Chapter 9
Water, Gender, Philanthropy, and Human Security: Courses and Concerns in MMCs

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9.1 Introduction

Islam begun in Mecca and spread quickly to water-constrained areas of West Asia and Africa where pasture and water were accessible by wondering nomads and became private property of the stronger tribes. People in these areas travelling for better pasture or water needed and created self-supporting voluntary social re-enforcement because of the absence of strong or resource-rich (central) government. Muslims need access to water for ritual purity before five daily prayers (see Chap. 1). For hundreds of years Muslim endowments arranged and/or delivered water, and established and managed water fountains for urban centers. Women as, land owners and *waqf* creators, played significant roles in funding waterwheels, watering troughs, springs, public bath houses (see Chap. 7). It is also very common to have local infrastructure for water supply (e.g. sinking hand pumps for water), or sanitation facilities established and run by *sadaqa* (see Chap. 3). Thus water, women, and philanthropy seem to be tied together in Muslim communities. Now the question is what is the status of water security in Muslim majority countries (MMCs—the focus of this Volume)?

Water security is "the availability of, and access to water sufficient in quantity and quality to meet the health, livelihoods, ecosystem and production needs of populations, coupled with an acceptable level of water-related risk" (EU, 2013).[1] Thus "water security" is determined mainly by access to and the availability of adequate volume of water in the correct quality of all, irrespective of gender and economic status. This chapter discusses the features of water resources, general

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[1] European Report on Development, 2012. http://www.erd-report.eu/erd/report_2012/documents/FullReportEN.pdf.

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challenges of improved water and sanitation in MMCs, and highlights the likely global impact of climate change, increasing pollution and population growth, on water security in MMCs.

This chapter deals with three important factors of water security (resources, quality, and use of water) in three main parts: water resources and security, improved water and sanitation, and the challenges beyond scarcity. The largest part, water resources, is divided along geographic regions and highlights main water resources issues as appropriate to different regions. The part on "improved water and sanitation" (Sect. 9.3) highlights the major aspects of access to and use of improved water and sanitation facilities in 47 MMCs. The next part ("Challenges to water security in MMCs," Sect. 9.4) is divided into two main sections: "water economy and security threats" (nonconventional water sources and their impacts) (Sect. 9.4.1), and "water management" (waste water management (Sect. 9.4.1.1), groundwater contamination (Sect. 9.4.1.2), and salinization (Sect. 9.4.1.3)). The last main section ("Hygiene, Water, Gender, and the Third Sector", Sect. 9.5) highlights the role of women and girls in water security—a major challenge of human security in many MMCs. The chapter analyses the importance of the third sector in improving human security by freeing women from water-chain in the affected MMCs. Improved water and sanitation, often with the help of the third sector, transform women and girls in MMCs from water-carrier to active and healthy citizens with education and employment ensuring higher security for all. Human security cannot be achieved without freeing women and girls from the "water-chains" which is only possible with the help of the third sector third sector because the government services do not cover all areas, especially the remote areas in the low income countries.

The work is based on data collected from the World Bank and other international and specialized organizations, as appropriately cited. Other relevant secondary literature is also surveyed and cited to highlight the major points and issues.

9.2 Water Resources and Security

Water is the most vital element of natural resources crucial for survival of all living organisms. Human settlements have long been established because of access to water. Water is essential for agriculture, domestic purpose (including drinking, cooking, and hygiene), industrial use, tourism and culture, and sustaining the earth's ecosystems. Nonetheless, this essential resource, due to growing national, regional, or seasonal scarcity in much of the world, is creating significant challenges to human security.

A key characteristic of the world's freshwater resource is its uneven distribution and variability with respect to time and space (UNSD, 1997), dictated largely by climate, resulting in considerable variation in water availability within and among countries and regions (IWMI, 1998). In countries within the tropical and temperate regions, due to enough precipitation, abundant volume of water is available for each person annually; on the other hand, there is an acute shortage of water resources in drier regions within the arid and semi-arid climatic conditions. In the latter group of countries average water availability is extremely scarce (Table 9.1), due to natural or financial reasons. Figures on national averages, however, hide significant temporal, regional, and national variation. As shown in Table 9.2, renewable water availability is even less than 100 m^3/person/year in some MMCs, e.g. Kuwait. In arid regions, freshwater resources may at times be limited to the extent that demand for water can be met only by going beyond sustainable volume of water use (Rogers, 2000). In some countries the situation is further aggravated by a gender dimension—women and girls, requiring the most for personal hygiene use, and being responsible for procuring daily water needs, are disadvantaged in other fronts, i.e. education, health, or quality of life.

Table 9.1 Availability of water resources in MMCs

Country	Average precipitation (km^3/year)	Annual renewable water resources (km^3/year)	Total renewable water resources per capita (m^3/per/year)
Africa			
Algeria	211.5	11.6	473
Burkina Faso	204.9	17.5	1,084
Chad	413.2	43	5,453
Comoros	1.675	0.2	1,552
Djibouti	5.1	0.3	475
Egypt	51.4	58.3	859
Gabon	490.1	162	10,485
Guinea	405.9	226	21,563
Guinea-Bissau	57	31	25,855
Libya	98.5	0.6	113
Morocco	154.7	29	971
Niger	190.8	33.7	3,107
Nigeria	1,062.3	286.2	2,514
Senegal	134.9	36.8	2,960
Sierra Leone	181.2	150	26,118
Somalia	180.1	14.2	1,538
Sudan[a]	1,043.7	64.5	2,074
Southwest Asia			
Bahrain	0.1	0.1	181
Iran	372.4	137.5	1,955
Iraq	94.7	75.6	3,287
Jordan	9.9	0.9	179
Kuwait	2.2	0.02	10
Lebanon	6.9	4.5	1,261
Oman	26.6	1.4	388
Qatar	0.8	0.1	94

(continued)

Table 9.1 (continued)

Country	Average precipitation (km^3/year)	Annual renewable water resources (km^3/year)	Total renewable water resources per capita (m^3/per/year)
Saudi Arabia	126.8	2.4	118
Syria	46.7	16.8	1,622
Turkey	459.5	213.6	3,439
United Arab Emirates	6.5	0.2	58
Yemen	88.3	2.1	223
Central Asia			
Azerbaijan	38.71	32.52	3,681
Kazakhstan	680.4	109.6	6,778
Kyrgyzstan	106.5	46.5	4,182
Tajikistan	98.9	99.7	2,625
Turkmenistan	78.7	60.9	5,218
Uzbekistan	92.3	72.2	2,026
South & South East Asia			
Afghanistan	213.4	65	2,986
Bangladesh	383.8	1,210.6	8,809
Brunei Darussalam	15.7	8.5	25,915
Indonesia	5,146.5	2,838	13,381
Malaysia	948.2	580	26,105
Pakistan	393.3	233.8	1,576

Data source: FAO/AQUASTAT (2012)
[a]Data include both Sudan and South Sudan

Table 9.2 Water dependency ratios for selected countries in Southwest Asia and North Africa

Country	Water dependency ratio (%)
Kuwait	100
Egypt	97
Bahrain	97
Syria	80
Iraq	53
Jordan	23
Tunisia	9
Iran	7
Lebanon	0.8
Algeria	4
Qatar	4
Morocco	0
Djibouti	0
Oman	0
Yemen	0
Saudi Arabia	0
Libya	0
United Arab Emirates	0

Box 9.1: Water Security: Different Dimensions

- Little or no water scarcity, i.e. abundant water resources relative to use, with less than 25 % of water from rivers withdrawn for human purposes.
- Physical water scarcity, i.e. a situation where there is not enough water to meet all demands, including that needed for ecosystems to function effectively. Arid regions frequently suffer from physical water scarcity. At this point, the indicator assumes that water resources development has exceeded the limit of the freshwater system to meet both socio-economic and environmental requirements. This definition (relating water availability to water demand) implies that dry areas are not necessarily water scarce.
- Economic water scarcity, i.e. a situation where human, institutional, and financial capital limit access to water even though local natural water is available to meet all the demands. In this case water resources are abundant relative to water use, with less than 25 % of water from rivers withdrawn for human purposes, but malnutrition exists.
- Water stressed, i.e. total renewable freshwater resources are between 1,000 m^3 and 1,700 m^3/person annually (UN Water, 2012).

Water security can be considered from four different dimensions: little or no scarcity, physical water scarcity, economic water scarcity, and water stressed (FAO, 2003; UN Water, 2012; Box 9.1). "Water Scarce" nations have an average of less than 1,000 m^3 of renewable fresh water per person annually. Twelve out of the world's 15 "water scarce" nations are Arab countries and located in the Southwest Asia and North Africa (Gleick, 2012). Southwest Asia is considered one of the driest and thirstiest areas in the world, and is to experience severe water scarcity by 2015 (FAO/AQUASTAT, 2012).

In addition to the impact on human health and food production, water scarcity leads to intense political pressure and instability. This is especially so in countries where the main sources of fresh water supply are transnational rivers or other surface water bodies as is the case in most Muslim Majority Countries (MMCs) in Southwest Asia, South Asia and West Africa. Water security is under severe pressure from many sources; a world population explosion, rapid shifts of people from rural to urban areas, the impact of dietary change as countries develop, increasing pollution of water resources, over-abstraction of groundwater and the issues created by climate change. Thus analyses of water resources and use both are important for human security.

MMCs encompass several regions with a range of climates generating a wide spatial variety of hydrological regimes. As a result, MMCs experience very uneven distribution in precipitation, water resources and water use (Fig. 9.1). A discussion of water resources (both surface and ground water) situation in each of the regions is presented below.

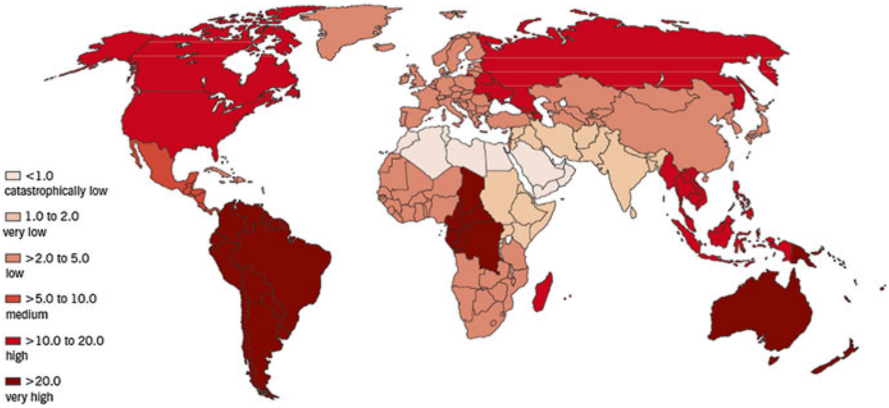

Fig. 9.1 Water availability by sub-region (1,000 m^3/capita/year) (source: http://www.unep.org/geo/GEO3/english/pdfs/chapter2-5_Freshwater.pdf)

9.2.1 South West Asia and Central Asia

Table 9.1 depicts water availability situation in the world. South Asia, Southeast Asia and Central Asia have much higher total renewable water resource per capita, while Southwest Asia and North Africa have lower total renewable water resources per capita. Climatic condition is partly responsible for the differences between the regions with Southwest Asia and North Africa located in the driest place experiencing the lowest annual precipitation. In Southwest Asia (one of the driest regions of the world) ready availability of fresh water has always been a major concern, except for the river basins. For example, ancient civilizations first emerged along the river basins, such as those of the Nile, Tigris-Euphrates and Jordan (FAO/AQUASTAT, 2012). Despite the contributions of rivers flowing in from more humid regions of Anatolia (e.g. the Euphrates River), Southwest Asia, especially the Arabian Peninsula, has the lowest absolute and per inhabitant water resources.

While Southwest Asia contains approximately 4.7 % of the world's total land area and 4.25 % of its population, the region's water resources are only about 1.1 % of the world's total renewable water resources, and less than 1,000 m^3/inhabitant (in ten out of 18 MMCs) (FAO, 2003). Topography, distance from the sea, latitude and resulting hydro-climatic conditions, the diversity of the hydrographic networks and of the geological structures, and trans-boundary rivers create extremely contrasting water situations in the region (Table 9.1).

The Gulf countries have particularly high scarcity of water, and are dependent mainly on groundwater, desalination and treated wastewater (FAO, 2003). Many groundwater aquifers within the Gulf countries, with no recharging capacity, are being mined in an unplanned manner because of poor regulatory system (FAO, 2008). Bahrain has virtually no freshwater (Riviere, 1989), while three-quarters of Saudi Arabia's freshwater comes from fossil groundwater (Postel, 1997).

These countries, except Yemen, use desalination plants to augment water supply either on a national or local scale.

Central Asia is reasonably endowed with water—3,320.5 m^3/inhabitant/year, but the climate and water resources across the MMCs vary (Table 9.1). These MMCs have reasonable reserve of fresh water, but annual availability of fresh water ranges from 78.7 km^3/year (in Turkmenistan) and 680.4 km^3 in Kazakhstan (Table 9.1). Countries in the region have done better in trans boundary water sharing. The figures for "external resources" (Table 9.1) correspond to either actual inflow affected by upstream consumption or to inflow secured through treaties. Therefore, the actual inflow may often be higher than the inflow secured through treaties (e.g. Uzbekistan).

9.2.2 South Asia and Southeast Asia

South Asia and Southeast Asia lie within the tropics, where rainfall is abundant for most of the year. South Asia is endowed with considerable water resources, with annual rainfall of over 4,000 km^3 and river flow of about 1,880 km^3 combined with estimated groundwater resources around 431 km^3 (UN Water, 2012, 2013a, 2013b, 2013c). Due to increasing population over the last 50 years, the per capita availability came down from a high of around 3,000 L/day to about 1,000 L/day in 2002. The region has large spatial and temporal variation in the distribution of water resources, thus has a practice of groundwater use for agriculture. Bangladesh and Pakistan use over 300 km^3 of groundwater annually. This is a large fraction of the world's total annual groundwater use, but the latter use is mostly for urban and industrial purpose.

Every country within South Asia is already facing increasing stress and resource depletion due to environmental factors, and a primary challenge is water scarcity. Population growth, urbanization, industrialization, and increased reliance on irrigated agriculture have steadily increased regional demand for water. Meanwhile, climate experts predict that global warming will eventually reduce the supply of water in the major river systems serving South Asia (IPCC, 2007). Pakistan is already in the category of "water-stressed societies" while Bangladesh is likely to fall in the category in the near future (Subramanian, 2004). The combination of these two trends—increasing demand plus decreasing supply and access—is likely to exacerbate disputes over regional water resources.

Located along the equator, Indonesia is surrounded by warm waters that create relatively stable year-round temperatures. Monsoons drive seasonal variations. The dry season may become more arid, leading to an increase in water demand, while the rainy season may condense higher precipitation levels into shorter periods, increasing the possibility of heavy flooding while decreasing the ability to capture and store water.

In Malaysia, recent economic development has relied on a growing industrial sector, expanded irrigated agriculture, and increased urban population. This multi-dimensional growth is now placing a great deal of stress on water supplies.

With approximately 22,000 m^3 of water available to each person annually, Malaysia is not considered water stressed. However, pollution from industrial, agricultural, and domestic sources is a major source of concern. Rapid population growth has contributed to the increasing volume of domestic sewage discharged into the rivers and drainage systems (FAO/AQUASTAT, 2012). There also have been incidences of increased waste streams, especially in Indonesia, due to growing industrial, domestic, and agriculture sectors.

In Brunei groundwater abstraction was initially undertaken in the 1950s for use by the oil and gas industries. However, this has been replaced by surface water resources. Groundwater abstraction, which accounts for 0.5 % of total water supply, is currently limited to the local bottled water industry.

9.2.3 West Africa

Climatic condition in the region ranges from semi-arid and dry humid in the north to tropical wet in the south. As a result West Africa experiences very contrasting levels of rainfall. For example, total annual renewable water resources in Nigeria are estimated to be 286.2 km^3 (Table 9.1). Western Africa's water resources are characterized by extreme variability over both space and time. Some MMCs such as Burkina Faso and Nigeria currently experience water stress that is expected to rise further. The sub-region has six major internationally shared river basins. The three largest basins are those of the Niger, Volta, and Senegal rivers.

These freshwater resources are unevenly distributed among these countries. Temporal variation in rainfall is common, but countries in the northern Sahelian zone regularly experience drought, while floods periodically affect countries in the wetter coastal belt. Groundwater mainly occurs in basement, coastal and Sahelian sedimentary aquifers. The availability of groundwater varies considerably from one type of hydrogeological domain to another, depending on the local levels of precipitation and infiltration, which determine the actual recharge. In Mauritania, for example, internal renewable groundwater resources, important for domestic use, irrigation and livestock watering, are estimated at 0.3 km^3/year. Water is highly vulnerable to climate variability, as illustrated by the disastrous impact of drought over the past 30 years.

Most MMCs in the region are highly water-interdependent with many trans-boundary river networks. The Gambia for instance, is located entirely within the Gambia River Basin, which is shared between Senegal (77.5 % of the basin area), the Gambia (13 %), Guinea (9 %), and Guinea-Bissau (0.5 %) (FAO, 2003). Water may lead to cross-boundary conflicts if not managed equitably.

9.2.4 Northern Africa

The northern Africa sub-region is dominated by arid conditions and extensive deserts, with the exception of parts of southern Sudan and an intermittent narrow strip along the Mediterranean shoreline, where the climate is more humid. This sub-region extends from the Mediterranean climate zone to the desert. It has two rainy seasons in autumn and spring, with a clear, dry summer season. There are major differences within the sub-region between the Maghreb (Algeria, Libyan, Morocco, and Tunisia) and Egypt (FAO, 2003). The Maghreb has climates varying from north to south, a divided and dispersed hydrography (only Morocco has some average-sized rivers), and an important endorheic zone (especially in the Sahara). Egypt has an arid climate and a simplified hydrography with only one river, the Nile River flowing from the highlands of Ethiopia. The major issue of concern is, therefore, freshwater availability for domestic, agricultural and industrial consumption (UN Water, 2013a, 2013b, 2013c). The region has scarce resources but very few trans-boundary exchanges, and thus risks for conflicts over sharing of water among nations.

The average total annual precipitation in northern Africa is estimated to be 1,503 km^3/year (FAO, 1995), and per capita water availability ranges from 26 m^3/year in Egypt to 1,058 m^3/year in Morocco (UNDP, 2000). Distribution of the precipitation varies dramatically, with almost 75 % falling in Sudan (the average is 436 mm/year, but it ranges from 20 mm/year in the north to more than 1,600 mm/year in the south) and just 3 % in Egypt (about 18 mm/year) (FAO, 1995). The rest is mainly lost by evaporation, transpiration, and seepage.

Renewable groundwater resources are in the form of shallow alluvial aquifers, recharged from the main rivers (for example, the alluvial aquifer beneath the Nile delta in Egypt) or from precipitation (along the North African Mediterranean coast). In the Sahara desert, the major water resources, the Continental Intercalaire non-renewable aquifer, extends from Egypt to Mauritania. Current annual rates of groundwater withdrawal in the sub-region are 407 % of the recharge rate in Egypt, and 560 % in Libya (UNDP, 2000). Exploitation of groundwater resources over the past 10 years has led to a reduction in water pressure levels at the oasis of the western desert. Over-extraction from the delta shallow aquifer has led to increased water salinization and a rapid inland advance of the saltwater interface.

9.2.5 Sudano-Sahelian and East Africa Sub-regions

The sub-region is marked by a climate zoning from arid in the north to tropical in the south. The hydrographic system is not dense but structured around major trans-boundary river basins such as the Nile and the Niger, flowing across the sub-regions. The drier countries in the Horn of Africa (Ethiopia, Eritrea, and Somalia) frequently experience drought, and have been devastated by drought-induced famine on several occasions over the past 30 years (UN Water, 2012). Annual freshwater withdrawal, in this area, is small compared to the similarly drier northern African region (UNDP, 2000). However, variability in rainfall results in frequent bouts of water scarcity and, during these times, demand exceeds supply. Further, with rapid population growth in the region, demand for freshwater is already a problem. Due to decreased rainfall, drought and desertification is likely to be more widespread in the Horn of Africa (IPCC, 2007), and thus mining of the groundwater aquifers is to increase. Wetlands are also being used to obtain water for humans and livestock, and as additional cultivation and grazing land. These activities are altering hydrological cycles, leaving the surrounding area more prone to flooding.

Agriculture, industry and increasing population density is creating pressure in limited water resources, and causing river pollution and health risks for people living close to the rivers in many MMCs. Much of the pollution results from inadequate treatment of municipal and industrial wastewater. The extensive algal blooms and mats of water hyacinth are also major concerns. Water hyacinths release toxins, cause discoloration, and reduce dissolved oxygen levels harming the water quality increasing the costs of water treatment. These man-made problems must, and are very easy to, be solved. The situation is further discussed in the next section.

9.3 Improved Water and Sanitation

Access to clean water for domestic use (drinking, cooking, and personal hygiene) as well as access to adequate sanitation is essential in maintaining human health. The importance of water and sanitation is articulated in the Millennium Development Goals (MDGs); specifically in the MDG-7 target of reducing by one-half the proportions of people without sustainable access to safe drinking water and to basic sanitation (as measured by the access to improved water sources and access to improved sanitation)[2] (WHO/UNESCO, 2004; UN, 2012). Globally, an estimated 876 million people lack reliable access to improved water sources and 2.63 billion do not have access to improved sanitation facilities.

Water quality may be a problem for varied reasons in different regions compounded by economic conditions. In the low income countries the problem is mainly due to poor sanitation, contamination of both surface and underground water by pesticide residues and nutrients from farms and dumping of untreated and/or partially treated domestic water. In the high income industrialized countries the issue is mainly a result of poor disposal of industrial waste water. In drier areas contamination of ground water by saline water seepage from the salty sea water is more common. All of these factors worsen water security in MMCs.

In Africa, rising levels of pollution of surface and groundwater resources compounds inadequate access to freshwater. The primary sources of pollution are sewage and industrial effluents. Agricultural run-off is an additional burden, through contamination with chemical residues and silt, and increased nutrient levels which causes eutrophication in water bodies. In MMCs in West Africa, this phenomenon commonly occurs in the coastal areas, where most industries and commercial agricultural plantations are located (UNEP, 2002; UNESCO, 2009). The health impacts

[2] Improved water sources, according to the WHO Global Health Observatory (WHO/GHO), include household water-supply connections, public standpipes, boreholes, protected dug wells, protected springs, and rainwater collection. Improved sanitation facilities include connections to public sewers or septic systems, pour-flush latrines, simple pit latrines or ventilated, improved pit latrines-but not public or open latrines (WHO/UNESCO, 2004; WHO, 2006).

of wastewater pollution on coastal waters have an economic cost of US$12 billion/year (Shuval, 2003).

MMCs in Southeast Asia face poor water quality resulting from environmental degradation and pollution. There also have been incidences of increased waste streams, especially in Indonesia, due to growing industrial, domestic, and agriculture sectors. Recent studies indicate that at least 80 % people in Indonesia have no access to piped water (Acharya et al., 2008). Due to limited access to clean water, a large number of people especially in the rural areas still use untreated water drawn from rivers for drinking, bathing, and washing (Table 9.3). The country, particularly its urban slums, sorely lacks wastewater treatment facilities, and basic sanitation infrastructure necessary to prevent human excrement from contaminating water supplies. Survey results show that about 56.15 % households dispose their domestic waste directly to the rivers (Acharya et al., 2008; Resosudarmo, 2003) and six major rivers in West Java do not meet requirement for drinking water quality.

Table 9.3 Indicators on drinking water supply in MMCs

		Drinking water					
		Urban			Rural		
		Improved		Unimproved	Improved		Unimproved
Country	Year	Total improved (%)	Piped on premises (%)	Surface water (%)	Total improved (%)	Piped on premises (%)	Surface water (%)
South & South East Asia							
Afghanistan	2000	36	10	10	18	0	39
	2010	78	16	5	42	0	11
Bangladesh	2000	86	23	0	77	0	3
	2010	85	20	0	80	1	2
Brunei[a]	2000						
	2010						
Indonesia	2000	91	31	1	68	5	6
	2010	92	36	0	74	8	4
Malaysia	2000	99	95	0	93	80	2
	2010	100	99	0	99		
Maldives	2000	100	67	0	93	0	
	2010	100	96	0	97	1	
Pakistan	2000	96	57	0	85	15	8
	2010	96	58	0	89	23	5
South West Asia							
Bahrain	2000	100	100	0			
	2010	100	100	0			
Iran	2000	98	96	0	85	76	2
	2010	97	96	0	92	88	0

(continued)

Table 9.3 (continued)

		Drinking water					
		Urban			Rural		
		Improved		Unimproved	Improved		Unimproved
Country	Year	Total improved (%)	Piped on premises (%)	Surface water (%)	Total improved (%)	Piped on premises (%)	Surface water (%)
Iraq	2000	95	92	2	49	37	35
	2010	91	89	2	56	50	17
Jordan	2000	98	96		91	83	
	2010	98	93		92	79	
Kuwait	2000	99			99		
	2010	99			99		
Lebanon	2000	100	100	0	100	85	0
	2010	100	100	0	100		0
Oman	2000	87	49	4	74	15	10
	2010	93	82		78	31	
Qatar	2000	100		0	100		0
	2010	100		0	100		0
Saudi Arabia	2000	97	97				
	2010	97	97				
Turkey	2000	97	95	0	85	73	1
	2010	100	99	0	99	97	0
United Arab Emirates	2000	100	80	0	100	70	0
	2010	100		0	100		0
Yemen	2000	83	77	1	52	20	7
	2010	72	71	1	47	26	6
Central Asia							
Azerbaijan	2000	88	72	1	59	18	17
	2010	88	78	2	71	20	16
Kazakhstan	2000	99	87	0	91	26	3
	2010	99	82	0	90	24	3
Kyrgyzstan	2000	98	82	1	73	30	23
	2010	99	89	0	85	34	11
Tajikistan	2000	93	77	4	50	18	36
	2010	92	83	6	54	25	44
Turkmenistan	2000	97	81	1	72	29	20
	2010	97					
Uzbekistan	2000	98	86	1	83	32	6
	2010	98	85	1	81	26	5
Africa							
Algeria	2000	93	84	0	84	52	1
	2010	85	80		79	56	
Burkina Faso	2000	85	17	0	55	0	7
	2010	95	23	0	73	0	5

(continued)

Table 9.3 (continued)

		Drinking water					
		Urban			Rural		
		Improved		Unimproved	Improved		Unimproved
Country	Year	Total improved (%)	Piped on premises (%)	Surface water (%)	Total improved (%)	Piped on premises (%)	Surface water (%)
Chad	2000	60	15	2	41	0	10
	2010	70	23	0	44	1	5
Comoros	2000	93	45	1	92	17	3
	2010	91	53	0	97	21	0
Djibouti	2000	88	73	0	63	11	5
	2010	99	79	0	54	1	5
Egypt	2000	98	95	0	95	66	1
	2010	100	100	0	99	93	0
Gambia	2000	90	40	0	77	3	0
	2010	92	51	0	85	5	0
Guinea	2000	88	25	3	52	0	33
	2010	90	29	0	65	1	14
Guinea-Bissau	2000	68	13	0	43	0	4
	2010	91	11	1	53	0	3
Libya	2000	54			55		
	2010						
Mali	2000	70	26	1	36	1	7
	2010	87	35	0	51	1	3
Mauritania	2000	45	26	1	37	8	7
	2010	52	35	0	48	14	6
	2010	100	100	0	99	99	
Morocco	2000	96	82	0	58	12	15
	2010	98	89	0	61	19	23
Niger	2000	78	30	0	35	1	3
	2010	100	39	0	39	2	3
Nigeria	2000	77	20	4	36	2	31
	2010	74	8	5	43	1	22
Somalia	2000	35	12	6	15	0	29
	2010	66	53	4	7	0	41
Sudan	2000	76	62	3	55	16	12
	2010	67	47	2	52	12	13
Tunisia	2000	98	92	0	77	33	2
	2010	99					

Data source: WHO/UNICEF (2013) Joint Monitoring Programme (JMP) for Water Supply and Sanitation http://www.wssinfo.org/
[a]Missing data

Population growth and development are worsening water quality in other MMCs. For example, the Niger River's ability to supply water for people of West Africa is decreasing. Degradation of water quality inland also creates problems for domestic, industrial, and agricultural users. In Senegal for example, 7,000 households are dependent on a groundwater source that was recently found to have nitrate concentration well above the WHO's guideline of 50 mg/L. Two sources of contamination were identified, namely: shallow nearby latrines; and waste organic matter carried in the groundwater (Tandia et al., 1999). These varied sources of low access to or quality of water require different solutions.

The climate is changing at an alarming rate causing temperature rise, shifting patterns of precipitation, and more extreme events (IPCC, 2007). Climate change will affect all facets of society and the environment, directly and indirectly, with strong implications for water and agriculture now and in the future. Water storage and control investments will be important rural development strategies to respond to climate change. The policies and laws set up to reduce greenhouse gas emissions or to adjust to a changing climate also need to be taken into account.

9.3.1 Sanitation

Most people in sub-Saharan Africa and Asia lack sanitation facilities (WHO/UNICEF, 2004); many MMCs in these regions have similar condition. As Table 9.2 shows, there was only minimal improvement in sanitation in most MMCs in Africa, South Asia (with the exception of Maldives in South Asia and oil-rich North African countries such as Libya, Algeria and Tunisia) and Central Asia. Similar to the case of improved water supply, majority of those in rural areas within these countries are worse off in terms of access to sanitation facilities in comparison to their counterparts in urban areas.

In Indonesia, over 30 % people are without improved sanitation (Table 9.4), and cases of open defecation worsen the sanitation and increases surface water pollution. Open defecation, most widespread in rural areas of the poorer countries, worsens the problem of poor sanitation in these countries. This is particularly so in the rural areas as well as in unplanned settlements in the urban areas. The problem is more prevalent in MMCs within Sub-Saharan Africa and parts of South Asia (Table 9.4). The situation has been improved in the recent past in MMCs, especially in South and Southeast Asia through interventions by community-based organizations or voluntary organizations to fill the service gaps (Lim et al., 2013; Sansom, 2014; also see Chaps. 6 and 7).

In the MENA region, about 75 % of the population has access to improved sanitation. Nonetheless, the variation among different countries and between urban and rural areas is very wide. For example, the oil-rich Arabian Peninsula countries such as Kuwait, Qatar, and the UAE have close to universal coverage of sanitation; Syria has 77 % coverage; while in Yemen only some 30 % people have access to basic sanitation (WHO/UNICEF, 2004). In most countries people living in urban areas

Table 9.4 Indicators on sanitation facilities in MMCs

		Sanitation facilities					
		Urban			Rural		
		Improved	Unimproved		Improved	Unimproved	
Country	Year	Total improved (%)	Total unimproved (%)	Open defecation (%)	Total improved (%)	Total unimproved (%)	Open defecation (%)
South & South East Asia							
Afghanistan	2000	46	54	11	28	72	33
	2010	60	40	2	30	70	22
Bangladesh	2000	58	42	5	43	57	24
	2010	57	43	2	55	45	5
Brunei	2000						
	2010						
Indonesia	2000	64	36	16	30	70	42
	2010	73	27	14	39	61	36
Malaysia	2000	94	6	1	90	10	4
	2010	96	4	0	95	5	
Maldives	2000	98	2	0	72	28	19
	2010	98	2	0	97	3	0
Pakistan	2000	72	28	6	20	80	53
	2010	72	28	4	34	66	34
Southwest Asia							
Bahrain	2000	100	0	0			
	2010	100	0	0			
Iran	2000	92	8	0	86	14	1
	2010	100	0	0	100	0	0
Iraq	2000	76	24	0	54	46	17
	2010	76	24	0	67	33	4
Jordan	2000	98	2	0	96	4	2
	2010	98	2	0	98	2	0
Kuwait	2000	100	0	0	100	0	0
	2010	100	0	0	100	0	0
Lebanon	2000	100	0	0	87	13	
	2010	100	0	0			
Oman	2000	98	2	2	71	29	29
	2010	100	0	0	95	5	
Qatar	2000	100	0	0	100	0	0
	2010	100	0	0	100	0	0
Saudi Arabia	2000	100	0	0			
	2010	100	0	0			
Turkey	2000	96	4	0	71	29	3
	2010	97	3	0	75	25	1

(continued)

Table 9.4 (continued)

		Sanitation facilities					
		Urban			Rural		
		Improved	Unimproved		Improved	Unimproved	
Country	Year	Total improved (%)	Total unimproved (%)	Open defecation (%)	Total improved (%)	Total unimproved (%)	Open defecation (%)
United Arab Emirates	2000	98	2	0	95	5	0
	2010	98	2	0	95	5	0
Yemen	2000	82	18	4	24	76	42
	2010	93	7	2	34	66	31
Central Asia							
Azerbaijan	2000	73	27	0	50	50	0
	2010	86	14	0	78	22	1
Kazakhstan	2000	97	3	0	97	3	1
	2010	97	3	0	98	2	0
Kyrgyzstan	2000	94	6	0	93	7	0
	2010	94	6	0	93	7	0
Tajikistan	2000	93	7	1	89	11	2
	2010	95	5	0	94	6	0
Turkmenistan	2000	99	1	0	97	3	1
	2010	99	1		97	3	
Uzbekistan	2000	97	3	0	87	13	0
	2010	100	0	0	100	0	0
Africa							
Algeria	2000	99	1	1	82	18	14
	2010	98	2	1	88	12	10
Burkina Faso	2000	46	54	10	4	96	83
	2010	50	50	9	6	94	76
Chad	2000	26	74	20	5	95	87
	2010	30	70	15	6	94	80
Comoros	2000	42	58	0	23	77	1
	2010	50	50	1	30	70	1
Djibouti	2000	69	31	6	30	70	53
	2010	63	37	0	10	90	61
Eritrea	2000	54	46		2	98	97
	2010				4	96	
Egypt	2000	95	5	1	79	21	7
	2010	97	3	0	93	7	0
Gambia	2000	67	33	1	60	40	
	2010	70	30	0	65	35	
Guinea	2000	26	74	3	9	91	42
	2010	32	68	1	11	89	30
Guinea-Bissau	2000	36	64	4	5	95	53
	2010	44	56	2	9	91	43

(continued)

Table 9.4 (continued)

		Sanitation facilities					
		Urban			Rural		
		Improved	Unimproved		Improved	Unimproved	
Country	Year	Total improved (%)	Total unimproved (%)	Open defecation (%)	Total improved (%)	Total unimproved (%)	Open defecation (%)
Libya	2000	97	3		96	4	
	2010	97	3		96	4	
Mali	2000	34	66	4	12	88	28
	2010	35	65	4	14	86	20
Mauritania	2000	38	62	20	9	91	68
	2010	51	49	15	9	91	81
	2010	91	9	0	88	12	0
Morocco	2000	82	18	2	43	57	50
	2010	83	17	0	52	48	38
Niger	2000	27	73	22	3	97	93
	2010	34	66	20	4	96	91
Nigeria	2000	37	63	10	32	68	32
	2010	35	65	12	27	73	31
Somalia	2000	45	55	13	10	90	72
	2010	52	48	3	6	94	83
Sudan	2000	48	52	15	16	84	54
	2010	44	56	20	14	86	59
Tunisia	2000	95	5	1	57	43	29
	2010	96	4				

Data source: WHO/UNICEF (2013) Joint Monitoring Programme (JMP) for Water Supply and Sanitation http://www.wssinfo.org/

have better access to improved sanitation than those in rural areas (Table 9.4). Another trend in cities like Cairo is that the urban newcomers often end up in informal settlements with limited access to basic services, such as water, sanitation, energy and transportation worsening the overall situation. In MMCs like Egypt or Yemen, the voluntary sector has been increasingly involved in the provision of water and sanitation facilitates for centuries (please see Chaps. 6 and 7). Some MMCs, for example Yemen, local voluntary sector has been urban service providers including water (see Zabara et al., 2011).

Overcrowding in urban slums (with no sanitation facilities) makes controlling of disease outbreaks, associated with exposure to raw sewage, difficult. The sanitation problem is worse in megacities in Africa and Asia such as Jakarta (Indonesia) and Lagos (Nigeria). In Lagos (a megacity with a population of 12 million) public water supply covers only about 35 % of the metropolitan population, but 60 % of the produced water is lost through leaks and illegal connections (World Bank, 2000). The other 65 % of the population rely on private wells, boreholes, and water vendors. Further, Lagos has no central wastewater collection system, and less than 12 % have an acceptable water-borne sanitation system. About 30 % households use pit latrines and 53 % use flush or pour-flush toilets. Thus wastewater eventually ends up in the storm water drainage system or the Lagos lagoon (WHO/UNICEF, 2004). In Nigeria and other parts of Africa, the situation has been improving (or much better that it should have been) because (Islamic) NGOs have been involved in the provision of water and sanitation facilities for years (see Salih, 2002; Saggiomo, 2012). Still there are water and sanitation crises in many MMCs creating much water security challenges.

9.4 Challenges to Water Security in MMCs

Each year, more than 2.2 million people in developing countries die from preventable diseases associated with lack of access to safe drinking water, inadequate sanitation, and poor hygiene. Improving water quality is vital to achieving water security, and better human health. There are many challenges, though. These challenges can be discussed in two groups: water, economy, and security threats, and water management.

9.4.1 Water, Economy, and Security Threats

Data on water withdrawal by sector refer to gross quantity of water withdrawn annually for a given use. Table 9.5 presents the distribution of water withdrawal by country for the three large water-consuming sectors: agriculture (irrigation and livestock watering), water supply (domestic/municipal use), and industry. Total annual water withdrawal for Southwest Asia is 271.5 km^3 (around 7 % of world withdrawals) (FAO, 2003; UN Water, 2012)—about 84 % is for agriculture, which is higher than the world average (70 %). Water use in agriculture is not much less in water-stressed MMCs (Table 9.5). In Saudi Arabia, Oman, Yemen and Iran, agricultural withdrawal accounts for more than 85 % of the total water withdrawal, while in Bahrain, Kuwait, and Qatar about 60 %. In some other MMCs, for example Iran and Turkey, water withdrawal in agriculture is less because high annual precipitation allows rain-fed agriculture, which is not feasible in dry countries, in most of the Arabian Peninsula (Table 9.5). It is estimated that 14 % more freshwater will need to be withdrawn for agricultural purposes in the next 30 years (FAO, 2007) to produce food for three billion additional people. This agriculture sector water need is to compete with the growing urban needs for clean water. People must become conscious and use water efficiently.

Water scarcity in MMCs, especially in Southwest Asia, did and force national economies to find alternative ways to satisfy demands for water (Gleick, 2000). There are non-conventional sources of water like the re-use of urban or industrial wastewaters (with or without treatment), which increases the overall efficiency of

Table 9.5 Freshwater withdrawal by country and sector

Region	Country	Domestic Use (%)	Industrial Use (%)	Agricultural Use (%)	Domestic Use (m^3/p/year)	Industrial Use (m^3/p/year)	Agricultural Use (m^3/p/year)
South & South East Asia	Afghanistan	2	0	98	14	0	785
	Bangladesh	10	2	88	25	5	222
	Brunei	–	–	–	–		
	Indonesia	8	1	91	28	2	325
	Malaysia	17	21	62	54	68	201
	Maldives	98	2	0	9	0	0
	Pakistan	5	1	94	52	8	933
Southwest Asia	Bahrain	50	6	45	221	27	199
	Iran	7	1	92	85	12	1,143
	Iraq	7	15	79	147	315	1,657
	Israel	36	6	58	97	16	156
	Jordan	31	4	65	45	6	95
	Kuwait	44	2	54	132	6	162
	Lebanon	29	11	60	89	34	185
	Oman	10	1	88	45	5	400
	Qatar	39	2	59	115	6	174
	Saudi Arabia	9	3	88	81	27	793
	Turkey	15	11	74	78	58	393
	United Arab Emirates	15	2	83	127	17	705
	Yemen	8	2	90	11	3	126
Central Asia	Azerbaijan	4	19	76	55	260	1,039
	Kazakhstan	2	17	82	38	367	1,817
	Kyrgyz tan	3	3	94	57	56	1,703
	Tajikistan	4	5	92	63	79	1,549
	Turkmenistan	2	1	98	81	36	4,645
	Uzbekistan	5	2	93	100	43	1,956

(continued)

Table 9.5 (continued)

Region	Country	Domestic Use (%)	Industrial Use (%)	Agricultural Use (%)	Domestic Use (m^3/p/year)	Industrial Use (m^3/p/year)	Agricultural Use (m^3/p/year)
Africa	Algeria	22	13	65	38	23	111
	Burkina Faso	13	1	86	6	0	42
	Chad	17	0	83	3	0	17
	Comoros	48	5	47	7	1	7
	Djibouti	84	0	16	19	0	4
	Egypt	8	6	86	62	49	695
	Eritrea	5	0	95	6	0	105
	Gambia	23	12	65	4	2	11
	Guinea	8	2	90	11	3	132
	Guinea-Bissau	13	5	82	14	5	90
	Libya	14	3	83	91	20	541
	Mali	9	1	90	44	5	442
	Mauritius	25	14	60	120	67	284
	Morocco	10	3	87	39	12	339
	Niger	4	0	95	5	0	130
	Nigeria	21	10	69	11	5	35
	Senegal	4	3	93	7	5	161
	Sierra Leone	5	3	92	3	2	60
	Somalia	0	0	99	2	0	351
	Sudan	3	1	97	23	6	835
	Tunisia	14	4	82	36	10	209

Source, FAO/AQUASTAT (2012)

use of water (extracted from primary sources), mostly in agriculture, but increasingly in industrial and domestic sectors, and the production of freshwater by desalination of brackish or saltwater (mostly for domestic purposes).

Total treated wastewater reused in the Southwest Asia is 2,663 million m^3 (FAO, 2003). On a sub-regional scale, the Levant sub region accounts for 72 % of the total reused treated wastewater, the Arabian Peninsula for 22 % and the Caucasus 6 %. Country-wise, Turkey accounts for 38 % of the total re-used treated wastewater in the region, followed by Syria and the UAE with 21, and 9 %, respectively. Only three countries, Iraq, Lebanon and Syria, provide data about re-used agricultural drainage water, which amounts to 1,500 million m^3, 165 million m^3 and 2,246 million m^3, respectively.

Desalination is a major source of water in Arabian Peninsula. On a sub-regional scale, the Arabian Peninsula accounts for 87.4 % of the total desalinated water estimated to be 3,225 million m^3/year. In absolute terms, three countries (Saudi Arabia, the UAE, and Kuwait) are by far the largest users of desalinated water, accounting for 77 % of the region's total with Saudi Arabia using an annual 1,033 million m^3 and the UAE and Kuwait 950 and 420 million m^3, respectively. In Saudi Arabia about 70 % of the drinking water is sourced in the desalination plants. Desalinated water is usually used for crop irrigation, golf courses, and urban landscaping. In the Gulf alone, MSF (Multi-Stage Flash) desalination plants treat large volumes of seawater (in excess of 25 million m^3/day) to obtain 5–10 million m^3/day. The remainder (about 20 million m^3/day of very heated and concentrated brine) is returned back to the sea—an issue that has become a concern. Though generally seen as benign, seawater desalination creates environmental concerns (Hashim & Muneer, 2005) that are still largely ignored. In spite of its scarcity and expensive sources, water is often wasted in the Arab world due to heavily subsidized low tariff which is around 35 % of the production costs and only 10 % of the desalinated water cost.

9.4.1.1 Wastewater Management

Higher use of water and volume of human waste has outpaced the development of wastewater management systems leading to the pollution of natural water bodies, unintentional use of wastewater in irrigated agriculture, irregular water supply, and environmental concerns for aquatic life (Van Rooijen et al., 2009). Overcrowding in urban slums worsens the situation and makes the control of disease outbreaks (due to the exposure to raw sewage) more difficult.

The primary sources of pollution in Sub-Saharan Africa, for example, are sewage and industrial effluents, agricultural run-off (contaminated with chemical residues and silt and increased nutrient levels), which eventually causes eutrophication (UNEP/GEMS, 2008) due to high nitrate and phosphate levels in agricultural run-off. This is particularly noticeable in the coastal areas in Nigeria, where most industries and commercial agricultural plantations are located.

Urbanization, industrialization, and agricultural activities in South Asian MMCs like many other countries have also resulted in environmental pollution.

Poorly sited waste dumping and seepage from landfills are the major causes of surface and groundwater pollution. This is specifically true about water bodies wherein various nutrients, toxic solid wastes, effluents and emission are being discharged, resulting in an excessive amount of toxic and hazardous metals in local ground and surface water. Due to discharge of untreated industrial effluents in the sewage channels, the deteriorated water quality has created major concerns for healthy, clean and good quality drinking water, especially in urban areas. The Indus River, draining the Himalayas flowing through densely populated regions in Pakistan, shows strong influence of various types of human activities. Tariq et al. (1996) have shown that the river becomes a drain at its mouth near Karachi after receiving urban and industrial waste from a number of cities along the route.

A recent government report stated that 80 % groundwater in Jakarta is polluted with pathogenic, disease causing bacteria, such as *E. coli* (two to 32 times more than the level tolerated by the Health Ministry); the problem, however, is not confined within the larger cities and has spread in the rural areas (Ardhianie, 2009).[3] Many Jakarta residents live in slums that cluster around the rivers and canals running through the city. These waterways, winding down from an inland mountain range, have become major recipients of industrial, household and human waste. In addition to domestic wastes, sources of water pollution in Indonesia also include waste water from textile, pulp and paper, petrochemical, mining, and oil and gas industries. Data show that water quality in nine out of 16 sampling point locations near mining areas is contaminated by heavy metal such as mercury (Hg) with the highest level of dissolved mercury in one of mining area reaching 2.78 μg/L (Resosudarmo, 2003; Schwarzenbach et al., 2010).

Pollution of surface and groundwater is a serious problem in Central Asia. The quality of surface water is low because of discharges of insufficiently treated or untreated sewage from populated localities or effluents from industrial plants or industrial accidents. Also, effluents from farms including residues from fertilizer, manure, or pesticides have led to increased salinity and pollution of water and groundwater by nitrates, phosphorus, and pesticides. According to data produced within Regional Water Intelligence Report Central Asia (Stockholm International Water Institute, 2010), salinity, fertilizers, agro-chemicals and uranium tailings are major regional water quality issues.

9.4.1.2 Groundwater Contamination

Due to the limited availability of surface water during the dry season, the use of groundwater has become increasingly important source of water for irrigation, municipal and industrial purposes in many MMCs. As surface and groundwater

[3] The World Health Organization (WHO) estimates that diarrheal diseases caused the deaths of around 20,500 children under 5 years old in Indonesia in 2008 (UN-Water, 2012; WHO/UNICEF, 2004).

hydrological systems are interdependent, the tapping of shallow and deep aquifers by wells and pumps has compromised the rate at which groundwater replenishes regional river basins. The World Bank warned that water is being drawn from underground aquifers faster than it is being replenished, leading to saltwater intrusion and land subsidence with attendant increases in floods and waterlogging which, in turn, aggravates groundwater pollution from septic tanks (World Bank, 2008a, 2008b).

Groundwater quality in southwest Asia is also affected by agricultural, municipal, and industrial activities in the recharge zone of most aquifers. Potential sources of contamination include recycled irrigation water, wastewater from human activities, and waste by-products from industrial activities (Morris et al., 2003). Since almost all renewable water resources in the Arabian Peninsula are in use, some countries are over-exploiting their water resources by about 10–20 % (FAO/AQUASTAT, 2012). As a result, water levels are dropping, groundwater resources are being mined, salinization and salt water intrusion are taking place.[4]

There is evidence of permanent depletion of groundwater levels in some countries, for example, in Bangladesh particularly in the northwest region of the country and Dhaka metropolitan area, where the water level's average annual decline is about 3 m (BADC, 2006). Groundwater in parts of Bangladesh has a high level of arsenic and fluoride content (World Bank, 2005; Madhavan & Subramanian, 2000, 2001), and in many areas fluoride of geological origin produces problematic groundwater concentrations—both creating major threat to human health[5] (World Bank, 2008).

Pollution of surface and groundwater is a serious problem also in Central Asia. According to data produced within Regional Water Intelligence Report Central Asia (Stockholm International Water Institute, 2010), the salinity, fertilizers, agrochemicals and uranium tailings are major regional water quality issues. Elevated concentrations of organochlorine pesticides and toxic metals, including arsenic, have been observed in human blood, milk, hair and urine of the population living in the Aral Sea Drainage Basin (ASDB) (Atanyiazova et al., 2001; Erdinger et al., 2004). The exposure to these pollutants through drinking water can considerably contribute to main health problems (Crosa et al., 2006; Friedrich, 2009; Törnqvist et al., 2011).

Simultaneously, increased water pollution is worsening the imbalance between water supply and demand in most MMCs, especially those in areas that receive inadequate rainfall or where surface and groundwater pollution is getting worse. In most of these countries water is crucial for sustainable development and poverty alleviation, like most of the low income countries where about 1.1 billion people or 18 % of the world's population lack access to safe drinking water, and 2.6 billion or 40 % of the world's population lack access to improved sanitation services

[4] See: http://www.fao.org/landandwater/aglw/aquastat/main/index.stm.

[5] For example, ground water with arsenic presence is used heavily in Bangladesh for drinking and all household activities leading to diseases and health hazards like arsenic poisoning, blindness, or physical disability (RDA, 2001).

(UNFPA, 2002a, 2002b). Global water demand is predicted to grow by 55 % between 2000 and 2050 (UN Water, 2012). Meanwhile, depletion of quantity and quality of fresh groundwater during this period is also expected to increase exponentially.

9.4.1.3 Salinization

Salinization is the most widespread groundwater quality problem and creates the greatest environmental and economic impacts (Morris et al., 2003). Often, agricultural activities (mainly irrigated agriculture) and urbanization result in the contamination of the aquifer.[6] Studies have shown an increase in the chloride ions in groundwater with a drop of groundwater levels (Morris et al., 2003; Lashkaripour & Ghafoori, 2011). Overexploitation of ground water in the coastal areas leads to salty sea water seeping into the wells contaminating the fresh ground water. This is particularly so in the arid and semi-arid zones in North Africa, Arabian Peninsula, and parts of Asia. Examples of major sources of saline water in the Levant region include: encroachment of sea water near the Mediterranean Sea and Red Sea; upward migration of highly pressurized brines in the Jordan Rift Valley and other areas; and subsurface dissolution of soluble salts originating in rocks throughout the region. Salinization from poor irrigation methods and pollution from industrial and domestic wastewater disposal are major water quality issues in Africa. For example, continuously saline conditions in the lower reaches of the River Gambia and its tributaries, where the population centers and tourism facilities are located, makes surface water in the Gambia, for example, unusable.[7]

In Indonesia, seawater is seeping into the reservoirs, with the salinized area in northern Jakarta expanding by up to 1 km annually inland from the coast (Corcoran et al., 2010). Contamination of fresh groundwater by saline water is thus a common problem in the region. In the coastal areas of Bangladesh, drinking water from natural sources has become contaminated by varying degrees of salinity due to saltwater intrusion from rising sea levels, cyclone and storm surges, and upstream withdrawal of freshwater (Khan et al., 2011). The coastal population of Bangladesh relies heavily on rivers, tube wells (groundwater), and ponds for washing, bathing, and obtaining drinking water. Domestic ponds, which take up 10 % of the total land area (excluding the rice paddies), are primarily rain fed but can also mix with saline water from the rivers, soil runoff, and shallow groundwater (Rahman & Ravenscroft, 2003). Approximately 20 million people living along the coast are affected by varying degrees of salinity (MOEF, 2006) and resulting hypertension, especially among the pregnant women (Khan et al., 2011). Thus, increased salinity in water may impact from health differently.

[6] Increased salt content of surface and groundwater is mainly due to irrigation return flows and saltwater intrusion along the coast (UN-Water, 2009).

[7] The potable water demand for urban areas, tourism, industry, irrigation, and livestock watering is supplied by groundwater sources (WHO/UNICEF, 2004).

9.5 Hygiene, Water, Gender, and the Third Sector

The WHO definition of access to water (varies according to location) is availability of 20 L/person/day water within 1 km walking distance from the household (UNICEF/WHO, 2004). Access to safe drinking water is a basic human right and essential for achieving gender equality (freeing women and girls from spending long hours fetching water), sustainable development, and poverty alleviation. The right to water entitles all human beings to sufficient, safe, and (physically and financially) accessible water for personal and domestic use. Nonetheless, only a small proportion of population in MMCs in Sub-Saharan Africa, North Africa and South Asia has water on their premises (UN, 2012). For the rest, water has to be collected from some distance by the women and girls responsible for the household chores. Women and girls in Africa[8] may walk over 6 km/day in search of water, spending as much as 8 h collecting water (UNICEF/WHO, 2004; UNFPA, 2002a, 2002b). The disproportionate number of hours spent by girls and women on labor-intensive, time-consuming, and unpaid domestic tasks such as fetching water[9] and other household chores reduce their opportunities for education, decent work, or political engagement, perpetuating gender divide and intergenerational transfer of poverty and disempowerment (see Rodda, 1991; Sorenson et al., 2011). Shortage of drinking water poses severe health risks as manifested through water-borne diseases and severe dehydration (UN, 2012; WHO/UNICEF, 2012). Women in these families take care of and fulfill the work of the people suffering from water-related diseases becoming more vulnerable.

The implications of lack of access to adequate sanitation are widespread. In some countries, girls are often not permitted to attend schools that do not have latrines out of concern for their privacy and modesty (World Bank, 2004). Access to fresh water and sanitation reduces travelling distance for women and girls for water collection, allowing the family better health,[10] girls opportunity to attend schools, women time for other activities including skills development, childcare, growing food, or productive works.

Global water and sanitation practitioners have recognized the importance of incorporating a gender perspective in water management programs based among others, the following observations: (1) women and girls are most often the primary users, providers and managers of water in their households and are the guardians of household hygiene; (2) If a water system falls into disrepair, women are the ones forced to travel long distances over many hours to meet their families' water needs; (3) conversely, women and girls benefit most when services are improved; and (4) low sanitation in educational institutions reduces female school enrolment, and literacy.

[8] In sub-Saharan Africa, 71 % burden of collecting water for domestic use falls on women and girls (UN, 2012). Currently, women and girls in sub-Saharan Africa spend on an average about 200 million h/day collecting water (UN, 2012).

[9] In most countries, girls often are given the task of collecting water, carrying home 15–20 L of water from the water point.

[10] A study in Pakistan demonstrated that the availability of increased quantity of water at the households was critical in preventing stunting growth in children (van der Hoek et al., 2002).

Therefore, investments in water infrastructure alone could save women billions of hours a year. Empowering or enabling women to play leadership roles in using and managing water and sanitation resources may improve family health, higher household incomes, greater access to education, and improved gender equity.

In Morocco, the Rural Water Supply and Sanitation Project of the World Bank aimed to release the girls from collecting water to attend schools. In the six provinces where the project is based, the girls' school attendance increased by 20 % in 4 years because the increased access to safe water reduced the time spent for fetching water by women and young girls by 50–90 % (World Bank, 2003). In Pakistan, school enrolment of all children increased by 80 % over 7 years as a result of the Punjab Rural Water Supply Project (ADB, 2003). The project involved both women and men in all aspects of planning, designing and implementation, brought water to 325 poor and remote villages and transformed the lives of 800,000 people. It has also been proven that improvements in infrastructure services, especially water and electricity particularly for poor women, can help free up women's time spent on domestic and care work (ADB, 2003). In Bangladesh, water projects have led to creating more leisure time for women and increased welfare. In Pakistan, putting water sources closer to the home was associated with increased time allocated to productive work. Improved water and sanitation may transform women and girls in MMCs from water-carrier to active and healthy citizens with education involved in productive works. The third sector has been and can be involved at a higher rate to bring human security freeing women from "water-chain" in the affected MMCs (Salih, 2002; Saggiomo, 2012; Lim et al., 2013; Sansom, 2014).

9.6 Conclusion

Water-related problems and concerns, though not new, are now becoming increasingly apparent and internationalized due to global interdependence. Water problems and related concerns vary considerably among MMCs across geographic regions influenced by climatic conditions. There are also disparities in the available water resources, and annual rate of precipitation. Due to increase in the population and volume of domestic, agriculture and industrial activities, the pressure on water resources intensifies, leading to tensions, conflicts among users, and excessive pressure on the environment. Within MMCs trans-boundary rivers, including the Nile in Africa, Jordan (Lowi, 1995), and Euphrates in Southwest Asia and the Indus, Ganges, and Brahmaputra in southern Asia, have led to disputes, and increased future global concerns.

Global progress made in access to improved sources of drinking-water has been achieved through gaining access to piped drinking water on premises. Some MMCs, e.g. those within the Arabian Peninsula and Southeast Asia have made significant progress in the provision of improved water. There have been better infrastructural facilities in many MMCs, nonetheless poor water quality creates major health risks. Water quality is reduced due to contamination by both natural as well as human influences including inadequate provision of sanitation facilities, sewage disposal, and wastewater treatment.

A recent report on the progress of Millennium Development Goals (MDG) points out that, while the MDG target on water has been largely met, 783 million people in the world still remain without access to an improved source of drinking water. The gap between urban and rural areas remains wide, with the number of people in rural areas without improved water source five times greater than in urban areas in some MMCs. Coping with increasing shortage of water to maintain sufficient water for health, hygiene, agriculture, and industry is a critical challenge for the near future. The future seems to be more challenging because of the climate change and rapid population growth in most MMCs with large number of poor households.

The burden of water collection in poor households falls most heavily on girls and women. Women and young girls, who are to access and carry water, are prevented from income-generating work or attending school. They are also at an increased risk for violence since they travel great distances on a daily basis, and are even at risk when they must go to the edge of the village to find a private place to relieve themselves. Reducing these disparities in national and local water and sanitation planning must be a priority.

The voluntary sector can and, as evident in the discussion, did play commendable roles in the provision of water and sanitation facilities in MMCs reducing gender disparity. In fact, due to religious (water required for ritual purity before five daily prayers), geographic (water constraints in arid and semi-arid MMCs), economic (women's ownership of land), and environmental (water pollution for misuse of surface water and over abstraction of groundwater) reasons water, women, and philanthropy seem to have been tied together in Muslim communities for centuries (also discussed in Chaps. 5–7). In the recent past these relationships have become important and prominent. Access to improved water and sanitation through the voluntary sector interventions are transforming women and girls in MMCs from water-carrier to active and healthy citizens with education involved in productive economic activities furthering better security for all in the family. Human security cannot be achieved without freeing women and girls from the "water-chains" which is only possible with the help of the third sector because the government services do not cover the vulnerable remote areas in the low income countries (see Chaps. 6–8).

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