WATER account

WORKING PAPER

MAY 2016

BANCO CENTRAL DE COSTA RICA

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Country Steering Committee

Costa Rica established a National Steering Committee (NSC), in order to mainstream NCA into policy making and support Environmental Accounts development. The technical advice, data and information provision by representatives of Ministries and government agencies under the Committee´s direction, is gratefully acknowledged through its members:

Mr. Edgar Gutiérrez (Chair), Minister, Ministry of the Environment and Energy (MINAE)
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Disclaimer

This document was prepared with figures from the Water Account for 2012 published in May 2016. However, the accounting tables for the Water Accounts available on the website of the Central Bank of Costa Rica correspond to the latest updated version. Given the ongoing revision process and strengthening of the Environmental Accounts, it is possible that the figures in this report do not match the figures published in the updated accounting tables of the website. To have access to the accounting tables published in May 2016, please address your request to the following e-mail address: estadisticasambientales@bccr.fi.cr

This work is part of an ongoing, continuous improvement process of Environmental Accounts compilation. It is therefore not a final or definitive version. The Central Bank of Costa Rica (BCCR) would appreciate suggestions, comments and the submission of complementary and updated data sources, which may help improve future versions of the accounts.

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ABBREVIATIONS AND ACRONYMS

ARESEP	Public Services Regulatory Authority
ASADAS	Community Water and Sewerage Administration Associations
AyA	Water and Sewerage Institute of Costa Rica
BCCR	Central Bank of Costa Rica
CA	“Canon por concepto de aprovechamiento de aguas” Water Abstraction Charges
CAV	“Canon Ambiental por Vertidos” Water Pollution Charges
DA	Directorate of Water of the Ministry of Environment and Energy
DIGECA	Directorate of Environmental Quality Management
DRAT	Arenal-Tempisque Irrigation District
DSE	Sectoral Directorate of Energy
EA	Economic activity
ESPH	Public Services Company of Heredia
GVA	Gross Value Added
GDP	Gross Domestic Product
ICE	Costa Rican Electricity Institute
IMN	National Meteorological Institute
INEC	National Institute of Statistics and Censuses
IRWS	International Recommendations for Water Statistics
MIDEPLAN	Ministry of National Planning and Economic Policy
MINAE	Ministry of Environment and Energy
MINSALUD	Ministry of Health
PN	Product nomenclature
SEEA CF	System of Environmental-Economic Accounting – Central Framework
SEEA EEA	System of Environmental-Economic Accounting – Experimental Ecosystem Accounting
SEEA-Water	System of Economic and Environmental Accounting for Water
SENARA	National Groundwater, Irrigation and Drainage Service
SINIGIRH	National Information System for Integrated Water Resources Management
SNA	System of National Accounts
SUTs	Supply and use tables

MEASUREMENT UNITS

hm^3	Millions of cubic meters (cubic hectometers); 1 hm^3 = 1 gigaliter (GL)
km^3	Billions of cubic meters (cubic kilometers); $1km^3$=$1000hm^3$
GWh	Gigawatt-hour (1 million kWh) =3.6 terajoules (TJ)
ha	hectare (10 000 m^2)

GLOSSARY

Wastewater	Defined by the SEEA-CF as water that is discarded because it is no longer required by the user. Comprises all discarded water, regardless of its quality, including returns from irrigation areas, and returns from hydroelectric power plants (SEEA-CF 3.86).
Abstracted water	Defined by the SEEA-CF as water that is abstracted or collected by economic units directly from the environment in the reference area. Includes water used in hydroelectric power plants and locks.
Final water use	Defined by the SEEA-CF as equal to evaporation, transpiration and water incorporated into products. Among water specialists it is also referred to as "water consumption".
Off-stream water use	For purposes of water management, off-stream use is that which requires removing water from its source and not all water is returning to the same source. It includes water used for agriculture and drinking water supply, water used by the manufacturing industry and for cooling of thermoelectric plants, and other uses.
Instream water use	For purposes of water management, instream use is that in which the water used is returned in its entirety to the source after its use. It includes water for hydroelectric plants, for operation of locks, and for aquaculture.

BANCO CENTRAL DE COSTA RICA

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1. EXECUTIVE SUMMARY

Costa Rica is a country that receives abundant rainfall (annual average precipitation of 2 626 mm, one of the highest in the world). However, most of it (73%) falls between May and October. In contrast, the province of Guanacaste, in the northwestern area of the country, has an annual average precipitation of 1 711 mm with almost no rain between January and April.

The demand for water in Guanacaste is rapidly growing due to increasing tourism. This province also has the largest irrigation infrastructure of the country, and some of the largest hydroelectric projects, which also compete for water, especially before the rainy season starts.

Access to drinking water is practically universal (99% coverage), however only 20% of the population is connected to sewerage networks, and a great proportion of the population use septic tanks, whose performance is unknown. Only a small proportion of wastewater collected by the sewer systems receives treatment before it is discharged into water bodies.

Water and sanitation utilities deliver the services to the users and bill approximately 570 colones for each cubic meter of water supplied ($US 1.00/m^3) on average. The value added of the industry represents 0.5% of Costa Rica's GDP, and Net Operating Saving is 24% of total production. However, the Consumption of Fixed Capital and the Accounts Receivable should be verified in order to accurately assess the performance of the industry. More than 50% of the water abstracted by the industry is lost before reaching the users.

Seventy-one percent of the country's electricity is produced in hydroelectric plants (2012 data), which are mostly run-of-the-river plants, which means that they depend entirely on climate conditions as they take advantage of river flows without regulation. These flows may be decreased by other water uses.

Seventy-five percent of the water abstracted for off-stream uses is used for agricultural irrigation, mainly in the northwestern part of the country. Water delivered by irrigation districts to users is billed at approximately 6 colones per cubic meter ($US 0.01 /m^3 on average), with subsidies from the Government needed for the operation of the irrigation districts. About half of the water abstracted for irrigation is lost before it reaches users.

To control demand, the Water Law specifies that users require a concession to be authorized to abstract or use water. Also permits are needed to discharge wastewater. Water abstraction charges and water pollution charges are used as economic and financial instruments to promote efficient use of water and to reduce emissions to water bodies. In 2012, the water abstraction charges collected by the Government were in the order of 2 500 million colones (about $US 5 million), which represents an important source of resources for watershed management.

The information provided above and the corresponding supporting data are presented in this document as part of the Environmental-Economic Account for Water.

2. INTRODUCTION

Starting in January 2014 the Central Bank of Costa Rica began efforts to prepare a system of national environmental economic accounts whose first stage includes issues related to water, forests and energy. In 2012 the United Nations Statistical Commission adopted the central framework of the System of Environmental Economic Accounting (SEEA; United Nations et al, 2014a), which allows the creation of an information platform for the design and evaluation of public policies combining environmental and economic variables. The SEEA is consistent with the System of National Accounts (SNA), which is used internationally to generate economic indicators, such as Gross Domestic Product (GDP).

The System of Environmental Economic Accounting (SEEA) has also been experimentally developed for Ecosystem Accounting, which allows evaluating the impacts of economic activities on the environment in a more detailed way. This instrument was also adopted by the UN Statistical Commission in 2012, not as a standard, but intended to be applied in different countries to gain experience that would lead to its adoption as a standard in the future (United Nations et al, 2014b).

These instruments may be applied in the particular case of water. The System of Economic-Environmental Accounting for Water (SEEA-Water) was adopted as a preliminary statistical standard by the UN Statistical Commission in 2007. The adoption of the SEEA-CF in 2012 and the development of the SEEA for Experimental Ecosystem Accounts provide a complete, consistent and comparable platform of different aspects of environmental accounting that make it possible to evaluate the impact of various water-related public policies.

The present document discusses the progress Costa Rica has made in preparing its Water Accounts, based on the use of SEEA and SEEA-Water. This work has been carried out jointly among several institutions, and represents a first iteration in a continuous process intended to improve the availability of information relevant for the formulation of policies that are related to or have an impact on water.

The document is organized in nine chapters. Chapter 3 presents information on the socioeconomic context. Chapter 4 addresses the issue of drinking water and sanitation. Chapter 5 begins the discussion of the hydrological cycle with the consideration of water resources, which is complemented in Chapter 6 with a consideration of water demand, and in Chapter 7 with a discussion of water pollution problems. Institutional aspects related to water management are addressed in Chapter 8 on water governance. Chapter 9 presents the water accounts tables and, Chapter 10 presents several conclusions. Lastly Chapter 11 proposes a research agenda for continuing with the process of preparing water accounts.

3. SOCIOECONOMIC CONTEXT

Costa Rica is a republic divided into political-administrative units: 7 provinces, 81 cantons, and 463 districts. Its population is of 4.3 million people (2011), of which 73% live in urban centers and 27% live in rural areas (Table 1). Its land area is of 51 100 km².

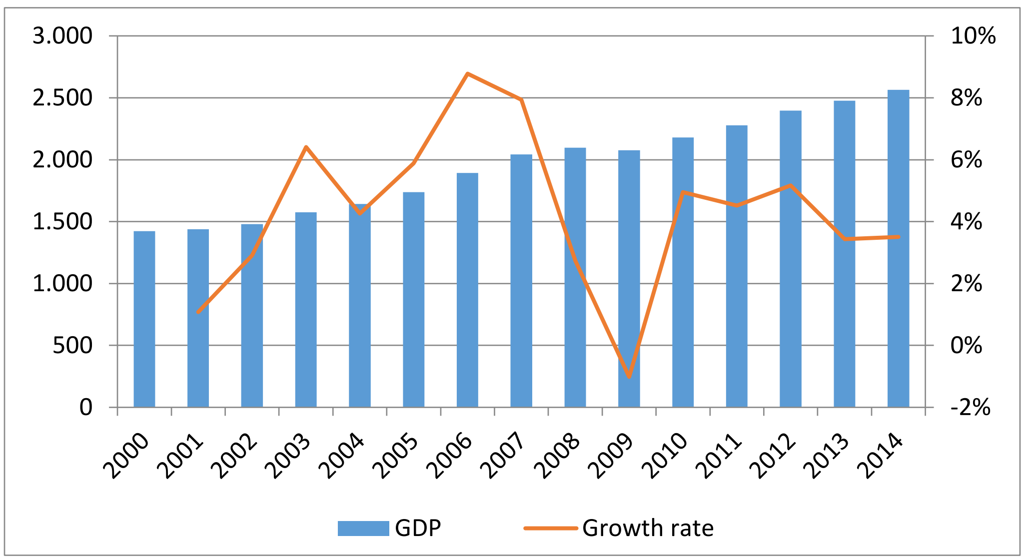
Table 1. Costa Rica: Population and Land Area by Provinces, 2011

Province	Total population	Urban population	Rural population	Area (km²)	Population density
San José	1 404 242	1 213 957	190 285	4 966	282.8
Alajuela	848 146	515 150	332 996	9 757	86.9
Cartago	490 903	404 999	85 904	3 125	157.1
Heredia	433 677	372 883	60 794	2 658	163.2
Guanacaste	326 953	180 332	146 621	10 141	32.2
Puntarenas	410 929	224 794	186 135	11 266	36.5
Limón	386 862	218 756	168 106	9 188	42.1
Total	**4 301 712**	**3 130 871**	**1 170 841**	**51 100**	**84.2**

Source: INEC (2011)

Figure 1 shows the behavior of real Gross Domestic Product (GDP) growth in Costa Rica during the period 2000-2013. Sustained growth is seen throughout the period, except for 2008-2009, when the world financial crisis significantly affected the country's economic growth.

Figure 1. Costa Rica: Gross Domestic Product, 2000-2014
(billion colones of 1991)[a/]



a/Figures for 2013 and 2014 are preliminary
Source: Authors' calculations based on data from the BCCR.

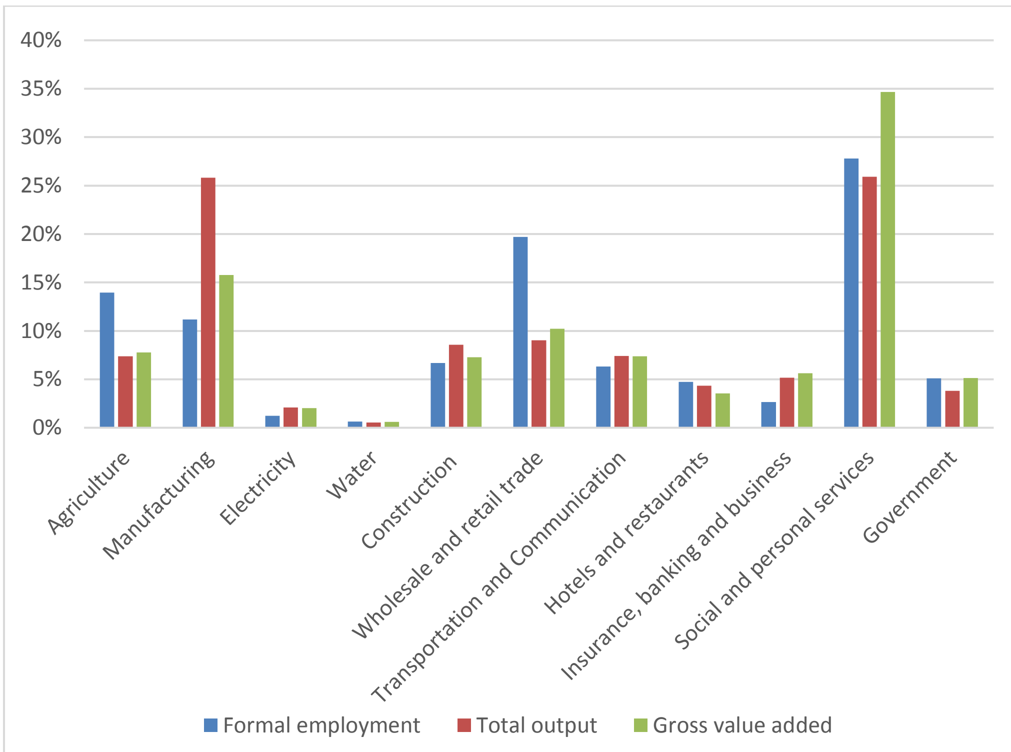
During the last 50 years, the country's productive structure has experienced considerable changes. It has moved from a productive model in which the agricultural sector prevailed during the 1960s to one in which the manufacturing sector became important during the 1990s, and more recently the economy has evolved towards the services sector. Table 2 shows the structural change observed in the Costa Rican productive system in the period from 1966 to 2012. Figure 2 shows the share of each of the economic activities in formal employment, total production and value added.

Table 2. Costa Rica: Percentage contribution to GDP by economic activity

Year	Agriculture	Manufacturing	Wholesale and retail trade	Services	Other
1966	23	17	21	10	29
1991	13	22	19	23	21
2012	6	15	13	37	29

Source: BCCR

Figure 2. Costa Rica: Share in employment, output and gross value added by industry, 2011



Source: Authors' calculations based on data from the BCCR

The growth of the Costa Rican economy has been determined primarily by growth in the services sector, which is the main source of formal employment, followed by wholesale and retail trade activities. The services and manufacturing industries have similar output levels, making them the economic activities that produce the most in absolute terms.

All these changes affect water use. An uncoupling can be expected through time between economic growth and water abstraction, since growth is based on tertiary activities, less intensive in the use of water. Even so, the main water user is still the agricultural sector, which provides employment to around 15% of the country's population.

4. DRINKING WATER AND SANITATION

Water is vital for human survival and essential for socioeconomic development. According to the United Nations, "Water is vital for reducing the global burden of disease and improving the health, welfare and productivity of populations. It is central to the production and preservation of a host of benefits and services for people. Water is also at the heart of adaptation to climate change, serving as the crucial link between the climate system, human society and the environment" [1]. As indicated in Table 3, Costa Rica has almost reached universal coverage of drinking water and sanitation.

Table 3. Costa Rica: Drinking water and sanitation coverage, 2013

	Water supply [a/]	Sanitation service
Total coverage	99.2	96
Urban coverage	99.9	n.a.
Rural coverage	98.1	n.a.

a/ Water supply includes piped water inside dwellings, outside of dwellings and inside the lot, and piping outside the lot. Sanitation includes sewers, and septic tanks.
Source: INEC (2013). National Household Survey.

4.1 Drinking water

Drinking water and sanitation services are provided by the Costa Rican Water and Sewerage Institute (AyA), which is the largest water utility that provides drinking water and sewerage services in the country. In addition to AyA, these services are provided by 31 municipalities, 1 500 Community Water and Sewerage Administration Associations (ASADAS), and other operators, such as the Heredia Public Services Company (ESPH).

ASADAS are entities that operate water systems in communities, consisting of small groups of neighbors that organize themselves to create water utility mainly rural, for the economy. The regulator of these community operators is AyA, as prescribed by its legislation.

According to data from the 10th National Population and Housing Census of 2011, presented in Table 4, the AyA serves around half of the total population. The ASADAS and Municipalities are in second and third places in terms of coverage, respectively. About 5% of the population is served by smaller companies or cooperatives, among them is the ESPH. Lastly, 8% of the population have their own individual water supply system.

In terms of urban and rural population, around 60% of urban population receive water from the AyA. In rural areas, community or rural utilities predominate, serving 54% of the rural population, while the AyA only covers 17% of this population, as shown in Table 4.

[1] UN (2016). Retrieved from: www.un.org/waterforlifedecade/water_and_sustainable_development.shtml on 01/06/2016.

Table 4. Costa Rica: National coverage of drinking water suppliers by type of population (%), 2011

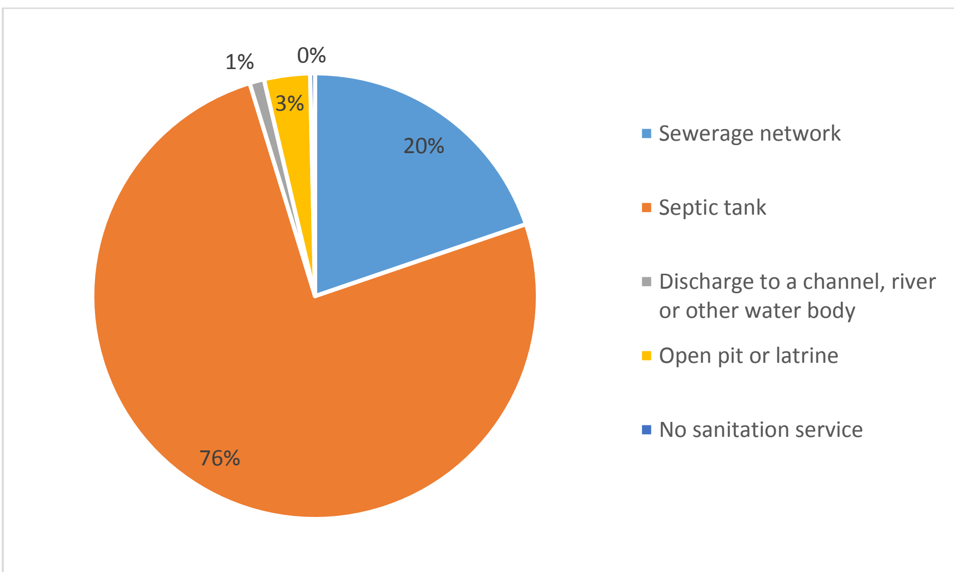
	National	Urban	Rural
AyA water utility	48	60	17
Rural or community water utilities (ASADAS)	24	13	54
Municipal water utilities	15	19	6
Independent water utilities	5	6	1
Own individual systems	8	1	22
Total	100	100	100

Source: INEC (2011). 10th National Population and Housing Census

4.2 Sanitation

Septic tanks and pits are the main type of sanitation in the country, 76% of users have this type of solution. Twenty percent of the population is connected to sewerage networks, while 3% use latrines and 0.39% do not have any improved sanitation system (Figure 3). It has been estimated that every year 13.1 million m^3 (414.6 l/s) of water collected by the country's sewer systems are treated in wastewater treatment plants (Ruiz, 2012).

Figure 3. Costa Rica: Sanitation coverage by type of solution, 2011



Source: INEC (2011). 10th National Population and Housing Census

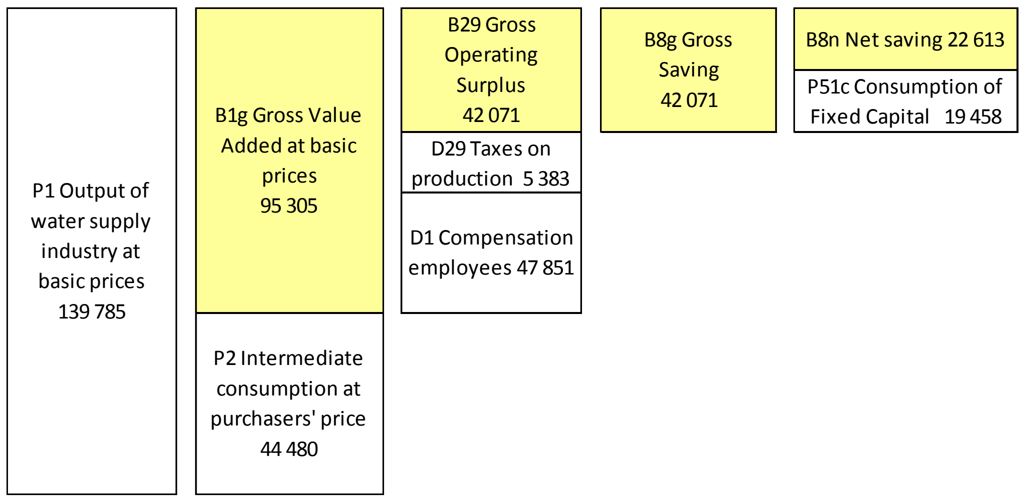
4.3 Indicators

Households use about 80% of the drinking water produced, but they cover only 50% of the total revenues of the water and sanitation industry. According to the 2012

SNA SUT the drinking water and sanitation activity had a total output of 140 billion colones (US$280 million, equivalent to 0.5% GDP), which means 576 colones/m³ (US$1 per m³). Figure 4 shows the complete sequence of accounts.

The Gross operating Surplus is 37% of total output. Consumption of fixed capital is estimated to be 12% of total output in the national accounts (Table 5). This amount may be underestimated and we would expect net saving to be zero or negative for most of the water utilities as it is common in Latin America.

Figure 4. Costa Rica: Monetary sequence of accounts for drinking water supply, 2012 (million colones) (with SNA codes)



Source: Authors' elaboration based on the 2012 SNA SUT, BCCR

Table 5. Selected indicators of water accounts for service providers, 2012

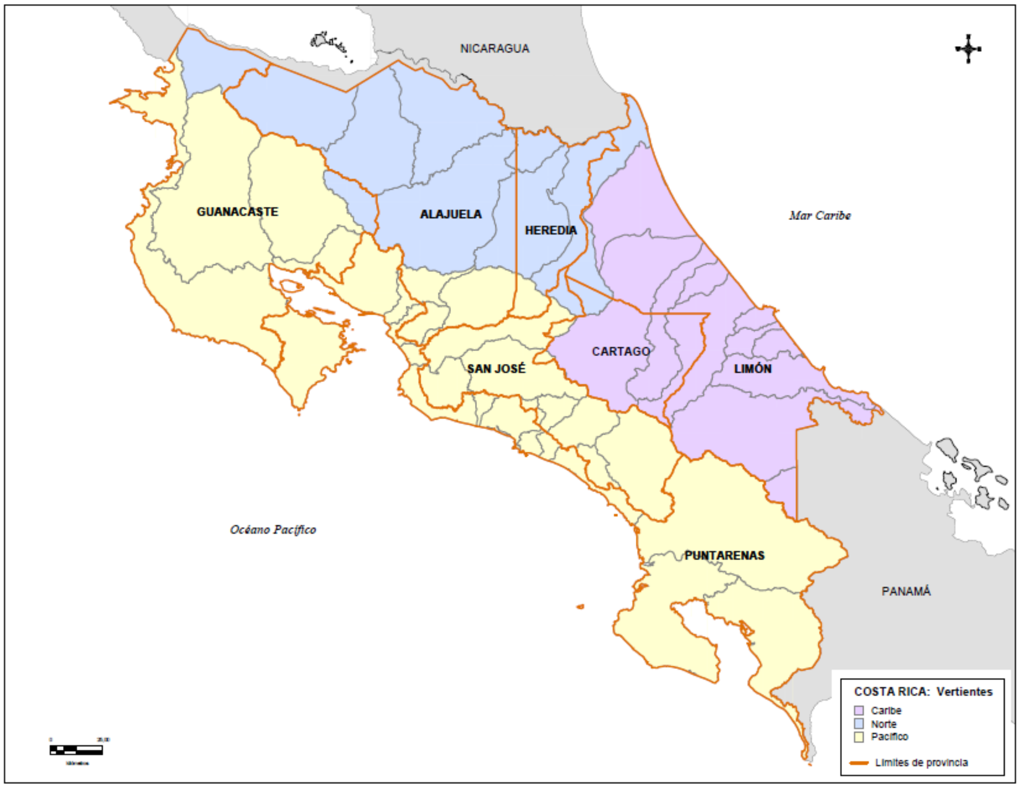
	AyA	Municipalities	Asadas	ESPH	Others	TOTAL
Water billed per person (L/person/day)	195	125*	125*	244		155
Gross Value Added as proportion of total output (%)	70	70	55	70		68
Average water rate (colones/m³)	667	479	398	467		576
Proportion of water billed that is supplied to households (%)	80	85	90*	75		82
Proportion of intermediate consumption that is electricity consumption (%)	28	14	18	21		24
Water not billed (%)	53	55	60	37		54
Proportion of clients supplied (%)	48	16	24	5	7	100

*Estimations.
Source: Authors' elaboration based on monetary data from National Accounts for Water Utilities, BCCR

5. WATER RESOURCES

Costa Rica is crossed by a northwest-southeast mountain range dividing the country into the greater Pacific and the Caribbean continental divides. Some of the rivers of the greater Caribbean divide flow into Nicaragua before they flow into the Caribbean Sea through the San Juan River, and are thus classified as part of the so-called Northern sub-divide. Figure 5 shows the grouping of watersheds in continental divides and their overlap with the seven provinces of the country. Figure 6 shows details of each of the 34 watersheds of the country, with their names and codes.

Figure 5. Costa Rica: Provinces and watersheds grouped by continental divides



Source: INEC (2016)

The Caribbean divide is composed of watersheds that have no defined precipitation period, but rains occur throughout the year (between 100 and 200 mm in the months with less rainfall). Rivers are characterized for being long, wide and shallow. The following 11 watersheds belong to this divide:

- La Estrella (85-02)
- Banano (83-03)
- Bananito (83-04)
- Moín (81-05)
- Matina (79-06)
- Madre de Dios (77-07)
- Pacuare (75-08)
- Reventazón (73-09)

- Tortuguero (71-10)
- Sixaola (87-01)
- Changuinola (89-34)

The last two watersheds, Sixaola and Changuinola, are shared with Panama. The provinces of Cartago and Limón belong to this divide.

Figure 6. Map of basins of Costa Rica

Source: INEC (2016)

The Pacific divide is characterized by shorter, deeper rivers with steep slopes. The basins of this divide have a rainy season from May to October, and a dry season from November to April. This divide consists of 16 of the main watersheds of the country:

- Península de Nicoya (72-18)
- Tempisque (74-19)
- Bebedero (76-20)
- Abangares (78-21)
- Barranca (80-22)
- Jesús María (82-23)
- Grande de Tárcoles (84-24)
- Tusubres (86-25)
- Parrita (88-26)
- Damas (90-27)
- Naranjo (92-28)

- Baru (96-30)
- Grande de Térraba (98-31)

The province of Puntarenas and most of the provinces of Guanacaste and San José are in this slope. It also encompasses a portion of the provinces of Alajuela and Heredia.

The Northern sub-divide is made up of transboundary basins that are part of Lake Nicaragua's basin, or empty into the San Juan River, which forms the border between Costa Rica and Nicaragua for 100 km and drains the waters of Lake Nicaragua to the Caribbean. It contains the following 7 watersheds:

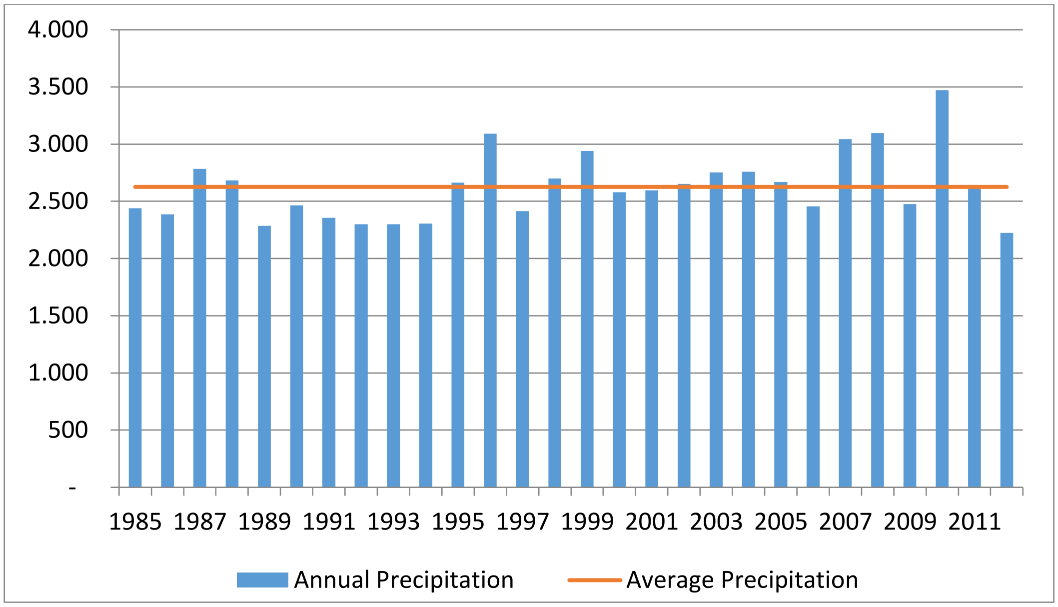
- Chirripó (69-11)
- Sarapiquí (69-12)
- Cureña (69-13)
- San Carlos (69-14)
- Poco Sol (69-15)
- Río Frío (69-16)
- Zapote (69-17)

The first four basins empty into the San Juan River, and the last three flow into Lake Nicaragua. This sub-division contains most of the provinces of Alajuela and Heredia, and a portion of the Guanacaste province. Some water from the Northern sub-divide (an average of 1 500 hm^3/year) is stored in the Arenal reservoir and transferred to the Pacific divide to produce electricity and irrigate the Tempisque area in the Guanacaste province.

Costa Rica's long term average annual rainfall is 2 626 mm. In most of the country the average annual rainfall exceeds 3 000 mm/year, with the exception of the North Pacific and Central climatic regions. The North Pacific climatic region, which encompasses most of the province of Guanacaste, has an average annual rainfall of 1 711 mm. The Central climatic region has an average annual precipitation of 1 688 mm, and it encompasses the high part of the Great basin of the Tárcoles River in the southeast of the province of Alajuela and the northwest of the province of San José.

There are significant differences in the precipitation every year. For example, in 2012 the annual precipitation was 15% below the long term average. Figure 7 shows the annual precipitation from 1985 to 2012.

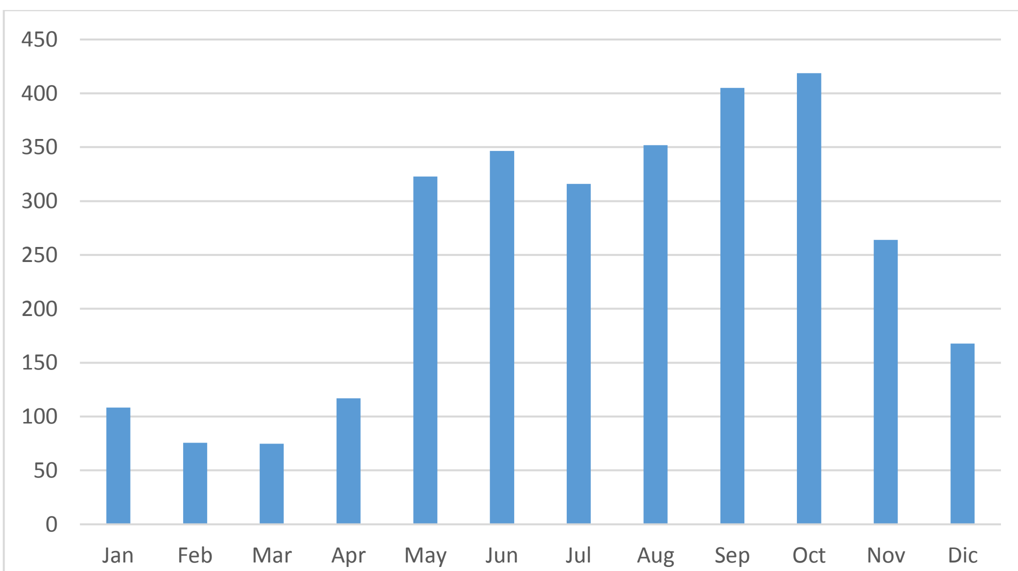
Figure 7. Costa Rica: annual precipitation 1985-2012 (mm/year)



Source: IMN (2014).

There are also important seasonal differences. At the national level, the half of the year with less rainfall (between November and April) receives only 27% of total annual rainfall. The months from January through April are especially dry, and even more so in the northwestern part of the country, in the province of Guanacaste. Figure 8 shows the behavior of the country's rainfall throughout the year.

Figure 8. Costa Rica: average monthly precipitation (mm/month)

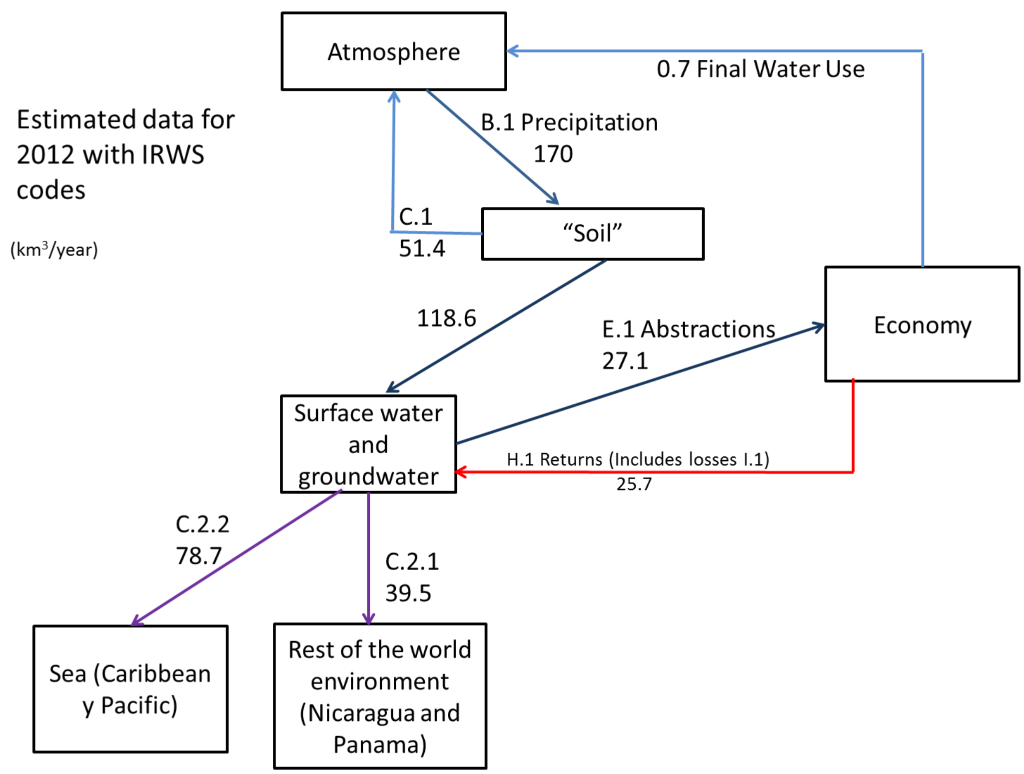


Source: Authors' calculations based on data from IADB, MINAE, IMTA (2008).

It is estimated that 30% of the annual rainfall becomes evapotranspiration. Of the remaining 70%, an estimated 23% seeps into aquifers and 77% becomes surface runoff.[2]

It is estimated that the average outflow to Nicaragua is 33 km^3/year, and 6.5 km^3/year to Panamá. All of the transboundary river basins of Costa Rica drain out of the country, so there are no water inflows from other countries.Figure 9 presents a simplified diagram of the water cycle in Costa Rica, with the flows of inland water resources, showing the interaction of the economy with the water cycle.

Figure 9. Simplified diagram of the water cycle in Costa Rica with IRWS codes (km^3/year), 2012



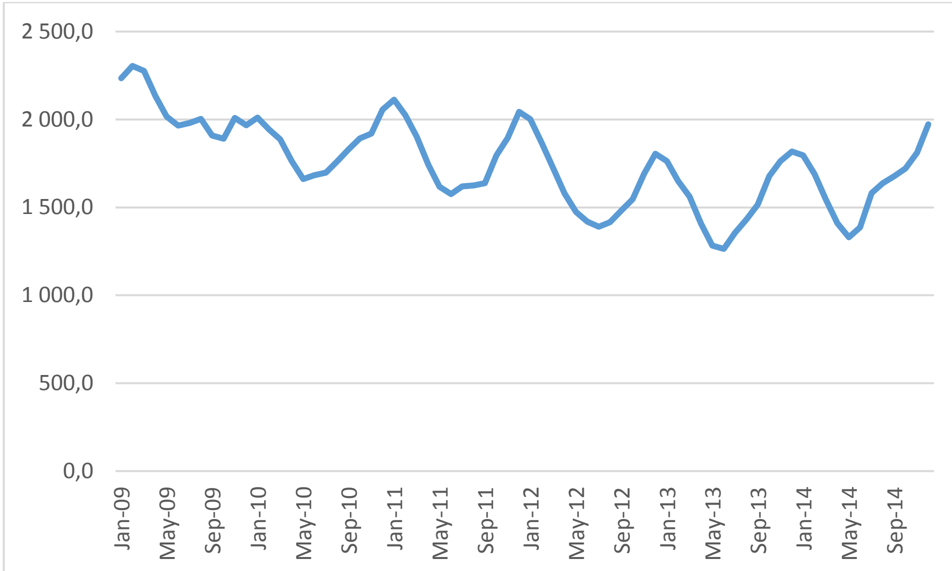
Source: Authors' calculations as part of the Water Accounts compilation.

It is estimated that the country's lakes and artificial reservoirs have a water storage capacity of approximately 2 547 hm^3, of which 91% is concentrated in the Arenal reservoir, which is in fact the only reservoir with multiannual storage capacity. Figure 10 shows the volumes stored in this reservoir during the last five years[3]

2 Thirty percent of the evaporation and 70% of the runoff is based on the UNESCO (2007). The figure of 23% infiltration and 77% runoff is based on IADB, MINAE, IMTA (2008).

3 In addition to surface water storage capacity, there is an additional storage capacity for groundwater in aquifers that is not included in the estimations.

Figure 10. Water volumes stored in the Arenal reservoir (hm³)



Source: Authors' calculations based on data from ICE (2014a) and Goitia Antezana (1995)

The results of the previous discussion are summarized in Table 6, which shows physical inland water resources assets in the SEEA-Water format.

Table 6. Physical asset account for water resources with IRWS codes, 2012 (millions of m³/year)

	Type of water resource			
	Surface water	Groundwater	Soil water	Total
Opening stock of water resources	2 001			2 001
Additions to stock (+)				
Returns (H.1)	26 465	881		27 346
Precipitation (B.1)			170 036	170 036
Inflows from other territories (B.2)				
Inflows from other inland water resources	94 893	23 723		118 617
Total additions to stock	121 358	24 604	170 036	315 998
Reductions in stock (-)				
Abstraction (E.1)	27 581	380		27 961
for hydro power generation	25 584			25 584
for irrigation of crops	1 746	42		1 788
for other uses	250	338		589
Evaporation & actual evapotranspiration (C.1)			51 419	51 419
Outflows to other territories (C.2.1)	39 500			39 500
Outflows to the sea (C.2.2)	54 515	24 224		78 739
Outflows to other inland water resources			118 617	118 617

Total reductions in stock	121 596	24 604	170 036	316 235
Closing stock of water resources	1 764			1 764
Change in assets	- 237	0	0	- 237

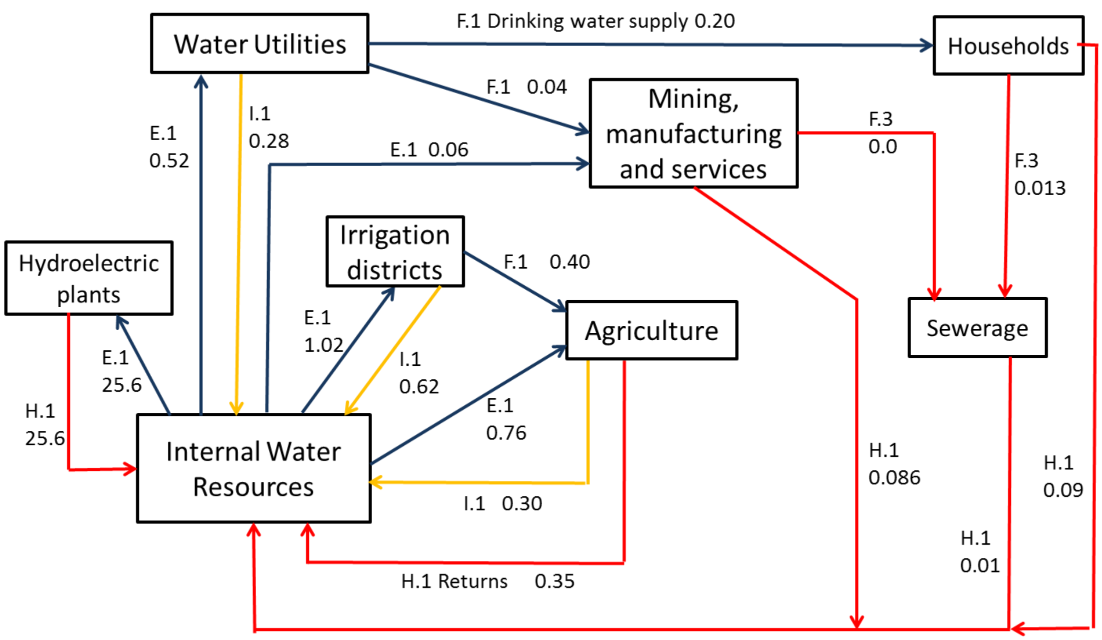
Source: Authors' calculations as part of the Water Accounts compilation.

6. WATER DEMAND

The water accounts show that 75% of the water abstracted in the country for off-stream uses is for agriculture, 22% is for drinking water supply, and the remaining 3% is water abstracted directly by manufacturing industries, services, construction, or mining companies, among others. In addition, in 2012 around 26 billion cubic meters of water were turbinated in hydroelectric plants, contributing to 71% of gross energy production of that year.

The SEEA-Water physical supply and use tables also show losses incurred by water utilities and irrigation districts when providing water to final users. It also shows wastewater (as defined by the SEEA-Water) which is generated after every use. This information is presented in Figure 11.

Figure 11. Simplified diagram with details of water flows in the economy 2012, with IRWS codes (km³/year)



Source: Physical Supply and Use Table, 2012.

The information in Figure 11 is presented in Tables 7 and 8. Table 6 presents the SEEA-Water supply table and Table 7 is the physical use table.

Table 7. Physical supply table for water, 2012 (millions of m^3/year)

ISIC Code	01-03	3600-2	05-33,33, 38,39,41-96	3600-1	3700	3510			
	Agriculture	Water supply for agriculture	Mining, manufacturing and services	Drinking water supply	Sewerage	Hydroelectric plants	Households	Flows from environment	Total supply
Drinking water				243					243
Irrigation water		409							409
Surface water								27 581	27 581
Groundwater								380	380
Losses	300	615		282					1 197
"Wastewater generated"	349		86		13	25 584	130		26 162
Final water use	524		21				70		615
Total	**1 173**	**1 024**	**107**	**525**	**13**	**25 584**	**200**	**27 961**	**56 586**

Source: Authors' calculations based on reports provided by AyA, Senara, DA, ESPH, BCCR

Table 8. Physical use table for water 2012, (millions of m^3/year)

ISIC Code	01-03	3600-2	05-33,33, 38,39,41-96	3600-1	3700	3510			
	Agriculture	Water supply for agriculture	Mining, manufacturing and services	Drinking water supply	Sewerage	Hydroelectric plants	Households	Flows from environment	Total use
Drinking water			43				200		243
Irrigation water	409								409
Surface water	723	1 024	35	215		25 584			27 581
Groundwater	42		29	310					380
Losses								1 197	1 197
"Wastewater generated"					13			26 149	26 162
Final water use								615	615
Total	**1 173**	**1 024**	**107**	**525**	**13**	**25 584**	**200**	**27 961**	**56 586**

Source: Authors' calculations based on reports provided by AyA, Senara, DA, ESPH, BCCR

6.1 Use of water for agriculture

The main crops cultivated in Costa Rica are coffee, oil palm, sugar cane and rice (Table 9). The main type of irrigation system used in the country is sprinkling; 45% of the farms use this system (INEC, 2014).

Table 9. Costa Rica: Main crops at national level

Crop	Number of farms	Cultivated area (ha)	Irrigated area (ha)[a/]	Proportion of cultivated area irrigated (%)
Coffee	26 527	84 133	5 585	7
Oil palm	2 169	66 420	3 124	5
Sugar cane	4 880	65 062	8 573	13
Rice	4 467	58 540	6 015	10
Banana	15 924	51 758	2 721	5
Pineapple	1 228	37 660	9 139	24
Oranges	12 913	19 596	1 345	7
Beans	14 707	19 470	1 962	10
Corn	17 756	15 769	1 584	10
Cassava	9 506	15 045	1 909	13
Plantain	17 487	10 015	662	7
Others	99 725	58 805	19 182	33
Total	**227 289**	**502 272**	**61 799**	**12**

a/ Authors' calculations based on number of farms
Source: INEC (2014). 6th National Agricultural Census.

National: According to data from the latest National Agricultural Census (INEC, 2014), it is estimated that there are 502 272 hectares of cultivated land in Costa Rica, of which 61 799 have irrigation systems, representing 12% of the total cultivated area. Table 9 shows that the crops that rely mostly on irrigation water (more hectares using irrigation systems) are pineapple, sugar cane and cassava.

Regional: The largest irrigation project in the country is the Arenal-Tempisque Irrigation District (DRAT) in the northern part of the country. This project is highly important in economic terms for the region. The irrigation district provides water to irrigate 27 381 hectares of agricultural crops. The main crops planted in this region are rice and sugar cane, while pisciculture has recently become more important. Table 10 shows the distribution of hectares planted by type of crop.

The information processed to prepare the water account, mainly obtained from concession records, shows that in 2012 farmers abstracted 765 million cubic meters of water, 723 from surface sources, and 42 from groundwater sources (wells). In addition, the irrigation districts abstracted 1 024 million cubic meters of water to distribute 615 million among farmers, while the rest was lost in open irrigation channels.

Table 10. Main crops in the DRAT

Crop	Area (ha)	Percentage (%)
Sugar cane	14 550.95	53.14
Rice	9 703.73	35.44
Pasture	2 265.80	8.27
Pisciculture	695.31	2.54
Watermelon	43.81	0.16
Citrus	44.01	0.16
Pineapple	27.68	0.10
Corn	25.51	0.09
Onion	8.00	0.03
Papaya	9,20	0.03
Sorghum	6.12	0.02
Cotton	1.50	0.01
TOTAL	**27.382**	**100**

Source: DRAT (2014)

6.2 Abstractions for drinking water supply

It is estimated that in 2012, water utilities abstracted 525 million cubic meters, 215 from surface sources, and 310 from groundwater sources. Of the 525 million cubic meters abstracted only 243 were billed. This means that non-revenue water[4] represents 54% of the water abstracted. For the SEEA-Water tables it was considered that the total of non-revenue water corresponds to losses. In the use of water for producing drinking water, the AyA, the largest water utility in the country, is estimated to abstract an average of 306 million cubic meters of water per year to supply water to approximately half of the Costa Rican population (Table 11).

Table 11. Water abstraction by AyA (millions of m^3)

Year	AyA
2005	302.4
2006	305.3
2007	304.5
2008	308.6
2009	301.4
2010	302.4
2011	305.1
2012	310.8
2013	308.8

Source: data from AyA.

The ESPH supplies water to 5 cantons in the province of Heredia. The company abstracts 50% of its water from surface sources and 50% from groundwater sources. In addition, the ASADAS and municipalities are distributors of drinking water, supplying water to the rest of the population through community managed

[4] Non-revenue water is produced water that is not billed due to losses in conveyance and distribution, meter errors, billing problems, etc.

water utilities. However, there is not yet a database that compiles the physical information necessary to form a clearer idea of their abstraction structure.

6.3 Water use by the manufacturing and services industries

During the last few decades, Costa Rica has changed its economic structure from an economy based on manufacturing and sectors such as agriculture, towards an emphasis on the services sector. In the manufacturing sector, the largest water users are the electronic industry (microprocessors), and companies that make food products and beverages, while in the services sector, real estate (condominiums) and hotel activities, as well as financial services and construction, stand out strongly.

Condominiums and hotels have experienced a great boom in the country. In particular, a strong growth in the construction of tourism projects has been observed in the province of Guanacaste during the last decade, increasing pressure on water resources in the zone of the country with the lowest amount of available water. This has led some firms to seek new alternatives, such as sea water desalination. A new project in the Conchal reserve is now underway, which is expected to open in 2019 and will obtain water through its own desalinization plant. This would be the first of its kind in Costa Rica.

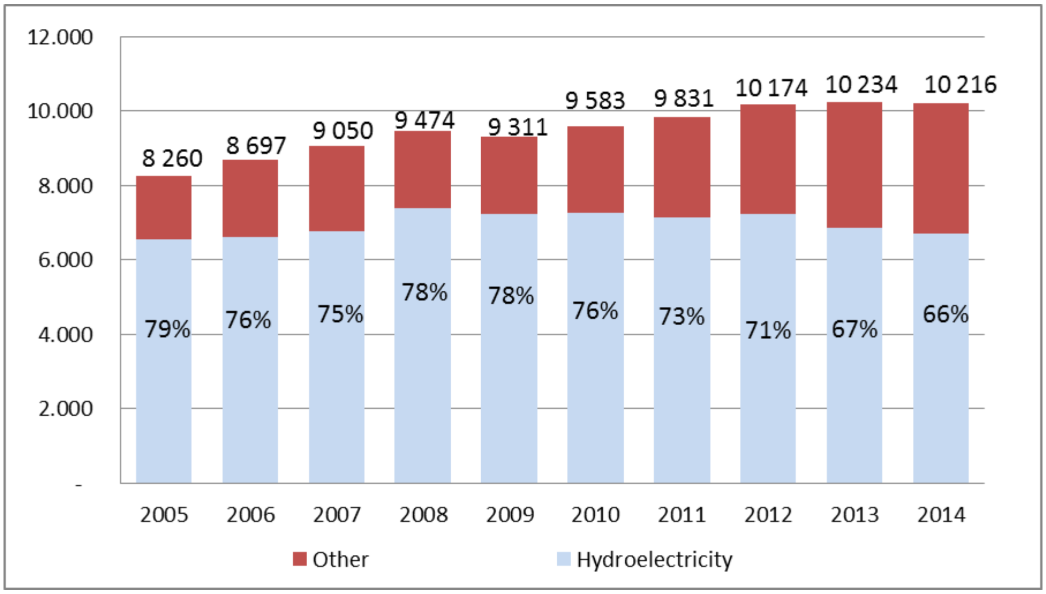
The bottled water business has also experienced a sustained growth over the past years. There were only 3 water bottling companies in the records of the Ministry of Health for 1999 (Anchía, 1999) but the list grew to 40 firms by 2005. Firms that may be operating but are not registered at the Ministry of Health are not taken into consideration (Mora and Catarinella, 2005).

Costa Rica still has a low level of consumption of bottled water compared to the rest of Latin American countries. According to Mora, Coto and Méndez (2010), in Costa Rica 20 liters of bottled water are consumed per person per year, while in México the amount is 226 liters and in Argentina 111 liters. For the purposes of physical accounts, bottled water represents a negligible volume, since 20 liters per person per year is less than one tenth of a million of cubic meters of water annually.

6.4 Use of water for generating electricity

Seventy-one percent of the electricity produced in the country in 2012 came from hydroelectric generation (Figure 12). This shows the great importance of water in the production of electricity in the country, which is vital as a source of clean energy. It is therefore necessary to obtain or ensure the necessary flows in rivers and the levels in reservoirs to maintain or increase the level of production, given that the alternative is to use energy sources that produce more pollution (greenhouse gas emissions).

Figure 12. Gross production of electricity (GWh/year) and proportion from hydroelectric plants, 2005-2014



Source: Energy Balances of the Sectoral Division of Energy 2005-2014. Preliminary data for 2012, 2013, 2014

It is important to mention that approximately 87% of the generation in hydroelectric plants comes from run-of-the-river plants, that is, plants that turbinate water directly from the river flow without any type of storage. This makes them totally dependent on the river flow, which depends on the weather.

Table 12. Costa Rica: Water concessions for hydroelectric generation

(millions of cubic meters)

Year	Volume granted
2000	14 524
2001	14 616
2002	16 517
2004	16 517
2005	16 917
2006	16 917
2007	18 537
2008	18 537
2009	18 537
2010	21 543
2011	24 859
2012	25 584
2013	27 038

Source: Authors' calculations based on data from the Registry of concessions.

Table 12 shows the amount of water granted in concessions by the MINAE through the Directorate of Water (DA) for hydroelectric plants, between 2000 and 2013. The concessions granted by the MINAE represent a license to use water resources; any economic activity or household which wishes to use a water source should apply for the appropriate license and pay the established water abstraction charges (which vary according to the use to be made of the water and the amount of water abstracted). The activity for which the largest volume of concessions has been granted is generation of hydroelectric energy. This activity is considered an instream water use.

7. POLLUTION MANAGEMENT

As indicated previously, only 20% of the country's population is connected to sewer networks, while the rest of the people uses septic tanks and other forms for disposing of wastewater, which are not necessarily appropriate.

It is estimated that 415 L/s, equal to 13 million cubic meters per year of wastewater enters the sewer system and is treated. This accounts for approximately 15% of the wastewater collected.

In September 2015, the "Los Tajos" Wastewater Treatment Plant was inaugurated, which is the largest treatment system in the country and in Central America. It has the capacity to treat wastewater from 245 thousand users, which will increase the percentage of water treatment at the national level. The treatment capacity of this plant is 1.15 cubic meters per second[5], which is equal to 36.3 million cubic meters annually.

In addition, the manufacturing and other industries generate wastewater. Their discharges are controlled by the Ministry of Health.

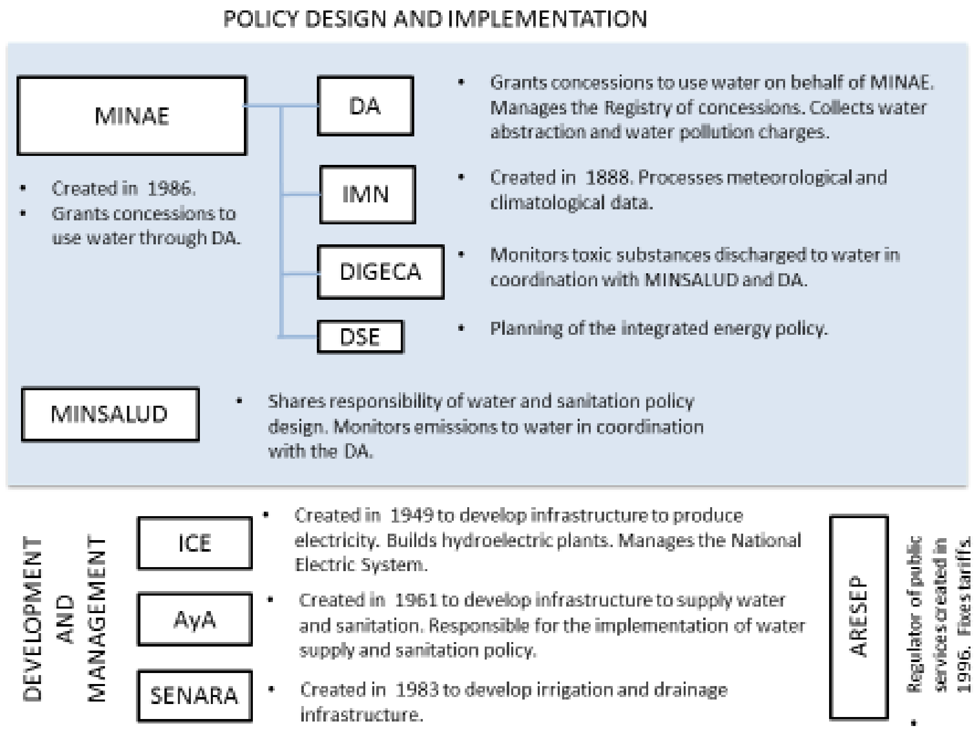
The Ministry of Health, in coordination with MINAE, is the entity responsible for issues related to pollution of water resources. Article 5 of the Rules and Regulations for Discharge and Reuse of Wastewaters Nº 33601 sets forth the following: "Every entity generating wastewater is required to prepare operating reports that it should periodically submit to the Ministry of Health's Division for the Protection of the Human Environment, when the effluent is discharged into a receiving body or sanitary or reuse sewer system."

8. WATER GOVERNANCE

The legal framework for the National Water Management System of Costa Rica is based on the Water Law of 1942 (Law Number 276), which establishes that all water bodies are the property of the nation. The Ministry of Environment and Energy (MINAE) was created in 1986, initially as the Ministry of Environment, Energy and Transport, to implement environmental policy, including water policy. Figure 13 shows main actors in the National Water Management System.

5 Retrieved on January 4, 2016 from the Official Website of the Government of Costa Rica: http://presidencia.go.cr/prensa/comunicados/costa-rica-cuenta-con-la-planta-de-tratamiento-mas-grande-de-centroamerica/.

Figure 13. Costa Rica: Main actors of the National Water Management System



Source: prepared by the authors based on legislation.

The Directorate of Water (DA) is MINAE's entity in charge of the implementation of the water policy. It is in charge of granting concessions to abstract water. It also manages the National Registry of Concessions and Riverbeds. It is in charge of collecting the water abstraction charges (CA) and the water pollution charges (CAV), which are used as economic and financial instrument for the implementation of water policies. Figure 14 shows the revenues for the concept of payment of water abstraction charges.

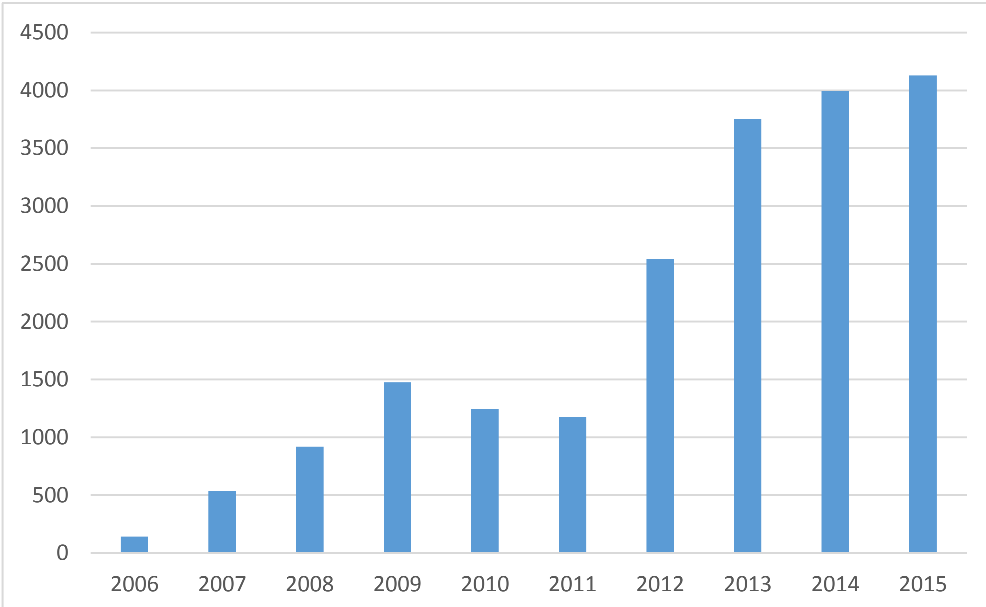
The Costa Rican Electricity Institute (ICE) was created in 1949 to boost electricity production in the country. The institute developed water resources in order to generate electricity in conventional hydroelectric plants and run-of-the-river plants. Other actors have been added. The ICE now manages the National Electric System, for which hydroelectric plants provide 66% of the energy.

The Costa Rican Water and Sewerage Institute (AyA) was created in 1961 to develop the water supply and sanitation infrastructure of the country. It is now the rector of water supply and sanitation in the country.

The National Groundwater, Irrigation and Drainage Service (SENARA) was created in 1983 to develop infrastructure to irrigate crops, mainly in the northwestern area of the country, and to reduce flooding of crops.

In 1996 the Public Services Regulatory Authority (ARESEP) was created. It is the entity responsible of ensuring that the services of water distribution, and sanitation are provided under optimum conditions regarding access, cost and quality. ARESEP is also in charge of water rates.

Figure 14. Costa Rica: Revenues for the concept of payment of water abstraction charges 2006-2015 (million colones)



Source: Republic's General Comptroller

9. CONCLUSIONS AND RECOMMENDATIONS

The water accounts show that Costa Rica is a country with abundant water, although some water stress problems have been identified in the northwestern region and during the driest parts of the year.

Irrigation of crops continues to be the main destination of off-stream water abstractions. A more detailed analysis must be carried out in order to identify the value and opportunity cost of irrigation water. Alternative uses, such as drinking water supply and generation of electricity, have to be taken into consideration when carrying out this analysis. The cost of water losses should be evaluated relative to the cost of making investments to reduce losses and making better use of water.

The amount of non-revenue water is a considerable part of the abstractions of drinking water. It is important to find out what proportion of these losses are physical, and how much is apparent (measurement errors, billing errors, etc.). In both cases, the value of recovering the losses versus the cost of investing to reduce them must be determined. The sequence of accounts of water utilities shows very favorable results; however, consumption of fixed capital, which is highly relevant in this sector, seems to be underestimated.

Time series show a considerable increase in the production of energy in hydroelectric plants, as well as in the amount of turbinated water. Appropriate measures should be taken to guarantee the flows that will make it possible to continue making use of this resource, and to minimize the use of fossil fuels for the generation of electricity.

10. FUTURE RESEARCH AGENDA

Although this water account exercise contains preliminary information, it is a good diagnosis about the water sector. However, it is still necessary to make improvements to construct a more exact account, based on better statistics.

Below are the main lines of work for further revisions of the water accounts:

1. A detailed revision of hydrological information is recommended. It is very important to process precipitation data and interpolate them to obtain average precipitation by continental divide, by watershed, by province, etc. This work may be performed with the aid of a Geographic Information System. It is important to construct time series, mainly of precipitation, to observe variations in different years (for instance, during the El Niño years), as well as to calculate the normal precipitation (e.g. 1981-2010).
2. As part of the previous point, processing information on a monthly basis is recommended, to obtain averages of national monthly precipitation, and monthly precipitation by watershed, by continental divide, by province, etc.
3. It is necessary to review the inventory of reservoirs, and to the extent possible construct water storage historical series. Estimations of the stock of underground waters should also be obtained to complete the asset accounts.
4. A more detailed disaggregation of the supply and use tables must be made to be able, for instance, to compare rain fed agriculture with irrigated agriculture. It is also important to separate figures for water used by the manufacturing industries and the services industries in more detail.
5. It would also be useful to review in more detail The 2014 Agricultural Census information, especially the data related to volumes of water abstracted and the hectares where those volumes are used. It is also important to have the monetary information that would allow evaluating the productivity increase achieved with crop irrigation.
6. Geographical disaggregation should also be carried out; for instance, constructing accounts for the northwestern region or the province of Guanacaste.
7. It would be useful to revise in detail information related to concessions based on the National Registry on Uses of Water and Riverbeds. Information about concessions should be compared to information about water abstraction charges paid. Time series should be prepared on the water volumes granted through concessions for different uses. Data on concessions for hydroelectric generation must be compared with the information on volumes of water turbinated in hydroelectric plants, and the energy generated.

8. Data should be obtained about the water abstraction charges (CA) and for the water pollution charges (CAV), both in monetary terms and in terms of the volumes used as the basis for the charge.

9. It is also necessary to present monetary information in a more disaggregated manner in terms of industries. Estimates should be made in order to be able to derive relevant figures for the water accounts, such as electric energy, drinking water and sanitation, rain fed and irrigated agriculture, etc.

10. The sequence of monetary accounts for water utilities should be improved. Above all, it is important to refine information on consumption of fixed capital to obtain a more realistic balance.

11. Emission accounts should be prepared. The present work does not include the SEEA-Water emission tables, which should be prepared in a further stage. In this area, it would be useful to prepare an inventory of wastewater treatment plants, and carry out a more in-depth analysis of the information the Ministry of Health keeps on discharges.

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12. ACCOUNTING TABLES

Table 13. Simplified SEEA-CF physical supply table for water, 2012 (millions of m³/year)

ISIC Code	01-03	3600-2	05-33,33, 38,39,41-96	3600-1	3700	3510			
	Agriculture	Water supply for agriculture	Mining, manufacturing and services	Drinking water supply	Sewerage	Hydroelectric plants	Households	Flows from environment	Total supply
Drinking water				243					243
Irrigation water		409							409
Surface water								27 581	27 581
Groundwater								380	380
Losses	300	615		282					1 197
"Wastewater generated"	349		86		13	25 584	130		26 162
Final water use	524		21				70		615
Total	**1 173**	**1 024**	**107**	**525**	**13**	**25 584**	**200**	**27 961**	**56 586**

Source: prepared by the authors as part of the water accounts.

Table 14. Simplified SEEA-CF physical use table for water, 2012 (millions of m³/year)

ISIC Code	01-03	3600-2	05-33,33, 38,39,41-96	3600-1	3700	3510			
	Agriculture	Water supply for agriculture	Mining, manufacturing and services	Drinking water supply	Sewerage	Hydroelectric plants	Households	Flows from environment	Total use
Drinking water			43				200		243
Irrigation water	409								409
Surface water	723	1 024	35	215		25 584			27 581
Groundwater	42		29	310					380
Losses								1 197	1 197
"Wastewater generated"					13			26 149	26 162
Final water use								615	615
Total	**1 173**	**1 024**	**107**	**525**	**13**	**25 584**	**200**	**27 961**	**56 586**

Source: prepared by the authors as part of the water accounts.

Table 15. Physical asset account for inland water resources 2012 (millions of m³/year)

	Type of water resource			
	Surface water	Groundwater	Soil water	Total
Opening stock of water resources	2 001			2 001
Additions to stock (+)				
Returns (H.1)	26 465	881		27 346
Precipitation (B.1)			170 036	170 036
Inflows from other territories (B.2)				
Inflows from other inland water resources	94 893	23 723		118 617
Total additions to stock	121 358	24 604	170 036	315 998
Reductions in stock (-)				
Abstraction (E.1)	27 581	380		27 961
for hydro power generation	25 584			25 584
for irrigation of crops	1 746	42		1 788
for other uses	250	338		589
Evaporation & actual evapotranspiration (C.1)			51 419	51 419
Outflows to other territories (C.2.1)	39 500			39 500
Outflows to the sea (C.2.2)	54 515	24 224		78 739
Outflows to other inland water resources			118 617	118 617
Total reductions in stock	121 596	24 604	170 036	316 235
Closing stock of water resources	1 764			1 764
Change in assets	- 237	0	0	- 237

Source: prepared by the authors as part of the water accounts.

Table 16. Combination of monetary and physical information 2012 (preliminary)

		B	C	D	E	F		H	I
		01-03	3600-2	05-33,33, 38,39,41-96	3600-1	3700	3510	3510	
		Agriculture	Water supply for agriculture	Mining, manufacturing and services	Drinking water supply	Sewerage	Other electric plants, gas, vapor, AC	Hydroelectric plants	Households
1	Production at basic prices 2012 (million colones/year)	2 603 614	2 587	35 739 839	139 785	29 832	366 390	366 390	
2	Intermediate consumption at purchaser's price 2012 (million colones/year)	1 339 377	259	16 178 940	44 480	6 554	147 519	147 519	15 300 611
	Of which:								
	Drinking water			57 270					82 515
	Irrigation water	2 587							
3	Gross value added at basic prices (million colones/year)	1 264 237	2 328	19 560 899	95 305	23 278		218 872	
4	Employment	260 945	91	1 820 626	4 942	1 055	6 366	6 366	
5	Water use (million m^3/year)	873	1 024	107	525	NA		25 584	200
6	GVA/Water use (colones/m^3)	1 448	2	182 983	182	NA		9	

Source: Authors' calculations.

BANCO CENTRAL DE COSTA RICA

Table 17. Time Series for water

DATA ITEM	UNITS	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Contextual Information																
Mid-year population of the country (1st July)	inhabitants	3 810 187	3 906 742	3 959 153	4 088 773	4 178 755	4 266 185	4 353 843	4 443 100	4 533 162	4 620 482	4 562 087	4 614 498	4 667 076	4 717 681	4 717 681
Continental surface area	km^2	51 100	51 100	51 100	51 100	51 100	51 100	51 100	51 100	51 100	51 100	51 100	51 100	51 100	51 100	51 100
26. Land area irrigated	ha	13 855	17 105	35 535	35 733	46 391	47 726	49 332	51 252	56 437	57 726	57 927	58 040	61 687	62 903	65 537
Irrigated area converted to square kilometers	km2	139	171	355	357	464	477	493	513	564	577	579	580	617	629	655
Electric energy generated	GWh/year						8 260	8 697	9 050	9 474	9 311	9 583	9 831	10 174	10 234	10 216
Hydroelectricity generated	GWh/year						6 566	6 601	6 769	7 386	7 224	7 262	7 135	7 233	6 851	6 717
Hydrologic Information (with IRWS code)																
B.1. Precipitation. In volume	hm3/year	152 945	156 893	162 937	163 507	168 172	161 002	146 863	170 875	183 359	151 183	205 962	154 952	170 036	126 401	151 833
C.1. Evapotranspiration from inland water resources	hm3/year		47 445	49 272	49 445	50 855	48 687	44 411	51 673	55 448	45 718	62 283	46 857	51 419	38 224	45 914
B.1.a. Surface runoff	hm3/year		87 559	90 932	91 250	93 853	89 852	81 961	95 362	102 329	84 372	114 943	86 475	94 893	70 541	84 735
D.6.Aquifer recharge	hm3/year		21 890	22 733	22 812	23 463	22 463	20 490	23 840	25 582	21 093	28 736	21 619	23 723	17 635	21 184
B.1 Inflow from neighbouring territories	hm3/year	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C.2.1 Outflow to neighbouring territories	hm3/year												25 000	25 000	25 000	25 000
C.2.2. Outflow to the sea	hm3/year															
1.1 Number of large artificial reservoirs	unidades											12	12	12	12	12
2. Artificial reservoir capacity	hm^3											2 650	2 650	2 650	2 650	2 650
Water in the economy (with IRWS code)																
E.1. Water abstracted by ISIC 36 (no agriculture) (drinking water)	hm3/year													525		
E.1. Water abstracted by ISIC 5-33, 38,39, 41-99 (3510 to be separated)(self supplied industries)	hm3/year													64	62,9	
E.1. Water abstracted for ISIC 1-3 (agriculture)	hm3/year												1 697	1 788	1 915	
E.1. Water abstracted by ISIC 3510 (only cooling)	hm3/year															
E.1. Water abstracted by ISIC 3510 (only hydropower)(turbinated water)	hm3/year	14 524	14 616	16 517		16 517	16 917	16 917	18 537	18 537	18 537	21 543	24 859	25 584	27 038	
I.1. Losses of water in distribution (ISIC 36 no agriculture) (water utilities)	hm3/year							-	-	-	-	-	-	300		
I.1. Losses of water in distribution (in agriculture)	hm3/year													915	615	
G.1 Water received by households connected to the water supply network	hm3/year						-	-	-	-	-	-		200		
G.1. Water received by industries connected to the water supply network	hm3/year						0	0	0	0	0	0		43		
Pollution related data items (with IRWS code)																
G.3. Wastewater collected by sewerage (ISIC 37)	hm3/year													125		
H.a. Returns from sewerage after treatment	hm3/year													13		
15. Number of wastewater treatment plants	units															
H.a. Returns from ISIC 5-33, 38,39, 41-99 (3510 to be separated) after treatment	hm3/year															
K+J.1 Gross emissions by industries connected to ISIC 37	ton BOD_5															
K+J.1 Gross emissions by industries NOT connected to ISIC 37	ton BOD_6															
10. Wastewater treated by ISIC 37 (emissions collected)	hm3/year															
Water-related social-demographic data items																
S.1. Population using improved water sources	inhabitants	3 709 581	3 824 412	3 880 725	4 026 414	4 124 587	4 210 189	4 304 634	4 405 113	4 485 801	4 586 656	4 508 679	4 571 767	4 628 705	4 682 022	
T.1. Population using imporved sanitation facilities	inhabitants	3 755 853	3 876 528	3 978 221	4 061 431	4 159 939	4 250 038	4 331 234	4 425 892	4 513 927	4 609 247	4 546 703	4 595 850	4 652 579	4 701 991	

Source: prepared by the authors based on reports from AyA, DA, ESPH, BCCR, ICE, SENARA, INEC, IMN.

Table 18. Basic Indicators from Time Series

INDICATOR OR INTERMEDIATE DERIVED DATA	UNITS	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Contextual Information																
Population density	inhab/km^2	75	76	77	80	82	83	85	87	89	90	89	90	91	92	
Hydroelectricity as proportion of energy generated	%						79%	76%	75%	78%	78%	76%	73%	71%	67%	66%
Electricity generated per capita	kWh/inhab						1 539	1 516	2 037	1 629	1 564	2 101	1 546	1 550	2 169	2 166
Hydrologic Information																
Precipitation in height	mm/year	2 993	3 070	3 189	3 200	3 291	3 151	2 874	3 344	3 588	2 959	4 031	3 032	3 328	2 474	2 971
Evapotranspiration as proportion of precipitation	%	0%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Internal Renewable Water Resources (IRWR)	hm^3/year	152 945	109 449	113 665	114 062	117 317	112 315	102 451	119 202	127 911	105 465	143 679	108 094	118 617	88 177	105 919
Total Renewable Water Resources (TRWR)	hm^3/year	152 945	109 449	113 665	114 062	117 317	112 315	102 451	119 202	127 911	105 465	143 679	108 094	118 617	88 177	105 919
Dependency ratio	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total Renewable Water Resources per capita	m3/inhab/yr	40 141	28 015	28 709	27 897	28 075	26 327	23 531	26 829	28 217	22 826	31 494	23 425	25 416	18 691	
Artificial reservoir capacity as proportion of surface runoff and inflows from neighbouring countries	%											2%	3%	3%	4%	3%
Artificial reservoir capacity per capita	m3/inhab	0	0	0	0	0	0	0	0	0	0	581	574	568	562	
Water in the economy																
Total water abstracted (only off-stream)	hm^3/year	0	0	0	0	0	0	0	0	0	0	0	1 697	2 377	1 978	0
Water abstracted per capita (only off-stream)	m^3/inhab/year												368	509	419	
Water abstraction as proportion of TRWR	%												2%	2%	2%	
Water abstracted for drinking water per capita	L/inhab/day													308		
Proportion of abstraction that is lost in water utilities	%													57%		
Water received in households per capita	L/inhab/day													117		
Proportion of abstraction that is lost in irrigation	%													51%	32%	
Abstractions for irrigation in height	mm/year												2 923	2 898	3 044	
Pollution related data items																
Proportion of sewage collected in sewers that is treated	%													10%		
Water-related social-demographic data items																
Proportion of population using improved water sources	%	97%	98%	98%	98%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	
Proportion of population using improved sanitation sources	%	99%	99%	100%	99%	100%	100%	99%	100%	100%	100%	100%	100%	100%	100%	

Source: prepared by the authors based on reports from AyA, DA, ESPH, BCCR, ICE, SENARA, INEC, IMN.

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Table 19. Abstraction-use correlation table for preparing the SEEA physical supply and use table, 2012

units in million cubic meters per year = hm3/year = GL/year

Flows

CIIU v4	Abstractors	E. Abstractions	E.1.1 Abstractions of surface water	E.1.2 Abstractions of groundwater	E.2 or E.3 Abstractions from the sea or precipitation	I.1 Losses	F. Supplied	Off-stream uses				In-stream uses
								ISIC 01-03 Agriculture	ISIC 5-33,38,39,41-96 Industries and services	ISIC 3510 Cooling in thermoelectric plants	Households	ISIC 3510 Turbinated water in hydroelectric plants
01-03	Agriculture	764	723	42		300	464	464				
3600-2	Water supply for agriculture	1 024	1 024			615	409	409				
05-33,33,	Mining, manufacturing and services	64	35	29			64		64			
3510	Cooling in thermoelectric plants	0					0			0		
3600-1	Drinking water supply	525	215	310		282	243		43		200	
3600	Households	0					0				0	
3510	Hydroelectric plants	25 584	25 584				25 584					25 584
5222	Waterway locks	0					0					0
	TOTAL FIRST USE OF WATER							**873**	**107**	**0**	**200**	**25 584**
	G.3.2 Reuse of water							0,0	0	0		
	TOTAL USE AND REUSE OF WATER							**873**	**107**	**0**	**200**	**25 584**
	"Water consumption" or Final Water Use							524	21	0	70	0
	Total "wastewater" generated							349	86	0	130	25 584
	Of which:											
	F.3 Wastewater to sewers for disposal								86	0	39	0
	H.1 Returns of water to inland water resources			0,41				349		0	91	25 584
	H.2 Returns to the sea							0	0	0	0	0
						CHECK		**0**	**0**	**0**	**0**	**0**
COEFFICIENTS FOR ESTIMATES												
	Water consumption coefficients							60%	20%	2%	35%	0%
	Proportion of water supplied received by households										82%	

Source: prepared by the authors.

Table 20. Sequence of physical accounts for water 2012 (millions of m³/year)

1	Renewable water	Resources	Uses	Balance
B.1	Precipitation (OECD-Eurostat question 1)	170 036		
B.2	Inflows from other countries or territories (OECD-Eurostat q. 4)			
C.1	Evapotranspiration (OECD-Eurostat question 2)		51 419	
Bal01	**Total Renewable Water Resources (TRWR)**			**118 617**

2	Ouflowing TRWR & returns	Resources	Uses	Balance
Bal01	Total Renewable Water Resources (TRWR)	118 617		
H.1	Returns of water to inland water resources	27 346		
E.1 (offstream)	Abstractions from inland water resources (offstream)		2 377	
E.1 (instream)	Abstractions from inland water resources (instream)		25 584	
Bal02	**Remaining flow after abstraction**			**118 002**

3	Water supplied and received	Resources	Uses	Balance
E.1 (offstream)	Abstractions from inland water resources (offstream)	2 377		
E.1 (instream)	Abstractions from inland water resources (instream)	25 584		
E.2 & E.3	Abstractions from other sources (sea & precipitation)	0		
G.2	Imported water	0		
F.3.2/G.3.2	Reused water	0		
I.1	Losses in transportation and distribution		1 197	
F.2	Exported water		0	
Bal 03	**Water supplied or self supplied to resident users**			**26 764**

4	Wastewater generated	Resources	Uses	Balance
Bal 03	Water supplied/received by resident users	26 764		
	"Water consumption"		615	
Bal04	**Wastewater (as defined in SEEA, regardles of quality)**			**26 149**

5	Final balance of wastewater	Resources	Uses	Balance
Bal04	Wastewater (as defined in SEEA, regardless of quality)	26 149		
I.1	Losses in transportation and distribution	1 197		
H.2	Returns to the sea		0	
F.3.2/G.3.2	Water for reuse		0	
H.1	**Returns of water to inland water resources**			**27 346**

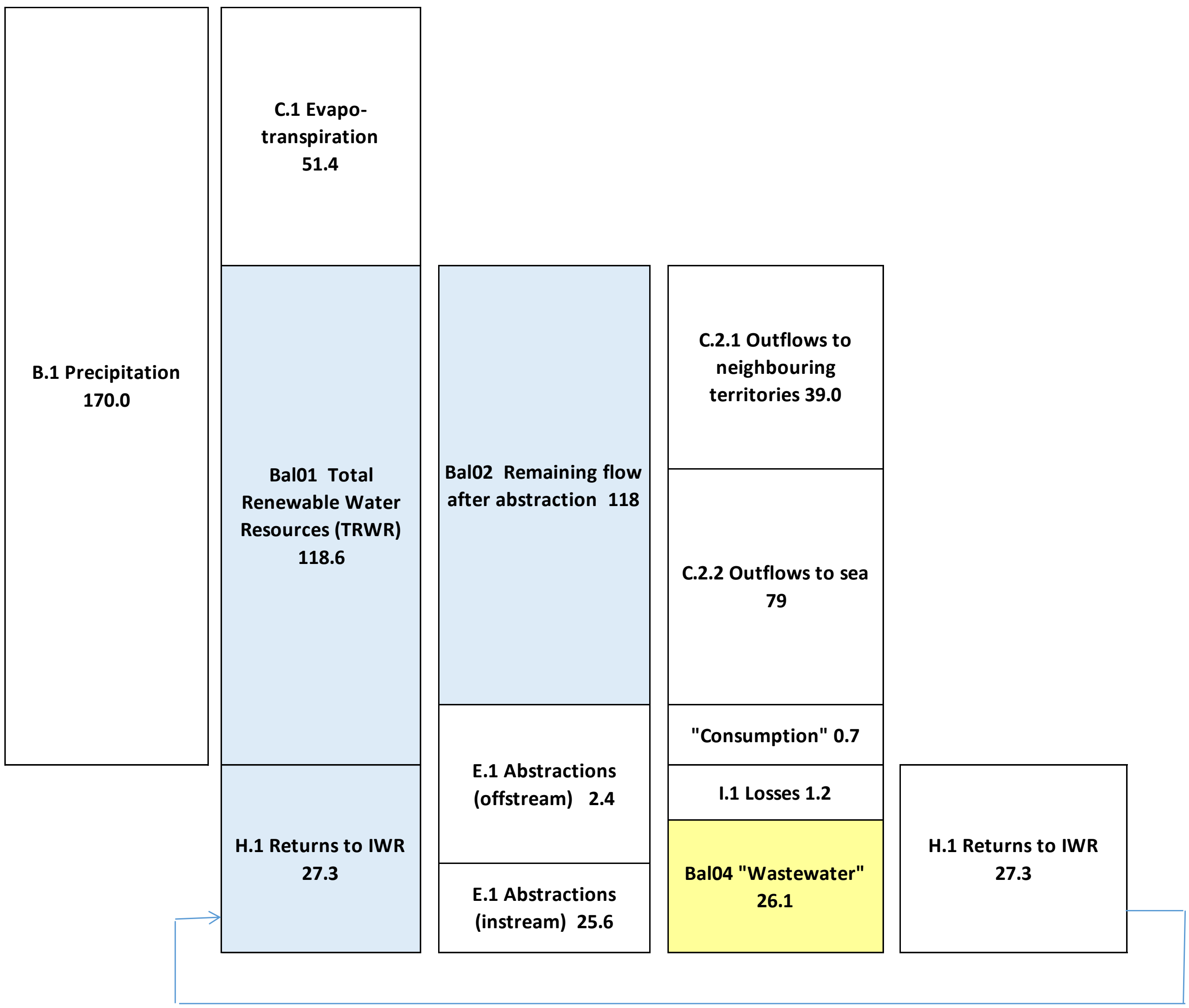
6	Final balance of discharges	Resources	Uses	Balance
Bal02	Remaining flow after abstraction	118 002		
C.2.1	Outflows to neighboring countries or territories (OECD-E q. 7). Estimaton of outflows to Nicaragua and Panama		39 500	
C.2.2	Outflows to the sea (OECD-Eurostat q. 6)		78 739	

Bal05	Net changes in Inland Water Resources			- 237

7	Balance Sheet	Opening	Changes	Balance
A.	Inland water resources	2 043	- 237	1 806

Source: prepared by the authors based on various sources.

Figure 15. Water cycle as a cascade sequence for Costa Rica (billions of m³ – km³), 2012



IWR = Inland Water Resources

Source: prepared by the authors based on reports from AyA, DA, ESPH, BCCR, ICE, SENARA, INEC, IMN.

Table 21. Indicators from the sequence of physical water accounts, 2012

Natural endowments			
Total Renewable Water Resources (TRWR)	Balance 01	118 617	hm3/year
Per capita	Balance 01/Population	25 416	m3/person/year
Precipitation per area	B.1/area	3 328	mm/year
Proportion of precipitation in wet half of the year	B.1(wet6)/B.1	73%	
Total Actual Renewable Water Resources (TARWR)	Balance 01-C.2.1.1	118 617	hm3/year
Evapotranspiration as proportion of precipitation	C.1/B.1	30%	
Water dependency indicators			
Dependency from other countries	(B2+G2)/Balance 01	0%	
Dependency from precipitation	(B1-C1)/Balance 01	100%	
Dependency from alternate sources	(E2+E3)/Balance 01	0%	
Water development			
Offstream abstractions as proportion of TRWR	E.1offs/Balance 01	2,0%	
Proportion of offstream abstractions that is freshwater	Freshwater/E.1offs	100%	
Total abstractions as proportion of TRWR	E.1/Balance 01	24%	
Proportion of offstream abstractions for agriculture	E.1 ISIC 01-03/E.1offs	75%	
Proportion of offstream abstractions for drinking water	E.1 ISIC 36-1/E.1offs	22%	
Proportion of offstream abstractions for cooling	E.1 ISIC 35-1/E.1offs	0%	
Artificial reservoir capacity as proportion of TRWR	2./Balance 01	2%	
Physical efficiency			
Losses as proportion of offstream abstractions	I.1/E.1offstream	50%	
Reuse as proportion of offstream water supplied	F.3.2/(Balance 03-E1ins)	0%	
Wastewater management			
Proportion of wastewater gen by HH & "indus" collected	F.3/Bal 04 (HH & "indus")	58%	
Proportion of wastewater collected that is treated	F.3/PubTreated	10%	
Population		4,667	million people in 2012
Area		51 100	km2
Population density		91	people/km2

NOTE: 1 hm3/yr = 1 million cubic meters per year = 1 GL/yr

Source: prepared by the authors based on reports from AyA, DA, ESPH, BCCR, ICE, SENARA, INEC, IMN.

Table 22. Monetary sequence of accounts and physical information for water utilities, 2012

	Water Utilities
E.1 Abstraction of water ("Produced water") (hm³/year) 2012	525*
Water billed (hm³/year) 2012	243*
of which:	
Households (hm³/year)	200*
Population supplied (thousand people)	4 282
Drinking water clients	684 060
Length of drinking water network (km)	9 529
Length of sewerage network (km)	1 509
P1. Production (million colones, basic prices) 2012	139 785
P2. Intermediate consumption (million colones, purchaser's price) 2012	44 480
of which:	
Electricity consumption (NP117)	10 706
Chemical products (NP078)	1 289
B1b. Gross value added (million colones, basic prices) 2012	95 305
D1. Compensation of employees	47 851
D2g. Taxes on production	5 383
B2g. Gross operating surplus = B8g. Gross saving	42 071
P51c. Consumption of fixed capital	19 458
B8n. Net saving	21 021

*Estimations based on assumptions for municipalities and ASADAS.
Source: prepared by the authors based on BCCR data (National Accounts)