Water Resources, Climate Change and Business Competitiveness in Latin America: A strategic management perspective

Antonio Lloret

Instituto Tecnológico Autónomo de México

Abstract

Latin American companies that want to stay globally competitive in the future must integrate sustainability practices into their business strategies. Natural resources scarcity and variability are increasing, society and consumer's preferences are changing, and governments are enacting trade and regulatory constraints. Competitiveness and sustainability are keys to the survival of the company, and thus companies must view the call to sustainability as a strategic opportunity. This paper shows a relation between competitiveness and environmental sustainability in Latin America by analyzing the likely economic impact that water resource variability will have in water intensive industries in the region.

Keywords: Water Resources, Latin America, Climate Change, Industry.

Introduction

Water is essential for life. Water is indispensable for growing food, for household water uses, for sanitation, and for energy production, and it is a critical input into industry. But this essential resource is under threat. Growing national, regional, and seasonal water scarcities in much of the world pose severe challenges for national governments, for international development, and for industry. The challenges of water scarcity are heightened by the increasing costs of developing water infrastructure, degradation of soil in irrigated areas, depletion of groundwater, water pollution and degradation of water-related ecosystems as well as wasteful use of already developed water supplies. (Rosegrant, Cai, & Cline, 2002). This problem is especially critical in Latin-American where about 14% of the Latin American population has no access to water infrastructure at all. Scientists estimate that people in the region who will experience increased water stress will range from 12 to 81 million in the 2020s and from 79 to 178 million in the 2050s (IPCC, 2007)

The variability of water resources in Latin America threatens economic development. When discussing water resources, we must consider climate change because the impact on water resources may be further exacerbated by climate induced uncertainties impacting urban, agricultural and industrial water supply and demand (Frederick & Major, 1997). Economic sectors such as insurance companies, infrastructure, tourism, transportation and water intensive industries will be affected as climate change impacts water resources. Effects in such sectors may be positive or negative, depending on the particular conditions of the regions in which companies operate. For the case of extreme variability, a scenario suggested by climate change models (**IPCC**, 2007). The inability of governments, businesses and humans to adapt in the short term means that climatic change may radically impact companies' operations (Bates, Kundzewicz, Wu, & Palutikof, 2008). However for the energy and the industry sectors that are sensitive to climate change effects on water resources, there are opportunities to adapt faster than the rate at which changes in the availability of water resources takes place.

In Latin America, a region that has approximately 35% of the world's freshwater resources the impact of climatic change in water resources will affect river system, lakes, and reservoirs. These resources are rather sensitive to climate change and vulnerable to the climate change variability associated with extreme weather conditions such as extended droughts or storms and hurricanes, many of them associated with the ENSO phenomenon ("El Niño and Southern Oscillation"). Large portions of Argentina, Bolivia, Chile, Peru, northeastern Brazil, Ecuador, Colombia, and central and northern Mexico have great difficulty meeting their water needs because two-thirds of Latin America is arid or semi-arid. Additionally, the impact of climate change on the hydrological cycle and its effects on precipitation intensity, timing and distribution, surface runoff; and groundwater resources will be aggravated in certain areas by population growth and inefficient development of water consuming activities. (UNESCO, 2009)

The main industries that are water intensive are the food and beverages industry, the mining and manufacturing industry, the construction industry and the retail and trade accounting for close to 60% of total GDP in the region. These industries themselves vary their water intensity and are subject to regulatory risk, water scarcity and demand by competing users (WRI, 2009).

Climate change will impact the distribution of water resources, and thus the value of industry in Latin America. Variability in water may pose a risk in the industries' values, and even in water plentiful countries, the lack of water resources, infrastructure, conservation and other problems may damage the value of the industry in the country.

In this paper, we analyze water as a limiting resource in Latin America. First, we compare for the main industries in the region per country in which data is available, the value of water and the associated risk due to climatic change effects on water variability. This analysis is important because it measures an economic value of the impact expected in Latina America as water resources increase in variability. Second, we compare country-wide data on water withdrawn by user (agriculture, industry and domestic) relative to OECD countries. Third, we focus our analysis on industry users alone. We analyze water intensive industries in the region based on the three foci of analysis: (1) water as an input of production, (2) water as an energy source, and (3) water quality as by-product of production in the form of wastewater discharges and their pollution potential. Finally, based on best water use practices in water intensive industries, we recommend strategic moves to tackle the problems caused by water constraints and offer business strategic recommendations for the region.

Water and Industry: a management perspective

Water plays a threefold role in industry, each requiring a different strategic management approach. First: water as an input, for which an industry is subject to water supply variability based on the geographic location and available infrastructure. Second: water as a source of energy, for which an industry pays a price subject to market and regulatory conditions. And finally: water quality as by-product of production in the form of wastewater discharges and their pollution potential.

Water is used by industry in multiple ways: for cleaning, heating and cooling; for generating steam; for transporting dissolved substances or particulates; as a raw material; as a solvent; and as a constituent part of products (as in the beverage, paper and chemical industries). The volume of water used by industry is low --less than 10% of total water withdrawals-- but there are large differences in efficiency of use. The impact of industry's wastewater discharges and their pollution potential in fact puts more pressure on water resources than the quantity used in production. (UNESCO 2009)

As water resources variability affects water demand and supply, water intensive industries must take preventive measures. In addition to adapting to regulatory constraints, water intensive industries must understand and assess eventual scarcity or a shift in water demand from competing users. Industry managers, then, must assess the impact that these changes pose in their respective industries, not only to secure their water resources but also to establish efficient managerial schemes that will insure that, under uncertainty, the industries are able to adapt to internal and external pressures from stakeholders, including regulatory constraints, and to mitigate the short, medium, and long term effects of water resources variability in their industries.

A sustainable view of the firm in which managers understand the likely effects of water resources upon their production chain allows them to work towards reducing the risks associated with uncertainty. The sustainable manager will have to plan for scarce resources that are critical for value creation and that can be imperfectly mobile and cannot be acquired in the open market.

Water itself is a rather complex natural resource: it is subject to variability, and even in plentiful regions it depends on the level of infrastructure available and government or agency efficiency to deliver the appropriate amount in a timely manner. Moreover, the sustainable company that foresees strategic scenarios to prevent value losses in their business will not only remain competitive in its industry; the sustainable company has an opportunity to become a first mover and to create isolating mechanisms by securing access to the resource at all times. That strategic move may translate into a firm that, even in a fiercely competitive industry, continues to have an edge over its rivals.

Next is a brief summary by CERES 2009 of the main business implications of climatic change in water resources where increasing demand, lack of supply and water contamination having an effect on businesses.

[INSERT TABLE 1 ABOUT HERE]

Management theory provides an approach to reduce the uncertainty associated with water resources variability. The resource-based notion of the firm can help us to understand the link between water constraints and management theory. The resource-based notion of the firm proposes the use and exploitation of strategic assets, resources, and capabilities, based on tangible and intangible assets that allow to the firm to remain competitive over time (Barney, 1991; Russo & Fouts, 1997). This hypothesis suggests that the resources and capabilities of a company create value when these are valuable, rare, inimitable and adaptable to the organization in a purely business context or with an extension to natural resources (Hart, 1995). Moreover, business sustainability goes hand in hand with the creation and implementation of strategic actions that meet economic and environmental constraints over time.

The natural resources based view of the firm supports the idea that restrictions imposed by natural resources can give firms a competitive advantage in relation to the environment. One way to obtain new capabilities and resources based on the limits and constraints of natural resources is to develop a sustainable vision of the company. Companies can acquire the first mover advantage reducing waste, designing new products and technologies, integrating stakeholders in the decision process and most importantly, having a long term vision. (Hart, 1995).

Sustainability and competitivity can be framed as part of a business strategy when sustainability is used to create competitive or comparative advantages. These advantages result from reducing costs by both, reducing resource waste, pollution, or potential costs accrued form regulatory fines, and by focusing on market segments that are willing to buy the product and pay the price of a sustainable good or service.

Failing to consider sustainability as unconnected to a firm's competitiveness, however, can generate a perception of high costs and high investment. Such a perception is true to a certain extent over the short term, when sustainability practices are not aligned with business strategy. Incorporating sustainability practices into a business strategy, however, can be a differentiator over the medium to long term that allows a firm to be competitive and sustainable. A sustainable business vision enables the company not only to look toward the future, but also to establish the basis and guidelines needed for business continuance in the future. The sustainable view requires long-term and efficient use of resources and capabilities over time and the reassurance to consumers that their benefits may be greater than the products and services with less sustainable attributes.

Taking a short term view of the firm implies that companies will only react to regulatory restrictions as they are imposed with chances of missing competitive opportunities and experiencing higher associated costs as laws are enforced. This may bring negative effects in the firm creating external costs that may damage their competitive advantage.

Water Value in Industry in Latin America

In order to tackle the challenges of water scarcity, strategic management approaches that address sustainability by strategically exploiting resources and capacities, or tangible and intangible assets that allow the firm to achieve a competitive advantage, may be of help for industries willing to become water efficient.

Worldwide, industry and energy water use accounts for about 20% of total water withdrawals, whereas agriculture accounts for 75%, and domestic and urban uses not related to energy account for the remainder. However, these ratios vary by geographical region, by water abundance, and by economic development, suggesting that countries value their water differently. Latin America[1] uses most of its water (70%) for agriculture and just 8.8% in industry whereas OECD countries have different water productivity and withdraw on average 33% and 46% respectively. Figure 1 below shows the productivity value[2] of water use in Latin American countries relative to their GDP. Figure 2 below shows OECD countries' water productivity value.

[INSERT FIGURE 1 AND FIGURE 2 ABOUT HERE]

Figure 1 and 2 show that industry in both agriculture and industry has the largest share of value relative to the amount of water withdrawn. This ration is an example of the importance of water in industry despite the small quantity needed relative to the agricultural sector. However, there is no simple explanation for each country's production value (water use/GDP) and its total industrial demand for water; demand depends upon the composition of the industrial sector, the processes in use, and the

[1] Top 20 most populated countries that account for 90% of Latin America population.
[2] Value per unit of water withdrawn ($m output per million m3 water withdrawn)

degree of recycling that is in place in each sector (Bergkamp & Sadoff, 2008). Thus, different industries demand different water quality and quantities.

Now we show the value that water resources have in water intensive industries. First we find the value of water for Latin American countries based on their industrial output, next we compare such value to OECD countries; and finally, we assess the likely risk that limited water resources poses in the industry because of climatic change conditions impacts on water resources in the region.

It is important to mention, however, that since water is generally under priced, the cost of water within the industry is not necessarily a driver for sustainable practices. That is, the cost in itself, relative to other resources such as energy, capital and labor out weighs that of water. Yet, in a water-restricted future, the chances that water becomes more valued increases as the demand from several users: domestic, agricultural, and energy production may change the relative advantage that low cost of water had.

In addition, for areas in which the variability of water may create an additional risk, it is important to show that companies must take a serious forward-looking perspective in order to adapt and mitigate at the minimum cost possible.

Table 2 below shows the relative value in the region and per country that water has for several water intensive industries. This table demonstrates that, assuming industries use water under similar conditions, the value of water per industry varies considerably. For instance, in Latin America, on average, the value of water as a unit of industrial output per cubic meter is equal to 26.7 units; the construction industry has the largest share of value per unit of water. These values, however, vary widely across the region. In water-plentiful nations such as Brazil, the value of water is relatively low in most industries, whereas in arid regions such as Chile or Costa Rica, water in most industries has a greater value.

[INSERT TABLE 2 ABOUT HERE]

Climate Change and Water Value in Latin America

The vulnerability of Latin American countries to climate change strongly depends upon the impact of climate change on water availability (**IPCC**, 2007). Alterations in hydrological balance resulting from climate change could reduce water supply and distribution systems in major Latin American cities and rural areas.

Climate variability means that normal climate alternates with a different, more vulnerable recurrent climate. Table 3 below shows for three time frames temperature changes in three different regions in the Continent. The case for precipitation changes is more complex, since regional climate projections show a much higher degree of uncertainty meaning potential negative effects in water availability due to precipitation in the region. What the table tells us is that in most regions over several time frames, the chances of a reduction on precipitation will largely impact the amount of water available.

For the Amazonian region, the wettest of them all, a reduced precipitation will alter the water availability up to -10%, likely having an effect on water demand and supply. If industry were to face an extreme reduction in water availability, the value of water in industry in the Amazonian states will likely increase. Industries must now begin taking steps towards adapting to future scarcity.

[INSERT TABLE 3. ABOUT HERE]

Adaptation Strategies

Adaptation in the industrial use of water resource refers mainly to the adjustments in natural systems or human systems that companies will have to face in response to observed or expected changes in water resources availability due to increase demand of competing users, stakeholders pressure or regulatory stringency. The adaptation mechanisms industries can take are aimed at reducing adverse impacts or taking advantage of opportunities.

In particular, as water availability diminishes, industries that require a certain quality, quantity in time and place, will have to pay an increased price for operational costs, even if water is plentiful but not in the times and places required. A factor to consider as well is that of energy generated through water resources, such as hydroelectric power. In Latin America, on average only 6% of the total energy production comes from water resources; however, some countries, like Costa Rica, Paraguay, Uruguay, and Chile, that do not necessarily depend on fossil fuel energy production do depend on hydroelectric power for at least 30% (WRI, 2009). It is expected that as fossil fuel energy resources become more scarce and face regulatory constraints due to carbon emissions restrictions, water resources will become more in demand, in which case infrastructure and reallocation will be necessary. As energy supplies diminish or become more costly, this will have a direct impact on companies and industry.

Competing users will also increase. OECD countries report that by 2030 manufacturing will require 2.8 times more water than the base year of 2000 and about 4 times more water for the year 2050. Should Latin America aspire to grow as much as OECD countries, it is likely that manufacturing water use will increase at a fast rate, limiting the resource to competing users such as agriculture or domestic and energy users.

Adaptation strategies then imply that water intensive industries must save water and energy, treat and recycle their own water and wastewater, and perhaps even develop alternative energy sources. Other alternatives include developing water markets, measuring water use and impact, and finally, engaging communities in their business operations to reduce potential conflicts with and risks to society. This is particularly true for Latin American countries in water scarce areas such as Mexico, Chile, Argentina, Panama, and others.

As water is used differently in each sector, the value of water and the adaptation mechanism is different for each sector. For example, securing water resources for the food and beverages industry is the most important factor, thus adaptation in this industry implies conserving water resources and securing fresh water. In the mining industry, the process is the most important factor, and since the industry does not requires high quality water, recycling and reusing water is the strategic move to adapt to water scarcity. Table 4 below shows the different uses of water in industry and suggest approaches to secure the resource.

Conclusions

In this paper we show a relation between competitiveness and environmental sustainability in Latin America by analyzing the likely economic impact that water resource variability will have in water intensive industries in the region. We used the natural resources view of the firm to suggest strategic management approaches that may allow industries to adapt to water constraints while maintaining competitiveness. To tackle the challenges of water scarcity, strategic management approaches that address sustainability by strategically exploiting resources and capacities include: measuring risk factors and water landscapes in their geographical region; measuring the industry water footprint and assessing water use in the supply chain, be it through product use of water, process or waste water including energy generation through water resources. Additionally, as demand increases and competing users demand more water, it is important to consult and engage stakeholders: water is a regional and local resource. And finally, companies must create a water policy for the company by setting usage goals and specific targets during time.

As water becomes scarcer, the value of the resource in the production will increase in value. The company that secures the resource will be the most capable of competing globally. Latin America, with its plentiful water resources, cannot sit and wait until adaptation becomes too late. In fact, Latin America needs to create a regional water policy and perhaps, by conserving and securing the valuable resource, attract investment from water intensive industries in other regions of the world that do not have a sustainable view of the company.

Tables and Figures

	Water Trends	Climate Impacts	Business Implications
Increasing Demand	Population growth- By 2030, the earth's projected eight billion inhabitants will need 25 percent more freshwater. The majority of this population growth will take place in developing countries, where demands on water resources are already high and supplies limited.	Increased water demand by agriculture due to higher temperatures – up to a 40 percent increase in additional irrigated land by 2080	Uncertain availability in water-stressed regions Higher costs for water
	Economic development and changing consumption patterns. The rise in the world's population and improvement in living standards will drive increased manufacturing of water-intensive goods and services, and will require significantly more food production. Already, the consumption of water-intensive red meat in large developing countries like India and China has risen 33 percent in the last decade and is expected to double globally between 2000 and 2050.	Increased hydration demand by farm animals due to higher temperatures	Regulatory caps on use Conflicts with communities and other water users
		Increased quantities of water needed for industrial cooling due to higher atmospheric and water temperatures	Growing demand for water-efficient products
Insufficient Supply	Over appropriation. More than one-third of the world's population – roughly 2.4 billion people – lives in waterstressed regions. By 2025, that number is expected to rise to two-thirds.	Decreased natural water storage capacity due to glacier/snow cap melt affecting key regions including China, India, Pakistan, and the western United States.	Decreased amounts of water available for industrial and agricultural activities Operational disruptions and associated financial loss
		Drought and groundwater declines expected for many sub-tropical and midlatitudes due to changes in precipitation patterns	Disruptions to operations of key suppliers and critical value chain partners
		Ecosystem damage due to temperature increases, changes in precipitation patterns, severe weather events, and prolonged droughts.	Impacts on future growth and license to operate
Declining Water Quality	Rapid industrialization. In China, many rivers are so badly polluted that industry cannot use the water. Nearly two-thirds of the country's largest cities have no wastewater treatment facilities.	Contamination of coastal surface and groundwater resources due to sea level rise and resulting saltwater intrusion.	Increased pre-treatment costs for water Increased costs for wastewater treatment to meet regulatory standards
	Millions globally lack safe drinking water. Increases in agricultural and industrial production, coupled with a lack of adequate wastewater treatment inhibit access to safe drinking water for almost 900 million people worldwide. Five million die each year from water-related illness	More algal and bacterial blooms due to increased water temperatures	New regulatory restrictions on specific industrial activities and investments
		Higher erosion rates and increased influx of soil-based pollutants into waterways due to extreme precipitation and flooding	Increased responsibility to implement community water infrastructure and watershed restoration projects
			Productivity impacts on the workforce linked to water-related illness

Table 1. CERES Study 2009 that summarizes the likely impact of Climate Change on water resources and the business implications

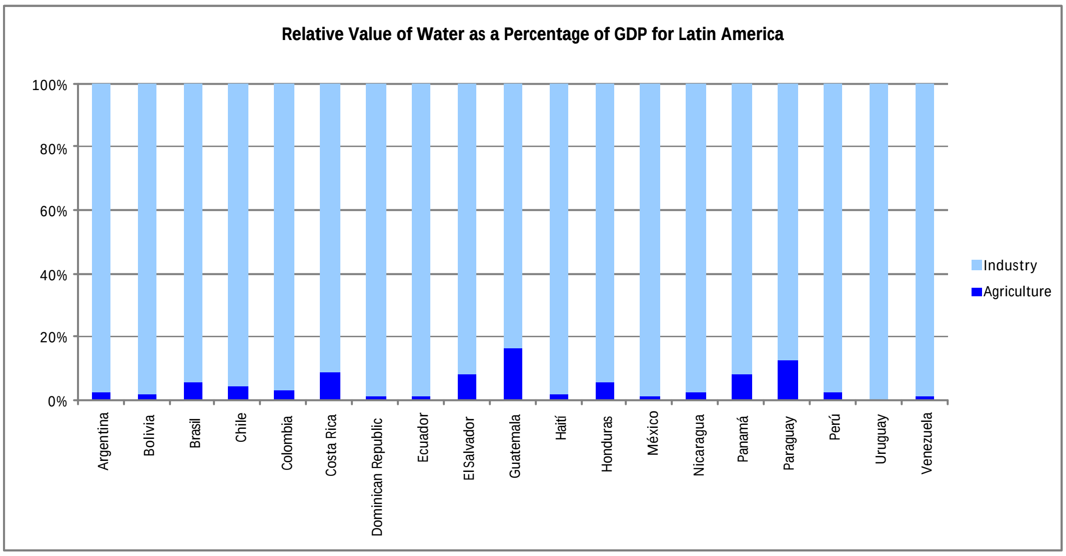

Figure 1. Relative Value of Water in Latin America. Source: Author with data from World Resources Institute 2010

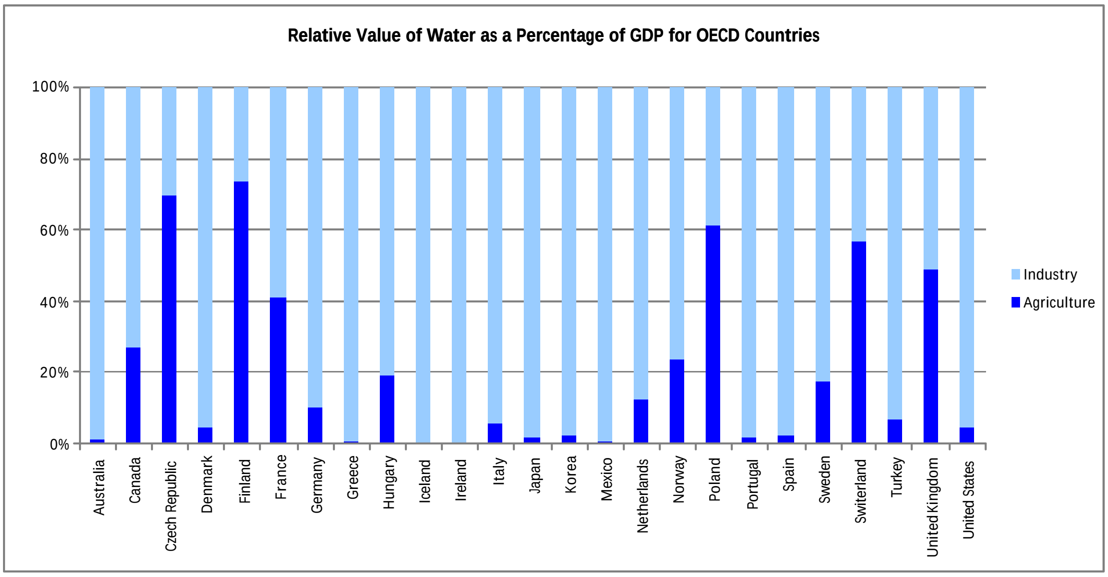

Figure 2. Relative Value of Water in OECD countries. Source Author with data from World Resources Institute 2010

Country	GDP in millions	Industry as a whole			Agriculture			Mining, Manufacturing and Utilities Industry	Construction Industry	Wholesale, retail trade, restaurants and hotels Industry	Transport, Storage and Communication Industry
		% GDP	Water withdrawn per unit of output	Value of Water (M3 per unit of output)	% GDP	Water withdrawn per unit of output	Value of Water (M3 per unit of output)	Value of Water (M3 per unit of output)	Value of Water (M3 per unit of output)	Value of Water (M3 per unit of output)	Value of Water (M3 per unit of output)
Argentina	313,626	36%	23.2	43.2	9.0%	762.2	1.31	0.46	2.75	0.98	1.53
Bolivia	9,742	32%	13.3	74.9	15.0%	787.8	1.3	22.62	256.35	64.09	76.90
Brasil	670.450	38%	41.9	23.9	8.0%	685.4	1.5	0.15	0.71	0.20	0.40
Chile	93.216	47%	71.6	14.0	6.0%	1.434.8	0.7	0.38	2.14	1.67	1.87
Colombia	99.130	34%	12.7	78.7	13.0%	382.3	2.6	2.83	8.82	6.10	11.34
Costa Rica	19,470	30%	77.9	12.8	9.0%	809.7	1.2	2.87	13.18	3.47	7.32
Dominican Republic	23,396	26%	11.1	89.8	12.0%	796.0	1.26	15.36	63.99	19.20	31.99
Ecuador	20.496	46%	90.0	11.1	7.0%	9.704.8	0.1	2.01	6.02	3.87	4.93
El Salvador	14.634	30%	46.4	21.6	10.0%	513.2	1.9	6.40	36.82	7.01	16.37
Guatemala	21.851	19%	62.8	15.9	23.0%	319.2	3.1	3.04	14.58	3.64	9.11
Haití	3,701	17%	15.7	63.9	28.0%	893.5	1.1	191.77	115.06	107.87	575.30
Honduras	7,098	31%	43.0	23.3	14.0%	701.0	1.4	14.90	54.62	19.28	46.81
México	636.268	26%	23.6	42.3	4.0%	2.366.5	0.42	0.24	0.95	0.35	0.74
Nicaragua	4.577	28%	30.4	32.9	19.0%	1.240.8	0.8	32.63	119.66	47.86	119.66
Panamá	14.245	16%	18.1	55.3	8.0%	202.5	4.9	35.30	77.67	21.57	22.84
Paraguay	8,030	19%	28.8	34.7	22.0%	199.3	5.0	25.40	86.34	18.77	53.97
Perú	65,353	35%	88.0	11.4	7.0%	3,608.6	0.3	0.58	2.90	0.97	2.17
Uruguay	21.632	31%	4.7	213.2	9.0%	1.551.3	0.6	51.86	140.77	61.59	98.54
Venezuela	131.270	52%	8.6	116.5	5.0%	599.2	1.67	1.81	12.68	8.07	14.80
Average LAM	*114.641*	*31%*	*37.5*	*26.7*	*12.0%*	*1.450.4*	*1.7*	*0.96*	*4.47*	*1.57*	*2.99*
Average OECD	*1,161,820*	*29%*	*57.3*	*17.4*	*2.9%*	*655.6*	*19.4*	*0.08*	*0.26*	*0.10*	*0.22*
Average BRIC	*888,583*	*38%*	*192.9*	*5.2*	*11.3%*	*1,969.5*	*0.9*	*0.02*	*0.10*	*0.05*	*0.09*

Table 2. Water Value in selected Industries in Latin America. Source: Author with WRI data.

Changes in temperature (°C)		2020	2050	2080
Central America	Dry season	+0.4 to +1.1	+1.0 to +3.0	+1.0 to +5.0
	Wet season	+0.5 to +1.7	+1.0 to +4.0	+1.3 to +6.6
Amazonia	Dry season	+0.7 to +1.8	+1.0 to +4.0	+1.8 to +7.5
	Wet season	+0.5 to +1.5	+1.0 to +4.0	+1.6 to +6.0
Southern South America	Winter (JJA)	+0.6 to +1.1	+1.0 to +2.9	+1.8 to +4.5
	Summer (DJF)	+0.8 to +1.2	+1.0 to +3.0	+1.8 to +4.5
Change in precipitation (%)		**2020**	**2050**	**2080**
Central America	Dry season	-7 to +7	-12 to +5	-20 to +8
	Wet season	-10 to +4	-15 to +3	-30 to +5
Amazonia	Dry season	-10 to +4	-20 to +10	-40 to +10
	Wet season	-3 to +6	-5 to +10	-10 to +10
Southern South America	Winter (JJA)	-5 to +3	-12 to +10	-12 to +12
	Summer (DJF)	-3 to +5	-5 to +10	-10 to +10
DJF= December/January/February, JJA= June/July/August.				

Table 3. Projected temperature (°C) and precipitation (%) changes for broad sub-regions of Central and South America based on Ruosteenoja et al. (2003). Ranges of values encompass estimates from seven GCMs and the four main SRES scenarios. In Climate Change 2007: Working Group II: Impacts, Adaptation and Vulnerability

Industry	Product	Process	Wastewater
Food and Beverages	Between 40 to 60% of water used in the beverages sectors goes into the product.	Most of Food´s industrial water footprint comes from growing and irrigating agricultural crops and livestock crop feeding.	Rinsing, cleaning an cooling beverage containers becomes gray water
Mining		Some water used in drilling in crushing More in wet-screening and grinding Clay processing is water intensive In coal mining water is used for dust control, cooling and inhibiting friction	Mining can release contaminants into water Water can be reused as some uses don't require high quality water
Chemicals	Water used in product when dilution required	Intensive water use in vessels washing and equipment cooling Many chemical processes require water	Cooling water is reused Some effluents can be treated and reused but some is wasted
Iron and steel		Processes are very water intensive, especially cooling Water also used for cleaning and boiler feed	Some water used in steel industry is recycled
Petroleum		Very water intensive, including cooling, boiler feed and process water	When water for cooling is reused wastewater is low
Automotive		Many automotive processes are water intensive such as pre-treatment installations, electrocoat, wet sanding lines, carwash and spray booths.	
Construction	Water needed to make concrete from cement	Production of construction materials e.g. cement and aggregates requires large amounts of water for cooling	Effluents can be affected by solids, altered pH or high temperatures
Computers/hi-tech		Production of integrated circuits is water intensive, mostly in cleaning and chemical mechanical polishing	Fairly high water recovery rate (75 %) but still wastage

Table 4. Water use in selected Industries.

WATER RESOURCES

Country	Water Resources					Internal Renewable Water Resources				Actual Renewable Water Resources			Water Withdrawals					Industrial water pollution (kg/day)
	Actual renewable water resources		Water Poverty Index	Use of an improved water source (% of population 2004)		Ground water recharge (km3)	Surface water (km3)	Overlap (km3)			Per capita (m3 per person)	Depen-dency Ratio	Total (million m3)	Per capita (m3 per person)	Sectoral withdrawls 2000 (percent)			
	Total (km3)	m3 per capita	2002	Urban	Rural				Total (km3)	Total (km3)			2000	2000	Agriculture	Industry	Domestic	1997-2000
Latin America	899.8	30,213	60.94736842	93.95	75.75	193.28	645.2	194.6842105	653.55	899.8	31,628	19.85	13,093	483.65	69.9	8.8	20.9	64.18181818
Argentina	814	20,591	61	98	80	128	276	128	276	814	20,941	66	29,072	784	74	9	16	
Bolivia	623	65,358	63	95	68	130	277	104	304	623	69,378	51	1,387	167	83	3	13	12
Brasil	8,233	43,028	61	96	57	1,874.00	5,418	1,874	5,418	8,233	45,573	34	59,298	345	62	18	20	
Chile	922	55,425	69	100	58	140	884	140	884	922	57,639	4	12,539	824	64	25	11	71
Colombia	2,132	45,408	66	99	71	510	2,112	510	2,112	2,132	47,469	1	10,711	254	46	4	50	101
Costa Rica	112	25,157	67	100	92	37.3	75	0	112	112	26,447	0	2,677	681	53	17	29	34
Cuba	38	3,368	N.A.	95	78	6.5	32	0	38	38	3,365	0	8,204	732	69	12	19	
Ecuador	432	31,739	67	97	89	134	432	134	432	432	32,747	0	16,980	1,367	82	5	12	33
El Salvador	25	3,546	56	94	70	6.2	18	6	18	25	3,815	30	1,273	205	59	16	25	22
Guatemala	111	8,410	59	99	92	33.7	101	25	109	111	8,788	2	2,005	176	80	13	6	19
Haití	14	1,599	35	52	56	2.2	11	N.A.	13	14	1,663	7	985	123	94	1	5	
Honduras	96	12,755	60	95	81	39	87	30	96	96	13,513	0	860	133	81	11	8	
México	457	4,172	58	100	87	139	361	91	409	457	4,357	11	78,219	791	77	5	17	291
Nicaragua	197	34,416	58	90	63	59	186	55	190	197	35,142	4	1,300	256	83	3	14	
Panamá	148	44,266	67	99	79	21	144	18	147	148	46,579	0	824	279	28	5	66	12
Paraguay	336	52,133	56	99	68	41	94	41	94	336	55,833	72	489	89	72	9	20	
Perú	1,913	66,431	64	89	65	303	1,616	303	1,616	1,913	69,395	16	20,132	776	82	10	8	
Uruguay	139	39,612	67	100	100	23	59	23	59	139	40,419	58	3,146	941	96	1	2	21
Venezuela	1,233	44,545	65	85	70	227	700	205	723	1,233	47,122	41	8,368	345	47	7	45	90
OECD Average	320	34,002	67	100	98	87	287	75	329	355	35,102	18	37,736	639	33	46	22	346
China	2,829	2,125	51	93	67	828.8	2,712	728	2,812	2,830	2,206	1	630,289	494	68	26	7	7,060
India	1,897	1,670	53	95	83	418.5	1,222	380	1,261	1,897	1,754	34	645,837	635	86	5	8	1,605
Russia	4,507	31,764	63	100	88	788	4,037	512	4,313	4,507	31,653	4	76,686	527	18	63	19	1,516

Table 5. Latin America Water Resources Summary. (WRI, 2009)

References

Barney, J. B. 1991. Firm resources and sustained competitive advantage. Journal of Management Studies, 17: 99-120.

Bates, B. C., Kundzewicz, Z. W., Wu, S., & Palutikof, J. P. 2008. El Cambio Climático y el Agua, Documento Técnico del Grupo Intergubernamental de Expertos sobre el Cambio Climático: 224 págs. Ginebra: Secretaría del IPCC.

Bergkamp, G. & Sadoff, C. W. 2008. Water in a sustainable economy: 25th Anniversary Edition. Special Section: Paying for nature's services., In 2008 State of the world: Innovations for a sustainable economy.: pp.107-238. Washington, DC, USA: Worldwatch Institute.

Frederick, K. D. & Major, D. C. 1997. Climate Change and Water Resources. Climatic Change, 37: 7-23.

Hart, S. L. 1995. A Natural-Resource-Based View of the Firm The Academy of Management Review, 20(4): 986-1014.

IPCC. 2007. Fourth Assessment Report: Climate Change 2007 Geneva , Switzerland Intergovernmental Panel for Climate Change.

Rosegrant, M., Cai, X., & Cline, S. 2002. World Water and Food to 2025: Dealing with Scarcity. Washington, D.C. and Colombo, Sri Lanka: International Food Policy Research Institute and International Water Management Institute.

Russo, M. & Fouts, A. 1997. A Resource Based Perspective on Corporate Environmental Performance and Profitability. Academy of Management Review, 40: 534-559.

UNESCO. 2009. The United Nations World Water Development Report 3: Water in a Changing World, World Water Assessment Program. Paris.

WRI. 2009. Water Resources and Freshwater Ecosystems: World Resources Institute.