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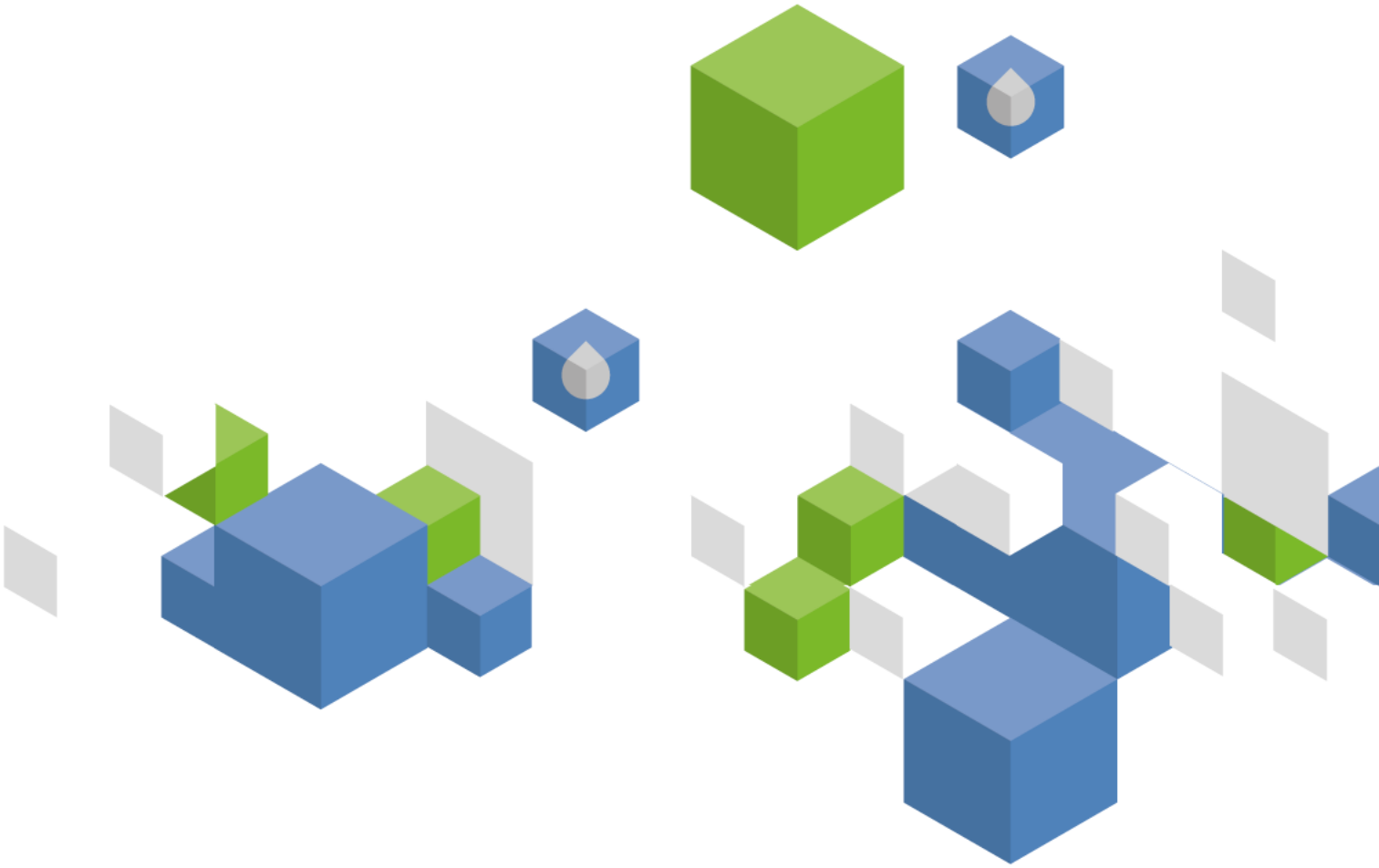

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Bahamas

GEOGRAPHY, CLIMATE AND POPULATION

Geography

The Bahamas, officially the Commonwealth of The Bahamas, comprises about 700 islands and cays, in the North Atlantic Ocean, that extend from 80 km east of Florida (United States of America) southeasterly to 80 km northeast of Cuba and Haiti. The total area of the country is 13 880 km^2.

The largest islands of the Bahamas are: North Andros (3 439 km^2), Great Inagua (1 544 km^2), South Andros (1 448 km^2), Great Abaco (1 146 km^2), Grand Bahama (1 096 km^2), Long Island (596 km^2), Eleuthera (518 km^2), Acklins (497 km^2), Cat Island (389 km^2), Exuma (290 km^2), Mayaguana (285 km^2), Crooked Island (241 km^2), New Providence (207 km^2), San Salvador (163 km^2) and Little Inagua (127 km^2).

The country is politically divided into 31 districts. It can also be divided into three geographical areas: (i) New Providence Island, where the capital Nassau is located; (ii) Grand Bahama, where the second most populated town Freeport is located; (iii) Family Islands, which is the name given to all of the other islands and cays (USACE, 2004).

In 2012, the total physical cultivated area was estimated at 12 000 ha, of which 67 percent (8 000 ha) consisted of temporary crops and 33 percent (4 000 ha) of permanent crops. Permanent meadows and pasture cover 2 000 ha, which brings to total agricultural area to 14 000 ha (Table 1).

Climate

The country has a marine tropical climate dominated by Atlantic Southeast Trade Winds in the summer and cool and dry North American high-pressure systems in winter.

Average annual precipitation in the country is estimated at 1 290 mm, ranging more than 1 600 mm in the northwestern part of the archipelago to 600 mm in the dry southeastern islands. Inagua, the southernmost island, is practically a desert. Rainfall occurs mainly during the warm summer months from May to October. Limited rainfall is contributed in the cooler months from November to April, due to the passage of North American winter frontal systems. Tropical storms and hurricanes have a great influence on precipitation, even when their tracts of passage are several hundred kilometers away from the Bahamas. The hurricane season officially extends from June to November.

The Southeast Trade Winds dominate the weather for much of the year, providing a cooling effect. Maximum temperatures in the Bahamas range from 25ºC to 30ºC and minimum temperatures range from 17ºC to 24ºC from north to south (USACE, 2004).

FIGURE 1
Map of Bahamas

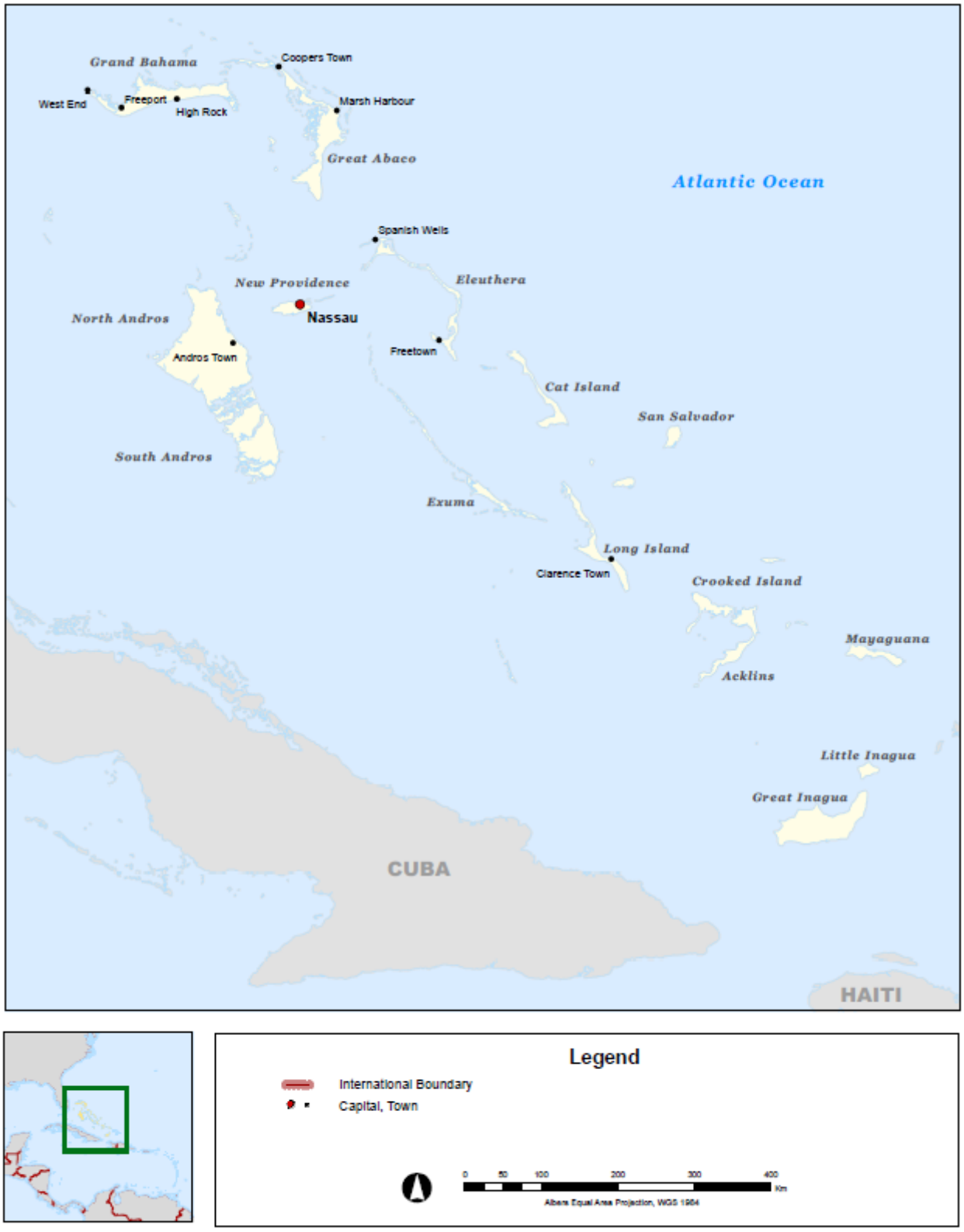

TABLE 1
Basic statistics and population

Physical areas:			
Area of the country	2012	1 388 000	ha
Agricultural land (permanent meadows and pasture + cultivated land)	2012	14 000	ha
• As % of the total area of the country	2012	1	%
• Permanent meadows and pasture	2012	2 000	ha
• Cultivated area (arable land + area under permanent crops)	2012	12 000	ha
- As % of the total area of the country	2012	1	%
- Arable land (temp. crops + temp. fallow + temp. meadows)	2012	8 000	ha
- Area under permanent crops	2012	4 000	ha
Population:			
Total population	2013	377 000	inhabitants
- Of which rural	2013	15	%
Population density	2013	27	inhabitants/km^2
Population economically active	2013	207 000	inhabitants
• As % of total population	2013	55	%
• Female	2013	48	%
• Male	2013	52	%
Population economically active in agriculture	2013	4 000	inhabitants
• As % of total economically active population	2013	2	%
• Female	2013	0	%
• Male	2013	100	%
Economy and development:			
Gross Domestic Product (GDP) (current US$)	2012	8 149	million US$/year
• Value added in agriculture (% of GDP)	2012	2	%
• GDP per capita	2012	21 906	US$/year
Human Development Index (highest = 1)	2013	0.789	-
Gender Inequality Index (equality = 0, inequality = 1)	2013	0.316	-
Access to improved drinking water sources:			
Total population	2012	98	%
Urban population	2012	98	%
Rural population	2012	98	%

Population

In 2013, the total population was about 377 000 inhabitants, of which around 15 percent was rural (Table 1). Population density is 27 inhabitants/km^2. The average annual population growth rate in the 2003-2013 period has been estimated at 2 percent.

Only about 30 of the islands are inhabited. New Providence Island accounts for 70 percent of the total population, mostly concentrated in the capital Nassau, follow by Grand Bahama Island which accounts for 15 percent of the total population, mostly located in Freeport. The Family Islands account for the remaining 15 percent (USACE, 2004).

In 2012, 98 percent of the total population had access to improved water sources (both urban and rural) and 92 percent of the total population had access to improved sanitation (also both urban and rural).

ECONOMY, AGRICULTURE AND FOOD SECURITY

In 2012, the gross domestic product (GDP) was US$8 149 million and agriculture accounted for 2 percent of GDP. In 2013, total population economically active in agriculture is estimated at 4 000 inhabitants (2 percent of economically active population), all male.

The economy of the Bahamas is heavily dependent on tourism. Banking, fishing, agriculture and manufacturing also contribute to the economy (USACE, 2004).

WATER RESOURCES

Surface water and groundwater resources

The long-term average internal renewable water resources (IRWR) are estimated at about 700 million m^3/year (Table 2 and Table 3).

TABLE 2
Renewable water resources

Renewable freshwater resources:			
Precipitation (long-term average)	-	1 292	mm/year
	-	17 930	million m^3/year
Internal renewable water resources (long-term average)	-	700	million m^3/year
Total renewable water resources	-	700	million m^3/year
Dependency ratio	-	0	%
Total renewable water resources per inhabitant	2013	1 857	m^3/year
Total dam capacity	-	-	million m^3

TABLE 3
Internal renewable water resources in Bahamas (Source: USACE, 2004)

Renewable freshwater resources:	**million m^3/year**
Abaco	131.70
Acklins	7.26
Andros	349.51
Bimini and the Berry Island	0.28
Cat Island	11.32
Crooked Island	2.90
Eleuthera, Harbour Island & Spanish Wells	13.54
Exuma & Cays	4.83
Grand Bahama	155.13
Great Inagua	1.43
Long Island	4.80
Mayaguana	1.08
New Providence	16.03
Ragged Island	0.02
San Salvador & Rum Cay	0.17
Bahamas	**700.00**

Freshwater resources are finite and vulnerable in The Bahamas. Fresh surface water is basically non-existent. There are no true rivers or streams on the islands due to the low relief of the country and to the high permeability of the limestone surface that permits the rainwater to percolate quickly to the water table. Thus, freshwater resources in the country are limited to very fragile freshwater 'lenses' in the shallow karstic limestone aquifers (USACE, 2004).

Inland water bodies are usually places where the water table is at or near the same level as the land surface. These bodies are usually saline or brackish nature. In some cases, ponding of water can occur after a heavy rainfall where the surface rock retards infiltration.

In 2000, total desalinated water produced was estimated at 7.4 million m^3.

WATER USE

Total municipal water withdrawal is estimated at 31 million m^3 in 2013 (Table 4). Tourism needs a large quantity of water, since it brings in about 4 million visitors a year.

TABLE 4
Water use

Water withdrawal:			
Total water withdrawal	-	-	million m^3/year
- Agriculture (Irrigation + Livestock + Aquaculture)	-	-	million m^3/year
- Municipalities	2013	31	million m^3/year
- Industry	-	-	million m^3/year
• Per inhabitant	-	-	m^3/year
Surface water and groundwater withdrawal (primary and secondary)	-	-	million m^3/year
• As % of total actual renewable water resources	-	-	%
Non-conventional sources of water:			
Produced municipal wastewater	-	-	million m^3/year
Treated municipal wastewater	-	-	million m^3/year
Direct use of treated municipal wastewater	-	-	million m^3/year
Direct use of agricultural drainage water	-	-	million m^3/year
Desalinated water produced	2000	7.4	million m^3/year

Agriculture does not have a significant impact on New Providence, where water demand for irrigation negligible. However, Grand Bahama and many of the Family islands do support agricultural and irrigation development.

The primary source of drinking water is fresh groundwater. Desalination is increasing in usage, and will most likely continue to increase, as fresh groundwater availability continues to decline, and water demands grow. Grand Bahama, Abaco, and Andros islands have enough fresh groundwater reserves to meet their demands, but for New Providence and many other islands, particularly the central and southernmost islands, desalination will be key in the future. Rainwater catchment is rarely used, supplying possibly 3 percent or less of the water.

As a summary, the main scenarios for water supply in the Bahamas are: groundwater provided via water authority on a large scale, private water wells, groundwater barged from one island to another, fresh groundwater blended with brackish groundwater, groundwater piped from one island to another by underwater lines, desalination (usually Reverse Osmosis), water trucking from one part of the island to another, bottled water for drinking and cooking. Water losses are large in Bahamas. For New Providence, water loss is estimated at 53 percent (USACE, 2004).

IRRIGATION AND DRAINAGE

Evolution of irrigation development

In 2012, the area equipped for irrigation was estimated at 1 000 ha, which is about 8 percent of the cultivated area (Table 5). The main irrigated crops are vegetables and citrus.

TABLE 5
Irrigation and drainage

Irrigation potential		-	-	ha
Irrigation:				
1. Full control irrigation: equipped area		2012	1 000	ha
- Surface irrigation		-	-	ha
- Sprinkler irrigation		-	-	ha
- Localized irrigation		-	-	ha
• Area equipped for full control irrigation actually irrigated		2012	-	ha
- As % of area equipped for full control irrigation		2012	100	%
2. Equipped lowlands (wetland, ivb, flood plains, mangroves)		-	0	ha
3. Spate irrigation		-	0	ha
Total area equipped for irrigation (1+2+3)		**2012**	**1 000**	**ha**
• As % of cultivated area		2012	8	%
• % of area irrigated from surface water		-	-	%
• % of area irrigated from groundwater		-	-	%
• % of area irrigated from mixed surface water and groundwater		-	-	%
• % of area irrigated from non-conventional sources of water		-	-	%
• Area equipped for irrigation actually irrigated		-	-	ha
- As % of total area equipped for irrigation		-	-	%
• Average increase per year		-	-	%
• Power irrigated area as % of total area equipped for irrigation		-	-	%
4. Non-equipped cultivated wetlands and inland valley bottoms		-	0	ha
5. Non-equipped flood recession cropping area		-	0	ha
Total agricultural water managed area (1+2+3+4+5)		**2012**	**1 000**	**ha**
• As % of cultivated area		2012	8	%
Size of full control irrigation schemes:	**Criteria**:			
Small schemes	< - ha	-	-	ha
Medium schemes	> - ha and < - ha	-	-	ha
large schemes	> - ha	-	-	ha
Total number of households in irrigation		-	-	
Irrigated crops in full control irrigation schemes:				
Total irrigated grain production		-	-	metric tons
• As % of total grain production		-	-	%
Harvested crops:		-	-	
Total harvested irrigated cropped area		-	-	ha
• Temporary crops: total		-	-	ha
- Vegetables		-	-	ha
• Permanent crops: total		-	-	ha
- Citrus		-	-	ha
Irrigated cropping intensity (on full control area actually irrigated)			-	%
Drainage - Environment:				
Total cultivated area drained		-	-	ha
• Non-irrigated cultivated area drained		-	-	ha
• Area equipped for irrigation drained		-	-	ha
- As % of total area equipped for irrigation		-	-	%
Area salinized by irrigation		-	-	ha
Area waterlogged by irrigation		-	-	ha

Women and irrigation

Women in Bahamas used to work only in subsistence agriculture that provided a small income for the family. In the last years, these women are entering the field at a number of different activities. Many of the younger women are highly educated and a lot of women are in research and development. They take on a range of roles from farmer, marketing manager to the complete business woman. They use different types of irrigation and injector systems to increase productivity (The Bahamas Weekly, 2015).

WATER MANAGEMENT, POLICIES AND LEGISLATION RELATED TO WATER USE IN AGRICULTURE

Institutions

The most important institution responsible for water resources is the Water and Sewerage Corporation (WSC), which is under the jurisdiction of the Minister of Works & Urban Development. The Corporation is a wholly government-owned organization, entrusted with managing, maintaining, distributing and developing the water resources of the Bahamas. Among others, the WSC is responsible of (WSC, 2015):

- Providing water supplies for domestic, business and other uses
- Providing adequate drainage and disposal of sewage and other effluent
- Expanding and extending the water and sewer systems to all parts of the country
- Ensuring and controlling the optimum development and use of the nation's water resources
- Serving as advisor to the Minister responsible for water and sewerage resources and systems
- Drafting regulations for the responsible Minister's consideration and approval
- Registering and servicing users of the water and sewerage systems

The WSC owns, operates and manages 83 percent of the country's water systems, while the private sector accounts for the remaining 17 percent. There is a move toward decentralization and towards increased privatization.

In addition to the WSC, there are three other major water utility entities operating: Paradise Utility (PU), Grand Bahama Utility Company (GBUC) and New Providence Development Company (NPDC). PU is the sole provider of water for Paradise Island and provides sewerage services as well. GBUC is the sole provider of water in Grand Bahama. NPDC supplies water on demand for WSC and operates a distribution system at the south-western end of New Providence. The private services are not approved and monitored by the WSC (USACE, 2004).

Other regulatory agencies, which overlap with WSC on water resource management, are (USACE, 2004):

- Ministry of Health (MOH), which is entrusted with the administration of the Environmental Health Act (EHA) and the Health Services Act that regulates and monitors the supply of water
- Department of Environmental Health Services (DEHS), part of the MOH, which is the primary regulatory agency for environmental matters affecting human health and assists in carrying out the requirements of the EHA
- Ministry of Works and Utilities, which is entrusted with the administration of the Building Control Act and Regulations
- Ministry of Agriculture, Fisheries and Local Government, which is responsible for the agricultural land, development, and its impact on the environment, including pollution from use of chemical pesticides and overuse of the water supply from irrigation, through the Department of Agriculture
- Public Utilities Commission (PUC), which determines standards for the provision of public services and regulates the rates to be charged

Water management

WSC has decided to take concrete steps to adopt and implement an Integrated Water Resources Management (IWRM) plan for the Bahamas. This decision was born out of the strong realisation that the water resources sector was in need of remedy. Efforts to establish an IWRM plan began in 2002 with a national stakeholder meeting and later a workshop organized by the Bahamas Environment Science and Technology Commission (BEST) in 2004. However, the process languished until WSC underwent institutional reform and at its completion, there was a renewed interest in IWRM. In 2007, WSC

continued with the planning process. The following initiatives are considered to be included in the plan (GWP, 2011):

- Involvement of other sectors in water resources management
- Highest level political commitment to the process
- Understanding of the linkage between IWRM and programme delivery in other related sectors
- Commitment to reform the legal and regulatory framework to implement the plan

Finances

One of the biggest concerns related to water resources management is the financial cost associated with producing water and the affordability of water by consumers (GWP, 2011). It is expected that better service and access due to new management plans will bring a reduction in water losses and improvement of meter reading and water fee collection.

Policies and legislation

Many legislative acts and regulations exist related to water resources. The central acts that contribute to the legal framework of the water and sanitation sector include:

- Water and Sewerage Corporation Act (1976), which placed use of water resources under the control of the government and established WSC to oversee water management and protection
- Out Islands Utility Act, regulating water management in the Family Islands
- Environmental Health Act (1987) promoting environmental protection to ensure human health
- Public Utilities Commission (PUC) Act responsible for the creation of the PUC and regulation of rates and the standards for public utilities
- Building Control Act (1971)
- Ministry of the Environment Act (2010), which established the Ministry for the combined water and environmental regulations
- The Bahamas Forestry Act (2010), which gives partial protection to certain water resources areas

Current legislation, however, does not fully protect the groundwater resources from over-abstraction and pollution, and is not adequate in achieving proper sewage treatment standards (USACE, 2004).

ENVIRONMENT AND HEALTH

In 2003, about 65 percent of the groundwater samples showed signs of microbiological contamination. Freshwater reserves are also affected by other types and sources of contamination. The nature of the geology and a deficient sewage collection and treatment system are contributing to groundwater contamination.

Over-abstraction of groundwater is already occurring on New Providence, where the greatest water demands of the country exist, causing saltwater intrusion. The aquifers are very shallow and are at great risk of becoming inundated with saline water even with a small rise in sea level due to climate change. Decreasing precipitation in some islands is also reducing freshwater availability. Natural disasters and severe weather, such as hurricanes, are probably the most threatening to the health of the freshwater reserves (USACE, 2004).

PROSPECTS FOR AGRICULTURAL WATER MANAGEMENT

The demand of water for industry, agriculture, and population are estimated to increase in the following years. The water resources of the Bahamas are in a dangerous position, threatened by over-abstraction,

misuse and pollution. The need to improve the management of water resources has become more and more urgent as issues become more complex (GWP, 2011).

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