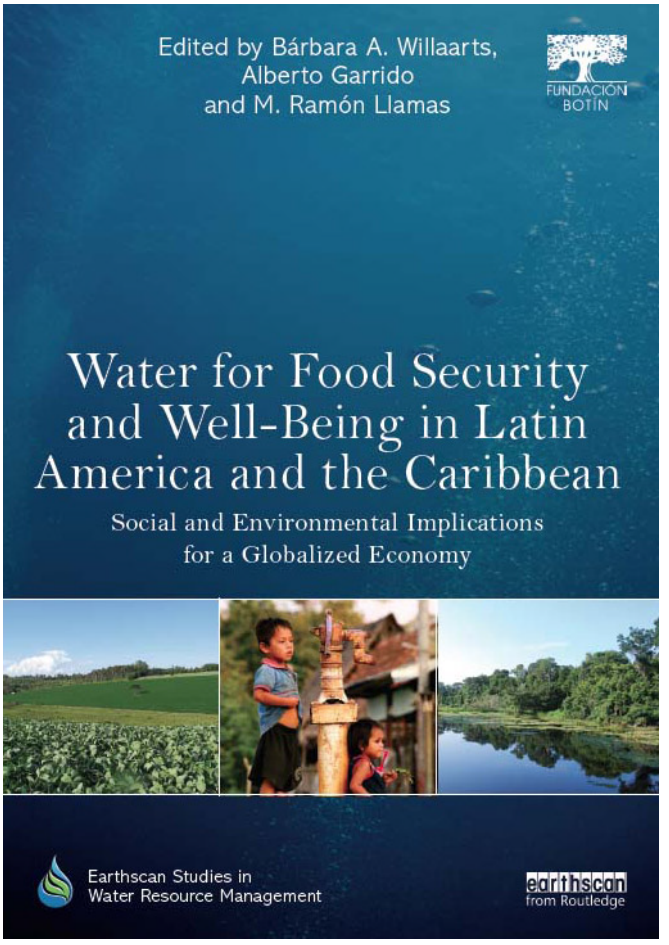

Chapter 1

Water and food security in Latin America and the Caribbean: regional opportunities to cope with global challenges

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WATER AND FOOD SECURITY IN LATIN AMERICA AND THE CARIBBEAN: REGIONAL OPPORTUNITIES TO COPE WITH GLOBAL CHALLENGES

Authors:
Bárbara Willaarts, Water Observatory – Botín Foundation, and CEIGRAM, Technical University of Madrid, Spain
Lucia De Stefano, Water Observatory – Botín Foundation, and Complutense University of Madrid, Spain
Alberto Garrido, Water Observatory – Botín Foundation, and CEIGRAM, Technical University of Madrid, Spain

Contributors:
Ramón Llamas, Water Observatory – Botín Foundation, and Complutense University of Madrid, Spain
Emilio Custodio, Dept. Geo-Engineering, Universitat Politècnica de Catalunya, Spain
Fermín Villarroya, Complutense University of Madrid, Spain
Pedro Martínez-Santos, Complutense University of Madrid, Spain
Maite M. Aldaya, Water Observatory – Botín Foundation, and Complutense University of Madrid, Spain

1.1 Setting the scene

1.1.1 Placing Latin America and the Caribbean in the global context

The world has never been so globalized and interconnected as today. Advances in transportation, logistics, telecommunications and global production systems have attained unprecedented levels of economic integration. Agricultural commodities are transported across hemispheres and trade makes consumers believe that food production no longer respects the traditional seasons. Thanks to technological progress, increasing production specialization, and the wide dissemination of scientific knowledge, world food systems have become more integrated and developed than ever before (Prakash, 2011).

Despite these achievements, important questions still exist as to whether the world's agriculture has the potential to feed a growing population, expected to reach 9 billion by 2050, unless significant improvements are made in production efficiency alongside the promotion of healthier consumption habits. In 2012, 870 million people were still suffering from hunger and malnutrition, equivalent to nearly 12.5% of the global population (FAO, WFP and IFAD, 2012). Furthermore, somewhat ironically, today there are more people overweight than people suffering from hunger globally. According to WHO (2013), in 2008 1.4 billion people were overweight, of which nearly 500 million were obese.

Bridging the hunger gap and addressing the high calorie intake of a growing and wealthier population, demand vast amounts of inputs: water, land, minerals, and energy. The challenge of feeding the world thus becomes particularly acute if it is to be accomplished without adding further pressure on natural resources and surpassing critical environmental tipping points. The National Intelligence Council (NIC) has identified the water–food–energy nexus as one of the four 'megatrends' which is likely to have major impacts on the world's future up to 2030, as an increasing, wealthier and more urbanized population will pose a higher demand on these inextricably linked resources (NIC, 2012).

The NIC report also predicts that the diffusion of power and geopolitical gravity shifts are ongoing megatrends that are likely to influence the world's future in the short term. As Naím (2013) claims, power[1] in the world is decaying as a result of a so-called 'triple-M revolution': the *more* revolution, the *mobility* revolution and the *mentality* revolution. Among the 'more revolution' facts that Naím mentions, a few are worth bearing in mind: the world's economic output has increased fivefold since 1950 and income per capita became 3.5 times greater; between 1990 and 2010, the number of people living on less than US$1.25 a day decreased to 700 million, thus meeting the Millennium Development Goal on halving extreme poverty five years earlier than planned; child mortality has dropped by 17% since 2000; undernourishment decreased from 34% in

1 Naím defines power as the 'ability to direct or prevent the current or future actions of other groups and individuals' (p.16).

1980 to 17% in 2008; the middle class increased from 1 billion in 1980 to 2 billion in 2012, and will likely reach 3 billion in 2020; 84% of the population is literate, up from 75% in 1990; and, last but not least, between 2000 and 2010 the human development index – an overall measure of global human well-being and living standards – has risen everywhere in the world with just a handful of exceptions. This promising picture of countries and citizens progressing, living longer, with healthier lives and improved basic needs, is crucial to understanding today's shifts and redistributions of power, and why it is becoming harder to obtain power and easier to lose it.

Much of these socio-economic transitions have occurred in Latin America and the Caribbean (LAC), a region that over the course of the last decade has shown great progress in social, institutional, political and economic spheres. Part of the economic success is due to the region's 'natural dividend', related to the relative and absolute abundance of natural resources, ranging from minerals and energy sources to land and water. As Naím (2013) argues, demand and access to abundant resources are in fact one of the main world drivers of power decay for countries that lack them and of power conquest for those that are well endowed. This partly explains why LAC countries with very little global power until recently are now influential members in the G20 (Argentina, Brazil and Mexico), major world energy providers (Bolivia, Colombia, Ecuador, Venezuela), crucial countries for LAC's overall security (Mexico, Colombia), key EU trading partners (Chile, Peru and Colombia, and the Central American states of Costa Rica, Guatemala, El Salvador, Honduras, Nicaragua and Panama), and leaders of the transpacific cooperation, as four countries (Chile, Peru, Mexico, Colombia) have created the Pacific Alliance to enhance cooperation within the region and across the Pacific with Asia. By all accounts, the LAC region has become a key player in global geopolitics. Exploring how these changes play out in the domain of water and food security contributes to understanding what paths of development this region is following and what are the implications regionally and globally.

1.1.2 Water for regional and global food security

Globally, the largest share of consumptive water use is associated to agricultural production, and just a minor fraction (less than 10% on average) is for cities and industries. Because of the prevalence of rain-fed agriculture over irrigation, the largest share of water consumed in agriculture is *green* water, soil moisture. *Blue* water – water taken from rivers and aquifers – represents a smaller fraction of the agricultural water footprint, although it varies amongst countries. The importance of water for agricultural production and the fact that agriculture is the lion's share of water consumption, renders it relevant and necessary to look at water and food security through the double lens of what Allan (2013) defines as 'food-water' water needed to secure agricultural production, either green or blue- and 'non-food water', which refers to the fraction of blue water providing all other water-related services, beyond food, which are important for human development and well-being.

LAC's agriculture is a strategic sector for rural development and poverty alleviation and it plays a key role in overcoming local and global food insecurities. During the last fifteen years, LAC's agricultural sector has grown considerably, to a large extent driven by trade liberalization policies, which have contributed to turning LAC into an increasingly important competitor in the global agricultural market (for both food and biofuel production). Its weight is not so much in terms of economic value, but in calories and vegetal and animal protein supply, making both developed and emerging economies increasingly more dependent on LAC's output. In recent years, this region has captured an increasing share of the global market of agricultural products, and LAC now controls over 18.4% of the world agricultural trade compared to the 11.4% in 1990 (World Bank, 2013a). Oilseeds, soybean, cereal grain and to a lesser extent livestock products accounted for more than half of this export growth, with a few countries such as Brazil, Argentina and Chile generating over 65% of total LAC exports (*ibid.*).

The expansion of agricultural production and exports has been partially stimulated by the peaks in commodity prices seen in 2007, 2008 and 2012. However, increased price volatility has a lingering effect in the minds of those responsible for managing and governing food systems at international and national levels, even after the price crises subsided. Many governments concluded that relying too much on food imports entailed serious economic and social risks. The notion of food security was thus redefined after the price crises, and food sovereignty is now gaining more prominence to the extent that increasing national food production is becoming an overarching objective in all domains of world and national governance. Nevertheless, under the likely scenario of reaching 9 billion people by 2050, the ongoing process of global urbanization and dietary shifts, the reliance on food imports will remain an indispensable strategy in order to overcome global water and land shortages and cope with future food demand. In this context, it is very likely that LAC will be a major supplier in this long-term scenario as it has already demonstrated over the last decade.

1.1.3 Water for economic development and human well-being

If food-water is essential for achieving food security, non-food water is an equally strategic element for human well-being and social progress. Population growth and the aspiration for higher incomes, greater services and job opportunities, have favoured a rapid and sustained migration flow from rural to urban areas over the last decades. Today, LAC is more urbanized than the average 'high-income' country, with almost 80% of the population living in cities in 2012 (World Bank, 2013b). The region holds four of the largest and most populated cities in the world (the megacities of Mexico D.F., Sao Paulo, Buenos Aires and Rio de Janeiro) and a fast-growing number of middle-size urban areas. This booming process of urbanization, often poorly planned, and the resulting high urban density, pose major challenges for managing water and the delivery of key services to citizens. These include securing access to safe water and sanitation, protection against water hazards such as floods, guaranteeing water provisioning services during drought periods

or addressing the growing water pollution problem and environmental degradation of freshwater ecosystems resulting from poor wastewater management policies, amongst other factors.

Non-food water is also a critical input for the industrial sector, including mining, energy production and navigation. Hydropower is the main energy source in the LAC region and still has a large growth potential. Yet its development faces growing physical and socio-economic constraints, including the rights of native and local inhabitants and environmental concerns. Similarly, the growth of the mining sector in LAC, particularly in South America and Mexico, is also generating a growing number of water conflicts. On one hand, because it competes with other economic sectors for sometimes scarce water resources. On the other hand, because of the large pollution problems this sector generates for downstream water users and ecosystems.

1.1.4 Development and sustainability goals: confrontation or alignment?

The strategic value of LAC's natural dividend offers a triple-sided topic of research and inquiry. On the one hand, the role of LAC in the world's current food system and its contribution to global food security cannot be emphasized enough. Interestingly, this crucial role has become a reality in just one decade, and the consequences are now beginning to emerge, in both the political and the scientific spheres. On the other hand, the local, national and regional impacts of this plethora of economic and business opportunities pose enormous challenges for LAC governments. In a time of rapid reconfigurations of power, civil society, NGOs and grassroots organizations have advocated bold reforms at the highest political level (reaching the constitutional one) that enshrine basic rights such as those regarding access to food and water. Last but not least, a fundamental question for the region is whether existing development opportunities and sustainability goals should be framed in terms of trade-offs, or they could also be thought of as win–win opportunities. This dilemma is pertinent worldwide, since decisions concerning to LAC's development and natural resource use will have global consequences for biodiversity, the earth energy balance and the world's climate (Rockström et al., 2009; Gloor et al., 2012).

1.1.5 This book's conceptual approach: linking food and water security

Over the last few years numerous authors and organizations have been looking at the consequences of LAC agricultural growth and globalization. Questions like *What are the socio-economic and environmental implications of this trend for regional development? How does it contribute to local water and food security? and What is the role of LAC in global water and food security?* are of critical importance to the region, but knowledge remains sparse and the overall picture is unclear. Behind all these key questions there are numerous interrelated phenomena and processes at the global, national and local levels

that must be jointly analysed in order to provide convincing explanations that allow valid conclusions to be drawn.

The answers to these questions have to be sought in the linkages between regional development, economic globalization, well-being, water resource use (food-water and non-food-water), and the global dimension of water and food systems in LAC. To tackle this complex phenomenon a first and fundamental concern is the biophysical sphere, the realization that no social and economic progress of human beings exists without an adequate *material stratus*. This link is sketched in Figure 1.1. A crucial feature that distinguishes LAC from other regions is that most of its vast agricultural production is obtained in rain-fed systems, relying thus primarily on green water. This green water embedded in agricultural exports are of critical importance for global food and water security. Likewise, LAC's food-water and non-food water are also crucial for regional development and for meeting its growing domestic consumption needs. In the particular case of LAC, with its booming economy and a heavy reliance on natural resources, one can imagine scenarios where the rest of the world's craving for food and natural resources compromises the livelihoods of future LAC's generations and scenarios where the two positively reinforce each other. The latter implies that the booming economy and social progress run along more sustainable paths. This book is an inquiry into the type of path LAC countries seem to be following.

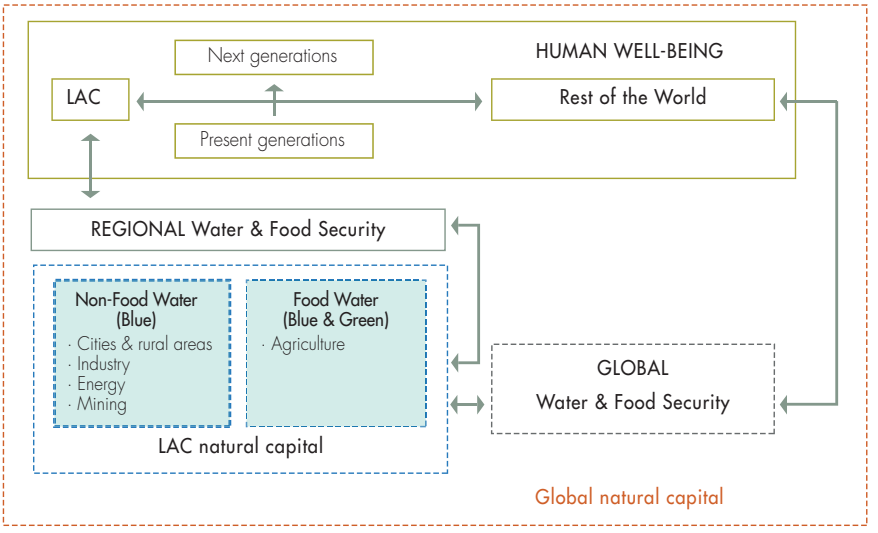

Figure 1.1 Biophysical dimensions of human well-being – water and food security – in LAC and in the rest of the world. *Source: own elaboration.*

A second and equally fundamental concern is the governancel system. If the biosphere represents the material stratus needed for the realization of any kind of security, governance systems represent the *intangible stratus* (Figure 1.2). An underlying theme of

this book is that LAC's future depends dramatically on strong governance and institutional frameworks, both within countries and at regional and global levels. Countries' governance systems are where rules for land and water uses are developed and where the bases for water and food security are laid out, as they intervene on how humans interact with the biophysical sphere. Furthermore, the global governance system – e.g. international trade policy, free trade agreements, food safety and sanitary measures – has also become pivotal for food security in LAC and globally. Considering the relatively weak global governance structures of present times, the engagement of national governments in far-seeing and inclusive policies and the demand of citizens of being lead equitably and responsibly are prerequisites for thinking optimistically about the future. This book does not attempt to revise all governance forces operating inside and out of LAC and summarized in Figure 1.2, but to specifically focus on those that have a direct impact on water governance in LAC.

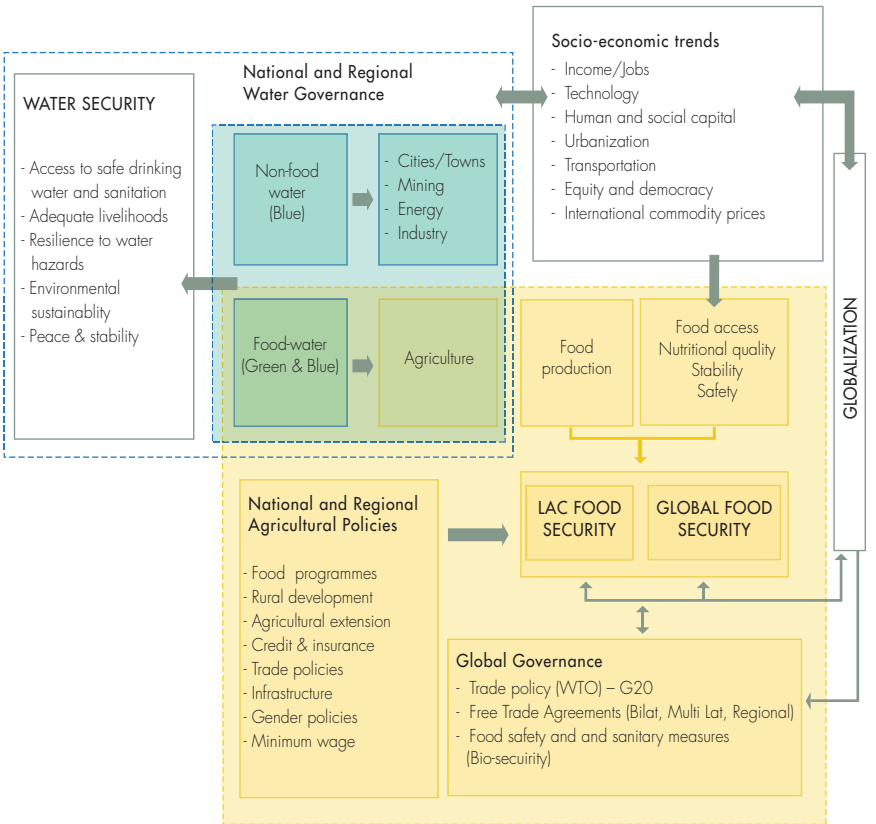

Figure 1.2 The book's framework: topics, inter-dependencies, drivers and focus.
Source: own elaboration.

1.2 The objectives of this book

This book's main goal is to provide an analytical and facts-based view of the progress of LAC's regional water and food security, its contribution to global water and food security and the challenges ahead. A full understanding of these regional changes requires framing LAC in the global picture: a region with increasing geopolitical power in an ever globalized world and a growing presence in global food markets. This overview ultimately aims at facilitating policy debates at national and global levels about these compelling issues. Within this overarching goal, the book has the following specific objectives:

- To diagnose water and food security issues in LAC, using prospective analysis and up-to-date literature. The book pays particular attention to food-water, how it is being used and the links to regional and global food security, without neglecting the importance of non-food water, as it also represents a key asset for development and progress.
- To investigate the role of the socio-economic 'megatrends' in LAC, identifying feedback processes between the region's observed pattern of changes of key biophysical, economic and social variables linked to water and food security.
- To document and analyse the environmental implications linked to the growth of a natural resources-intensive economic model over the last decade, i.e. LAC becoming the world's *food basket* and a key economic actor in domains such as mining and some key industrial products, whilst reviewing the policies in place that have been pursued to mitigate their negative consequences.
- To review the critical changes that are taking place in the institutional and governance water spheres, including the role of civil society, which may represent promising means to advance towards the goal of improving water security in LAC.

Covering a wide array of spheres and databases ranging from biophysical, social and economic variables to detailed records of legal and institutional reform in LAC countries, the book's unique approach offers a complementary view of previous works, including Jiménez-Cisneros and Galizia-Tundisi (2012), Regional Process of the Americas (2012), FAO (2012) and OECD (2013). The first two publications provide considerable updated data on water-related aspects and formulate extremely relevant policy conclusions, while FAO (2012) offers a valuable review of the food security challenges in the LAC region, and OECD (2013) in the world. While this book has a central focus in LAC's water and food challenges, compared to other publications it makes two main contributions: 1) it focuses primarily on the synergies and relationships that both food and water security goals represent for LAC, and 2) it seeks to cover a much vaster domain linking trade and globalization, with water economic uses, pressures on environment and ecosystem services, and water policies, with an overarching view of water and food security for the people and the productive economy in LAC. It does so by first considering international food trade flows and using water accounting techniques to quantify its significance in terms of virtual water movements.

This book will provide an overall picture of LAC's current status and the challenges regarding these compelling issues. But problems and challenges greatly differ across and within countries. LAC is a highly heterogeneous physical territory, even though culturally it is more homogeneous. Whilst this cultural convergence helps in terms of human relations, the different national identities do have an influence on how countries share resources and address common problems, including the widely different standpoint each one has about globalization and the major megatrend. A similar phenomenon can be observed within regions (provinces, states) of the same nation. Thus, although the continental view provides an overall picture, it may also greatly differ from the local vision. It would be impossible to include such a degree of detail within the scope of this book, but in the different chapters some of the striking differences are identified as examples.

1.3 The structure, scope and contents of this volume

This book contains a collection of fifteen essays (including this one) that look at fundamental issues surrounding water for food and human well-being in an increasingly globalized LAC. Most chapters take a regional approach, covering a broad range of data and variables pertaining to most of countries in the region, although a sharper focus is placed in some chapters on seven countries (Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico and Peru), as these are the countries represented in the partners' consortium of the project which lead to the present book (see the Foreword). To cover this vast number of issues, the book generates new data, delves into the vast array of already existing literature and datasets about the region and explores linkages among phenomena and trends.

The book is structured in four parts. Part 1 is this introductory chapter. Part 2 sets the scene for the book looking at the biophysical and socio-economic context of LAC. Part 3 describes the main drivers for land and water uses in the region and for the particular case of the seven aforementioned countries. Part 4 presents the economic, legal and institutional context where those uses occur and where water and food security is to be achieved. In the following sections, the topics, data and approaches of each volume's part and chapter are outlined.

1.3.1 Part 2 on the biophysical and socio-economic context

Chapter 2 provides a general overview of the status and trends of water resources in LAC: its spatial and temporal distribution, its uses and the main challenges that those uses pose to the conservation of water and its associated ecosystems.

Chapter 3 describes the status and main pressures on land and ecosystem services and shows that, as a result of the expansion of agricultural and livestock production, LAC has undergone some of the most noteworthy land use changes in modern history. Associated with these changes significant reductions in the provision of ecosystem services have occurred. The chapter discusses the available options to minimize competition between agricultural land and forests.

Chapters 4 and 5 seek to identify the major socio-economic drivers of change within LAC, looking both at endogenous and exogenous global aspects. Chapter 4 describes

and documents a wide selection of socio-economic megatrends of LAC including demographic dynamics, economic growth, migration, income growth, disparity and poverty, human development, education, trade and liberalization, food-consumption patterns, technological change, and climate change. Chapter 5 provides an overview of the trends of direct investment, trade flows and policy, and adds further data about the region's connectivity with the rest of the world. The predominance of trading agricultural and mining commodities stands out for its amount, growth and continuity. The chapter also reviews the literature on the impacts of virtual water trade and some of the most serious concerns, anticipating a more complete presentation of data and discussion in Chapter 7.

Chapter 6 explores the meaning of water and food security in the context of LAC countries, taking a wide perspective and trying to account for all those aspects concerning water and food which are important for human well-being beyond its physical availability. It provides a quantitative analysis on the performance of water and food security indicators between 2000 and 2010 with a view to assessing progress and the links between them. This chapter concludes with a final section assessing the influence of socio-economic factors on water and food security advances.

1.3.2 Part 3 on water demand and drivers

Chapter 7 analyses the challenges and opportunities of water management in the region from the perspective of the agricultural sector. The chapter provides detailed data pertaining to water quantity and quality obtained under the framework of the water footprint indicator. Connecting the data on trade presented in Chapter 5, virtual water trade in the LAC region is also analysed with reference to both countries and time. In the final section, the chapter includes a productivity analysis taking into account social and economic aspects.

Chapter 8 focuses on the urban sector. First, it reviews the major challenges associated with the objective of expanding coverage and sanitation to hundreds of large and middle-size cities which are constantly undergoing processes of expansion and economic growth. It further goes on to analyse the challenge of maintaining the existing infrastructure to provide safe water to hundreds of millions of LAC people. This is illustrated in a number of case studies including Sao Paulo, Rio de Janeiro, Mar del Plata, Mexico D.F., Santiago de Chile, Buenos Aires and Lima. In many cases groundwater has a very significant r ole, even if is not a dominant one. It is also remarked upon that some poor natural water quality problems are a concern, especially in small towns and rural areas.

Chapter 9 focuses on mining, energy and industrial sectors. Each of these is reviewed covering the major challenges each faces as water users and potential pollutants. The mining and industrial sectors stand out for having large impacts on the environment, in addition to wastewater discharges from large cities. The mining sector is potentially subject to water shortages since many mines are in desert areas and they compete for scarce water resources with the urban users and the environment.

1.3.3 Part 4 on the economic, legal and institutional context for achieving water and food security

Chapter 10 reviews the efficiency of water resource use in LAC. To this end, it provides the concepts and definitions together with the drivers for water efficiency. Then, it analyses the efficiency of water resources use in Latin America, looking at the different water users: urban and industrial, mining, agriculture, energy and the environment.

Chapter 11 describes fundamental aspects of water governance, including the constitutional provisions in relation to water, water laws, and the recognition of the human right to water and sanitation. The chapter also analyses financial aspects, funding schemes and investments made and needed in order to ensure the enforcement of constitutional and legal mandates on water.

Chapter 12 focuses on different strategies that stakeholders apply in order to influence water governance in LAC. After reviewing the main sources of tensions regarding water in the region, the chapter looks at practices of activism and advocacy often triggered by disputes that represent informal but important spaces for the participation of civil society. Then the chapter discusses means to achieve transparency, accountability and more robust governance, including, the creation of formal venues of participation as a space for negotiation, the role of the private sector, water certification approaches and legal provisions to ensure access to information.

Chapter 13 explores the role of economic instruments in coping with the most pressing challenges of LAC's water problems. The chapter covers pricing policies, as applied to users of natural resources or mere abstraction activities, and to final users in the urban sector or agricultural sectors. It also reports on a few initiatives with pollution charges and the use of payments for ecosystem services. Since Chile is the only country in the region with experience with water markets, the chapter also offers a brief assessment of how they function and mentions the most recent reforms. The chapter concludes with the potential for improving water and food security indicators by using economic instruments.

Chapter 14 explains how LAC countries are confronting the environmental downside of an economic model based on the intensive use of natural resources and the process of urbanization. It reviews the constitutional and legal approaches and economic initiatives meant to address environmental protection that have been implemented in a large number of LAC countries. It then looks at the impediments and the potential effects private rights and ownership could have. It ends with a technical and detailed discussion of the role of payments for ecosystem services, complementing the brief introduction in Chapter 13.

Chapter 15, the last chapter, relates most of the topics and aspects that have been covered in the book with the changing and ambiguous concept of integrated water resources management (IWRM). The reasons for rethinking the concept of IWRM include a number of innovations and recent findings in fields traditionally not placed at the core of water resource sciences, such as non-conventional water resources, climate science and water globalization.

1.4 Main book's highlights

While it is not prudent to make generalizations for the entire LAC region, as it is obvious that LAC challenges might differ across and within countries, the following section summarizes the main highlights emerging from this volume, grouping them under six main headings: (1) globalization, trade and the role of LAC in international food and water security; (2) implications for LAC's role in the social and environmental spheres; (3) the performance of LAC's indicators of water and food security; (4) the challenges of urbanization, large cities' water, intensive industrial and mining sectors; (5) progress in water governance; (6) democracy, education and good governance as a basis for LAC's natural resources and social dividends.

1.4.1 Globalization and international trade have changed the way of coping with food and water security challenges and LAC is a key player in this new setting

In 2011 the value of traded goods globally was equivalent to 59% of the world's GDP, up from 49% in 2000, and 39% in 1990. With US$1.356 trillion traded in 2011, agricultural products represent the world's third largest sector in traded value, after fuels and non-pharmaceutical chemicals. LAC's agricultural exports now account for 18.4% of global agricultural exports and in value terms they grew by 21% in 2011, mostly because of the increase in commodity prices. In total, LAC's exports of mining and agricultural products represent between 38% and 40% of all goods exports.

The growth in exports of agricultural and mining products has been a major source of income for the wealthiest nations of LAC. But the region's exports have not been sufficiently diversified and hence un-manufactured and less processed products still account for the largest share of LAC agricultural exports. Within the group of the eleven largest economies of LAC, only Argentina (with automobile exports in the third place) and Mexico (with exports of sound and telecommunication equipment in the third place) had, in 2008, a non-agricultural or non-mining sector amongst the three largest exporting sectors (Dingemans and Ross, 2012).

Because of the abundance of agricultural land and the favourable climate, agricultural production in LAC is primarily rain-fed. International demand for agricultural products is mostly satisfied with green water and thus through the use of vast amounts of land. Over 95% of the production water footprint in LAC (≈1060km^3/year, an average for the time period of 1996–2005) is for food production and nearly 20% of this 'food water' (≈ 203km^3/year) is exported from LAC, mostly to Asia and Europe.[2] The growing

2 According to Dalin et al. (2012), South America exported in 2007 approximately178 km^3 of virtual water outside the LAC region, i.e. to Asian and European countries. This would imply that roughly over 87% of the 'food water' exported annually by LAC countries is meant to meet the demand from other regions, and only 13% is traded regionally.

international demand for protein crops, oilseed, cereal grains, and meat products has contributed to increasing virtual water exports of 37.5% between 2000 and 2010. The remaining 80% of food water consumption is used for to satisfy the internal demand of a growing and wealthier population.

South America's main trading partners are now in Asia, especially China and India, while Central America and the Caribbean still export primarily to North America. Exports from South America to Asia contributed to 30% of the virtual water trade increase between 1986 and 2007, 95% of which is green water. In this context, Brazil and Argentina are now major players in the global markets of agricultural commodities, providing up to 13% of the global annual green water exports. The expansion of transportation infrastructure connecting ports with vast inland regions will probably enhance the effects of globalization in the more remote areas of the region.

Falkenmark and Rockström (2011), Dalin et al., (2012) and OECD (2013) amongst many others conclude that international trade is a basic element for achieving global food and water security, particularly taking into consideration the future global population and the shifting dietary habits. This points to the key role that global governance architecture, including the World Trade Organization as part of its founding elements, should play in ensuring a fair food trade as a necessary premise for global security. It also suggests that, despite the growing importance the food sovereignty discourse is gaining across many countries, agricultural trade will be still necessary, and LAC is likely to remain a key food provider globally.

1.4.2 Pursuing global water and food security intensively taps into LAC's natural capital and has social and environmental trade-offs

The growth of the agricultural sector in LAC is a result of rapid modernization and competitiveness gains, pushed by technology adoption and innovation, infrastructure development and increasing production efficiency, in both physical and economic terms. LAC still has much potential for scaling up its agricultural output owing largely to its rich natural endowment, especially in terms of land and water. Currently, the appropriation of land for agriculture represents 27% of the total LAC area, a figure comparatively lower than the 38% global average. With less than 13% of this land equipped for irrigation (FAO, 2012), the green water dependency of LAC's agriculture is considered a comparative advantage compared to blue water intensive agricultural production systems. However, relying largely on rain-fed agriculture for food security is not exempt from trade-offs since its expansion implies important environmental impacts and the loss of valuable ecosystem services (e.g. deforestation, widespread pollution, carbon emissions, biodiversity loss).

The growth of rain-fed agriculture in LAC has significantly changed land use patterns. Yet, LAC is the second largest deforestation hotspot in the world, only preceded by Southeast Asia. Between 2000 and 2010, close to 1 million km^2 of forest have been transformed into agricultural land, an area equivalent to the size of Venezuela, with large consequences for biodiversity and ecosystem services. Deforestation has been particularly

intense in South America, with Brazil accounting for 60% of LAC's forest clearing during the last decade. The great majority of the ongoing deforestation in South America is related to the growing international demand for oilseeds grains. In Mesoamerica, deforestation has advanced at a slower pace, and the drivers seem to be related mainly to the low agricultural productivity, which keeps pushing at the agricultural frontier in order to overcome local food insecurity gaps. Annual deforestation rates peaked between 2000 and 2005 and declined slightly in 2005–2010, but are still higher than in 1995–2000.

The sustainable intensification argument was brought up with enthusiasm, as a 'win–win' solution, which may allow the achievement of the triple goal of ensuring food–water–environmental security. However, gains from this sustainable intensification will be slow and require large investments in research and field trials to avoid falling in the 'intensification trap', since as agriculture intensifies, input demands (e.g. energy, fertilizers, water) also rise, and this has additional environmental consequences (Titonell, 2013). Non-point source pollution of water and soil is, jointly with biodiversity loss and built-in resistance to pests and weeds, the main unwanted consequence of agricultural expansion in LAC. Important causes are the extensive application of pesticides and fertilizers, irrigation-induced salinity and the reuse of insufficiently treated wastewater for irrigation. Improvements in agricultural productivity across many countries in LAC will surely help to spare land and reduce the impacts of deforestation, but important challenges remain in order to mitigate the resource-use dependency of agriculture.

1.4.3 LAC's water and food security indicators have improved, but important goals remain and new challenges are emerging

The buoyant global tailwinds that enabled the remarkable economic development of LAC over the last decade have undoubtedly contributed to social progress in the region. Social advances are obvious in the achievements of LAC countries to meet many of the Millennium Development Goals (MDGs) (see Table 1.1). At the continental level, LAC has made notable advances in alleviating extreme poverty (MGD1a), undernourishment (MDG1c) and improving access to drinking water and sanitation (MDG7). Yet progress achieved upon the rest of MDGs, albeit notable, is still not sufficient to meet the 2015 objectives.

When analysing the achievements made by countries separately, the wide divergences in accomplishing the different MDGs become evident. Overall, high and medium-high income countries (e.g. Southern Cone countries, as well as Brazil, Mexico, Costa Rica, Peru, Panama or Ecuador) are on good track to meet at least those MDGs related to basic indicators of water and food security (MDG1 and MDG7). Goals related to improved education, health, equity and female empowerment are progressing but at a slower pace, and there is a risk that they will not be accomplished by 2015 if the prevailing trend continues. In the Caribbean islands there is a large knowledge gap and the information that is available shows slow progress for the most part. Low-income countries also run the risk of not meeting most of the 2015 goals, except in Bolivia, Nicaragua and Honduras.

Table 1.1 Millennium Development Goals (MDG) progress in Latin America and the Caribbean (LAC) between 1990 and 2010.
Target goals on track to be accomplished by 2015 or earlier are represented in green, observed progress but off track if prevailing trends persist are presented in yellow, and off-target ones in red.

		PROGRESS SCORE							
		MDG 1a	MDG 1c	MDG 2	MDG 3	MDG 4	MDG 5	MDG 7c	
		Extreme poverty	Undernourishment	Completion primary schooling	Gender and women empowerment	Reduction of child mortality	Improve maternal health	Access to safe drinking water	Access to sanitation
Mesoamerica	Honduras								
	Mexico								
	Nicaragua								
	Panama								
	Costa Rica								
	El Salvador								
	Guatemala								
Caribbean	Cuba								
	Dominican Republic								
	St. Kitts and Nevis								
	St. Lucia								
	St. Vincent and the Grenadines								
	Haiti								
Andean	Bolivia								
	Colombia								
	Ecuador								
	Peru								
	Venezuela								
Amazonian	Brazil								
South Cone	Chile								
	Paraguay								
	Uruguay								
	Argentina								
LAC countries	On Target	9	13	1	4	6	1	17	10
	Some Progress	8	6	17	16	17	16	4	9
	Off Target	0	4	0	3	0	3	1	3

Source: own elaboration based on UN (2013).

These improvements imply that between 1990 and 2012 the percentage of the population living in poverty in LAC has decreased from 49.4% to 28.8%. Still there are 168 million people living in poverty, the majority living in urban areas (ECLAC, 2013). Income distribution inequality is still the Achilles heel of LAC, but a clear downtrend has been evident since the early 2000s. Nevertheless, by 2011, 30% of the population still received over 60% of the total income (*ibid.*).

With regard to food security improvements, the number of people undernourished has decreased from over 65 million in 1990–1992 to 49 million in 2010–2012 (FAO, 2012). The prevalence of stunting in children under five years has also decreased from 19% in 2000 to 14% in 2010, but the problem remains that one in every seven children born in LAC will have stunted growth. In addition to sub-nutrition, LAC is also facing a growing problem of malnutrition. Obesity now affects nearly 18% of the Latin American population (> 110 million people) and overweight up to 33% (> 200 million people) (Finucane et al., 2011). Malnutrition is particularly affecting middle and high income countries like Chile, Brazil, Uruguay, Argentina and Mexico. Current rates of overweight and obesity in LAC are at least double those of other developing regions and comparable to the ones found in Europe.

Regarding water security, LAC boasts the highest renewable water resources per person among the world's regions, but climatic variability, together with urbanization patterns, generates asymmetries between water demands and water availability across the region, and results in water stress in some of the most economically dynamic areas of the region. Over 100 million LAC citizens currently live in basins which face physical water scarcity.

The number of people without access to an improved sanitation facility has decreased from 146.7 million in 1990 to 103.8 million in 2011 (WHO-UNICEF, 2013). The greatest improvements, however, have been achieved in reducing the number of people without access to safe drinking water from 63.8 million in 1990 to 32.8 million by 2011 (WHO-UNICEF, 2013). These figures mask important differences across countries, between urban and rural areas, as well as within urban areas. Overall, and particularly across the poorest countries, water service deficiencies in rural areas are still very significant.

The vulnerability of countries to growing water hazards stands as another important priority when attempting to increase regional water and food security. The frequency of extreme hydro-meteorological events such as floods has quadrupled between 2000 and 2009, compared to the period of 1970–1979 (EM-DAT,2013). The social impacts of floods and storms have remained relatively stable (< 3% of the LAC population affected annually) at the LAC scale, but in countries like Belize, Guyana or Cuba, social exposure risk has increased. The economic impacts have grown considerably, and in 2010 they peaked with damages accounting for almost 2% of LAC's GDP. A major reason for this high vulnerability to floods in LAC is related to accelerated urbanization with little or no urban planning, but also to the fact that many cities are located in very flat areas, where large concentrated rain events may produce serious problems such as the 2013 flooding of La Plata. Hydro-climatic variability, in the form of droughts, also represents a major risk for

regional food security. Currently, only 13% of the total agricultural area in LAC is equipped with irrigation (FAO, 2012) which makes the agricultural sector in LAC highly vulnerable to drought. Only some parts of Mexico, Chile, Peru, the Northwest of Argentina, and the Northeast of Brazil rely on irrigation water for food production, mostly for the production of value added products such as fruits and vegetables. The potential to expand irrigation is huge but fairly unrealized: FAO (2013) includes Argentina, Brazil, Colombia, Mexico and Peru in the list of twenty world countries with the largest potential, but only Brazil and Mexico stand among the twenty countries with the largest area already equipped with irrigation. However, groundwater salinity, poor drainage in flatlands and droughts make irrigation developments very risky unless large infrastructure investments are made.

1.4.4 The development and operation of the urban water cycle in large cities, intensive industries and the mining sector pose major environmental challenges

Providing a quality drinking water service, improved sanitation and adequate treatment of wastewater is challenging, especially in LAC where the population, particularly in urban areas, has expanded rapidly. The root of the problem is neither economic (scale economies allow for the provision of good quality and sustainable water services at a reasonable cost) nor technical (current engineering can deal with the most complex problems). Barriers to cope with the already diagnosed problems are mostly the lack of governance and institutional leadership, as well as political agendas that often do not include the universal coverage of water supply and sanitation as key priorities.

During the last decade, infrastructure development for domestic supply has been for the most part orientated towards water service provision while sanitation and wastewater management investments have received less attention. In fact, public and private investment on this front has levelled off recently. Another challenge associated with urban water supply is that initial investments for providing access to water have not been followed by stable funding for maintenance and in fact many water services are currently in dire need of replacement and modernization. This and the large population growth, especially in urban areas, are responsible for the deficient quality of supplied services. Regional Process of the Americas (2012) explicitly highlights among these deficiencies: the insufficient water disinfection, the poor surveillance of water abstractions, discontinuous service, insufficient pressure, high leakage percentage (above 40% in many cases) and the limited wastewater treatment. These are big challenges and making use of economies of scale seems to be the most logical and feasible solution to provide a good quality urban water service to the citizen at the lower possible cost, when all involved costs and long-term economic balances are considered (Cabrera et al., 2013). However, this needs a good administrative structure, political support and remarkable leadership amongst decision makers. Although the main focus of water services in large cities is on domestic supply improvements, natural hazards and pollution are also serious concerns in many rural and

small urban areas. These are brought to the attention of national authorities through local political and social representatives.

Although water consumption for energy, industry and mining may only be a small percentage of countries' consumption, it can be locally significant, especially in small basins and in the arid and hyper-arid areas of LAC. This consumption may also be economically and socially important, and therefore water quantity and quality should be guaranteed.

Mining and industrial production are emerging sectors in the region and represent an important share of LAC's economy. Furthermore mining is a key source of income and employment. Nonetheless, industrial activities, and in particular mining, contribute to water resources deterioration, threatening water security locally and downstream. This is due to the disposal of water with high salinity, often containing acids and diverse unwanted and noxious solutes. These unwanted constituents are derived from minerals – diverse heavy metals – or from concentration and processing, such as flotation compounds. Quicksilver (mercury) and cyanide can also be found in the case of the many gold mines in LAC, especially the small and artisanal ones. Pollution management is hindered by financial constraints, as well as by insufficient monitoring programmes and wastewater treatment investments. Yet pressures to maintain and expand mining activities will grow because of the world's demand for metals and non-ferrous products. LAC countries currently supply 51% of the world's silver, 45% of its copper and overall 25% of the world's metal market. The production of lithium, a series of secondary metals and coal are also important, as well as gems. Water productivity in the mining and industrial sector is at least one order of magnitude higher than in the agricultural sector.

1.4.5 In LAC water governance is evolving to address the challenges posed by rapid socio-economic changes, however, as is often the case, the implementation of reforms lags behind

Large unexploited natural resources, coupled with the sustained growth pattern of many LAC countries, contribute to create situations where different needs, interests and understanding of the concept of socio-economic development lead to tensions. Poor legal compliance, insufficient legal instruments and lack of funds are often at the root of significant environmental damages and conflicts. Disputes are mainly related to the construction and operation of water works, water diversion, industrial and mining pollution and the privatization of water supply and sanitation coverage in urban areas. This means that most tensions spin around 'non-food water', i.e. a small fraction of the water actually consumed in the region, as high potential of pollution, new risks of flood and fear to lose the precarious water supply in marginal urban areas act as powerful catalysts for stakeholders concern.

Advocacy networks play a key role in empowering and giving national and international visibility to local populations directly affected by environmental degradation or social unfairness. During the past two decades, the demands from civil society for

more inclusive, sustainable, efficient and effective governance, as well as the influence of international organizations and supranational agencies, have triggered significant institutional reforms in the region in the form of much legislative activity.

Common elements in those reforms include: a shift towards decentralization, often complemented with the creation of coordination and supervising bodies at a higher level; the formulation of new water laws and policies that include IWRM principles (environmental sustainability, integration, participation, accountability, transparency, cost recovery); and the creation of water use taxes and tariffs for cost recovery. Additionally, in its search for improved water security, LAC has pioneered the recognition of the right to water and sanitation as a human right.

In most of the countries the focus is now on implementing institutional reforms, where the main challenges are related to the lack of integrated planning of water use, the poor coordination of the main stakeholders (both governmental and non-governmental), insufficient local capacity and the need for management instruments that best fit the specific regional differences.

In the spaces for dialogue and participatory decision making created by reforms (e.g. watershed committees, water councils or customary tribunals), formal participation is mainly limited to water users, usually those representing large-scale economic activities. Some accomplishments in participation deserve to be acknowledged, and there are efforts for refining those formal instruments to make them more inclusive and representative of civil society. Nonetheless, the credibility of participation is often questioned due to stakeholders' unequal capacity to participate and the direct access of strong economic lobbies to decision-makers. Other interests not associated to water rights or the perspectives of indigenous population are often underrepresented and social activism still prevails as the main instrument to voice their demands.

Governance failures at different levels have spurred civil society's claims for higher accountability of elected representatives and public authorities. As a reaction, most LAC countries passed, during the last decade, information transparency laws, which apply also to environmental and water-related public information. The actual implementation of the legal obligations to disclose information, however, is still deficient, thus hindering the process of accountability of public authorities before their constituents.

The progressive deterioration of water resources and the need to finance water services provision have fostered the establishment of economic instruments to implement the 'polluter-pays-principle' and increase cost recovery rates. Environmental taxation has been implemented in some LAC countries, but enforcement and collected revenue are still low and do not act as a true deterrent to polluters. After decades of little or no cost recovery rates in irrigating schemes, some countries, such as Argentina, Mexico, Peru and Brazil, have taken steps to make farmers pay for operation and maintenance costs of the infrastructure supplying their water. This may be a tax on exports to compensate for government investments in infrastructures when the product is sold to other country.

Incentives for environmental conservation like payments for ecosystem services (PES) and PES-like schemes have been developed in LAC over the last few years as a

complementary instrument to conventional command-and-control and financial instruments. Yet the most successful initiatives have been orientated towards securing availability and quality of water for urban areas (e.g. Produtor Agua in Brazil or Fondo para la Protección del Agua (FONAG) in Ecuador), and thus are geared towards protecting non-food water for cities. The dependency of many PES schemes on international funds, their often weak financial sustainability and the lack of secure land tenure and property rights, amongst other factors, hinder the implementation and long-term sustainability of many other PES initiatives.

1.4.6 Democracy, education and good governance are the basis for using LAC's large natural and human capital for the achievement of human well-being

At present, in LAC, fertility and birth–death rates have decreased, and the population structure is fairly young, with over 50% of working-age. Such a 'demographic dividend', if maintained and accompanied with the corresponding investments and policies, represents a key asset for assuring LAC's socio-economic development in the decades to come. A deeper democratization, the emergence of a powerful civil society, the rise of a middle class, economic openness, and macro-economic stability are also key elements explaining the recent evolution of LAC societies (World Bank, 2013c).

Economic development and the rapid urbanization process have changed societies in LAC, their needs and the way the population use their natural resources. Economic growth and international trade are contributing to changing the dietary habits of LAC citizens, thus affecting the use of water and land. During the past few decades, globalization and the global trade of goods has opened up new development paths and has triggered dynamics whose implications in terms of water and food security in LAC are still difficult to grasp in full.

The opportunities for LAC to achieve a more sustainable and efficient use of their resources, and facilitate a transition towards a green economy are numerous. In fact, there are already a number of successful cases of application and a window of opportunity for the evaluation of trade-offs whilst identifying the potential for significant improvement. The extraordinary natural endowment coupled with the population dividend represents a unique opportunity to foster LAC's socio-economic development.

Nevertheless many challenges still need to be faced, as in several cases economic growth in LAC has been achieved at the expense of land use, energy and water resources intensification, combined with an increase in the levels of pollution and the loss of ecosystems and biodiversity. The reinforcement of national and global governance schemes and their alignment on the achievement of true and universal human well-being, under ethical and moral principles, and will remain an inescapable prerequisite to facing these challenges.

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