period), abundant natural resources, and cheap labour (it should be noted that even though agribusiness farms pay higher median wages than other comparable economic sectors, the labour-to-capital ratio is markedly low). It can be seen at the bottom of Table 9.2 that the rate of cropland area per employee increased significantly between 1970 and 2006. Because of heavy machinery, it is now possible to cultivate very large tracts of land (many thousands of hectares) with a handful of permanent and temporary workers. This is obviously part of the extraction of surplus value, and mitigates the increasing tendency to acquire capital in the form of additional farmland.

Labour accounts for less than 3.0 % of agricultural production costs in MT, while seed, fertilizer, and agrochemicals—generally sold by transnational companies—represent 54.98 % of the total costs (figures from the production season 2014–2015, as presented in Table 9.3). This is

[4] Since April 2014, fluvial ports in the Amazon have become another viable alternative for the export of soybean coming from Mato Grosso and other states.

Table 9.2 Evolution of production and labour intensity in Mato Grosso (1970–2006)

	1970	1975	1980	1985	1995	2006
Crop production (ha)	753,749	501,267	1,553,248	2,129,443	2,951,745	6,865,763
Pastures (ha)	31,588,303	11,243,468	14,779,703	16,404,370	21,452,061	22,809,021
Employees (persons)	373,039	263,179	318,570	359,221	326,767	362,895
Tractors (number)	4386	2643	11,156	19,534	32,752	40,657
Crop land/employee	2.0	1.9	4.9	5.9	9.0	18.9

Source: IBGE Agriculture Census (2006)—original table 1.3.25

Table 9.3 Soybean production costs in the State of Mato Grosso

	2010–2011	2011–2012	2012–2013	2013–2014	2014–2015**
Main inputs (R$)*	768.38	811.56	968.34	1192.56	1601.75
Labour (R$)	25.08	24.54	44.36	64.36	74.88
Total costs (variable + fixed) (R$)	1483.7	1635.82	1908.09	2347.47	2913.38
Annual rate of inflation (%)	5.91 (2010)	6.50 (2011)	5.84 (2012)	5.91 (2013)	—
Main inputs/Total costs	51.79 %	49.61 %	50.75 %	50.80 %	54.98 %
Labour/Total costs	1.69 %	1.50 %	2.32 %	2.74 %	2.57 %

*Main inputs = seeds, fertilizer, and agrochemicals; R$ = Brazilian currency 'real'
**Projection
Sources: IMEA (weekly bulletin of 4 April 2014)/Central Bank of Brazil

undeniably a demonstration of the neoliberal nature of agribusiness, which aims to produce more and more food, energy, and raw materials using less and less labour (Moore 2010). A complex system is in place here, where continuity and change operate at different scales—farm, state, and nation—and combine old patterns of socio-ecological exploitation with modern production and justification approaches.

One the one hand, continuity is related to the concentration of agribusiness in the hands of MT's large proprietors. According to Werner (2011), 3.35 % of landowners control 61.57 % of the land (in many cases without adequate land deeds), while family farmers only own 6.86 % (the national average is 33.92 %). Agrarian inequalities only exacerbate tensions relating to the ethnic origins of different groups of farmers. While the symbolic component of agribusiness is praised by political and economic leaders (most of whom have German and Italian heritage) as the belated redemption of the region from a past of isolation and backwardness maintained by a (non-white) regional population, there is evidence of racism, escalating hostilities, and harassment of subsistence farmers and landless groups seeking to legalize their land. MT was the state with the second highest level of rural violence in Brazil in 2014 (a trend that has persisted for many years), with 30 serious incidents involving 1618 families, as well as six cases of water-related conflicts (CPT 2015). In an interview with a subsistence farmer in the municipality of

Cláudia (Dec. 2014), it was affirmed that 'we had a long struggle to avoid having our piece of land in this region dominated by agribusiness. We only live because of are stubborn, we occupy space. Agribusiness has a lot of support [*apoio*], but we only have constraints ["*arroio*"]'.

Cases of violence against family farmers are extremely alarming, but perhaps it is even more troubling to observe the return and escalation of systematic hostility towards indigenous groups (tragically, after five centuries of systematic abuse and genocide). Widespread aggression is nonetheless openly justified by the organizations that represent agribusiness farmers, as can be seen in numerous articles on the webpage of the soybean association Aprosoja-MT that refer to what is described as the 'Indian Problem'. Land disputes involving indigenous groups were, in effect, identified in some of our interviews with agribusiness leaders as their main problem and the key challenge affecting the sector due to the demands of several displaced tribes. At the same time, indigenous groups are well connected and aware of the value of soybean lands and are increasingly seeking to obtain a share of this value by either renting out or cultivating the land themselves.

Another phenomenon that vividly connects violence across centuries and geographies is the re-emergence of slavery in the countryside, where those displaced by the advance of modern agriculture are then retained to work without pay, using various means of coercion, such as pending debts or isolation (Figueira and Prado 2011). In 2013, the Ministry of Labour and Employment listed 61 properties in MT in the national database of slavery cases, including soybean farms, cattle ranches, and timber companies (Diário de Cuiabá 2013). Slavery-like situations were found on the properties of even the most powerful and well-connected farmers, such as the family of the former state governor Blairo Maggi. The power and influence of such farmers raises serious obstacles to their prosecution (Reporter Brasil 2010). The existence of slavery in the ultra-modern agriculture of MT brings back memories of some spectral elements of capitalism, which never actually disappeared: the invisible becomes visible again (Derrida 1994).

On the other hand, the agribusiness sector has demonstrated a great ability to dilute and deny its responsibility for mounting negative socio-ecological impacts. While neoliberalized agriculture maximizes the use of fossil fuels, biotechnology, and agrochemicals, it also necessarily has to

respond to environmental concerns and customer expectations (Otero 2012). In MT, the response has come in the form of a belated fondness for claims of sustainability and ecological modernization. The association of soybean producers published a bilingual booklet, *On the Road to Sustainability*, which emphasizes the environmental consciousness of soybean producers, citing in particular the concentration of production in savannah areas (rather than in the Amazon forest) and the adoption of integrated technologies. According to the association, 'there is a strong correlation between soybean yield and macro socio-environmental indicators, such as the Human Development Index (HDI). The ten cities with the largest soybean production have rates above the state and the country averages' (Aprosoja-MT n.d.: 11). In our interviews, the association's spokespersons make frequent reference to the 'green passport' of agribusiness in MT, basically because of the adoption of no-tillage technology and gains of productivity (supposedly preventing the opening of new production areas). In this way, agribusiness in MT has tried to reinvent itself as an environmentally sensitive sector, deeply concerned about the impact of its activity on the well-being of wider society.

However, although agribusiness farmers are proud to say that MT still maintains large areas of original vegetation, this tends to be because these areas are remote and would not be cost-effective locations for soybean production. Every year, this frontier of cost-effectiveness moves, with technological improvements and increases in land prices in the consolidated zones, leading to the constant opening of new production areas. The situation embodies the Jevons paradox (Ceddia et al. 2013), where the use of a resource becomes increasingly efficient, but increasing demand for the same resource leads to a greater rate of consumption: higher agricultural productivity in MT has increased, rather than decreased, rural land use. Despite constant increases in the use of resources—land, water, and energy in particular—concepts like sustainability and flexible regulation have been used by sector representatives to confer an image of righteousness on modern, intensive agriculture practices:

> Our agriculture cannot be considered anything but sustainable. Sustainability is profitable: we don't do things to gain foreign recognition, but only because of the economic results. (…) We do it despite lots of production difficulties

> [that we face]: too much regulation, the [legal] requirement to set aside part of our property uncultivated [between 20 %–50 %, depending on the location]…But this again demonstrates that we are sustainable. (Interview, MT soybean association director, June 2013)

The surprising 'environmental turn' of the agribusiness sector has been accompanied by a search for national and, crucially, international recognition. In a talk at a workshop in the Wilson Center in Washington DC on 4 December 2008, the then state governor Blairo Maggi (2003–2010) [senator since 2011] provided a textbook defence of MT's ecological prerogatives. Leader of a family business established by his father a few decades earlier, when the clan moved from the south of Brazil to MT, Maggi is the owner of one of the largest soybean companies in the world (responsible for around 5 % of the total amount of soybean produced in the country, and increasingly involved in large public infrastructure, transnational trade, and financial services). According to various interviews in May 2014,[5] during his time as governor, Maggi repeatedly claimed to be running the state administration as a business enterprise, and played a key role in the consolidation of agribusiness (including new legislation instituting the transfer of public funds to support Aprosoja-MT, making it the strongest and most active representation of soybean producers in the country). At the Wilson Center, Maggi used his training as an agronomist to explain how technology helps to protect the environment. Although Maggi was awarded the sarcastic 'Golden Chainsaw' trophy by Greenpeace in 2005, as the Brazilian who contributed most to the destruction of the Amazon rainforest, in Washington, the governor talked about the risks of anthropogenic climate change and the need to act 'not because of the environmentalists, but because the scientists are now telling us the urgency and relevance of such issues'.

The most evocative part of Maggi's intervention during the workshop was his passionate defence of market-friendly solutions, especially the role of payment for ecosystem services, carbons markets, and the Reducing Emissions from Deforestation and Forest Degradation (REDD) scheme

[5] In 2014, Senator Blairo Maggi was also under criminal investigation by the federal police due to suspicions of using illegal sources to fund his senate election campaign in 2010 Maggi succeded Ms Abreu in May 2016 as the new Secretary of State of Agriculture.

advanced by the United Nations. 'We must find a way to ensure that forests are more valuable standing than destroyed,' said Maggi (Wilson Center 2009: 2). Governor Maggi stressed the urgency of creating such a mechanism. 'Global warming has been scientifically proven; we no longer have the right to ignore climate change.' The appropriation of environmental claims to serve business and political interests is also evident in Maggi's trajectory as a congressman. After becoming a senator in 2010, Maggi was one of the main advocates for the reform of the Forest Code, which was eventually approved in 2012 after a lengthy controversy and with detailed regulation introduced in 2014. The aim of the reform was to flexibilize the previous requirement to maintain a certain percentage of the natural vegetation on rural land. The reform means that it is now possible to compensate for deforestation on a rural property with another forested area elsewhere, which in practice 'creates' more cropland. This preference for self-regulation and market-based approaches, instead of stricter forms of environmental control, reflects the pressures and opportunities created by the mechanisms of ecological modernization in a context of global environmental awareness (Jansen and Vellema 2004).

The trend towards commodification of rural activities and the double, interconnected exploitation of labour and nature are specific elements of the 'necessity' of present-day neoliberal capitalism. Necessity, in the Hegelian tradition, is the central property of the process of historical change, not as deterministic cause but part of the contingent emergence of things in their present form (Mann 2008). In the specific case of the MT experience, it seems that agro-neoliberalism necessitates synergies with other associated public policies based on new rounds of commodification, as in the case of ecological modernization approaches. Moreover, these are all examples of highly contested bio-politics spreading through agri-food networks and revealing the questionable prospects of market-centred alternatives and the limited nature of agribusiness sustainability (Marsden 2004). The rationalization of socio-environmental regulation according to specific economic interests and following the logic of agro-neoliberal polices also demonstrates the influence of power hegemonies affecting the configuration and the responses of the state apparatus (Ioris 2014). The dialectics between the contingent and the necessary evolution of agribusiness has helpful explanatory capacity here in the sense

that it makes evident, beyond the more abstract explanation in terms of accumulation regimes, both the local specificities of intensive farming and its insertion into the cross-scale features of contemporary capitalist agriculture reflected and acted upon by the state. It reveals the 'agro' being transformed and reshaped according to the business rationality of commodification, privatization, and maximum exploitation needed to sustain profitability. Or, as denounced in a timely fashion by Oliveira (2003), the unfolding of novel socio-economic relations dynamically reproduces and invigorates outdated features from previous stages of the long trajectory of capitalism.

Conclusions: The Frontiers and Prospects of Neoliberalized Agribusiness

The previous pages discussed how the apparent economic and technological success of the agribusiness sector in Brazil is also characterized by organized attempts to influence policymaking and conceal risks and impacts associated with a narrow production basis (i.e. exports increasingly concentrated on a small range of commodities, soybean in particular). The Brazilian experience illustrates how agro-neoliberalism flourishes in a context of market-centred solutions and regulatory flexibility, but also that it demands novel forms of government support and relies on some of the oldest political traditions (e.g. aggressive manipulation of party politics, lack of transparency, deceitful claims of progress, and elements of racism). The advance of neoliberalized agribusiness has been the embodiment of the most technologically advanced and socio-ecologically regressive elements of a national economy on the periphery of globalized capitalism. The image of success is daily reaffirmed by sector representatives and endorsed by the national government in its effort to gain political support and maintain the export revenues generated by agribusiness. The result is a nuanced and highly contested situation that connects, often in unexpected ways, different scales, sectors, and public policies. The various techno-economic innovations adopted by agribusiness players—including land and gene grabs, biotechnology and genetically modified organisms (GMOs), dispossession of common

land, financialization, and administration of production by TNCs (transnational corporations)—are all strategies that emerge from business and political interactions, which combine old and new features of the capitalist economy. All this requires appropriate interpretative approaches able to unpack the idiosyncratic combination of incremental innovations in a context of hegemonic market globalization.

It is in agribusiness frontier areas, as in the case of MT, that neoliberalized agribusiness makes evident its most profound abilities, contradictions, and, ultimately, failures. Agribusiness is especially successful at the agriculture frontier because it is in itself an economic, ecological, and ethical frontier, in which interpersonal and intersectoral relations have a particular configuration that allows authorities to deceive the population and impose undemocratic measures due to the primacy of production and the emphasis on rapid accumulation. It constitutes a favourable arena for rehearsing the flexible mechanisms of accumulation and regulation required by neoliberal activities, while this frontier is shaped by market freedom, low moral standards, and associated forms of violence. The advance of agribusiness depends on the perpetual re-enactment of dreams (merged with novel forms of violence and frustration) related to the promises of rapid wealth accumulation and social prestige. High expectations are needed to motivate the conquest and transformation of territory to make way for crop production. The peculiar dialectics taking place at the frontier, including processes of transnationalization, displacement, and mystification, are firmly mediated by structures inherited from the past, which create a complex pattern, spatially and temporally heterogeneous. The curious attacks on the apparatus of the state by agribusiness farmers—who have been major beneficiaries of state investments and regional development policies—are emblematic examples of an inbuilt opportunism and peculiar production rationality located between the demands of the state and those of transnational corporations.

The agribusiness frontier in MT has provided opportunities for both the renovation of capitalist institutions (i.e. globalized transactions, maximized use of territorial resources, novel forms of political legitimization) and the reintroduction or reinforcement of old practices of the preindustrial or early industrial phase of capitalism (i.e. brutal appropriation of the commons, commodification of features previously beyond market

transactions, and even cases of twenty-first-century slavery). At the frontier, the politico-economic institutions of neoliberalism can expand and take on, to some extent, a life of their own. Similar to the expansion to the west of the USA more than a century ago, ethical and legal safeguards tend to be suspended or overlooked due to the alleged need to occupy the 'wild' territory and then sustain the production of the most marketable and profitable goods. The consolidation of agribusiness in MT involved constant innovation and new players, who retained old, vicious practices that have never disappeared. Martins (2009) argues that this is a human frontier shaped by the false dichotomy between civilization and non-civilization, because it constitutes a degraded but comprehensive reality, one of the most brutal chapters of economic development in Brazil, where the main protagonists are the victims (Indians and subsistence farmers). The frontier in MT is in this case a real 'territory of death' and the place where the most inhuman archaisms are reborn; it is 'exactly the opposite of what the imagined idea of a "frontier" proclaims' (Martins 2009: 13–14). In that sense, the totality of the frontier, as a space fraught with politico-economic and socio-ecological tensions, must be seen as a peculiar locus of intolerance, ambition, and, all too often, tragedy.

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