Human Development in South Asia 2013

Water for Human Development



Mahbub ul Haq Centre

HUMAN DEVELOPMENT IN SOUTH ASIA 2013

Water for Human Development

Mahbub ul Haq Human Development Centre Lahore, Pakistan

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ABBREVIATIONS

ADB	Asian Development Bank
BOD	Biochemical oxygen demand
BWDB	Bangladesh Water Development Board
CBDR	Common but differentiated responsib-
	ilities
CO ₂	Carbon dioxide
COP	Conference of the Parties
CSD	Commission on Sustainable Develop-
	ment
DALYs	Disability adjusted life years
ENSO	El Niño-Southern Oscillation
GBM	Ganges-Brahmaputra-Meghna
GCF	Green Climate Fund
GDP	Gross domestic product
GHGs	Green house gases
GLOFs	Glacial lake outburst floods
GWP	Global Water Partnership
HYPHEN	Himalayan and Peninsular Hydro-
	ecological Network
ICIMOD	International Centre for Integrated M-
	ountain Development
IFIs	International financial institutions
ILR	Indian Interlinking of Rivers
INGOs	International non-governmental orga-
	nizations
INR	Indian rupee
INSA	Imagine a New South Asia
IPCC	Intergovernmental Panel on Climate
	Change
IWMI	International Water Management Ins-
	titute
IWRM	Integrated water resource management
JRC	Joint River Commission

КРК	Khyber Pakhtunkhwa
MDGs	Millennium Development Goals
MSMEs	Micro, small and medium enterprises
NAMAs	National Appropriate Mitigation Acti-
	ons
NAPAs	National Adaptation Programmes of
	Actions
NASA	National Aeronautics and Space Adm-
	inistration
NGOs	Non-governmental organizations
PKR	Pakistani rupee
PPPs	Public-private partnerships
SAARC	South Asian Association for Regional
	Cooperation
SARI	South Asia Regional Initiative for
	Energy
SAWI	South Asia Water Initiative
SDGs	Sustainable Development Goals
UN	United Nations
UNCIW	UN Convention on the Law of the
	Non-Navigational Uses of International
	Watercourses
UNEP	United Nations Environment Program-
	me
UNESCO	United Nations Educational, Scientific
	and Cultural Organization
UNFCCC	United Nations Framework Conventi-
	on on Climate Change
UNICEF	United Nations Children's Fund
US\$	United States dollar
WCD	World Commission on Dams
WHO	World Health Organization

Foreword

The year 2013 is the International Year of Water Cooperation and March 22 of 2013 was held as the World Water Day. The UN system is highlighting this year with a number of initiatives around the world. So we start this Report by quoting from UN Secretary General's message on March 22 on this issue:

"Water holds the key to sustainable development. We need it for health, food security and economic progress. Yet, each year brings new pressures. One-in-three people already lives in a country with moderate to high water stress, and by 2030 nearly half the global population could be facing water scarcity, with demand outstripping supply by 40 per cent. Competition is growing among farmers and herders; industry and agriculture; town and country; upstream and downstream; and across borders. Climate change and the needs of populations growing in size and prosperity mean we must work together to protect and manage this fragile, finite resource."

(Message of UN Secretary General, March 22, 2013 New York)

Mahbub ul Haq Centre needed to devote a report on water not only from the point of view of its availability and usability by its growing population but also from the perspective of human development. The concern of this Report was to analyse how water could impact people's ability to survive and prosper in this region, in the context of potential scarcity of water by 2030 and the variability of weather due to climate change. South Asia's other concern is the transboundary river issues that can at any moment lead to a huge conflict within the region which is already plagued by mistrust among the countries.

Water is intimately connected to all the major challenges that are facing South Asia today. The region with a huge emerging economy is, at the same time, facing declining water availability, food insecurity, poverty, environmental degradation and a large number of people without adequate health and education. The economies of most countries are growing, but are the people moving up with the economies? And how is this emerging water issue going to impact this unequal and unjust growth? Can this growth be sustained without efforts to mitigate climate change? In the context of reduced water supply, can this region afford not to cooperate with its neighbours on water sharing? These are some of the issues that this Report tries to address.

The Report contains five chapters. Chapter 1 introduces the theme of this year's Report on water and human development. Chapter 2 analyses both water and sanitation from the point of people's Chapter 3 provides an well-being. economic analysis of water by looking at supply, demand, pollution, conservation and institutional infrastructure to support water economy. Chapter 4 explores the impact of climate change on water. Finally, chapter 5 critically analyses the issue of transboundary water management in South Asia. Based on the analyses of these chapters, the Report comes up with six major conclusions:

- 1. The world, particularly South Asia, can no longer take water for granted.
- 2. In South Asia, lack of access to water is reinforcing the existing social inequalities.

- 3. Water should be managed and conserved appropriately so that the present generation, as well as the future generations, can benefit from this vital resource.
- 4. Water is a critical driver of economic growth in South Asia.
- 5. Climate change, which is a formidable challenge for South Asia, can no longer be ignored.
- 6. South Asian countries have to work together under a regional framework to resolve and manage transboundary water issues.

I would like to acknowledge the contribution of the United Nations Development Programme (UNDP) Regional Bureau for Asia and the Pacific, particularly Dr. Ajay Chhibber, Director of the Regional Bureau for Asia and the Pacific, for financial support to the Mahbub ul Haq Human Development Centre. Without UNDP support, it would not be possible for the Centre to carry on this work. I thank the Advisory Board of the Mahbub ul Haq Centre, especially Prof. Frances Stewart, Prof. Gustav Ranis, Prof. Jayati Ghosh, Mr. M. Syeduzzaman and Dr. Adil Najam, for guiding the content of this Report and by providing their comments on the concept note and outline of the Report. I am always so grateful to them for keeping up their support and work for the Centre. I thank Mr. Sartaj Aziz, Vice-Chancellor of Beaconhouse National University and a member of Mahbub ul Haq Centre Governing Board, for guiding and supervising the research team. I thank another Board member, Shaheen Attiq-ur-Rehman, for her advice and support for the research team. I am thankful to Syed Babar Ali, Pro-Chancellor of LUMS, for providing a home to Mahbub ul Haq Centre at LUMS, an academic institution of excellence with a superb campus and hospitable atmosphere. We are so grateful for this unique privilege.

This is the first annual report of Mahbub ul Haq Centre that is prepared by the in-house staff. Currently, the total research staff strength of the Centre consists of four senior research fellows-all of them are highly qualified and motivated to handle the research, writing and advocacy work. For the last two months they have worked through the weekends in order to complete the job. I am truly grateful to each one of them for their commitment to the Centre. I thank Nazam Maqbool, Umer Malik, Fazilda Nabeel and Amina Khan for their untiring efforts. I also thank Tanveer Ahmed for handling the administrative work.

Lahore 24 June 2013

Khadija Haq

Team for the preparation of the 2013 Report Coordinator and lead author: Khadija Haq

MHHDC research team

Nazam Maqbool Umer Malik Fazilda Nabeel Amina Khan

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We would also like to thank the librarians of the Lahore University of Management (LUMS) in Lahore, Sustainable Development Policy Institute (SDPI) in Islamabad, Pakistan Institute of Development Economics (PIDE) in Islamabad, and Beaconhouse National University (BNU) in Lahore.

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About Mahbub ul Haq Centre

Under the umbrella of Foundation for Human Development in Pakistan, Mahbub ul Haq Human Development Centre (MHHDC) was set up in November 1995 in Islamabad, Pakistan by the late Dr. Mahbub ul Haq, founder and chief architect of United Nations Development Programme (UNDP) Human Development Reports (HDRs). With a special focus on South Asia, the Centre is a policy research institute and think tank, committed to the promotion of the human development paradigm as a powerful tool for informing people-centred development policy, nationally and regionally.

The Centre organizes professional research, policy studies and seminars on issues of economic and social development as they affect people's well-being. Believing in the shared histories of the people of this region and in their shared destinies, Haq was convinced of the need for cooperation among the countries of the region. His vision extended to a comparative analysis of the region with the outside world, providing a yardstick for the progress achieved by South Asia in terms of socio-economic development. The Centre's research work is presented annually through a Report titled, *Human Development in South Asia*.

Continuing Mahbub ul Haq's legacy, the Centre provides a unique perspective in three ways: first, by analysing the process of human development, the analytical work of the Centre puts people at the centre of economic, political and social policies; second, the South Asia regional focus of the Centre enables a rich examination of issues of regional importance; and third, the Centre's comparative analysis provides a yardstick for the progress and setbacks of South Asia vis-à-vis the rest of the world.

The current activities of the Centre include: preparation of annual reports on *Human Development in South Asia;* publication of a collection of unpublished papers of Mahbub ul Haq; preparation of policy papers and research reports on poverty reduction strategies; and organization of seminars and conferences on global and regional human development issues, South Asian cooperation, peace in the region and women's empowerment.

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Mahbub ul Haq Human Development Centre

Lahore University of Management Sciences, Academic Block, Ground Floor Opposite Sector U, DHA, Lahore Cantt, 54792. Tel: 042-35608000 ext. 2156 Fax: 92-42-35748713 e-mail: hdc@comsats.net.pk website: www.mhhdc.org

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WATER FOR HUMAN DEVELOPMENT: AN OVERVIEW

Water, like religion and ideology, has the power to move millions of people. Since the very birth of human civilization, people have moved to settle close to it. People move when there is too little of it. People move when there is too much of it. People journey down it. People write, sing and dance about it. People fight over it. All people, everywhere and every day, need it.

—Mikhail Gorbachev¹



Water for Human Development: An Overview

Introduction

Water encompasses all aspects of human life Water is an issue of critical concern to South Asia today. Water—its availability, distribution, consumption and impact on people's lives and livelihoods—is intimately connected to all the major challenges that the region faces now and will continue to do so in the future as well. Declining water availability, food insecurity, poverty, environmental degradation, and unsustainable development are all closely related to, or determined by water—its availability and usability.

In essence, water encompasses all aspects of human life. It plays a critical role in people's well-being and economic development. Lack of water, on the other hand, undermines people's capability to achieve their full potential in terms of good health, education and employment. Part of the problem lies in how people conceive water—as a need, a right, or a commodity. If water is perceived as a commodity, a critical link between water and people's well-being is missed. This is because water is a necessity and a right for people's survival. Increasingly water is being treated like a commodity, which reduces its true value as an essential resource that the state should provide to all its citizens.

The fundamental premise of this Report is based on the importance of water for human development. It lays out the linkage between water security and the concept of human security, framing the two concepts within the wider framework of human development. Clean water, sanitation and economic growth are the factors that combine to form the critical pillars to determine water's role for human development. Improvements in people's lives and livelihoods, and their capabilities to contribute to the economy are determined by the availability of water at the time when it is required, unhindered by droughts and floods engendered by climate change, and conflicts within and among nations.

This year's Report illustrates the state of water resources in the South Asian region, which although endowed with a fair share of the world's water resources, experiences considerable temporal and spatial variability in per capita water availability. Climate variability, in recent years, has made countries in the region prone to severe droughts and intense floods, with unpredictable patterns of rainfall. Climate change has multiplied the threats and risks that people are exposed to and the lack of equitable and effective water sharing agreements both within and across countries has become problematic. Among South Asian countries, the largest country, India, has limited water resources as compared to the size of its large and diverse population. Pakistan is heavily dependent on the Indus River for its surface water and groundwater resources. The country finds it increasingly difficult to manage the impact of natural disasters that have resulted in a high number of deaths, enormous devastation and destruction of livelihoods and settlements since the floods of 2010 and an economic loss amounting to several billion dollars. Bangladesh has most of its river systems originating in other countries and is the downstream riparian, which makes it potentially vulnerable to other riparian states' decisions to control the flow and volume of water during critical times of the year, when water availability is low. Bhutan and Nepal, on the other hand, have abundant water resources in the region and will benefit immensely by investing in and tapping into their vast hydropower potential. The Maldives has been successful in using rainwater harvesting as a method to conserve and use water, especially for drinking purposes and is relying less on groundwater extraction. Sri Lanka, on the other hand, is facing a sharp fall in water availability by 2025. Afghanistan is an arid country, but because of its terrain and landscape of snow-capped mountains, it is fairly rich in water resources. However, water infrastructure in Afghanistan is underdeveloped; the country has one of the lowest storage capacities in the world.

Why a South Asia report on water now?

Water has not been at the top of the policy agenda in South Asia and has received very little policy attention. Territorial disputes, in the absence of adequate water sharing agreements, have taken a central position in the water debate in South Asia. This Report, however, shows that any discussion on water needs to deal with other issues related to water, given its multifaceted nature and the complexities that surround it. The reality of water-stressed regions within a country and the journey towards becoming water scarce in a span of two decades should be a daunting issue for the policy makers to devise coherent national water policies and back them up by regional collaboration. South Asian countries are all facing a lack of institutional capacity and ineffective water management. These issues, coupled with limited, dilapidated and ageing infrastructure, high conveyance losses and low storage capacity, add to the problems of water governance in South Asia.

The water debate is also shaped by international commitments, particularly the Millennium Development Goals (MDGs), where South Asian countries have committed themselves to achieving these goals. Goal 7 of MDG calls for (i) integrating the principles of sustainable development into country policies and programmes and reversing the loss of environmental resources; (ii) reducing biodiversity loss; (iii) halving by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation as compared to 1990 levels, and (iv) achieving a significant improvement in the lives of at least 100 million slum dwellers by 2020.

Recent progress noted for the MDGs in 2012 shows that the world has met the target of halving the proportion of people without access to improved sources of water in the year 2010. The proportion of people using an improved water source has increased from 76 per cent in 1990 to 89 per cent in 2010. Between 1990 and 2010, more than two billion people gained access to improved drinking water sources, in the form of piped supplies and protected wells. China and India alone recorded nearly half of the world's progress, with increases of 457 million and 522 million people gaining access to water, respectively. However, rural areas are still behind cities in terms of access to water. More importantly, the sanitation target remains unfulfilled. The number of people forced to resort to open defecation, the largest sanitation challenge, remains a formidable health hazard. Sixty per cent of the people, mostly in rural areas, do not have sanitation facilities.²

Given the state of the water and sanitation deficit facing South Asian countries, will 2015 be a reflection of the several water decades and global action plans that have remained unfulfilled? The answer to this basic question is rooted in the fact that any measure of success or failure in achieving the water and sanitation target by 2015 will depend on national policies and international cooperation. Both national policies and international cooperation have largely remained ineffective, bearing testimony to the fact that much more needs to be done. The second question is, if national policies and international cooperation are not enough, do the forces to break the

Water has not been at the top of the policy agenda in South Asia and has received very little policy attention Water is one of the critical areas for achieving sustainable development and an important part of the post 2015 development framework vicious water-sanitation cycle need to come from somewhere else?

In addition to the MDGs as a necessary goal post for South Asian countries to achieve coverage in rural and urban areas for water and sanitation, the year 2013 is also important because the United Nations (UN) General Assembly has declared it as the 'International Year of Water Cooperation'. In two years, the post 2015 framework will come in the form of Sustainable Development Goals (SDGs), which will replace the MDGs. Water is one of the critical areas for achieving sustainable development and therefore, it is an important part of the post 2015 development framework.

Water cooperation is dependent on a wide variety of factors. First, it requires the identification and participation of relevant stakeholders who need to be brought into the mainstream discussion on water. Their collaborative ventures in unique and innovative ways may well serve as a solution to the water crisis that the region will face in the future. Second, water needs to be managed well by all stakeholders and communities in addition to the overall populace of the region. This can take the form of freshwater resource management, drinking water and sanitation management, wastewater management, coastal zone management, climate change and disaster management, and management of water resources allocation across sectors.

Closing the research and policy divide is another major challenge, which needs to be dealt with. Often the research carried out on South Asia is not reflected in policy decisions (starting from policy inception to implementation)—very little policy focus is given to water. This however has started to change, mainly because of the impact of climate change, which has enduring consequences on people through hydrological and climatic variability. South Asia is ill-equipped to treat the devastating impact of climate change when it comes in the form of excessive floods or prolonged droughts without a collaborative regional initiative.

Food insecurity has also become a problem for the world, and especially for South Asia, with countries relying on agriculture as a critical driver for economic growth, and more importantly, for food production. Since over 70 per cent of available freshwater resources are used to produce food grains, decreasing water availability in the region will put pressures on food production. Within agriculture, intensive use of water in farming, and to a greater extent, overextraction of groundwater for agricultural purposes, contamination of water sources by fertilizers, pesticides and effluents, improper disposal and channeling of wastewater have reduced the amount of water available for the present and the future. This is a challenge that South Asian countries need to deal with, because put together, water and food are essential ingredients to life.

Moreover, dietary patterns and the consumption basket of food are altering in new ways in both rural and urban South Asia. These place a greater pressure on the region's water resources and therefore, need to be tackled in a systematic way so that water security and food security are not compromised for this generation or for the generations to come in the future. The increased demand for water is partly due to increases in population and partly due to rapid rates of urbanization, with a large concentration of people seen in South Asia's major cities. This in turn, means less water will be available for more people.

The issue is not simply a supply or demand side issue, which can be resolved by market dynamics alone. Water's fundamental importance to human development means that each person in South Asia should have access to enough water to meet their individual and household requirements, in addition to sufficient quantities of water for agricultural production, economic development and environmental sustainability.

Defining water in its appropriate context

The way in which water resources are used determines people's hydro-social contract with water. Given the centrality and importance of water for daily survival, sustenance, livelihood opportunities and quality of life, it is necessary to acknowledge and recognize the different roles that water plays in people's lives and according to those roles, how they treat water. It is in this context, that the Report seeks to define water in its appropriate setting. There is a plausible argument about water as a fundamental human need, and therefore it should be considered a human right that ought to be progressively realized by respective countries in the region.

The issue with categorizing water as a commodity or economic good is mainly equity. Commodification allows an inequitable distribution of water. If market forces alone determine access to water, there will be high inequity and people's needs will not be met if water prices are set too high, especially for the poor, who will not be able to afford it. From a human development perspective, this would be unfair.

Hence, placing water in its appropriate context and recognizing that it has multiple uses and multiple definitions, should help South Asian countries in coming to a more holistic understanding of water. This way they would be better equipped to discuss the different dimensions of water resources. Under conditions of water scarcity, which will characterize the region's deficit two decades from now and given water stress that has already crept up in Pakistan and in some parts of India, both the uses and users of water need to be looked at carefully. If water is only seen as an input in the production process for agriculture, industry and electricity generation, there will be a tendency to divide water resources in all its competing uses and very little will be left for other uses.

Water as a human right

In 2002, the UN Committee on Economic, Social and Cultural Rights adopted a General Comment which stated that "the human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic use", thereby establishing a non-legally binding normative framework for the 'progressive realization' of the human right to water. Deeming water a human right, just as the international community has done in the past for a human right to food and to life, has some clear reasoning. First, this would encourage South Asian countries and their governments to step up their efforts towards meeting water needs of their population. Second, by recognizing this right, the pressure to translate this into well-designed and appropriate national and international legal responsibilities is more likely to occur. Third, this would continue to shed light on the deplorable state of water management in several parts of the region. Fourth, this would highlight the role of shared water use by identifying minimum water requirements and water resources allocation for basin parties in South Asia who share the same rivers and tend to get locked into disputes with little avenue for conflict management and shared water use. Lastly, this would help set key priorities for an effective water policy, in which meeting a basic water requirement for people everywhere would come first in place followed by other decisions related to water use and management.

A long-term view by policy makers is definitely required, and South Asian countries committed to these efforts at the global arena as early as 1948, when the Universal Declaration of Human Rights was recognized. The roadmap from the Universal Declaration to the Geneva Convention that followed a year after laid the basis for several rights to be recognized whether civil, political, economic, social, or cultural. The rights of children and The human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic use women were underscored. Sixty years later in 2008, the UN appointed an independent expert and Special Rapporteur, Catarina de Albuquerque for the human rights obligations related to safe drinking water and sanitation. Yet today the people of South Asia stand in the midst of poverty, underdevelopment and gross water and sanitation deficits, which could have been corrected if the right policies were brought into place and acted upon with due diligence.

The right to water should not be looked at in isolation, but as part of achieving wider human development goals to which the South Asian countries have already committed themselves. The imperative and logic for providing safe water and adequate sanitation is known to common people in South Asia and policy makers alike, but far too often, people, especially women and children, suffer under extreme circumstances for lack of access to water and a proper toilet. Human lives and livelihoods that are linked to water need to be seen in a much wider context of water and sanitation's importance in public health, education and the economy. More importantly, it needs to be viewed as South Asia's growing population's journey towards enjoying a decent standard of living, a good quality of life and improved well-being so that both individuals and household members can expand their capabilities and lead healthy and productive lives in the present and in the future.

Seen in this light, the human right to water is a responsibility, both from a moral and an economic standpoint. The moral dimension is rather clear—the costs of not providing people with the right to water and sanitation are encapsulated in the number of deaths and diseases that people contract from dirty and contaminated water. These deaths and diseases are preventable and avoidable, in many instances, and therefore, the moral responsibility is even greater. The economic dimension is also intuitive in the sense that people contribute towards the economy in numerous ways, and if countries lose a great deal of their population to waterrelated problems and diseases, then economies will tend to lose a productive and healthy workforce which could have added to their economic development.

Current orthodoxies in the water domain still regard water as an economic good and official documents do not fully endorse the human right point of view. The underlying assumption is that water as a human right is in tandem with water as an economic good and therefore, both aspects can be discussed simultaneously with the view that even if something is a right, there is still a need to pay for it, as in the case of food. Nevertheless, in principle, the right to water can be seen as a counterweight to the commodification of water, which can undermine the rights of poor people. As countries have adopted the privatization of water as a policy choice in some parts of the world, the private sector's role in providing water has been enhanced. The implicit cost of this action, however, has been borne by the poor. In this respect, the human right to water can be a powerful tool for empowering the people of South Asia, especially the poor, wherein appropriate legislative and regulatory frameworks are laid out.

The importance of water for human development cannot be underestimated as it encompasses all aspects of people's lives and livelihoods. The pressures of population growth and urbanization and the threats from climate change are disturbing the intricate relationship between water and human beings. Therefore, finding an adequate balance between the multiple uses and users of water requires efficient use and equitable distribution of this important resource.

Water is a vital resource that has a significant impact on human development. People rely on water availability, distribution and consumption for meeting their

The right to water should not be looked at in isolation, but as part of achieving wider human development goals needs and requirements for improved well-being and sustenance. Economies too need water as a driving force for economic development because of its use in agriculture, industry, the environment and in energy production.

The foundation of this Report is the critical link between water and human development. It encompasses the concept of water security that is tied to the concept of human security in addition to outlining the links between water for people's wellbeing and economic growth. Moreover, regional issues that are connected to water are also discussed with respect to climate change and transboundary water resources management.

Overall, the Report assesses the state of water resources in South Asia. It finds that it is a region endowed with a sizeable share of the world's water resources, but due to temporal and spatial differences in water availability during critical times of the year and due to the recurrent phenomenon of climate change manifested in droughts, floods, and unpredictable rainfall patterns, some South Asian countries are facing adverse waterrelated problems.

Understanding water's role in human development is critical. The Report highlights this relationship. First, the concept of human security is tied to water in that it underpins different aspects of people's lives and livelihoods. Any disruption in these is a breach of human security. These aspects include: economic security, food security, health security, environmental security, and personal security.

Second, the importance of clean water and sanitation for human development is stressed upon, with the arguments that they reduce income poverty and child mortality, break life-cycle disadvantages, enhance female education and free girls' and women's time from collecting water from long distances.

Third, the interaction between water and economic growth is studied. The analysis points out that with improved access to water, a healthy and productive labour force can contribute to national income. Improved education and health standards can create employment opportunities. Furthermore, the use of water in agriculture is critical to food production, sustenance and economic development. Water is also a relatively cheap source of energy. The productive capacities of sectors in the economy depend extensively on water. More importantly, by improving the conditions of the poor through better access to water resources, water can play a fundamental role in poverty alleviation.

Fourth, the link between water and climate change is analysed. Climate change has an effect on the hydrological cycle and reduces water availability. It alters the timing, quantity and quality of available water. The frequency and severity of extreme weather events causes disruptions in people's lives and livelihoods and increases their risks and vulnerability to climate change. The effect on women and the poor is even greater. Therefore, appropriate mitigation and adaptation policies and practices need to be put in place in order to restore people's lives and livelihoods with the increasing threats that climate change poses.

Finally, the relationship between transboundary water resources management and human development is explained in the context of the 'hydrological interdependence' between riparian countries. Upstream water usage can affect the quantity, quality and timing of water flowing downstream. Water management and hydropower infrastructure on shared rivers affect people's livelihoods and ecosystems in riparian countries. Therefore, cooperation between riparian states overlaps with economics, politics, environment and security concerns.

These five dimensions combined, portray a complete picture of water's relationship with human development and the underlying nuances and complexities of this intricate and important relationship are further explored in succeeding chapters. The concept of human security is tied to water in that it underpins different aspects of people's lives and livelihoods People's access to water and sanitation is a fundamental part of human development and is a major challenge that South Asian countries need to overcome. In order to do so, the right to water and sanitation must be reflected in policymaking and implementation. Infrastructure for water needs to be upgraded with increased financing and better management.

People's well-being is an integral part of the human development paradigm. This, in turn, will be determined by people's access to drinking water and adequate sanitation. Looking at the status of water and sanitation in South Asia, it is unfortunate to realize that a vast majority of the population in the region is deprived of water and sanitation. To live without sufficient quantity of good quality water and proper sanitation makes people vulnerable to impurities, diseases, and ill-health.

South Asia has made remarkable progress over the past two decades in the provision of water and sanitation facilities. However, the data fail to capture the underlying problems with access. There is under-reporting of the extent of access in rural areas and the areas where the urban poor live. For them, it is not a situation of water coming to people as it does in highincome neighbourhoods, but people going to water, which is sometimes very difficult for them.

Municipal bodies and water utilities provide water to formal settlements and for those with a piped water supply system. The majority of people, however, do not have this facility and are therefore, not able to access water at all times of the day. The state of the water and sanitation infrastructure is poor. Investments in improving the infrastructure require adequate financing, which is not easily available. Low-cost technologies are an option, but few developing countries have made progress with those.

Government budgets and foreign assistance are limited and insufficient to

cover the requirements of the water and sanitation sector. The right investments can help to improve its condition and increase people's access. However, neglecting the sector over time will mean that more financing will be needed to cover operations and maintenance of the run-down infrastructure.

There is a glimpse of hope that policy makers will take a step forward and bring the water and sanitation sector into mainstream policy-making while planning for the future. This is largely because the post 2015 development framework will have a greater focus on water. Governments committing to the SDGs will need to change their policy orientation towards effective water management. More importantly, they will need to recognize the human right to water and sanitation and take adequate measures to implement their national water and sanitation policies, especially to ensure universal access to water and sanitation for all in South Asia.

South Asia, which was once water abundant, is now facing increasing challenges of water insecurity. The challenges arise from an increase in water demand across different sectors—agriculture, industrial, domestic and energy, from inefficiency and wastage, from overexploitation and pollution, from poor management and inequitable distribution. Unfortunately, all of these are having a telling impact on economic and social development of a large segment of South Asia's population.

For South Asian countries access to water is synonymous to life. Its importance can be gauged from the fact that one country derives its name from a river (India from Indus) and in others like Bangladesh, Nepal and Pakistan access to water determines economic and social progress.

Access to water is inextricably linked to progress in human development. Water is essential to sustain human lives and to ensure their economic growth and

South Asia has made remarkable progress over the past two decades in the provision of water and sanitation facilities social development. Water availability in various sectors of the economy provides people with the means to earn a living which is then used to develop other social assets like improved education and better health. Without water, the economic fabric of life is disrupted.

Water availability is a serious concern in almost all the South Asian countries, barring Bhutan and to some extent Nepal and Bangladesh. The growing population of the region is central to increasing demand for water and in creating a situation of water stress. As total water resources are finite, the addition of each individual in the population is decreasing per capita water availability. The increasing population is also demanding more food, more industrial goods and higher energy requirements, thereby making the competition for available resources more intense.

Inefficient use of water and water pollution are the two major threats that the region is facing in terms of sustainability of water resources. The region is wellendowed with sufficient water resources. The rivers originating from the Himalayas, annual rainfall and groundwater aquifers provide abundant water supply. However, inefficient water use, inculcated by intensification of agriculture, primitive irrigation techniques and poor pricing is resulting in rapid depletion of available resources. Similarly, water pollution due to agricultural run-offs contaminated with chemical fertilizers, pesticides, industrial waste and effluents being dumped in water courses is affecting the quality of available water. All of these are having severe environmental and health consequences, in addition to affecting the livelihoods of people whose income sources depend on economic activities generated by availability of quality water.

Increasing competition over water resources has raised equity, access and distribution concerns in South Asia. Water distribution is a significant bone of contention between sub-national entities especially in India and Pakistan. States and provinces are often at loggerheads over riparian rights, present and future water requirements and sharing of costs and benefits of water projects. Distributional issues also perpetuate at local levels where political influence and socio-economic status largely determine access to water. In many South Asian countries, water conflicts are also emerging among alternative and competing uses of water in various sectors of the economy.

The damages caused by floods, especially in Pakistan, and the continued demand for cheap and renewable sources of energy have reinvigorated the demand for water storage infrastructure. The region was doing well up until the 1960s and 1970s to build water storage infrastructure, however since then progress has been slow.

These issues point towards poor water management in South Asia. Though there is an abundance of institutions and laws to deal with water issues, many of these have conflicting and overlapping agendas. A comprehensive policy to deal with all water issues is also lacking and the non-availability of reliable data further hampers the development of a comprehensive and coherent water management strategy.

The ray of hope for South Asia is that there is no absolute shortage of water. All that needs to be done is to adopt improved water management practices; to increase water productivity, reduce water pollution, augment storage capacity and to develop an integrated framework for water systems management.

The effect of climate change in the form of melting of glaciers, changing precipitation patterns, extreme weather events and sea level rises, on water resources and systems negatively affects people's well-being in South Asia. The region has a challenge to reduce poverty and deprivation and promote human development in the face of climate change. This requires the mainstreaming of adaptaIncreasing competition over water resources has raised equity, access and distribution concerns in South Asia

tion and mitigation practices into a sustainable development strategy.

South Asia is already facing water shortages due to population growth, rapid urbanization, faster industrialization and poor water management. Climate change will exacerbate stresses on water resources in South Asia by negatively affecting water quality, quantity, demand, security and transboundary issues.

The region is amongst the most vulnerable regions of the world to climate change due to high levels of poverty and deprivation. Weak institutional capacity, inadequate water storage facilities, and shortage of finance and technology are also responsible for this. Moreover, heavy reliance of the region on climate sensitive sectors such as crops, livestock, forestry and fisheries also place it in a vulnerable position.

The melting of Himalayan glaciers is expected to increase water run-offs in the short run resulting in floods. In the long run it will result in water shortage. Also, increased variability in the magnitude and timing of rainfall, especially during the monsoon season, will result in increased water stress. Similarly, an increase in the intensity of extreme weather events such as floods and droughts will negatively impact water resources and water security. And lastly, a rise in the sea level is projected to result in water inundation and increased groundwater salinization in many coastal areas in South Asia.

All of these will have negative implications for people's well-being in the region. The agricultural sector including forestry and fisheries will be affected by both shortage and excess of water impacting livelihoods, rural development and food security. Water-related disasters and droughts will result in displacement of a large number of people. Women will be more prone to vulnerabilities than men due to limited access to resources, poor adaptive capacity and their traditional responsibilities. The consequences have already been evident in the region in terms of increased frequency and intensity of climate-induced disasters.

A number of national, regional and international level initiatives have been adopted to address the impact of climate change on water and human development in South Asia. However, these policies have not yielded significant results.

The countries in the region have to focus on inclusive and sustainable development. This will require both climate change adaptation and mitigation measures. For adaptation there is a need to institutionalize good practices and incorporate them into sustainable development planning. Also, there is a need to empower people, especially women.

South Asia is at a critical juncture with respect to its water resources. The management of shared river systems needs to evolve from a unilateral or bilateral perspective to a regional one, where optimal and sustainable use of water is ensured. The region needs collaborative mechanisms for reducing trust deficits, forging robust water sharing treaties and overseeing projects that are contentious. Power relations between riparian countries need to be re-negotiated for better symmetry in resolving and improving transboundary issues in water management.

Transboundary water management—its challenges and opportunities—have a crucial bearing on lives and livelihoods in South Asia. Six out of the eight countries in the region share river systems that span national boundaries. Thus, there is a need to better understand the 'hydrological interdependence' that binds these countries and how it should be managed not only for ensuring water security and sustainability, but also peace in the region.

Analysing the nature of transboundary water issues in South Asia in the context of the historical water sharing agreements, it can be said that hydro-

Climate change will negatively affect water quality, quantity, demand, security and transboundary issues diplomacy between most of the riparian countries in South Asia has left much to be desired. There are a number of factors that drive the region's 'hydro-politics'. Understanding these factors is essential before one can suggest any bilateral or multilateral solution for resolving them. Rapid population growth and consequently the increasing gap between the supply and demand for water is a major driver of water stress and insecurity in many parts of South Asia. Added to this is the effect of the climate induced water variability that affects the hydrological cycle and thus water availability. The delicate balance of the transboundary water equation is also affected by the actions of riparian states-in many cases unilateral decisions on water management projects or lack of sharing of hydrological information for shared rivers have triggered conflict. These factors further interact and reinforce political economy issues and asymmetric power relationships between countries.

For some countries in the region, cooperation on transboundary water management becomes a missed opportunity because of a lack of institutional arrangements between riparian countries. For instance, there is no water sharing arrangement between Pakistan and Afghanistan on the Kabul River, even though Pakistan draws as much as 17 per cent of its water supplies from the Kabul River. Even where institutions for water management and water sharing agreements do exist, they are not comprehensive. The treaties over the Indus (between India and Pakistan), over the Ganges (between India and Bangladesh), and over the Mahakali (between India and Nepal) have stood the test of time despite fluctuating political relations between the countries. These water sharing arrangements, however, are far from holistic, and seldom focus on establishing integrated systems for optimum development, use and sustainability of shared water resources.

South Asia is at the crossroads of the water resources issue. Clearly the man-

agement of shared river systems needs to grow beyond the sphere of national sovereignty and bilateralism, and needs to be addressed at the regional level to achieve optimal use and sustainability of the available water. A region-wide institution for shared water resources should have mechanisms and processes for exchange of data and information to improve the current trust deficit between countries; help the region forge more robust water sharing treaties especially with regard to climate change and hydrological variability, particularly in the case of Afghanistan and many rivers in Bangladesh where there is an absence of any water sharing agreement; be able to address issues of pollution and degradation especially in the context of arsenic in aquifers in India and Bangladesh; promote better flood management; and be able to manage contentious hydroelectric projects on the shared watercourses.

So far, the political economy factors and power asymmetry issues have precluded the development of an effective regional framework for holistic basin wide management. An effective regional institution will have to go beyond basin politics and involve all stakeholders in the Indus and Ganges-Brahmaputra-Meghna (GBM) basins, including Afghanistan and China, both of which have no water sharing treaty with any of the other South Asian countries. India's position as an upper and lower riparian and as the largest economy in the region will obviously be central to carving out a regional institutional framework for transboundary water management.

* * *

Having dealt with the various dimensions that encompass water and human development, the central message the Report provides is that the key to utilizing water in the presence of competing demands and scarce supply is effective management of water across the board. Individuals and The management of shared river systems needs to grow beyond the sphere of national sovereignty and bilateralism households have a big role to play in using water efficiently and judiciously. The agricultural sector needs to reorient its strategy away from the intensive use of water and plant crops, which use less water. The agricultural and industrial sectors also need to treat wastewater in a way that contaminants are not dumped into the water. Governments need to address the situation of drinking water and sanitation. In view of climate change adequate mitigation and adaptation policies and practices need to be put in place. And, last but not least, riparian states need to treat water as a shared resource in order to deal with transboundary issues in a collaborative and integrated way.

These options will ensure that water for human development is sustainable for the current and future generations. Certainly, the actions taken today will have repercussions in the future. Therefore, it is prudent to take appropriate measures now for better water management as a pathway to sustainable human development.

It is prudent to take appropriate measures now for better water management as a pathway to sustainable human development CHAPTER **5**

Access to water and sanitation is fundamental to people's well-being. Individuals and households consume water in various forms. Water has been subjected to several pressures in the last few decades. Population growth, urbanization, rural to urban migration and overall hygiene practices have increased the demand for water. Given the profile of water in South Asia, especially the competing uses of water in agriculture, industry and hydropower development, has meant that there is less water available for individual and household use. Climate change has also reduced water availability and presented new challenges.

These challenges notwithstanding, the water and sanitation sector has not been an area of great policy concern for South Asian policy makers. Water and sanitation have a low priority in budgetary allocations of all South Asian countries. Time and again, this sector falls lower and lower in terms of importance to the country's development and for basic human survival. The water supply system is not organized to deliver water to every single person in rural and urban areas. Even when water is available, it is of low quality, unreliable in terms of the short span for which water comes to the tap and unaffordable for the poor. The governing bodies in charge of water and sanitation provision are inefficient and shift the responsibility to other departments or their ministries for poor provision by attributing it to lack of financing (see box 2.1).

Water and sanitation provision boils down to five key issues, which have been tackled in this chapter. The first is the issue of coverage. International data, in the absence of comparable regional data, tends to overestimate the number of people with access to water and sanitation. The ground realities in both rural and urban areas of South Asia are quite different. The second is the issue of the link between demand for water and the lack of supply. The discussion assesses the overall situation and underscores the magnitude of the problem. The third deals with health and focuses on better water, sanitation, and hygiene practices as a conduit for lowering the incidence and burden of water-borne diseases. The fourth brings forward the gender dimension as an important aspect of the water and sanitation debate since women and girls bear the brunt of poor water and sanitation services in South Asian countries. Finally, the discussion points towards financing issues.

People in South Asia need quality water for consumption and domestic use as much as other sectors do; but allocation of water across sectors is inequitable. Knowing that water is the essence of life, yet choosing to ignore the significance of water and sanitation facilities for people's wellbeing has only exacerbated the public health crisis due to water-related diseases. More and more people in informal settlements, which are out of municipal jurisdiction for water supply, resort to unhygienic practices.

There should be no doubt that water and sanitation are intrinsically related and therefore, improving access to water without improving access to sanitation is a catastrophe. The emphasis should be on providing universal access to quality water and adequate sanitation. Rather than becoming the biggest development challenge for South Asia, concerted efforts made in this area will prove to be fruitful People in South Asia need quality water for consumption and domestic use as much as other sectors do; but allocation of water across sectors is inequitable

Box 2.1 Water and sanitation policies in South Asia: An implementation deadlock?

Enacting policies for water and sanitation are a necessary first step, but are by no means effective if those policies are not backed by proper implementation and tangible results. All South Asian countries have national drinking water and sanitation policies; yet with the exception of a few, most policies have not endorsed the human right to water and sanitation. In addition to that, many countries have a very long way ahead in terms of achieving universal access to water and sanitation.

Pakistan's national drinking water policy envisions the year 2025 to provide water to the entire population. Pakistan's sanitation policy aims to achieve the Millennium Development Goal (MDG) by 2015 and proposes universal access to sanitation by 2025. Neither of the two policies outlines exactly how these policies will translate into action on the ground. They are inadequate in the sense that a target of 2025 has been set as a final goal, but no intermediate targets in the period between now and 2025 have been specified. This means that while good intentions are in place, the policies do not have a well-designed plan to follow. This begs the question as to whether Pakistan will be able to provide water and sanitation to all by 2025. Given the low priority

attached to the water and sanitation sector in the budget every fiscal year, the possibility for financing universal access is unlikely. Nonetheless, turnarounds are possible, if the preferences of policy makers and the government are altered in line with the underlying need for safe drinking water and sanitation. International and local non-governmental organizations (NGOs) may take up a portion of the burden, but it will not be sufficient to meet the goals that have been set. The government should consider an alternative stance and understand the consequences of dealing with a water and sanitation crisis in the presence of prolonged neglect.

India, which is home to one of the worst sanitation practices and contains some of the largest slums in the world, also has a formidable challenge in providing safe water and sanitation. The country has a series of missions that are spread out in all the states, two of which are the Rajiv Gandhi National Drinking Water Mission and the Nirmal Bharat Abhiyan. The Rajiv Gandhi Drinking Water Mission has developed annual action plans to achieve state-wise goals for drinking water. The objective of the Nirmal Bharat Abhiyan is to accelerate sanitation coverage in rural areas in India and to complete doing so by the year 2022. Although there are some complex problems associated with these programmes, the benefit they provide is comprehensive state-wise coverage for drinking water and sanitation. By dividing such programmes among the states, the tasks for achieving universal access become more manageable. It becomes easier to show which states are lagging behind and which are performing better, how resources are utilized by different states and what the results are on the ground.

Unlike Pakistan and India, however, Sri Lanka, has done remarkably well in terms of policy and implementation. Both the national drinking water and sanitation policies consider water and sanitation to be legal rights, which are as inalienable as other rights are. The advantage of recognizing the two as rights provides considerable weight to the water and sanitation sector and more resources are devoted to achieving universal access.

Hence, the enactment of well-defined policies solves only one part of the water and sanitation problem; the major part that needs policy attention is accountability for results and the legalization of the right to water and sanitation.

Sources: GOP 2006 and 2011 and SWA 2012.

for the region, not only in terms of a better quality of life and improved well-being, but also in terms of providing South Asian economies with a productive labour force that can fuel the growth process.

Status of water and sanitation in South Asia

Between 1990 and 2010, the proportion of people using an improved water source and an improved sanitation facility has increased in South Asia as can be seen in figures 2.1 and 2.2. While water for many countries, with the exception of Afghanistan, is reaching a vast majority of the population, access to sanitation, with the exception of Sri Lanka and Maldives, lags far behind. The poorest 40 per cent of the population in South Asia have barely benefitted from improvements in sanitation, whereas improvements in drinking water supply have been more equitably distributed.¹

Despite the various commitments undertaken by governments, the provision of sanitation facilities has increased at a slow pace with respect to population growth and rates of urbanization. While progress has been notable, it is still insufficient to meet the water and sanitation requirements of the entire population of South Asia. International data sources that report access to water and sanitation using proxy indicators also overestimate the extent of provision; therefore, they need to be looked at with caution (see table 2.1).

Coverage rates for water and sanitation

A threshold level has been set by the United Nations Children's Fund (UNICEF) and World Health Organization (WHO) of a minimum requirement of 20 litres of water a day from a source within one kilometre of the household in order to cover drinking and basic personal hygiene. Levels below this minimum threshold are associated with a lack of physical well-being and lack of human dignity. Unfortunately, the threshold level of acquiring even the minimum level of water is affected when South Asian countries face periods of dry season with water availability and water usage dropping significantly. This compromises people's well-being to a great extent, especially since the threshold is already set at a very low level, as compared to the minimum usage of water that people have access to in developed parts of the region, and more so, in the developed world, where water and sanitation facilities are easily accessible.

As far as coverage rates are concerned, the data show that the extent of improved access to water and sanitation is relatively high in South Asia, especially for water, and for urban areas, as compared to sanitation and access in rural areas. There are several problems with regard to coverage in water and sanitation. First, coverage levels for water and sanitation for individuals and households tend to rise with income levels. The richer a country, the greater the coverage. Yet there may be an exception to this rule. On the economic growth front, India is an emerging economy, yet the country is home to some of the largest slums in the world where there are millions with no access to adequate water and sanitation. On the other hand, Bangladesh, which has a lower





Figure 2.2 Proportion of population using an improved sanitation facility in

economic growth rate than that of India, has better sanitation provision.

The second problem with the coverage data lies in the collection methodology of global data. The data collection methodology used by the Joint Monitoring Programme of UNICEF and WHO is designed in a way that does not correctly measure the extent of the gap between the

Table 2.1 Population using improved and unimproved water and sanitation sources in urban and rural areas in South Asia, 2010

	Urban (thousands)			Rural (thousands)				
	Total improved		Total unimproved		Total improved		Total unimproved	
	Water	Sanitation	Water	Sanitation	Water	Sanitation	Water	Sanitation
India	3,56,482	2,13,154	11,025	1,54,353	7,71,397	1,97,135	85,711	6,59,973
Pakistan	59,819	44,864	2,492	17,447	99,041	37,836	12,241	73,446
Bangladesh	35,473	23,788	6,260	17,945	85,567	58,827	21,392	48,131
Afghanistan	5,537	4,259	1,562	2,840	10,211	7,294	14,101	17,019
Nepal	5,188	2,678	391	2,901	21,455	6,583	2,926	17,798
Sri Lanka	2,956	2,627	30	358	16,087	16,623	1,787	1,251
Bhutan	252	184	0	68	446	137	28,000	3,37,000
Maldives	127	124	0	3	184	184	6	6

Source: UNICEF and WHO 2012b.



provision of water and sanitation. Sometimes the poor are not reported in national surveys because their households are located in areas that are not officially recognized by governments. Sometimes governments have very little information about these households. Also the mere presence of a source does not transform automatically into safe, adequate, and sufficient clean drinking water or sanitation. The greatest challenge is to keep water and excreta separate—which not only has consequences for individuals and households, but also for public health and public policy.

The third problem with coverage is timing, flow, and availability of water. For thousands of people in South Asia, water taps remain dry or very little water comes out of the taps. Patterns of water use in South Asia are far more complex and dynamic than the static picture presented in global reporting systems. The data are limited in terms of accounting for drinking water quality, the availability of adequate quantities of water for domestic use, the number of service hours provided, the distance to a water source or sanitation facility and the time household members spend on accessing and using these sources and facilities.

One way of expanding the dimensions of water use for individuals and households is to include other determining factors for coverage. Figure 2.3 shows the dimensions of water use in terms of access, quantity, quality, affordability and reliability. The figure also mentions the major issues that are associated with each of the features in gauging access to water, which are largely overlooked in the data.

Increased demand for and constrained supply of water and sanitation services

There is an increased demand for water and sanitation services both from rural and urban areas in many parts of South Asia, yet supply is constrained. Over the years, scores of people have come to the region's cities from backward and underprivileged areas in search of better work opportunities, and with the hope of enhancing their life chances and opportunities. However, cities have accommodated these people in an unplanned and disorganized manner, due to which places like Kolkata, Mumbai, Delhi, Dhaka, and Karachi have become overcrowded and overpopulated. This pressure has added to the problem of constrained public service delivery for water and sanitation in major urban and peri-urban areas (see box 2.2).

Municipal bodies provide water at a low cost in urban areas. Households with a direct link to the network get access to water through household taps. Poor households in urban areas, on the other hand, have to get water indirectly through a web of intermediaries-truckers, vendors, and carriers. Although obtaining a connection from a formal network would reduce the price of water for the urban poor, two prohibitive barriers work in tandem with each other-one, the high capital costs involved in linking the urban poor to existing networks and two, the restrictive nature of providing water to informal habitants who have no formal property rights.2

Water tariffs and how they are structured also shape poor households' access to water. Several South Asian governments regulate tariffs in order to achieve a range of equity and efficiency goals. These tariffs are structured in such a way that water becomes both affordable to households and also generates sufficient revenue to cover a part of or the entire cost of delivery. Tariff designs can vary across countries in South Asia. In Dhaka, Bangladesh, for instance, a *flat rate* is applied to all users regardless of whatever volume of water is used.³ Such systems provide no incentives for water conservation, and in turn encourage water wastage. These are applied because utilities have very little to almost no capacity to monitor water use through meters. Block tariffs are the other kind, which are commonly used. In these structures, prices rise on a tiered basis in conjunction with the volume of water consumed. A rising block tariff system can serve several public policy goals, for instance, a low or zero tariff applied to the first block can make water affordable and accessible to poor households.

In many utilities, however, tariff rates are set well below the levels required to meet the entire costs of operation and

Box 2.2 Improving urban water governance in South Asia through benchmarking

services are failing people. Access to water is utilities to introduce and sustain benchmarkunreliable and the quality of water provided is ing practices in order to enhance service poor. In the absence of good water governance, utilities do not run efficiently and even the absence of adequate regulation of water in areas with a piped water supply network, water does not run in taps 24 hours a day. For informal settlements and slums, the situation is worse, in that people have to wait for days to access water. In order to correct these failures, the architecture of urban water governance needs to change and the efficiency of urban utilities needs to increase. Benchmarking of water utilities is one possible solution.

An initiative in Pakistan, India and Bangladesh in association with the Water and strength. Benchmarking allows water utilities

Source: Sharma 2006.

delivery. Benchmarking has several benefits in utilities in South Asia. First, it helps to gather information from all water utilities. Even if record keeping is poor and the data collected is limited, the very fact that information is being collected and analysed for performance assessments makes a strong case for better record keeping and maintenance of information for the future.

Second, measuring and monitoring performance regularly allows the water sector to enhance capacity and to build institutional

In several parts of South Asia, urban water Sanitation Programme has targeted urban to identify gaps and weaknesses in their delivery and management processes and facilitates improvement through information sharing and good practices prevailing in other utilities within the region and beyond.

> A well-functioning water utility is key to providing safe access to water in urban areas. With the onset of urbanization, which is gaining momentum each day, only efficient and sustainable utilities will be able to handle the pressure and deliver water to the incoming cohorts. Therefore, benchmarking will help to improve service delivery and should be used rigorously in all water utilities across South Asia.

Continued underinvestment in water and sanitation infrastructure has magnified the severity of the water and sanitation crisis in South Asia

maintenance. This, in effect, implies a subsidy to all households with private taps. These are mainly higher income households which benefit from a lower tariff as compared to poor income households which go through a chain of intermediaries to gain access to water. Usually standpipe operators, water vendors, and truckers resell water to the poor at the highest cost. Moreover, when poor households pool in to receive a metered connection, their combined consumption places them in the higher price tiers. Due to these inefficiencies, water utilities are locked in a vicious cycle of under-financing, low maintenance, and under-expansion of infrastructure. Pricing is distorted, with lower prices skewed towards fairly richer households and high-income neighbourhoods, while poor households pay higher prices. These distortions combined with the lack of tariff revenue needed to maintain and expand the water supply network means that minimal financial resources are left to provide water to un-served and under-served households.

People living in cities, especially those living in slums co-exist with cesspools overflowing with lethal pathogens, open sewers, and drains. Even in rich neighbourhoods, heavy rain during the monsoon season can clog drainage systems, causing overflows and breakages in the water supply and sewerage systems. The cities' municipal bodies then find it a daunting challenge to address such problems. This is mainly because of poor planning, lack of infrastructure, and poor management, maintenance and supervision. Even if cities in South Asia show increased coverage rates for water and sanitation, a highly run down and overburdened water infrastructure lacks capacity to provide water and sanitation to all needy people in South Asia.

The extension of water infrastructure highlights important public policy issues. One is the financial side, in terms of where the financial resources will come from. And the other is, who will benefit from this investment? In most cases, poor infrastructure poses the greatest form of deprivation for the un-served and underserved population of the region. These are the people who have no choice, but to resort to open defecation on roadsides and in plastic bags. Open defecation rates are some of the highest in the world for South Asian countries with 626 million people in India, 40 million in Pakistan, 15 million in Nepal and 6 million people in Bangladesh engaging in this practice.⁴

If water and sanitation services are not extended to these people, the risk of diseases and deaths related to human waste will only increase in the future. In the case of Pakistan, in the cities of Lahore and Karachi, a few million people live in informal slum areas. Both cities receive water through groundwater and canal water. However, most of the water supply is unfiltered and the effluents untreated. There are only a handful of effluent treatment plants. Continued underinvestment in water and sanitation infrastructure has magnified the severity of the water and sanitation crisis in South Asia and therefore, the third area of public policy concern is public health that stems from human waste and industrial pollution. Leakages from sewage and industrial waste have led to epidemics of unimaginable proportions, and public health systems are inadequately equipped to deal with these issues.

The health dimension to water and sanitation

Access to safe drinking water and improved sanitation facilities can have far-ranging and positive effects on human health, especially physical and emotional wellbeing of men, women and children. It can help improve the quality of life of millions of people in South Asia. The health dimension is not only important for achieving Goal 7, Target C of the Millennium Development Goals (MDGs), but also the ones for reducing child mortality, improving maternal health and reducing the incid-- ence and burden of malaria.

Public health is an important part of public policy. Water management, drinking water supply, sanitation, and hygiene should form the basis for preventing a significant majority of water-borne diseases that plague the region. These include diarrhoeal diseases, arsenic poisoning, intestinal infections etc.

Population growth and urbanization contribute to poor human health, because of increasing water demand and water pollution. The incidence of diseases due to insufficient and unsafe water used for personal consumption and hygiene has led to several health issues (see table 2.2).

According to WHO's Guidelines for Drinking-water Quality, access to safe drinking water is fundamental to health. Investments in water supply and sanitation can yield a net economic benefit as well as help in reducing adverse health effects and associated healthcare costs. Interventions in improving access to safe water that favour the poor, whether in urban or rural areas, can be an effective part of poverty alleviation programmes.⁵ Water, sanitation and hygiene investments can be in the form of several interventions—safe disposal of human excreta, proper handwashing with soap, improving water quality and advancing household water treatment and safe storage. Safe disposal of children's faeces is critical in reducing fecal-oral contamination that facilitates the transmission of diarrhoea pathogens. Hand washing with water and soap is the most cost effective hygiene practice that can reduce the incidence of diarrhoea in children under the age of five. Undernourished children face a higher risk of death and severe illness due to diarrhoea, especially in South Asia.

The gender dimension to water and sanitation

The water and sanitation discourse in South Asia also has a gender dimension. The lack of access to water and sanitation

Table 2.2 Consequences of poor water, sanitation and hygiene practices on health in South Asia, 2004

Water, sanitation and hygiene attributable (thousands)				
	Disability adjusted life years (DALYs)	DALYs in children under-five	Deaths	
India	15,375,120	14,210,426	454,367	
Pakisran	1,845,099	1,631,260	59,188	
Bangladesh	2,196,561	2,061,105	64,970	
Afghanistan	2,216,607	2,139,966	66,723	
Nepal	459,046	430,767	13,875	
Sri Lanka	35,347	28,045	810	
Bhuttan	8,768	8,168	267	
Maldives	1,792	1,632	46	

Source: WHO 2010.

has a huge impact on girls and women in South Asia. Inadequate access to water means that girls and women have to go a long distance to collect water. This becomes a primary household chore for them, in addition to having to go far away in order to use a toilet. In the absence of toilets, especially in rural areas, girls and women have to go at odd times of the day and night to complete these basic human functions.

Those girls who have to spend long hours collecting and carrying water supplies for their households pay a huge cost in terms of not attending schools which is a missed opportunity. Absenteeism rates for girls are also higher in the adolescent years because of a lack of proper sanitation facilities in schools.

Similarly, lack of access to safe water occupies a lot of women's time. Better access would create more time for women to carry out income generating activities. For instance, in Sri Lanka a study found that improved access to water saved women thirty hours a month—which is three days of work in a typical village.⁶

The gender dimension to water and sanitation has serious consequences for human development. The greater the disparities between men and women's access to water and sanitation in the region, the larger the inequalities between them. Girls and women will continue to face insecurity, loss of dignity and negative health outcomes which are associated with the lack of access to water and sanitation. Women generally place a higher value on private sanitation, and if their voices are not heard and not taken into account in the decision-making process of the family and the country, this will eventually hurt the whole society.

In several parts of South Asia, women have a weak voice. This translates into a lack of priority attached to sanitation and lack of adequate expenditure dedicated to securing a toilet facility within the household. Similarly, political structures that extend from villages through to local governments or national governments also attach a low priority to sanitation when women are unheard. In short, the systematic neglect of sanitation for girls and women undermines progress in education, poverty reduction, and the generation of income and wealth.

Scarce water, deteriorating water quality, food insecurity and poor governance are significant factors in the context of gender differences in access to and control over water resources. Short term and unsustainable decisions have negative consequences for men and women in communities in South Asia. Scarcity created at a local level and decisions related to water sharing, allocation and distribution between different uses and users have important implications for women. Rural women tend to rely on common water resources such as small water bodies, ponds and streams to meet their water needs, but in several parts of the region these are not only unsafe and unhealthy, they have also been appropriated by the state or by industries to meet water needs of urban areas.

Using an integrated gendersensitive approach to development, especially in line with the human development paradigm, can have a positive impact on the sustainability and effectiveness of water interventions in addition to water conservation. The role of both men and women are critical in the design and implementation stages of water-related interventions which can lead to effective solutions. The gender-sensitive approach to project planning and implementation can help governments to avoid common planning mistakes, make projects more sustainable, and make sure that infrastructure development yields the highest economic and social returns. This would advance wider development goals such as reducing poverty and hunger, reducing child mortality and improving gender equality.⁷

Financing of the water and sanitation sector in South Asia

The financial aspects of the water and sanitation sector show how little policy attention is given to the sector. It is difficult to disaggregate the data for water and sanitation since it comes under social sector spending in most countries. Nonetheless, from the data that is available, it becomes evident that minimal budgetary allocations are made for the sector. The lack of financing in the water and sanitation sector is a major hurdle that must be overcome. With ageing and dilapidated water infrastructure and low maintenance of the piped water supply network, the possibility of increased costs and reduced coverage will be greater in the long run.

Government financing for water and sanitation

In India, central budget allocations to the water sector started in 1951. A national rural water supply programme began in 1972. India's budgetary allocation for the sector increased from 1.8 per cent to 4 per cent between the 1st and the 8th Five Year Plan. However, most of the funds were allocated to water. In the 8th Five Year Plan, 96 per cent of the budget was for water supply and the remaining 4 per cent was for sanitation. Over the period 2007-12, the actual investment in water and sanitation infrastructure has averaged 0.41 per cent of gross domestic product (GDP).⁸ In Pakistan, between 2002 and 2005, the budget for water and sanitation was 0.1 per

The systematic neglect of sanitation for girls and women undermines progress in education, poverty reduction, and the generation of income and wealth cent of GDP. In Bangladesh, overall government expenditure for water and sanitation remained stable until recently when the 2012-13 budget allocation was cut by US\$121 million.

Although South Asian countries are signatories to the Millennium Declaration and have laid out plans to improve access to water and sanitation, the actual financial and technical resources budgeted and utilized have varied substantially. The deficit in financing in the water and sanitation sector, whether it is for infrastructure development, or regular maintenance, or the introduction of low-cost technologies, has resulted in lower coverage.

The priority attached by South Asian governments to this sector has been minimal, and in certain countries such as Bangladesh, funding has been cut back by a significant amount that was allocated for the sector. In Nepal, the water, sanitation and hygiene sector receives a low priority when compared to other parts of the budget. Over the years, the proportion of the national budget allocated for water and sanitation has remained stable, but other social sectors have seen an increase in budgetary allocation. Even though sanitation is a real and formidable challenge in the country, adequate resources are not being channeled to this sector.

Ending the water and sanitation crisis is certainly one of the biggest development challenges that South Asian countries need to overcome. The region is home to one of the highest proportions of people without access to clean water and adequate sanitation. This crisis has several negative outcomes, manifested in poor health, hygiene and quality of life. National governments in South Asia should bear the primary responsibility for ending the water and sanitation crisis and closing the gaps between the served and un-served population within their respective countries. Stronger leadership and ownership of the solutions to address this problem are required. While actions at the government level are essential in delivering good leadership and the necessary reforms that accompany it to correct the water and sanitation sector's problem, on their own they will only solve part of the problem.

International Assistance

Given the lack of financing from the public sector, there is a need for international assistance for water and sanitation in South Asia. International assistance should go to the areas where the poor live since they are disproportionately affected by lack of access to water and sanitation and carry the greatest burden of disease and unhygienic living conditions. Donors should assist rural areas where facilities are inadequate to meet the needs of the people. Aid should be targeted better so that the groups that are most in need are helped by the additional finance generated in developed countries.

Among the top ten recipients of foreign aid for water in 2011, five countries of South Asia received considerable assistance for the sector (see table 2.3).

Table 2.3 2 2011	Foreign aid for water in South Asia,
	Foreign assistance received (million US\$)
India	723
Bangladesh	687
Afghanistan	116
Nepal	92
Sri Lanka	118

Source: OECD 2013.

Private sector participation

Private sector investment has been minimal for water and sanitation in South Asia, except for a few countries. Between 2000 and 2009 in South Asia, there were 12 private sector projects, all of them situated in India and totaling an investment value of US\$400 million.⁹

Only a handful of utilities under the public sector efficiently deliver water and sanitation services in South Asia. In Sri Lanka for instance, the National Water The deficit in financing in the water and sanitation sector has resulted in lower coverage The private sector can fill a critical capacity gap and provide the right technologies, skills and resources to enhance access to water Supply and Drainage Board has emerged as an efficient provider after undergoing a series of governance reforms that have reduced coordination failures across agencies and improved their financial performance. On the other hand, apart from a few exceptional states in India, water utilities are reportedly inefficient.

Since the 1990s, there has been an increase in the number of public-private partnerships (PPPs) that have been initiated or awarded in India. Before 2004, only four PPP contracts were awarded and another 13 have been awarded since 2005. Nearly 5 million people in urban areas have access to water through projects or arrangements that involve the private sector. Most of the water-related PPP projects in the 1990s were geared towards bulk water supply systems. This has changed since the early 2000s. Now the majority of projects deal with operation and maintenance improvements of the distribution system. Most PPPs in India use the management contracting method in order to utilize the managerial efficiencies of the private sector.¹⁰

Although the circumstances vary, public utilities can be successful in a public policy environment that meets certain key criteria that include:

- Financial autonomy in order to guard against political interference in resource allocation;
- Participatory and transparent policy that establishes accountability at all levels;
- Separation of the regulator and the service provider, with the regulator's functions limited to oversight and the publishing of well-defined performance standards, which service providers must adhere to; and
- Adequate public financing for the expansion of the water and sanitation network, along with national strategies that pin down actionable recommendations, guidelines and

steps that need to be undertaken to provide universal access to water and sanitation facilities.

Unless public utilities can meet these and several other criteria, depending on the country's water and sanitation conditions, there is a long way for them to go before water and sanitation can reach all un-served and under-served areas, urban or rural. Moreover, given the top-down nature of the service provision model of most public utilities, which are neither transparent nor responsive to the needs of their users, the private sector can fill a critical capacity gap and provide the right technologies, skills and resources to enhance access to water. However, governments promoting private sector participation in the water and sanitation sector have to recognize that the private sector may place efficiency over equity. The role of governments in these cases should be to ensure that equity concerns are taken into when consideration preparing the contracts for the private sector and, more importantly, during implementation of the projects by the private sector.

The role of the private sector can vary depending on the country's profile and what is possible given the extent of the infrastructure and the efficiency gains that the private sector can provide. In Maharashtra, India, for instance, the private sector is working under a service contract for the duration of one to two years, where management is shared, but ownership, investment, and risk are the responsibility of the public sector.

In terms of commercial viability on one hand, and the delivery of affordable water to all, three common failures have corrupted the water and sanitation system from performing well—namely, inadequate regulation, financial unsustainability and lack of transparency in contracting. These are mainly the reasons for making a case for private providers. In essence, whether the provider is public or private, the bottlenecks and constraints in water and sanitation are mainly for the poor with underlying problems that emanate from bad governance and consistent underfinancing and underperformance. In the absence of a coherent strategy for providing clean, drinking water to all, which has tangible benefits for the poor, most countries in South Asia may continue to suffer from the water and sanitation crisis.

Policy conclusions

Several countries have introduced policies related to drinking water and sanitation. Policies are important in realizing the human right to water and sanitation. They are also seen as a guiding force for focused programme planning for water and sanitation. They set the stage for implementation and provide the incentives and the enabling environment for projects related to water and sanitation. However, enacting sound policies is only part of the process. The next important steps are the implementation processes and the outcomes that are generated in terms of better water and sanitation coverage.

The human right to water and sanitation is a fundamental concern for its premise is built on the principles of equality, universality, and freedom from discrimination. Exclusions based on affordability, poverty, caste, creed, or ethnicity, or place of habitation is a violation of the human right to water. Governments in South Asian countries are not upholding this right as duty-bearers and are failing to meet the MDGs. There is an inadequacy of laws, policies, procedures, and institutions in the region to progressively realize the right to water and sanitation. National budgeting is a key component towards a comprehensive strategy for achieving progress in water and sanitation. Establishing the human right to water, coupled with a national budgetary policy with a high priority attached to it, can be a concrete investment rather than a vague notion that can be overlooked time and again.

In some countries in South Asia, voices towards realizing the right to water and sanitation come from below. Community activism such as Bangladesh's Community led Total Sanitation Campaign is a case in point. The rural poor, women's organizations, and urban slum dwellers' associations have mobilized their own resources. New partnerships have developed between governments and the people and between international philanthropists and people in local communities in South Asia. The number of non-governmental organizations (NGOs) and international non-governmental organizations (INGOs) has seen a substantial increase in terms of presence, visibility and outcomes in the region. Moreover, in addition to bilateral and multilateral foreign assistance, new financing mechanisms, and technologies are being explored to reduce the burden of cost sharing for the poor in South Asia.

While the parameters for policy design will vary from country to country, some broad approaches that can be considered are as follows:

Legislation for water as a human right: Having a constitutional right to water is important-but not as important as the legislative obligation of governments and water providers to give practical policy substance to that right. Setting out the investment, pricing and monitoring arrangements for progressively extending the right to a basic minimum of 20 litres of water for every citizen is the starting point. Moreover, governments can aim towards establishing clear goals and benchmarks for measuring progress through a national water policy; ensuring that secure financial provisions in annual budgets and a medium term expenditure framework backs policies in the water sector; developing clear strategies for overcoming structural inequalities and inequities based on wealth, location and other markers of disadvantage; and creating governance systems that make governments and water providers accountable for achieving the

National budgeting is a key component towards a comprehensive strategy for achieving progress in water and sanitation goals set under national policies.

Equity through pricing and subsidies: Governments can correct pricing distortions that adversely affect the poor. These could include connection subsidies, innovative payment strategies, targeted subsidies, lifeline tariffs, and targeting of informal settlements, where authorities can provide full or intermediate residency rights to established informal settlements. They can also require that utilities supply water regardless of location, if necessary by providing financial guarantees or investment incentives; and cross-subsidies from higher income water users to poor house-holds.

Regulation: Regulation is critical to the progressive realization of the human right to water and protection of the public interest in water provision. In a market with limited competition, and for water that is fundamental for people's well-being, regulatory authorities need to ensure that providers are managed in a way that equity,

efficiency and accountability are secured.

Civil society: Civic action by civil society is crucial to raise pressure from below. The use of citizen report cards in Bangalore, India, gave residents, associations and community groups a voice in reforming the water utility, and improving accountability by evaluating and publicizing utility performance assessments. Citizen groups, civil society and water user associations do not operate in a vacuum. Government policies and institutions, especially the normative and legislative framework and the political space created by governments, affect their activities and scope for achieving change.

A mixture of policy interventions and civil society actions can determine the path for reducing the water and sanitation crisis in South Asia. It is important for the well-being of South Asia's people that timely attention be paid to their needs and requirements, for them to be able to lead healthy and productive lives as the human development paradigm envisages.

A mixture of policy interventions and civil society actions can determine the path for reducing the water and sanitation crisis in South Asia
CHAPTER Grand

Water for Economic Development: The Challenges

Water is central to people's lives. Few resources have greater impact on the lives and livelihoods of people than water. All social and economic activities and functions of the ecosystem critically depend upon water. Beyond drinking and sanitation requirements, water is necessary for food production and for generating economic activities. In addition, it is also a source for cheap and renewable energy.

South Asia once was a region that was justly proud of the extensiveness of its irrigation system. Now the region lags behind many other regions in ensuring access to safe water to all its citizens. South Asia's transformation from a waterabundant region to a water-stressed one is in large part created by its own mismanagement. Annual per capita water availability in South Asia has been declining, and the region is facing increasing challenges of competition between different sectors, from overexploitation and pollution, and from poor management and inequitable distribution.

In order to successfully address the complex challenges posed by water insecurity, South Asia needs to make a paradigm shift in the way the countries manage water. They need to improve water resource management systems in order to ensure efficient water usage and resolution of water distribution issues. The focus of this chapter is the productive use of water in South Asia in view of increasing demand for water in the context of reduced and erratic supply and growing demand of economic growth for an increasingly rising population.

Demand for water in growing economies of South Asia

South Asia is experiencing a dynamic transformation with economic growth, industrialization and intensive agricultural development. These are desirable for socio-economic progress and for human development in the region, but they require more and better quality of water, thus intensifying the pressure on available resources.

In addition, the growing population and their food requirements are also increasing demand for water. The size of the growing population is a major concern for the region as, despite a slowdown in the population growth rate from 2 per cent to 1.5 per cent during the last two decades, the region is expected to grow to 2.3 billion people by 2050.¹ Increasing population implies an even further increase in demand for water for both consumption and production purposes.

At present the region is wellendowed with sufficient water resources. However, water availability becomes a concern in per capita terms. For a region of one-fourth of the world population, the amount of water resources per inhabitant is 1,199 cubic metres, which is less than one-fifth of the world average of 6,236 cubic metres per person.²

The growing population of South Asia is central to the decreasing availability of water. As the total amount of water available is relatively fixed, larger number of people will reduce total per-capita water availability over time. More freshwater All social and economic activities and functions of the ecosystem critically depend upon water would be needed to provide food for the growing population and for their domestic consumption. In addition, increasing quantities of water would also be needed to produce industrial goods and to generate electricity.

Agriculture

Water is essential to grow crops and for livestock. Therefore in South Asia, as in other parts of the world, the agricultural sector as a whole is the largest consumer of water than any other sector (table 3.1), accounting for 91 per cent of all water use in South Asia exceeding water withdrawn industry, energy and domestic by consumption. Water withdrawal by the agricultural sector is much higher in South Asia than the global average of 70 per cent, highlighting the region's critical dependence on this important resource.

Despite increasing competition from other sectors of the economy, demand for water in agriculture has increased over the last decade in South Asia. The increasing demand for food would necessitate yet a further increase in demand for water by the agricultural sector. According to estimates presented in the United Nations World Water Development Report, water withdrawal by the agricultural sector would increase by 11 per cent between 2008 and 2050.³ As water is vital for food security, any reduction in water supply would worsen food availability in the region.

Agriculture has always been the mainstay for South Asian economies. It is the most important economic activity and the largest employer in the region. In Pakistan, agriculture accounts for approximately one-fifth of its gross domestic product (GDP), generates employment opportunities for half of its labour force, and three-fourths contributes of export earnings.⁴ In India, agriculture is the single most important source of livelihoods for the masses, with 58 per cent of India's work force relying on agriculture for employment, and accounting for 14.5 per cent of India's total GDP in 2010-11.5 Similar situation exists for other South Asian countries.6

The need for water to sustain lives and livelihoods is more critical for the poor living in rural areas. Here access to water largely determines poverty levels. Secure access to water results in an increase in agricultural production that sustains livelihoods in agrarian settings. It generates income for non-food consumption and creates employment opportunities. It enables people to develop other assets that diversify their means of earning, thereby improving the overall resource base. The water security and livelihood nexus is more apparent in South Asia where the impor-

Table 3.1 Annual water withdrawal by sector, 2008								
	Agriculture		Industry		Municipalities		Water withdrawals	
	cubic	% of	cubic	% of	cubic	% of	total (cubic	per capita
	kilometres	total	kilometres	total	kilometres	total	kilometres)	(cubic metres)
India	688.0ª	90.4	17.0	2.2	56.0	7.4	761.0ª	613.0ª
Pakistan	172.4	94.0	1.4	0.8	9.7	5.3	183.5	1038.0
Bangladesh	31.5	87.8	0.8	2.1	3.6	10.0	35.9	238.3
Afghanistan	20.0^{d}	98.6	0.1	0.6	0.2	0.8		
Nepal	9.3 ^b	98.1 ^b	0.03°	0.3 ^b	0.2°	1.6	9.5 ^b	334.7 ^b
Sri Lanka	11.3°	87.3	0.8	6.4	0.8	6.2	13.0°	638.8°
Bhutan	0.3	94.1	0.0	0.9	0.0	5.0	0.3	458.0
Maldives	0.0	0.0	0.0	5.1	0.0	94.9	0.006	18.4
South Asia ^e	932.8T	90.8	20.2T	2.1	70.4T	7.2	1,003.2T	618.8

Notes: a: Data refer to 2010. b: Data refer to 2006. c: Data refer to 2005. d: Data refer to 2000. e: It is the weighted average or total (T). *Source:* MHHDC 2013 *Profile of Water in South Asia.*

tance of agriculture to rural livelihoods and water to agriculture is significant as reflected by the contributions of agriculture to rural income.

Water security for agriculture pervades all aspects of human development. The incomes generated from agriculture are partly channeled into developing social and physical infrastructure. Security of water is thus a key asset that determines their access to other basic amenities of life such as education and health. However, future supply of water for agriculture is not guaranteed. Climate change, industrial development, urbanization are all changing the availability of water for agriculture.

Industry

The industrial sector in South Asia is relatively less water intensive, consuming only two per cent of total water withdrawals. Nevertheless, competition for water is bound to intensify in future as water demands by industries are foreseen to increase with rapid industrialization that the region is witnessing. Water withdrawals are linked directly with the pace of industrial development. In India, with a higher level of industrialization, water withdrawals by industry stand at 17 cubic kilometres accounting for 85 per cent of the industrial water withdrawals of the region. This is followed by Pakistan with 1.4 cubic kilometres or 7 per cent of the total regional water withdrawals by industry. In contrast, industrial water withdrawals are meagre in Nepal, Bhutan and the Maldives (table 3.1).

At a country level, water withdrawals by industry are still very low compared to other sectors of the economy. In India, despite high demand, water withdrawals by industry are only 2.2 per cent of total water withdrawals and in Pakistan it is merely 0.8 per cent. However, industrial water withdrawals are often under reported. Water required for small scale industries and commerce is sometimes confused with domestic consumption. Consequently, industrial water withdrawals can be higher than often reported.

At a regional level, industrial water withdrawal has decreased over the last decade. The share has declined from 4 per cent to 2 per cent between 1999 and 2008. However, this does not indicate that industrial water demand has been declining; it highlights extreme competition in water demand. This is true especially for India where growth in some of the water intensive industries has been significant, putting pressure on overall water demand by industries. Annual growth in chemical industry and construction has been around nine per cent since the 1990s, followed by six per cent in textile and food and five per cent in paper and paper product industry.⁷

Water security for agriculture pervades all aspects of human development

Energy

According to estimates by South Asia Regional Initiative for Energy (SARI), energy use in South Asia is increasing at a rate of six per cent per annum and is expected to double in another decade.8 The total energy consumed by its population is about 600 million tons of oil equivalent per year. South Asia has a growing energy demand for its agriculture, industry, transport and residential sectors. The mechanization of the agricultural sector has increased the demand for energy in rural areas. Energy is required for operating tubewells, tractors and other equipments. With the rapid pace of industrialization, it needs electricity, oil and natural gas to satisfy the growing demand for energy. The transport sector is also consuming substantial quantities of oil and gas. Urbanization has also increased the demand for electricity in the residential sector. Overall, the energy demand for South Asia has been growing rapidly, along with the pace of economic development.

Water is essential for energy production. It is needed in the extraction of coal, oil and gas; as a cooling agent in thermal plants; for cleaning purposes in solar panels and windmills; in irrigation for crop cultivation; for bio-fuels; and, most importantly, to power turbines in the hydropower plants. Continuous supply of water is thus essential to ensure continued supply of energy to fuel South Asia's expanding economies.

Just as water is essential to generate energy, similarly energy is needed to make water available for human use and consumption. Energy is a primary engine for extraction of surface water and groundwater; for purification of drinkable water; for transporting to households, agriculture or industrial needs; for wastewater treatment; and so forth.

The region however is facing endemic shortage of electricity that is hampering its industrial and socio-economic growth. It is unfortunate that despite possessing immense hydropower potential, the region has only been able to utilize 29 per cent of its potential.⁹ Hydropower projects have a potential to provide cheap, environmentally friendly and more stable source of electricity. However, lack of adequate infrastructure, such as dams, is an important factor contributing to the current situation.

Until recently, South Asia has been regarded as the fastest growing region in the world. Continued supply of electricity along with other sources of energy is vital to sustain economic growth in the region. The main challenge with regard to water and energy is to ensure effective use of water resources to meet energy demands. It is in this context that the policy makers need to better manage the energy sector's water vulnerabilities through greater integration of energy and water policies.

The challenges: Scarce supply or inefficient use?

Availability of water in South Asia

A snapshot of water availability in South Asia highlights the magnitude of water scarcity in the region (table 3.2). Almost all the countries in the region, except Bhutan and to some extent Nepal and Bangladesh, face water availability concerns. Out of the South Asian countries, India, Pakistan and the Maldives are facing severe water stress. Water availability is a serious issue for Pakistan and India which have water availability of less than 1,700 cubic metres per inhabitant, which is considered to be a threshold below which there are indications of water stress. Bangladesh has no current shortage of water available for use as it has approximately 8,153 cubic metres per inhabitant. However, for Bangladesh

Table 3.2 Water availability in South Asia, 2011							
	Precipitation				Total rene	Total renewable water	
	in depth	Groundwater	River flow	Internal renewable water resources		resources	
				total (cubic	per capita	total (cubic	per capita
	(millimetres)	(million	acre feet)	kilometres)	(cubic metres)	kilometres)	(cubic metres)
India	1,083	350	1,515	1,446	1,165	1,911	1,539
Pakistan	494	45	194	55	311	247	1,396
Bangladesh	2,666	17	978	105	698	1,227	8,153
Afghanistan	327	9	52	47	1,457	65	2,019
Nepal	1,500	16	170	198	6,501	210	6,895
Sri Lanka	1,712	6	42	53	2,509	53	2,509
Bhutan	2,200	6	63	78	105,691	78	105,691
Maldives	1,972	0.02	0	0.03	94	0.03	94
South Asia ^a	1,164	450T	3,014	1,982T	1,199	3,791T	2,292

Note: a: It is the weighted average or total (T).

Sources: FAO 2013a and MHHDC 2013 Profile of Water in South Asia.

the problem is heavy dependence on upper riparian neighbours, as 90 per cent of the rivers bringing water to Bangladesh flow through India and China. With water availability becoming a serious concern in the upper riparian countries, Bangladesh might witness a drastic reduction in per capita availability of water in the next few decades.

Major sources of water supply in South Asia include rivers originating from glacial melting of the Himalayas, precipitation due to rainfall, and groundwater resources. Together they determine the overall water supply of the region. The river flows in South Asia are currently experiencing an increase in water supply due to global warming. The total available annual water flow through rivers amounts to over 3,000 million acre feet, of which half flow through India, and another onethird flows through Bangladesh. However, diminishing glaciers will be incapable of sustaining consistent supplies to the major rivers of the region in the long run. Some climate change scenarios suggest that these glaciers could shrink by as much as 80 per cent by 2030 affecting river flows.¹⁰ This is especially true for the Indus River that relies approximately 70 to 80 per cent on glacial melt. Persistent shortages of water for the Indus River are predicted to begin between 2030 and 2060 under various climate change scenarios.11 Similar conclusions are also drawn for the Ganges River Basin and the Brahmaputra River Basin.

South Asia is in a comfortable position as far as total precipitation is considered. Average annual precipitation in the region is about 1,164 millimetres. However, temporal and spatial inequities in its regional distribution is an issue of concern, as precipitation rates vary across South Asia from around 327 millimetres in Afghanistan to 2,666 millimetres in Bangladesh. Seasonality of rainfall is another concern that affects South Asia. The southwest monsoon from June to September is the source of most rainfall. This causes very large river run-offs during the monsoon period and very low flows during the rest of the year. Developing infrastructure to store the excess flows is crucial to ensure continuous supplies.

Groundwater is another important source of freshwater in South Asia. Since the time of the Green Revolution, South Asian countries, particularly Pakistan and India, have started relying extensively on groundwater for irrigation and domestic supply. The aggregate groundwater potential for South Asia is estimated to be 449 million acre feet, mostly concentrated in India (350 million acre feet) followed by Pakistan (45 million acre feet). Groundwater currently supplies a significant proportion of crop water requirement. In Pakistan this contribution is around 45 per cent.¹² Its use has been preferred, since it allows greater control over water availability and is reliable for timely application to crops. However, the drastic pace at which it has been exploited poses crucial questions over its sustainability over time.

Inefficient use of water in South Asia

The agricultural sector which is the largest user of water in South Asia operates with low efficiency and productivity. Water productivity in Pakistan for example, is around 10 times lower than that of Brazil.¹³ Lower water productivity implies lesser revenues per unit of water. Increasing water productivity would be crucial to increase income from the agricultural sector and in reducing poverty. However it would require a commitment to increase water efficiency both by individual farmers and at the policy level by policy makers.

Several factors contribute to inefficient use of water in the irrigation sector in South Asia. Prominent among these are: poor irrigation techniques, inadequate lining of water channels and canals leading to excessive seepage, intensification of agriculture especially using water intensive crops, low levels of water recharge, excessive reliance on groundwater, and limited The agricultural sector which is the largest user of water in South Asia operates with low efficiency and productivity water recycling technologies being employed. Furthermore, government policies, especially water pricing policies, have promoted inefficient water use.

Primitive nature of the irrigation system

Irrigation techniques in South Asia are largely primitive. Surface irrigation accounts for 97.7 per cent of irrigation techniques, which greatly exceed water efficient technologies like pressurized sprinkle irrigation (1.7 per cent), and localized irrigation (0.7 per cent).¹⁴ In fact, in all of South Asia water efficient technologies are only employed in India and that too on a limited scale. Surface irrigation systems, though easier and less costly, are typically less efficient in using water than either sprinkler or localized systems. Application is excessive, and evaporation, transpiration and seepage losses from both canals and fields are high. Often the plants cannot use more than a fraction of water that is applied. In contrast, sprinkler irrigation, either drip irrigation or spray irrigation, saves water, avoids conveyance losses and provides more control in application of water. However, these are slightly costly to begin with, and therefore require some incentives from governments.

Intensification of agriculture

Though the Green Revolution has its benefits in terms of preventing starvation of millions of people, it also has its repercussion on water ecology due to its water intensive nature. The irrigation system currently feeds 46 per cent of the total cultivated area of the region, which is more than double the global average of 20 per cent. In Pakistan it is as high as 94 per cent, resulting in severe stress on water resources.¹⁵ In addition, increased availability of water through canals and water channels has decreased reliance on sustainable practices of localized irrigation, through ponds and tanks that are largely rain-fed. Rain-fed crops are generally more water efficient as compared to irrigated crops.¹⁶

More than the increased pressure on irrigation, the Green Revolution has patronized crop varieties and cropping patterns that induce inefficiency of water use. Rice is a predominant crop in South Asian agriculture. In South Asia, rice represents 29 per cent of all harvested irrigated crop area, only second to wheat which comprises 30 per cent of total harvested irrigated crop area. The percentage is as high as 86 per cent in Bangladesh, followed by 37 per cent in Nepal and 36 per cent in India.¹⁷

Modern agricultural practices have reduced the water retention potential of the soil and increased the demand for water. The shift from organic fertilizers to chemical fertilizers, substitution of water prudent crops to water thirsty crops and reliance on new varieties of seeds that are more water intensive are some examples of how modern agricultural practices have driven water inefficiency.

Over-extraction of groundwater

Overexploitation of groundwater resources is yet another example of the inefficient use of water in South Asia. Though the importance of groundwater, especially for small farmers across India, northern Sri Lanka and in Pakistan's Punjab and Sindh provinces cannot be denied, the excessive rate at which it has been extracted raises significant concerns over its sustainability. Many countries rely on groundwater resources, but nowhere else in the world is the dependence as high as in South Asia.

Overexploitation of groundwater is rapidly depleting the resource in South Asia, especially in India. In an assessment undertaken in 2007 by the Ministry of Water Resource Management in India, out of 5,723 assessment units (blocks/talukas) around 19 per cent have been declared overexploited or in a critical situation. There are 550 semi-critical units, where groundwater development is between 70

Overexploitation of groundwater resources is another example of the inefficient use of water in South Asia to 100 per cent.18

With lack of any formal binding regulations on water use, there is no incentive for individual users to curtail demand, leading to rapid depletion of this shared water resource. In addition, lack of documentation and missing property rights is also compounding the problem of overuse. As the rights to use groundwater are indirectly linked to land rights, which are undocumented and undefined, groundwater is also distributed inequitably and unsustainably. Private land owners get absolute authority to groundwater beneath their land, and they extract as much as they want without considering its impact on adjacent land owners. Furthermore, South Asian governments encourage the overexploitation of groundwater through heavy subsidies. In India, farmers are subsidized to around 90 per cent of the cost of electricity supply, amounting to INR240 billion a year.¹⁹ Though the agricultural sector consumes one-third of the total electricity produced, the revenues from farmers are only three per cent of total revenues. Similarly, in Pakistan electricity subsidies to pump groundwater for irrigation summed up to PKR12 billion in 2010 through the 'relief in peak hours policy'.²⁰ Such policies are incentives for excessive use of water by farmers resulting in the depletion of water tables.

In addition to the depletion of the scarce resource, highly intensive development of groundwater has resulted in undesirable side effects such as lowering of groundwater tables, drying up of shallow wells, deterioration of water quality, and land degradation due to saltwater intrusion, increasing water-logging and salinity in farm lands. Unfortunately, these implications are more severe for small and marginal farmers, whose dependence on groundwater resources is more than the farmers with large land holdings.

Pricing of water

Inefficient use of water in the agricultural

sector has been backed by the poor pricing of water. In South Asia, irrigation charges are generally very low, to an extent that it renders the irrigation system financially unsustainable. In Pakistan for example, it has been estimated that water charges account for 2.5 per cent of the gross value of production. Similarly in India, this is only 2.8 per cent.²¹ While inflation has affected all the sectors of the economy, water charges have largely remained unaffected. Generally in South Asia, and specifically in Sri Lanka and Nepal, there is a traditional belief that water is a Godgiven free commodity and only the water supplied to urban areas for domestic use is charged on a volumetric basis, while for irrigation a minimal service charge is applied.

The basic reason behind inefficiency in water use in South Asia is the inherent delink between water charges and the quantity used. Water pricing in South Asia is independent of actual water consumption. In the case of Pakistan, water is charged either on the basis of area or on crop based flat rates. Similarly, in India, irrigation water is priced on a per acre basis.²² Such pricing methodologies do not encourage efficiency in water use, as neither of the two relates to actual water usage.

Pricing water appropriately not only ensures efficient water use, it is also necessary for adequate maintenance of irrigation infrastructure to prevent water losses in the irrigation systems. In this region, canal water charges are generally so low that they fail to recover operation and maintenance costs. In Pakistan, the pricing structure is one in which the government recovers only 24 per cent of the annual operation and maintenance cost. In addition, the recovery rates are low and 40 per cent of the users fail to pay the regular charges.²³ The result over the long run is one that portrays continued neglect of water courses and canals, reducing water efficiency further.

In essence, more than water

The basic reason behind inefficiency in water use in South Asia is the inherent delink between water charges and the quantity used The increasing pollution of water is stemming from intensive agricultural usage and rapid industrialization

scarcity, inefficiency of water use is the primary problem for South Asia. In fact, part of the solution to water scarcity lies in inculcating practices that use water efficiently. South Asian countries would need to take drastic measures to increase water-use efficiency and productivity. This would involve using more efficient technologies like drip or sprinkle irrigation. Revival of age-old practices like rain water harvesting through community built infrastructures like small reservoirs or tanks is also important. Some countries in South Asia have already realized this need and are experimenting with conservation of excess flows through small scale storage infrastructure. In order to increase the net benefit per unit of land and water, cultivation of crops with high water requirements should also be reduced. Much of the interventions have to be state driven. As water efficient technologies are cost intensive to begin with, governments would need to provide incentives to encourage their use through subsidies etc.

Water pollution

Water pollution is a key issue in the current global policy debate because of its longlasting impact on human development. Water is not only an essential component for human life, it is also too often a carrier of pathogens that cause diseases. Globally more than five million people die annually from water-related diseases.²⁴ In addition to the repercussions of water pollution on health, it also implies economic losses through loss of human productivity. Water pollution affects the poor people more than the rich. Their inadequate diet, unhygienic living conditions, lack of access to health facilities, and greater exposure to polluted water increases the vulnerability of the poor to harmful effects of water pollution on human health.

The quality of water in South Asia has been deteriorating rapidly. The increasing pollution of water is attributed to the pressure on water resources stemming from intensive agricultural usage and rapid industrialization. Excessive use of fertilizers and pesticides, release of industrial wastes in addition to domestic sewage and solid waste being dumped in the water courses are significantly deteriorating water quality in the region.

Pollution by agricultural activity

Water from agricultural run-off is a major reason for water pollution in the region. While increased use of chemical fertilizers and pesticides has significantly increased agricultural production, its indiscriminate use has added compounds in water bodies above harmless levels. Consumption of mineral fertilizers in South Asia has increased rapidly over the last three decades and the use of fertilizers is considerably higher than in other regions of the world.²⁵

The excessive levels of nitrates are not only a threat to the environment, but also for animals and humans, due to the toxins produced. In Sri Lanka, Kotmale reservoir, Nuwara Wewa, Mahaweli System, and Kandy and Gregory lakes are all victims of nutrient enrichment due to excessive fertilizer use.²⁶ The problem becomes severe as many of these reservoirs supply water to municipalities.

Pesticides used for agriculture are another source of water pollution. Pesticide use has increased significantly over the last four decades, to achieve higher crop vield of better quality. In Pakistan for example, 70 thousand tons of pesticide are used annually.27 Similarly in India, pesticide use is growing at a very rapid rate, especially in the state of Punjab. Very few of these are effectively utilized by plants, but a large proportion finds its way into the freshwater sources, polluting them with carcinogens and other poisons that have serious health consequences. Many rivers of South Asia, especially the Ganges in India, show pesticide levels well above the permissible limits.²⁸ Poor manufacturing and transportation, improper storage and careless disposal also create pesticide

contamination, especially for drinking water.

Pesticides also destroy freshwater and coastal ecosystems, as they not only kill the targeted species, but also nontargeted species present in the ecosystem. Deleterious, and often lethal, effects of water pollution have been witnessed on fisheries in the water courses and at the coastal end. In the Bay of Bengal, high concentration of pesticide traces were found in the tissues of Skipjack tuna indicating pesticide pollution in the seawater.²⁹ Box 3.1 presents a case study of Manchar Lake in Pakistan to illustrate the harmful effects of water pollution on health, livelihood and ecology.

Pollution by industrial activity

Increasing industrialization in South Asia and the gradual transformation of agriculture-based economies is having serious environmental side effects particularly because of pollution. Industrial pollution levels indicated by biochemical oxygen demand (BOD) are rising in South Asia and the region is second behind Central and Northeast Asian countries across Asia in terms of BOD emissions.³⁰

The major sources of pollution are industries producing textile, cement, glass, paper and pulp, ceramic and metals. These industries emit large amount of nitrogen, sulphur and carbon dioxide into the air. These pollutants dissolve in the water and fall as acid rain. Emissions of lead, arsenic, chromium and other heavy metals from glass, iron, steel industries and others that are involved in electroplating are also very toxic and introduce heavy metal load into the river systems. Extensive use of these metals and their improper disposal results in accumulation of toxic metals in the soil and water. Long term exposure to these pollutants in drinking water leads to a number of health problems and increases the risk of cancer, gastrointestinal problems and diseases of the heart and the nervous system. Mining activities also degrade

Box 3.1 Water pollution in Manchar Lake in Sindh

The Manchar Lake situated in Sindh is Pakistan's biggest shallow water lake and one of Asia's biggest. It provides a natural water storage facility, receiving water from several canals of the Indus River, hill torrents and from the main Nara valley drain. The lake is the main source of domestic water supply for communities living in several districts of Sindh including Karachi and Hyderabad. Its water also supports livelihoods as it is used for irrigation and fisheries. However, in recent years the lake has been subjected to severe deterioration from agricultural run-off, and the once life-giving lake is now posing a severe threat to the livelihoods, health and lives of communities dependent on its water.

An assessment undertaken to determine the physio-chemical properties of the lake's water found high concentrations of sodium, chlorine, calcium,

Sources: Mastoi et al. 2008 and Zehra 2010.

magnesium, potassium, nitrates and phosphates. Significant traces of heavy metals such as copper, nickle, zinc, iron, lead and cadmium were also found. The concentration of lead and cadmium were reported to be higher than the World Health Organisation's guideline values for drinking water quality. The water quality indicators measuring salinity, pH and hardness characteristics were also found to be deteriorating. The assessment concluded that the water quality of the Manchar Lake has degraded and is not fit for consumption.

Water pollution has destroyed the lake's unique culture and exposed the population living in that area to poverty and health issues. Consumption of polluted water has led to varied diseases such as Hepatitis C, skin and eye infections, tuberculosis and night blindness, especially amongst women and children, resulting in high infant and maternal mortality. In 2004, around 38 people, mostly children, died due to a diarrhoea epidemic largely attributed to contaminated water from the Manchar Lake. Polluted water has led to a decline in fish catch.

Water pollution also resulted in severe environmental consequences. The lake which once supported 2,600 species of plants, animals and fish, has witnessed declining numbers of species. Fourteen out of 200 species of fish have been declared extinct, and many species of popular and commercial value have disappeared. Additionally, in recent years there has been a reduction in numbers of Siberian migratory birds visiting the Manchar Lake, that was once a prominent feature. water quality.

These industries do not control the discharge of wastewater effluents and other industrial waste. Untreated industrial wastewater is thus disposed into nearby open land, drains, canals or rivers, from where these chemicals mix with the surface water and also seep into the groundwater.

Industrial water pollution is a severe threat in India, affecting surface water and groundwater quality. In India, 119 districts across 19 states have reported excessive levels of fluorides pinning the blame on industrial effluents as a primary source.³¹ Contamination of groundwater and surface water with highly toxic mercury from industries producing fluorescent lamps, thermometers, and electronic switches has affected 1,080 million people in Tamil Nadu and Maharashtra.³² Similarly, West Bengal, Chattisgarh, Bihar and Uttar Pradesh, which are among the most populated states of India, too have witnessed high levels of arsenic contamination.³³ More than India, arsenic poisoning is a major threat in Bangladesh, with around two-fifths of the population at a risk of using arsenic polluted water. Arsenic traces were also found in rice grown areas in Bangladesh.³⁴ In Pakistan too, 99 per cent of the industrial effluents containing biological and chemical pollutants are discharged into rivers without treatment.35 In Nepal, water pollution by industries is the most serious environmental quality issue. There is no treatment plant in any industrial district and industrial waste is discharged directly into the rivers and streams. Recent analysis has revealed alarming levels of water pollution in 25 districts of Nepal.³⁶

Combating water pollution

Improving water quality management would require some precautionary steps in the legal and institutional framework across South Asia. In this regard, efforts may include: legislations and institutions to deal with water pollution; setting acceptable standards of water quality and proper monitoring of these standards; and designing strategies to attain set standards. South Asian countries have generally done well to frame legislations. However, implementation in terms of both monitoring and enforcement is lacking.

Firstly, there is a lack of coordination between several governmental organizations spanning federal, provincial and local levels, entrusted to control water pollution and maintain water quality. In India, for example, Central Pollution Control Boards set uniform discharge standards for industrial effluents to be enforced by State Pollution Control Boards. There is limited coordination between the two departments; hence the standards set are not enforced.³⁷ Secondly, administrative inefficiency in controlling pollution of water resources is another cause of ineffective implementation. Insufficient budgetary allocations, weak law enforcement and absence of trained staff are possible factors behind poor implementation of water quality regulations and laws. For example, in Pakistan laboratories to monitor environmental quality have been established in all the provinces, but are not fully functional due to the absence of appropriate staff and inadequate budget. In addition, the lack of a comprehensive central database for water quality results in poor implementation. Political interference and corruption are also factors hindering implementation of environmental laws.

In addition to controlling pollution, South Asian countries would also need to make efforts to reclaim water lost due to pollution. Water polluted by organic waste could be used as fertilizers in agriculture. Similarly, water of lesser quality may be adequate for some industries. Hence, use of recycled or reclaimed water needs to be encouraged to tackle water scarcity issues. In India, several small scale projects are ensuring supply of treated water for consumption in many villages and small towns, at a low cost.³⁸

In Bangladesh around two-fifths of the population is at a risk of using arsenic polluted water

Saving the scarce resource: Water storage

As competition for water increases in South Asia and concerns for water availability get severe, the need for additional storage will increase in the future. Dams have played an important role and hold a continued potential to benefit communities and economies to utilize water resources for food production, energy generation, flood control and domestic use. More predictable energy supply is important for human development. Similarly, human development goals cannot be reached without food security. Floods too have the potential to derail any human development achievements through loss of lives and livelihoods.

Status of water storage infrastructure in South Asia

In the 1960s and 1970s South Asian countries made massive gains in building infrastructure to stock water flowing in some of the largest rivers in Asia. The Bakhra Nangal Dam (1962) in India was amongst the earliest built multi-purpose water infrastructure. Pakistan commissioned Mangla and Tarbela dams in 1967 and 1977, respectively. Bhutan and Nepal also built several small and medium dams in the period between 1960s and 1970s. These efforts resulted in developing water storage potential of 217.1 cubic kilometres. However, since then the construction of big dams has slowed down, and in the last 20 years the region has cumulatively added only 57.9 cubic kilometres of water storage capacity, concentrated largely in India. As a result, per capita water storage capacity has declined from 182.1 cubic metres per inhabitant in 1990 to 176 cubic metres per inhabitant in 2010 (see table 3.3).³⁹ Recently, there has been a renewed and aggressive approach in the region to enhance water infrastructure. The projects are yet to be materialized and are in various stages of planning and implementation.

Table 3.3 Water storage capacity in South Asia, 2010				
	Total (cubic	Per capita		
	kilometres)	(cubic metres)		
India	224.0ª	190.8ª		
Pakistan	27.0	152.9		
Bangladesh	20.3 ^b	141.0 ^b		
Afghanistan	3.7	113		
Nepal	0.1	2.8		
South Asia ^c	275.1T	176.3		

Note: a: Data refer to 2005. b: Data refer to 2007. c: It is the weighted average value or total (T). *Source:* MHHDC 2013 *Profile of Water in South Asia.*

The need for water storage infrastructure

Enhancing water storage infrastructure in South Asia can serve multiple purposes. Dams are needed to enhance water storage capacity, to control flood, and to drain excess water from irrigated land. In addition, dams are a major source of energy that not only satisfy the growing need of electricity, but in cases like Bhutan are also a significant source of revenue.

The primary need for dams is to store water for irrigation and agricultural purposes. Agriculture is the major driver for economic activity in South Asia and any disruption in the supply of water for irrigation would have serious repercussions on the well-being of millions of people relying on agriculture for their livelihoods. South Asian countries, despite having one of the world's oldest and most extensive irrigations systems are now facing massive water problems. The dams built earlier are rapidly losing their storage capacity due to siltation, as seen in Pakistan where the Tarbela and Mangla dams have lost up to three million acre feet due to silt deposit.⁴⁰ This is severely hampering water supply at a time when demand for water is increasing.

In addition to this, the region needs new water storage facilities to prevent drainage of excess water into the sea. Since most of the river basins in the region like the Indus in Pakistan, the Narmada in India and the Ganges in Nepal, India and Bangladesh are semi-- closed basins with no excess outflows during the low flow season but excess outflows during high flow season, excess water needs to be stored. For example in Pakistan, during the summer months when flood discharges are very high, around 35 million acre feet of excess and unused water is discharged into the Arabian Sea.⁴¹ Storing this water and reallocating it between seasons can yield significant benefits.

Seasonal excess flows occur due to the hydrological characteristics of the region. Most of the rainfall in the region is seasonal, falling between the months from June to September. This causes very large river run-offs during the monsoon period and very low flows during the rest of the year, making it imperative to store water if it is to be used. For example, in India 50 per cent of precipitation falls in just 15 days and over 90 per cent of river flows in just 4 months.⁴² Similarly in Bangladesh, 40 per cent of the country is inundated during the monsoon period whereas a large part of the country faces water scarcity in the pre-monsoon season.43

The need for water storage facilities also arises because of the increasing pace of glacial melt from the Himalayan mountain range. Global warming has affected the Himalayas more than in any other mountain range of the world.44 The accelerated melting of glaciers requires water storage infrastructure for two reasons. Firstly, in the short run, glacial melt will cause high run-offs in rivers. This combined with the sporadic nature of rainfall in South Asia will increase the likelihood of floods. The harmful impact of floods on the lives and livelihoods of people was evident in Bangladesh in 2004 and in India in 2008, and more recently in Pakistan in 2010. Water storage infrastructure is therefore necessary to store the additional and unexpected flow of water. Secondly, in the long run, the region is expected to face water shortages as glaciers recede, hence it is imperative to store water now for future use (see chapter 4).

In addition to irrigation, flood control and water supply, multi-purpose dams are critical for South Asia because of energy needs. Currently with the exception of Bhutan, which produces surplus electricity compared to its domestic requirement, all the countries in the region are facing electricity shortages. Power shortages are more critical in India, with a shortfall of 11,673 megawatts or 8.8 per cent of the peak demand.⁴⁵ Similarly, in Pakistan the energy crisis is rampant and power shortfall is resulting in massive loadshedding across the country. Power outages are having serious repercussions on future growth and development; 40 per cent of the industries in Pakistan have identified the energy crisis as a major constraint for development of their business.⁴⁶ Apart from energy needs, hydropower projects are also vital for revenue generation. Bhutan and Nepal see a huge potential for earning revenues from the sale of surplus electricity. Revenue from hydropower generation is the single largest source of earning for Bhutan, comprising 45 per cent of national income. Nepal too, is planning capacity addition to produce and export surplus electricity to India. Hydropower projects are also seen as the most viable energy option in Pakistan, as the per unit cost of electricity from hydro projects is cheaper compared to alternative thermal sources currently dominant in the country's energy mix.

Future challenges

Realizing the need and importance for enhancing water infrastructure for storage and for generating electricity, South Asian countries, especially Nepal, Bhutan, India and Pakistan have put in place massive plans to build dams. Bhutan has initiated work on Punatsangchhu Dam and Mangdechhu hydroelectric project to generate electricity, while Nepal too has initiated work on Arun III and Upper Karnali projects. Pakistan also is aggressively working towards the Neelum-Jhelum hydro-

In addition to irrigation, flood control and water supply, multi-purpose dams are critical for South Asia because of energy needs power project while planning of the Diamer-Bhasha Dam is also underway. In India, several projects are currently under construction, highlighting the renewed push for building dams in the region.

Funding issues

The most challenging task for South Asian countries is to acquire funds required by these projects. According to estimates by the World Commission on Dams (WCD) the region is seeking in excess of US\$100 billion for dams in the next ten years⁴⁷, and these costs are expected to rise with the increase in construction costs. International financial institutions (IFIs) like the World Bank and Asian Development Bank (ADB), donor agencies and governments have played an important role in the past in arranging funds for massive infrastructure projects in the region. Tarbela, Mangla and Ghazi Barotha dams in Pakistan have previously been completed with the support of the World Bank and ADB. Similarly, ADB is funding dams in Bhutan and India too. The contributions from IFIs would be significant in the future too to complete many of these proposed projects. However, much of the assistance from IFIs hinges on conditionalities like environmental impact assessments and domestic reforms, thereby remain uncertain. Nepal, for example had to abandon the proposed West Seti Dam project, as the contractors were unable to raise sufficient funds once the project failed to comply with ADB's environment policy, involuntary resettlement policy and public communication policy, as well as recommendations by the WCD.⁴⁸ Similarly in Pakistan, ADB has refused to fund the proposed Diamer-Bhasha Dam because Pakistan has been unable to reform its power sector appropriately. It is therefore vital for countries in the region to seek alternative source of financing to complete the proposed projects.

Funding from friendly donor countries and countries with mutual inter-

est has provided an alternate source of funding. China has been active in helping Pakistan complete the Neelum-Jhelum project, while the United States has promised to provide US\$5.5 billion for Diamer-Bhasha Dam. India has been assisting governments in Nepal and Bhutan to accomplish their water infrastructure projects, with the aim to import a significant proportion of the produced electricity. However, considering the global recession and fragile financial situation in many of the advanced economies, it would be difficult to rely on foreign sources for funding domestic projects.

Generating funds from domestic sources would also be extremely difficult as many of these governments lack the financial capacity to fund these massive projects on their own. In future, much of the funding would be derived from private partners and through loans from international and local banks. Involving private companies with profit motives would ease the availability of funds, however it will raise the energy prices to the detriment of the poor.

Social and environmental impacts

The construction of dams has huge social and environmental costs that pose a challenge to the proposed expansion of water storage infrastructure in the region. Also, all of these proposed projects are likely to submerge vast area of land, forest and villages, impact fisheries and cut off access to roads and degrade water sources. Submergence remains a serious issue as most of the people living on the banks of these rivers derive their living from water. They use river water for agriculture that provides food and fodder. The fish from rivers are also an important source of food and income, and the forests watered by the rivers are also an integral part of the economy and ecology of these people. Submergence of land would cause forced displacement of people affecting their resource base, their lives and livelihoods. In the case of the Tarbela Dam in Pakistan,

The construction of dams has huge social and environmental costs that pose a challenge to the proposed expansion of water storage infrastructure in the region about 96,000 people were displaced. The Tehri project in Uttarakhand, India has led to displacement of more than 100,000 families.⁴⁹ Inappropriate compensation for the loss of land and livelihood makes construction of dams more contentious.

These environmental and social impacts are not only confined to dam location; serious impacts are also to be felt downstream from the mountains, to the plains and all the way to the mangroves in the delta areas. The degraded quality, reduced quantity and varied pattern of water flow will affect daily water use, agriculture and irrigation, fisheries, wetlands and mangroves that rely on upstream water. For example in Pakistan, the reduced flow of water in the lower Indus River, has led to a sharp reduction in the area covered by mangrove forests and severe encroachment of the sea into delta areas.

Dams have also resulted in increased erosion and sedimentation problems, which would aggravate with increased construction activity. Sedimentation is a critical issue reducing the lives of reservoirs built for water storage. In Pakistan, Tarbela, Mangla, Chashma and Warsak dams have lost a significant proportion of their water storage capacity. Analyses reveal that with the current rate of sedimentation, more than eight million acre feet of water storage capacity would be lost due to sedimentation by 2025.⁵⁰ Ironically, creating new storage infrastructure increases the rate of sedimentation and erosion, decreasing the storage capacity in the dams built downstream. In addition, the accumulation of sedimentation in the dams also deprives downstream plains with fertile nutrient soil and silt deposits.

Social and environmental impacts due to the construction of dams have caused grievances and conflicts both within countries and at transboundary levels as well (as discussed in chapter 5). Many of these have impacted successful implementation of projects and have delayed the projects beyond commissioning dates. A case in point is the Kalabagh Dam in Pakistan which has been under consideration since 1953, but has been delayed because of politicization of social and environmental impacts (box 3.2).

Issues of water distribution

The growing demand for water has led to concerns regarding access, equity and

Box 3.2 Kalabagh Dam: A bone of contention

The dam under consideration since 1953 is proposed to be located on the Indus River. It is a multi-purpose development project for irrigation, hydropower and flood control. The proposed dam has the capacity to store 6.1 million acre feet water, irrigate 2.4 million acres of land and generate 11,750 kilowatt hours of electricity, to benefit the whole country. However, despite being found technically feasible and economically viable by international experts, and with approved funding from the World Bank, the project has been held hostage in a political quagmire since its inception.

The construction of the Kalabagh Dam has raised several environmen-

Sources: Bengali 2003 and Brisco and Qamar 2006.

tal and social apprehensions by two provinces, Sindh and Khyber Pakhtunkhwa (KPK). KPK fears that the dam would make Nowshera town vulnerable to floods, inundate a large area of fertile land, cause water-logging and salinity in Mardan and Swabi districts and Pabbi tehsil in Nowshera district and dislocate a large number of people. Sindh is concerned with sea water intrusion in the delta area affecting groundwater quality, mangrove forests and fish production, reduced flood cultivation in *sailaba* areas (flood recession cropping areas), and desertification.

While all these concerns are genuine, and would arise in dam constru-

ction anywhere in the world, they are not unresolvable. Pakistan in fact possesses the best possible institutional framework in the form of the Indus Water Accord 1991, agreed between provinces to resolve these issues in a transparent and fair manner. The Accord defines, unambiguously and in perpetuity, the shares of available water which can be used by each of the provinces and establishes clear entitlements for each province to surface water.

However, the Kalabagh Dam has been delayed, due to lack of political will and failure to develop a consensus to resolve the controversies. distribution. Water distribution issues in South Asia are diverse in nature, each country having its own set of concerns. In India and in Pakistan, water sharing issues revolve around water usage in the agriculture sector as well as within provinces or states (see annex table 3.1). In Bangladesh and Nepal, on the other hand, water sharing disputes mainly concern distribution within various sectors of the economy.

Water distribution between provincial *listate entities*

Water scarcity is a primary determinant of conflicts both between provinces/states and within provinces/states. As the hydrology of Pakistan has changed from a water rich country to one on the verge of water stress, tensions over water sharing have intensified between provinces. Punjab needs water through the Chashma-Jhelum and Taunsa-Punjnad link canals to supply water to irrigate Bahawalpur, Bahawalnagar and Rahim Yar Khan districts, without which they would go dry and barren. For Sindh, any water withdrawal upstream in Punjab would impose a cost downstream, affecting not only irrigational needs, but also accelerating degradation of coastal mangroves and intrusion of sea water in the delta areas. The conflict has resulted in the wastage of around 38 million acre feet of surplus water as no new reservoirs of significant capacity have been constructed lately.

Apart from the water scarcity issue, designing and constructing dams is a significant bone of contention between regional entities. Disputes largely concern submergence of land of economic value to construction of reservoirs, resettlement and rehabilitation of affected people and the permitted storage level as it would determine the flow of water downstream. In India, in the Damodar Basin project, the state of Jharkand has serious concerns as land with significant coal potential will be submerged in water if the proposed dam is constructed. Resettlement and rehabilitation of people affected by the construction of the dam has been a major issue in settling the Sardar Sarovar project in the Narmada Basin.

In the context of South Asia, the water issue has significant bearing on politics. For example in Pakistan, construction of the proposed Kalabagh Dam on the Indus River has been delayed due to politicization in each province (see box 3.2).

Water distribution at local levels

Various sectors of the economy compete against each other for the sharing of water. Agriculture has a dominant share, with irrigation accounting for a significant share of the utilized water supply in South Asia. With rapid growth of South Asian economies and especially the industrial sector, the demand for water from industries also has a strong potential for conflict. In Bangladesh, conflicts among alternative and competing uses of water are becoming sharper as the demand for water has been increasing, especially between agriculture and fisheries (box 3.3). Inter-sector water use conflicts are also predominant in Nepal especially because of the environmental concerns.

At a sub-regional and local level, political economy also plays a role in water allocations, largely to the detriment of those who lack power to influence. One example of this is the conflict between powerful and more resourceful commercial operators of shrimp farming and less privileged local rice farmers in Bangladesh (box 3.4).

Political and economic power also continues to influence water use in villages in Pakistan and India. As water rights are generally linked to land rights, water use is skewed against the poor. Water theft by tampering water flows through obstruction and influencing *warabandi* (water turns) are common practices in South Asian villages. Here too political influence overrides equitable and fair distribution of water for irrigation. Tail-end farmers, away Water distribution issues in South Asia are diverse in nature, each country having its own set of concerns

Box 3.3 Farmers versus fishermen: Land and water use conflict in Bangladesh

Fisheries play a significant role in Bangladesh's economy. They account for 5 per cent of Bangladesh's GDP and 12 per cent of its export earnings, playing a dominant role in providing employment. The main fishing areas are the wetland areas, constituting rivers, streams, freshwater lakes and marshes that Bangladesh has in abundance. However, the increase in population and the demand for agrarian products has created a conflict in the utilization and allocation of water resources between two important water using sectors: farming and fishing.

Development activities in the wetland areas to increase the size of farmland and to reduce flood levels to facilitate agriculture have altered the natural hydraulic regime, which is detrimental to the interests of fishermen. Withdrawal of water for irrigation, drainage of flooded areas for cropping and other flood control measures has resulted in a reduction in the size of fish habitats and prevention on fish movements. The farmers, on one hand, are inclined to increase their crop output, but fishermen, on the other hand, are disadvantaged in maintaining sustainable livelihoods. Drainage of wetlands has diminished fish output, but increased both cropped area and cropping intensity.

The water use conflict between farmers and fishermen is a recurrent annual phenomenon. In the months of November and December, when the farmers need rapid drainage of water for rice cultivation, it is in the interest of fishermen to hold water for breeding fish. However, in late February the situation reverses as farmers now need water to flood their land, fishermen want to decrease water levels in marshes to maximize their catch.

The conflict in allocating and utilizing water between the farming and fisheries sector is a continuous problem in water management in Bangladesh. With the increasing demand for food security, national planning promoted agriculture expansion. Thus, the interest of farmers received priority and the interest of fishermen was neglected. Some of the impacts have been positive as Bangladesh has averted serious food insecurity and in fact has been self-sufficient in rice production. However, there are some serious adverse impacts as many fishermen have lost their livelihoods.

Source: Siddiqui and Kheli 2004.

Box 3.4 Rice cultivation versus shrimp cultivation: A case of power politics determining access to water

In Bangladesh, the indigenous practice of shrimp farming was based on a shrimp and rice rotation, with shrimp grown in the dry season, and rice grown in the wet monsoon season. With the advent of commercial shrimp farming, affluent and powerful entrepreneurs started leasing land from local rice producers for short durations, for shrimp production. Serious disputes have often arisen between rice farmers and shrimp producers, as shrimp farmers have moved away from indigenous practices to maximize yield. They would retain saline water in the fields as long as possible, and also use other practices like liming of the ponds, to maximize shrimp production. This is detrimental for the small rice farmers, who are politically and economically weak to prevent shrimp farmers getting their way. As a result, the rice farmers do not get adequate time to drain saline water and hence plantation is delayed and rice yields are reduced.

Source: Siddiqui and Kheli 2004.

from the head or middle of the canals, receive not only less water, but also suffer from uncertain supplies compared to those at the head or middle of an irrigation canal.

In conclusion, despite the varying nature of water sharing disputes in South Asia, due to physical diversity, variations in water availability and water use, there are certain common themes that emerge. Mistrust between concerned parties, lack of openness and transparency in sharing information and poor administrative and institutional arrangements to resolve these issues are just a few instances highlighting the extent of challenges that exist in this context.

Institutional framework to manage water resources

Water management in South Asia has become critical due to growing demand and increasing conflicts between alternate uses, as discussed in earlier sections. The cross cutting nature of water as a productive resource, its distributional significance and its repercussions on human development underlines the importance of managing water. Water management involves planned development, equitable distribution and use of water resources in accordance with set objectives relating to both the quantity and quality of water. It should also aim at reducing the economic and environmental exploitation of water.

Water management in South Asia

Institutions for water management in South Asia

South Asian countries have an elaborate institutional setup that looks after the distribution, management, allocation, regulation of water protection and resources across varied sectors of the economy. In addition, in many of these countries, these institutions are decentralized to operate at different scales ranging from federal level to local communities. For example in India, Pakistan and Sri Lanka, there are provincial and state level ministries for irrigation. These countries also have farmer organizations for operation and maintenance of water channels for village irrigation. At a local government level, there exist municipal councils, urban councils and rural councils to ensure water supply.

It is common in South Asia to see ministries and departments responsible for water resources, irrigation, environment, energy, urban water supply, rural water supply, sanitation, transport, health, and so on. In some cases, the task of individual ministries and departments overlap. For example in Bangladesh, both the Ministry of Agriculture and the Ministry of Water Resource are responsible for water resource management and farm level management. Similarly, in Pakistan the Water Resource Research Institute and Pakistan Council for Research in Water Resources are more or less mandated to do the same tasks. This results in the complexity and fragmentation of institutions that are supposed to govern and manage water.

To some extent, this fragmentation of water management under various institutions originates from the centrality of water to all aspects of development, underpinning every social and economic sector. However, it also points towards poor governance. South Asian countries have failed to develop a unified system of management and governance of water resources. There is an urgent need to resolve the confusion in water governance and unite these fragmented institutional structures, at national and sub-national levels, under a single governing institution.

A coherent and comprehensive approach to design policies and legislations to manage water resources is lacking in South Asia. Policies and regulations are important aspects of water resource management as they lay down principles and norms governing the rights to, and the usage and protection of water resources.

In many South Asian countries, existing water policies are not comprehensive, as evident in the cases of Bangladesh, Pakistan, Sri Lanka and the Maldives. Though there are segregated policies that cover various aspects of water management, for example Bangladesh has put in place a National Agriculture Policy, a National Water Policy, and the National Water Management Plan, a single all encompassing policy is lacking. In Sri Lanka, there are many acts of the Parliament concerning the water sector, but since a coherent policy is lacking, there are gaps, overlaps and conflicting laws governing water resources. In Pakistan too, a draft National Water Policy has been in the process of approval since 2005 and hence laws concerning water currently are disaggregated under various plans and laws. India and Bhutan are the only two countries in the region with a national water policy. In Bhutan, the Water Policy was signed in 2003 and in India the National Water Policy was adopted in 1987 and revised in 2003.

Strategies for water resource development in South Asia have so far been centred on flood control as in the case of Bangladesh and for irrigation expansion as in the case of Pakistan and India. Food production and food security indeed are essential, but demand for water has increased very sharply among alternative In many South Asian countries, existing water policies are not comprehensive and competing uses. Effective policies and legislations can reduce natural, economic, technical and social uncertainties. Legislations are essential to define roles, rights and responsibilities at different levels. In doing so, they also determine restrictions and provide for mediation of conflicts.

Management of water: The way forward

Successful water management would require managing water resources, service delivery and the gap between supply and demand.⁵¹ Dealing with water resources entails managing water in natural aquifers in terms of storage, recharge, allocation and maintaining ecosystems and quality. Water service delivery is associated with supply from aquifers or storage infrastructure to the end user through water distribution systems. It also includes recapturing the used water and its disposal. Managing trade-offs is an essential component of water management ensuring sustainability of water resources. Expanding demand for water generally for competing needs necessitates managing trade-offs through allocation and entitlement agreements and pricing policies.

Water resource management in South Asia has largely focused on infrastructure development. The supply side approach to water management was particularly followed as the region was naturally gifted with abundant water resources in terms of glaciers, lakes, rivers and significant rainfall. The need was to enhance storage and develop physical infrastructure for distribution. However, with the pace of development South Asia is facing difficulty in securing adequate and reliable access to water for production and consumption needs.

Three important policy implications follow from this analysis: improve water productivity, price water for efficient allocation, and use integrated water resource management (IWRM) technique.

Improve water productivity

Improving water productivity at the farm level requires using improved and sophisticated irrigation techniques. Technology like drip irrigation systems provide water directly to the root zone of the crop ensuring supply of optimal amounts of water at optimal times. Since it supplies water directly to the crop rather than the land as in flood irrigation, water losses due to evaporation and distribution are reduced. Additionally, it also reduces salinization and water-logging. Such technologies have been effectively used on experimental basis in Andhra Pradesh, Madhiya Pradesh and Maharashtra in India and also in Nepal. However, utilizing them on a large scale and on a permanent basis would require governmental support in terms of subsidies.

The impact of water scarcity can also be mitigated by adopting water harvesting techniques that store water in times of abundance for reuse in times of scarcity. Tanks, ponds and dams are some water harvesting techniques that are small scale and less costly with significant potential to increase water availability, especially for the poor. In addition to supplementing water supply in dry months, they are useful to increase water moisture in the soil and help in replenishing groundwater.

Increasing water productivity in South Asia would also require reducing water used in crop planting. One way to do this is introducing new crop varieties. Utilization of improved planting methods like multi-cropping, crop rotation, intercropping, zero tillage and direct seeding techniques help in increasing water use efficiency and would go a long way in reducing demand for irrigation in South Asia. Cropping patterns could also be adjusted to the availability of water, through a shift from post monsoon irrigation to monsoon irrigation, to reduce the use of irrigated water.

Successful water management would require managing water resources, service delivery and the gap between supply and demand In industry, water recycling technologies should be fostered for recycling water for use in the same industry or by cooperative use of water in industrial estates where water flows from one industry can be used by other industries requiring water of lesser quality. This would also reduce the increasing hazards of pollution of surface water and groundwater due to discharge of polluted water in water bodies.

Pricing water to achieve optimal allocation

Water for economic needs, especially canal water for agriculture in South Asia, is grossly undervalued. In this context raising water prices is the most important economic solution to address water scarcity issues in the region. Higher water prices would motivate farmers to plant waterefficient crops and invest in water-efficient technologies thus maximizing output per unit of water. Increasing the prices paid by the consumers would reduce the demand for water and avoid wastage.

However, implementing full cost water pricing would have a negative impact on poor farmers more than the rich, as poor farmers possess limited resources to cope with the increased price. Therefore, a balance needs to be created while increasing water pricing, such that the principle of equity is not ignored. This would require realigning water subsidies in a way that they benefit the poor.

Pricing water would only be effective if it is accompanied by quantity restriction. This would also ensure that even if financial resources are available, efficiency in water use should still be encouraged. Proper valuation of water and its pricing would have added benefits of providing a mechanism to resolve distributional issues of water between sectors of the economy and between sub-national entities.

Integrated water resource management (IWRM)

The main purpose behind an IWRM is to ensure effective and efficient management of water resources. This can be achieved through developing coordination between policies, frameworks and institutions working towards planning, operation and management of one or more aspects of water use. One of the primary goals of IWRM is to develop a framework to reconcile several economic development needs of water and balance them with environmental needs such that the sustainability of water resources is ensured. Some of the key characteristics of the IWRM framework would include: developing a national water policy to be followed by all stake holders to ensure coordinated action for sustainable water management; treating water as an economic good by pricing water-related services appropriately; establishing water rights; and ensuring participatory water resource management with the involvement of end users, especially women and the poor.

Moving towards an integrated framework for water management would be helpful for South Asia, but might not be easy. First, water economies of South Asian countries are largely informal, therefore implementing water pricing, basin level water allocation, and water legislations would be difficult, unless institutional reforms are undertaken simultaneously. Secondly, South Asian countries to a large extent still lack basic water infrastructure that is currently mandated to be provided by government organizations. Encouraging efficiency (at the expense of equity) through privatization, as IWRM suggests may bring into debate ethical issues. Thirdly, considering water as an economic good would contradict the general perception of water as a common good and a natural right. While economic principles

Moving towards an integrated framework for water management would be helpful for South Asia might inculcate efficiency of water use it would deprive the very poor to consume water for basic needs.

In conclusion, the water crisis in South Asia is not about water shortage. The drying up of rivers, falling levels of groundwater tables, and degradation of water-based ecosystems can be traced to inefficient use, overexploitation, pollution, inequitable distribution and to poor management that has created scarcity of water. Efficient water management holds the key to sustainable use of water for production and consumption.

Annex table 3.1	Annex table 3.1 Water sharing conflicts between states/provinces in South Asia				
Basin/ Dam	Conflicting provinces/states	Salient features			
Indus–Pakistan	Punjab, Sindh	Sindh demands water sharing as per 1991 Accord. Punjab demands agreement on construction of new reservoir before implementing water sharing formulae. Current status: Ongoing with threatening consequences, in terms of floods and droughts.			
Indus Basin: Ravi, Beas, Sutlej–India	Haryana, Punjab, Rajasthan	Conflict on excess flows (over and above allocated flows under Punjab Settlement Accord 1985). Haryana, Punjab, Rajasthan have right to flows as of July 1, 1985 for irrigation and other consump- tive purposes. Excess flow to be decided by Ravi-Beas Tribunal. Current status: Ongoing due to a constitutional impasse, after the Punjab Termination of Agreements Act (PTAA), 2004, that discharges Punjab of all obligations arising from the earlier agreement. Hearings of the Tribunal have come to depend on the outcome of a Presidential Reference related to constitutionality of the PTAA.			
Yamuna–India	Delhi, Haryana, Himachal, Rajasthan, Uttaranchal	Irrigation needs of Uttaranchal and Haryana clash with municipal and industrial needs of Delhi and Rajasthan. Uttaranchal and Haryana often withdraw excessive water for irrigation to the detriment of municipal and industrial needs of Delhi resulting in frequent referrals to courts. Current status: Agreement reached in 1994. Upper Yamuna Board set up to regulate allocation of available flows amongst the states and monitoring of return flows.			
Sone–India	Bihar, Madhya Pradesh, Uttar Pradesh	Water utilization at Rihand hydropower plant clashes with Bihar irrigational needs. Bihar does not accept an assessment made by the Sone River Commission of the 75 per cent availabil- ity of the basin yield. Current status: Ongoing.			
Damodar– India	Jharkand, West Bengal, Union Government	Damodar Valley Corporation set up for integrated river basin management to optimize irrigation, power generation and flood control objectives. West Bengal needs more water for irrigation which does not optimize power generation capacity. Jharkand objects to full flood storage in the reservoirs as it would submerge land with coal potential of significant economic value. Current status: Ongoing. The initial plan of seven dams is not achievable. Five dams that have been created are partially impounded due to submergence problems and the existing dams are not able to provide planned benefits.			
Upper Ganga including Ramaganga– India	Uttaranchal, Uttar Pradesh	The conflict arose after the creation of Uttaranchal state from Uttar Pradesh. The sharing of costs and benefits is a contentious issue as most of the headworks are in Uttaranchal, while extensive irrigation and power benefits accrue to Uttar Pradesh.			
Barak–India	Assam, Manipur, Meghlaya, Mizoram, Nagaland, Tripura	The project aims to provide hydropower, flood control and irrigation benefits through the Tipaimukh project. The progress is slow due to the lack of consensus on issues of reservoir submergence and sharing of benefits.			

Continued		
Basin/ Dam	Conflicting provinces/states	Salient features
Narmada– India	Gujarat, Maharashtra, Madhya Pradesh	The height of the dam, benefit sharing and mode of settlement of project affected people created difficulties in project implementation, particularly on Sardar Sarovar Dam. A tribunal award has resolved water sharing and power benefits issues. Conflict unresolved between affected people and the states on resettlement and rehabilitation package and its implementation, which according to affectees is against the public interest. Supreme Court cleared the project on Public Interest Litigation. However, litigations and conflicts still continue on the sidelines, seriously delaying the pace of work. Conflict slowed the pace of work, and hence delayed the yield of benefits with only 3 lakh hectares irrigated against the promised 27 lakh hectares. Current status: Ongoing, with resettlement and rehabilitation disputes resolved on the sidelines through Narmada Control Authority, state Governments and through litigations.
Godavari– India	Andhra Pradesh, Karnataka, Orissa, Maharashtra, Madhya Pradesh	Conflicts arose on issues of equitable distribution of dependable flows, submergence caused by the project, sharing of excess or deficient supplies and water diversion. A tribunal was set-up to resolve the issues in 1969, which in 1980 gave the Final Award, a decision agreed by all the concerned states. Current status: conflict resolved.
Krishna–India	Andhra Pradesh, Maharashtra, Karnataka	Conflict is of water sharing nature. Karnataka desired to reallocate water shares through alteration in Almatti Dam design, as per the Award in 1976. The step was disallowed by the SC, which resulted in Karnataka seeking court permis- sion to stop any new project in Andhra Pradesh, till a new water sharing accord is reached. In a fresh award in 2011, a new water sharing agreement has been announced. Karnataka has been allowed to raise the storage level in Almatti Dam, but to ensure regulated release of water downstream for lower Krishna delta region.
Cauvery–India	Karnataka, Kerala, Pondicherry, Tamil Nadu	Conflict is of water sharing nature. Karnataka demands water supplies for its drought prone areas, and permission to continue develop- ment projects for irrigation. Tamil Nadu also needs water for irrigational needs, but is dependent on upper riparian Karnataka. Despite interim awards, state intervention through Prime Minister's Relief Package and Supreme Court decisions, the conflict still continues and there has been no permanent solution. The conflict is highly politicized. Current Status: Ongoing. Though the final award on water sharing formulae has been announced in 2007, it still needs to be notified and implemented.
Pennar–India	Andhra Pradesh, Karnataka	The conflict is due to non compliance of an earlier agreement. An agreement reached in 1892 has been reopened on grounds of improvement to tanks and unauthorized diversions. Current Status: Ongoing, Karnataka has initiated legal proceedings.
Brahmani- Baitarani–India	Jharkand, Orissa, Madhya Pradesh	No outstanding conflict owing to surplus water flows.
Subernarekha– India	Bihar, Jharkand, Orissa, West Bengal	No outstanding conflict. Projects are undertaken by mutual agreement as the cost and benefits to be shared are well defined.
Mahi–India	Gujarat, Madhya Pradesh, Rajasthan	No outstanding conflict. All project specific issues are resolved with mutual agreements as clear understanding exists on sharing of water, costs of land acquisition, resettlement and rehabilitation and the sharing of benefits.
Tapi–India	Gujarat, Maharashtra, Madhya Pradesh	No outstanding conflict. Project agreements and inter-state control board has worked to achieve mutual benefits.
Mulla Preiyar Dam–India	Kerala, Tamil Nadu	The conflict is regarding dam safety and submergence of land. Kerala has apprehensions on dam safety, and raising of conservation storage level that will submerge forest land and wildlife sanctuary. An expert committee report and later a Supreme Court decision have authorized Tamil Nadu to raise conservation levels not to the satisfaction of Kerala.

Source: Siddiqui and Kheli 2004 and MHHDC Staff compilations.



The inevitability of climate change can no longer be questioned. Its impact can be seen everywhere in rich and poor countries alike as demonstrated by floods, droughts and changes in weather patterns. The previous chapters have analysed the issues and challenges of water, with respect to its sources and uses in South Asia. In this chapter the impact of climate change on water in South Asia is explored.

The main sources of water in South Asia are the melting of snow from the Himalayan glaciers and the monsoon rains, both of which are impacted by climate change. The largest three river systems of the Indus, Ganges, and Brahmaputra are partly fed from the snow melt from mountains, while the monsoon rains account for more than 70 per cent of the annual rainfall in most of the region. The impact of climate change, in the form of melting of glaciers, heavy and untimely rainfall, extreme weather events, and sea level rise, threaten people's well-being in South Asia by affecting water resources and systems. According to Intergovernmental Panel on Climate Change (IPCC's) technical paper on Climate Change and Water, "water and its availability will be the main pressures on, and issues for, societies and the environment under climate change."1

The relationship between climate change and water is complex.² Possible changes in temperature, snow and ice melt, precipitation and evapotranspiration may result in sea level rise and could increase floods through backwater effect of tides. Variation in precipitation and evapotranspiration may also result in changes in soil moisture, groundwater recharge and run-offs and could intensify flooding and droughts. These effects will have implications for agricultural, industrial and municipal water supplies. This will negatively impact people in South Asia through effects on food security, livelihoods, health and migration patterns, distressing more women than men.

Climate change and green house gas (GHG) emissions

The main source of climate change is the emission of GHGs. These are generated by activities in agriculture, transportation, industry and energy sectors. Economic growth, urbanization, changing life styles and increasing demand for energy are all going to increase GHG emissions. Although the contribution of developing countries including South Asia is low in global GHG emissions, currently their massive demand for energy, transport, urban systems and agricultural production will lead to more, not less, emission of GHGs. Unlike developed countries, developing countries including those in South Asia do not have the option to grow first and then to address climate change threats. This means that the region has to develop without accelerating the pace of climate change. The region has to follow a different growth path using energy efficient technologies, cleaner sources of energy, and reducing its carbon intensity of output. This also means major shifts in lifestyle and a transformation of how we manage our land and forests.

In South Asia, GHGs are composed of 60.8 per cent of carbon dioxide (CO₂), 32.1 per cent of methane, 6.5 per cent of nitrate oxide, and 0.6 per cent of other gases. The situation varies within South Asia: CO₂ is the dominant The impact of climate change threatens people's well-being in South Asia by affecting water resources and systems gas in India, Sri Lanka and Pakistan, resulting primarily from fossil fuel combustion and cement manufacturing; methane is the main gas in Afghanistan, Nepal, Bhutan and Bangladesh, resulting largely from agricultural activities, industrial production landfills, wastewater treatment, tropical forests and other vegetation fires. Nitrous oxide accounts for 35 per cent of total GHG emissions in Bangladesh followed by 29 per cent in Nepal and 19 per cent in Afghanistan and results from fossil fuel combustion, fertilizers, rainforest fires and animal waste (see figure 4.1).





Figure 4.2 GHG emissions per capita (metric tons of carbon dioxide equivalent), 1990-2005

Per capita GHG emissions remain small in South Asia due to lower industrialization as well as low access to energy by the vast majority of the population. Between 1990 and 2005, these emissions increased in the region from 1.2 to 1.6 metric tons of carbon dioxide equivalent (CO₂e), but remained the lowest compared to other regions, high income countries and the world average (see figure 4.2). They vary within South Asia from 2.8 metric tons of CO₂e in Bhutan to 0.5 metric tons of CO₂e in Afghanistan. Per capita GHG emissions have been low in all South Asian countries, but are rising now due to growth in the industrial and service sectors, commercialization of agriculture and increase in energy use.

Total GHG emissions in South Asia rose at an annual rate of 3.4 per cent between 1990 and 2005 which is the highest growth rate in the world only after the Middle East and North Africa (3.8 per cent).³ South Asia's share in world's GHG emissions also increased from 3.8 per cent to 5.3 per cent during this time period.

In South Asia, the energy sector is the largest contributor in GHG emissions followed by agriculture, waste and industry sectors. Between 1990 and 2005, the share of energy and industry in total GHG emissions increased while that of agriculture and waste decreased. However, agriculture still contributes more than one-fourth of total GHG emissions. The situation varies within the region based on energy use and deforestation. In India, Pakistan and Sri Lanka, energy related consumption is responsible for the bulk of emissions, reflecting an increase in urbanization and industrialization, while in Nepal and Bangladesh agriculture accounts for the majority of emissions (see table 4.1).

There is a positive relationship between gross domestic product (GDP) growth and per capita energy use which indicates that an increase in growth may result in an increase in GHG emissions. However, the region can grow in ways that would minimize GHG emissions. This will

Table 4.1 Share of GHGs by sector in South Asia, 1990-2005									
	E	Energy		Industry		Agriculture		Waste	
	1990	2005	1990	2005	1990	2005	1990	2005	
India	59	67	2	5	30	22	9	7	
Pakistan	47	54	3	4	40	33	10	9	
Bangladesh	20	30	0	2	66	56	14	12	
Nepal	9	13	0	0	84	78	8	8	
Sri Lanka	22	51	1	3					
South Asia	53	61	2	4	35	27	9	7	

Source: WRI 2012 and MHHDC staff computations.

require the use of modern technology and more efficient utilization of energy.

Energy

The share of fossil fuels (which includes coal, oil and gas) in South Asia's total energy supply increased from 54 per cent in 1990 to 71 per cent in 2006 (figure 4.3).⁴ Although this ratio is the lowest in the world, it has increased at the highest rate due to increasing dependence of India on coal and of Bangladesh on gas. In 2009, the share of fossil fuels in total energy consumption varied from 73 per cent in India to 11 per cent in Nepal.⁵

In South Asia, the contribution of coal is not only high in energy supply but has also increased over the last one and a half decade (see figure 4.3). The region has 108,961 million tons of coal reserves, but due to its low quality, India, Pakistan, Bangladesh, Nepal, Sri Lanka and Bhutan import it. In the case of oil, all the regional countries are importers. Between 1990 and 2006, the use of oil for energy supply more than doubled, indicating an increased dependence on volatile international oil markets. Gas is relatively a cleaner and more efficient source of energy. India is importing gas to meet its domestic needs, while Pakistan and Bangladesh are meeting their gas needs from domestic production. But the gas resources are expected to deplete in future in South Asia.⁶

South Asia needs energy not only to boost economic growth, but also for poverty alleviation, welfare improvement and people's empowerment. An increase in fossil fuel based energy consumption will increase CO₂ emissions. Sustainable development will require using resources that pollute less such as gas, and renewable energy resources such as biomass, solar power, wind, hydro and geothermal. This will entail the formation and implementation of national level renewable energy policies. Also, private sector, regional and global level institutions have to play a vital role for the provision of finance and technology transfer. Currently, all South Asian countries have set up renewable energy policies which reflect their focus towards renewable energy resources. However, they have to increase their practical efforts as well as research and development spending for renewable potential.

Agriculture



Agriculture in South Asia is the second

largest sector in terms of its contribution in regional total GHG emissions. These emissions are from three sub-sectors: crop production, livestock, and land use and deforestation. The main gases are nitrous oxide from the use of fertilizers in soils, methane from the production of rice and livestock, and CO_2 from the soils and deforestation (see table 4.2).

In terms of *crop production*, nitrous oxide is produced in soils (both directly and indirectly) from the use of nitrogen based fertilizers and animal manure. These emissions are the largest source of non- CO_2 emissions in the agricultural sector. They account for more than a half of regional agricultural sector emissions and one-fifth of global nitrous oxide emissions from soils. Besides this, flooding land for rice cultivation also causes emission of methane gases, accounting for 13 per cent of regional agricultural sector emissions and one-fifth of global methane emissions from rice.

In South Asia, *livestock* demand is increasing rapidly due to rising per capita incomes and higher population. The result is an increase in industrial livestock production, with more pressure on land and natural resources and further GHG emissions. In 2005, emissions from livestock in South Asia accounted for more than one-fourth of the regional agricultural sector emissions and 15 per cent of global methane emissions from livestock. The main sources and types of gases from livestock are methane from animals, CO₂ from land use changes, and nitrous oxide from manure.⁷ Land use change and deforestation also results in CO₂ emissions. It mostly results from converting lands for agricultural purpose, urbanization, unsustainable logging practices, forest fires and natural disasters. Its contribution in total GHG emissions is minimal. For instance, in Pakistan land use and deforestation contributes 3 per cent to the country's GHG emissions.⁸ The sector has a great potential for climate change mitigation through promoting aforestation and reforestation and decreasing deforestation.

In future, the region has to increase agricultural production to address issues such as the growing demand for food and change in dietary patterns. South Asian countries need to follow a sustainable pattern of production and consumption. This will require the use of technologies, processes and policies to increase agricultural production in a way to minimize GHG emissions and protect natural resources. There is a need for a new strategy to make agricultural production green and sustainable. Such a strategy may include:9 shift towards organic farming, use of techniques to ensure flooding of rice for fewer days to reduce methane, use of zero tillage farming to drill seeds into the soil to minimize CO₂ releases from the plough of soils, promotion of aforestation and deforestation, and transforming the waste into biochar to reduce CO₂ from burning crop residues. Furthermore, a move to fair and balanced consumption patterns will also help reducing GHGs.

South Asian countries have recognized the importance of all these measures

Table 4.2 GHG emissions by main sources in the agricultural sector in South Asia, 2005						
	Nitrous oxide from soils	Methane from livestock	Methane from rice	Nitrous oxide and methane from manure	Nitrous oxide and methane from burning	Total
Metric tons carbon dioxide equivalent	536	275	129	40	24	1,005
% of region's total	53	27	13	4	2	100
% of source's world total	20	15	20	9	3	17

Source: Rosegrant et al. 2009.

in their national agricultural plans and policies. They are also using these techniques at different levels to ensure sustainable agricultural production. For instance, in India the National Mission for Sustainable Agriculture 2008 has been set up to make the agricultural sector more resilient to climate change. Under this Mission, the Indian Council of Agricultural Research has started a scheme on the National Initiative on Climate Resilient Agriculture with an outlay of INR350 crores for 2010-12.10 Such initiatives are steps in right directions. However, there is a need to increase the scale and outreach of such programmes.

Industry

The industrial sector causes GHG emissions directly from energy demand for production. It causes further GHG emissions through transportation of raw materials and final goods, and the mismanagement of industrial waste. Industry in South Asia accounts for 4 per cent of total GHG emissions. Also, it accounts for more than one-fourth of fuel combustion in the energy sector. In the industrial sector of South Asia, much of the GHG emissions come from micro, small and medium enterprises (MSMEs). For instance, in India SMEs account for 70 per cent of industrial pollution.¹¹ These enterprises use outdated and inefficient technologies and operate outside environmental laws and regulations.

The region needs to expand its industrial base in the future in a way that reduces negative environmental impacts of industrial energy. This requires an improvement in energy efficiency especially in MSMEs and can be achieved by substituting raw materials that need less energy or using such technologies that reduce energy requirements. For this purpose, the role of national policies and plans are of paramount importance as they will enable the industrial sector to grow in a sustainable way using energy efficient technologies. For instance, the 2001 Energy Conservation Act of India chalks out a plan to improve industrial efficiency. This Act has been further strengthened and supported by the 11th Five Year Plan (2007-12), the National Environment Policy 2006 and the National Mission for Enhanced Energy Efficiency in Industry 2008. However, such policies do not adequately address energy efficiency issues of MSMEs. Countries in the region need to improve financial and technical capacity of MSMEs and increase awareness about the use and benefit of modern and cleaner technologies.

Impact of climate change on glaciers, weather patterns and sea level

Climate change impacts glaciers, precipitation patterns, extreme weather events and the sea level. These have far-reaching effects on *water resources* and *systems*. In South Asia, the possible impacts of climate change in the form of melting of glaciers, changing weather patterns and sea level rise on water include:

- a) *Melting of glaciers*, affecting downstream water availability.
- b) Impacting average annual *rainfall*, especially during monsoons, affecting water resources.
- c) *Extreme weather events*, affecting water resources and water security.
- d) *Sea level rise*, with direct and indirect inundation impacts in the form of increased salinization of groundwater, increased storm surge, changing sedimentation pattern and ocean current.

Melting of glaciers

Glacial melt is an important source of freshwater for millions of people living in South Asia (see box 4.1). Warming, particularly of the Himalayas, can result in melting of glaciers at a rapid rate, negatively impacting downstream water availThe region needs to expand its industrial base in the future in a way that reduces negative environmental impacts of industrial energy ability in the region. It can change patterns of water run-offs in the short and the long run. In the short run, glacial melt will increase the risk of floods due to more run-offs in rivers. However, in the long run, it will result in water shortage along with a decline in river run-offs.

The warming in Himalayas has been higher than the world average. For instance, warming in Nepal was 0.6°C per decade between 1977 and 2000 compared with a global average of 0.74°C over the last 100 years.¹² On average, glaciers in Himalayas are also melting faster than the

global average with a critical impact on the stability of water supplies. This trend of glacial melt is expected to accelerate in future, with severe consequences for water availability.

A study has shown that in Asia with a 2°C increase in temperature by 2050, 35 per cent of the present glaciers will disappear and run-off will increase, peaking between 2030 and 2050.13 Rapid melting of glaciers in the Himalayas has already resulted in an increase in the number and size of glacial-melt water lakes and an increase in the threat of glacial lake

Box 4.1 Glacial melt and water availability in South Asia

The Himalayan glaciers cover about 3 million hectares or 17 per cent of mountain areas worldwide, forming the largest body of ice outside the polar region. These glaciers store about 12,000 cubic kilometres of freshwater and provide short and long term water storage facilities. About 15,000 Himalayan glaciers form an important reservoir which supports rivers such as the Indus, Ganges and Brahmaputra which provide freshwater to millions of people in South Asian countries (India, Pakistan, Bangladesh, Nepal and Bhutan).

Glacial melt provides water which is vital for certain ecosystems, especially in arid areas and during critical periods from the dry season to the monsoon season. Snow and glacial melt contribute to the 10 largest rivers in Asia, ranging from 2 per cent of the average flow in the Yellow River to about 50 per cent of the average flow in the Indus River. This flow of water is of vital importance for more than 1.3 billion people downstream (table 4.3). In the shoulder seasons before and after precipitation from the summer monsoon, snow and ice melt contribute approximately 70 per cent of the flow of the Ganges, Indus, Tarim and Kabul rivers. The Himalayan rivers of Nepal contribute about 40 per cent of the average annual flow in the Ganges Basin. They supply about 70 per cent of the flow in the dry season. The Indus irrigation scheme in Pakistan depends on 50 per cent of run-offs originating from snowmelt and glacial melt from the eastern Hindu Kush, Karakoram and the western Himalayas.

River			River basin			
River	Mean discharge (cubic metres per second)	% of glacial melt in river flow	Population (thousands)	Basin area (square kilometres)	Water availability (cubic metres per person per year)	
Amu Darya	1,376		20,855	534,739	2,081	
Brahmaputra	21,261	12.3	118,543	651,335	5,656	
Ganges	12,037	9.1	407,466	1,016,124	932	
Indus	5,533	Up to 50	178,483	1081,718	978	
Irrawaddy	8,024		32,683	413,710	7,742	
Mekong	9,001	6.6	57,198	805,604	4,963	
Salween	1,494	8.8	5,982	271,914	7,876	
Tarim	1,262	Up to 50	8,067	1,152,448	4,933	
Yangtze	28,811	18.5	368,549	1,722,193	2,465	
Yellow	1,438	1.3	147,415	944,970	308	
Total			1,345,241			

outburst floods (GLOFs). There are about 9,000 glacial-melt water lakes in India, Pakistan, Nepal, Bhutan and China.¹⁴ In the Hindu Kush Himalayan range, about 204 such lakes have been identified as potentially dangerous which can burst any time.¹⁵ The IPCC has projected that if the earth keeps warming at the same rate, many glaciers in the Himalayas will retreat while a number of small glaciers will disappear.

Unlike floods in the short run, the region will face water shortage in the long run. The IPCC has concluded that increased glacial melt in the Himalayas will result in increased river run-offs and flood-ing for the next two to three decades. How-ever after that, river flows will decrease due to an increase in glacial recession. A study by the World Bank shows that river flows will increase during the first 50 years and decrease by 30 to 40 per cent during the next 50 years.¹⁶ This shows the need for a coordinated regional approach to address the issues of GLOFs and water management.

Temperature and precipitation

The monsoon is the most significant climate event in South Asia, accounting for 70 per cent of the region's total annual precipitation.¹⁷ This makes the region vulnerable to climate change which can affect water resources by affecting the monsoon cycle. Climate change has the potential to change the temperature and increase the variability in the magnitude and timing of rainfall especially during the monsoon season. It can result in lesser water storage and increased water stress which can have devastating consequences for South Asia where about two-thirds of the cultivated area is rain-fed. This is not only expected to happen in the future but is already happening in many countries in the region. For instance, monsoon rainfall in India has decreased by about 5 to 8 per cent since the 1950s.18

In South Asia, both increasing and

decreasing trends in rainfall have been observed over the last century.¹⁹ Decreasing trends in annual mean rainfall were observed in the coastal belt and arid areas of Pakistan, parts of Northeast India, and Sri Lanka during the month of June. On the other hand, Bangladesh, Northwest India, northern areas in Pakistan, and Sri Lanka observed increases in rainfall during the month of February.

Unlike mixed trends in the past, in the future an increase in temperature has been projected to decrease rainfall in South Asia. A study predicts a decrease in monsoon precipitation by 20 per cent in most parts of Pakistan and Southeastern Afghanistan by the end of the 21st century.²⁰ According to World Development Indicators 2012, annual mean temperature is projected to increase in all South Asian countries. This will be accompanied by a decrease in number of annual cool days and cold nights, and an increase in annual hot days and warm nights (see table 4.4). This means an increase in risks associated with water-related climate change in South Asia.

Extreme weather events

Climate change can increase the incidence and frequency of extreme weather events such as floods, droughts, heat waves and cyclones, negatively affecting water resources and water security. South Asia is already facing this problem. The average number of natural disasters in the region

Table 4.4 Climate variability in South Asia, 2045-65ª					
	Change in annual temperature	Change in annual cool days/cold	Change in annual hot days/warm		
	degrees (Celsius)	nights	nights		
India	1.9 to 2.6	-2.0 / -2.2	4.6 / 13.3		
Pakistan	2.4 to 3.4	-1.8 / -1.9	3.4 / 8.1		
Bangladesh	1.7 to 2.4	-1.7 / -2.1	3.4 / 11.8		
Afghanistan	2.3 to 3.6	-1.4 / -1.5	3.1 / 7.0		
Nepal	2.2 to 3.4	-2.1 / -2.1	2.5 / 8.0		
Sri Lanka	1.5 to 1.8	-2.8 / -2.9	7.9 / 23.9		

Note: a: These are projected values during the period specified, relative to the control period 1961-2000. *Source:* World Bank 2012.

Table 4.5 Summary of observed changes in extreme climatic events and impact on water resources in South Asia					
Phenomenon and direction of trend	Key trends and examples	Possible impact on water resources			
Floods: an increase in frequency of heavy precipitation	Serious and frequent floods in Bangladesh, Nepal and India during 2002, 2003 and 2004; A 100 year record 944 millimetres extreme rainfall in Mumbai, India on July 26 and 27, 2005 resulting in deaths of over 1,000 lives and US\$250 million in terms of economic losses; 730 millimetres rain in the southern province of Sri Lanka on May 17, 2003; 2010 floods in Pakistan affected more than 20 million people and were the worst in the region since 1929; 2011 and 2012 floods in Pakistan and India.	Adverse effects on quality of surface water and groundwater, contamination of water supply, and water scarcity may be relieved.			
Drought: an increase in area affected	Droughts in Northwest India and Pakistan during 1999 and 2000 resulting in the decline of water tables; droughts in Orissa, India during 2000 and 2002 affected about 11 million people; and droughts in Northeast India during the summer monsoon of 2006.	More widespread water stress due to a decline in water tables.			
Heat waves: an increase in frequency	Increase in frequency of hot days and multiple day heat waves in India during the past century with an increase in deaths due to heat stress in recent years.	An increase in water demand, and water quality problems.			
Cyclone: an increase in intensity	A decline in the frequency of monsoon depressions and cyclone formation in the Bay of Bengal and the Arabian Sea since 1970, however an increase in its intensity; on November 15, 2007 the cyclone Sidr in Bangladesh hit 22 South and Southwestern districts and killed 3,000 people and affected 9 million survivors.	Disruption of public water supply due to power outages.			

Sources: IPCC 2007 and Khatun and Islam 2010 and MHHDC staff compilations.

more than doubled from 234 in 1980-89 to 478 in 2000-09, with an increase in the number of deaths and the magnitude of economic losses.²¹

Table 4.5 provides a summary of the increasing trend in the intensity and frequency of extreme weather events and the possible impact on water resources and water security in South Asia. It shows that the frequency of intense *rainfall* events has increased in many countries while the number of rainy days and total annual amount of precipitation has reduced. This may have severe effects on the quality of surface water and groundwater as well as the contamination of water. The frequency and intensity of *droughts* has also increased due to rising temperatures during the summer and drier months, and during the El Niño-Southern Oscillation (ENSO) events. This has the potential to increase water stress by decreasing water tables. Similarly, there have been larger durations of *heat waves* with a number of severe heat wave cases across South Asia. This trend has significant implications for an increase in water demand in a region which is already facing water stress. Evidence is similar for *cyclones* with implications for water supply disruption due to power outages.

In the future, the intensity of floods, droughts and cyclones is expected to increase in South Asia, with negative impact on water resources. For instance, the *flood area* in Bangladesh is projected to increase by 23 to 29 per cent with a 2°C increase in global temperature.²² Millions

Box 4.2 Pattern of sea level rise

The global average sea level is rising and the rate of change has been increasing over time. The global mean sea level has risen by 20 centimetres since 1870. The average per year sea level was 1.7 ± 0.5 millimetre per year for the 20th century, 1.8 ± 0.5 millimetre per year for 1961-2003 and 3.1 ± 0.7 millimetre per year for 1993-2003. The trend is expected to remain the same in the future. If global emissions remain low compared with 1980-99 levels, the global mean sea level is expected to rise by 0.18 to 0.38 metres by 2090-99.²⁸ The main sources for global sea level rise are thermal expansion, massive loss from glaciers and ice cap, and massive loss from the Greenland and Antarctic ice sheets.

The situation is similar in Asia including South Asia. For instance, the

current sea level rise in the coastal areas of Asia is between 1 and 3 millimetres per year. In India and Pakistan, the mean sea level rise has been about 1 millimetre per year. In Bangladesh, the situation is more serious. According to the IPCC, the mean sea level in Bangladesh is projected to increase by 14 centimetres by 2030, 32 centimetres by 2050 and 88 centimetres by 2100.

Sources: Bates et al. 2008, Khatun and Islam 2010, UNDP 2011, UNDP-APRC 2012, UNEP 2008 and World Bank 2009.

of people living in river basins are likely to be affected by this. Droughts are also expected to increase due to decreased precipitation and increased temperature and earlier and less abundant snowmelt. The situation will be similar in the case of cyclones. For instance, a study shows that a 2°C to 4°C rise in sea surface temperature is projected to increase tropical cyclone intensity by 10 to 20 per cent in South Asia.²³ This growing intensity of extreme climatic events is going to affect all the countries in the region and provinces/states differently because of the variable capacity of societies and communities to respond and protect themselves.

Sea level rise

The global sea level is rising at an increasing rate (see box 4.2). The trend is similar in South Asia, which is more vulnerable due to its long and densely populated coastlines, many low lying islands such as the Maldives, and the threat of saltwater intrusion for its agricultural plains and freshwater resources. Sea level can have direct inundation impacts and indirect consequences in the form of changes in salinity levels, increased storm surge effects, changing sedimentation patterns and changes in ocean currents.

A large number of people in South Asia live in coastal areas that are only 10 metres higher from the sea level (see table 4.6). A rising sea level will inundate a

Table 4.6 Population living in coastal zones in South Asia, 2000					
	Population	Population in coastal zones			
	Total	% of total population			
India	63,188,208	6.27			
Pakistan	4,157,046	2.94			
Bangladesh	62,524,048	45.56			
Afghanistan	0	0			
Nepal	0	0			
Sri Lanka	2,231,097	11.79			
Bhutan	0	0			
Maldives	290,923	100			

Source: CIESIN 2007.

majority of these areas and people living there. For instance, it is expected to submerge the Maldives completely in a worst case scenario. Similarly, a one metre rise in sea level will inundate one-fifth of Bangladesh's land and impact one-tenth of its population.²⁴ In India a one metre rise in sea level will inundate 5,763 square kilometres of land.²⁵ Besides direct inundation impacts, rising sea levels are also projected to increase areas of salinization of groundwater, resulting in deceased freshwater availability in coastal areas. For instance, a study shows that in two small and flat coral islands in India, the thickness of freshwater lenses decreased from 25 metres to 10 metres and from 36 metres to 28 metres respectively, for a sea level rise of 0.1 metre only.²⁶ Overall, by the end of the 21st century, rising sea level could make 125 million people homeless across India, Pakistan and Bangladesh, which is a

staggering figure and presents a challenge for human development in the region.²⁷

Impact on people

The impact of climate change—in the form of melting of glaciers, heavy and untimely rainfall, extreme weather events, and sea level rises—on water resources and systems threaten people's well-being. It stunts people's capabilities in many ways ranging from incomes and livelihoods to health, migration and other dimensions of well-being. The possible effects on people include:

- a) Impact on *agriculture, forestry and fisheries* sectors through changes in the available freshwater resources by intensifying droughts and floods.
- b) *Health* risks from extreme weather events such as floods and droughts, salinization of land and freshwater resources due to rising sea levels, and associated waterborne diseases.
- c) Human *migration* due to extreme weather events such as floods and droughts, rising sea levels, and melting of glaciers.
- d) The impact of climate change and water on *women* which includes: increased time to manage livelihoods, increased food insecurity, increase in vulnerability to migration and violence due to an increase in water-related disasters, and increase in the disease burden.

Impact of climate change on livelihoods

In South Asia, a majority of the population depends on the agriculture, forestry and fisheries sectors for their livelihoods. Climate change in the form of changes in precipitation patterns, glacial and ice melt and soil moisture will increase droughts and floods in the region. This will affect available freshwater resources, impacting production and productivity of agriculture and related sectors. For instance, in India freshwater availability is projected to decrease from around 1,900 cubic metres currently to 1,000 cubic metres by 2025 due to climate change and population growth.²⁹ This will have negative repercussions for the rural population especially for poor and marginalized communities. The possible impacts will be felt in the following sectors:

- The agricultural sector will be affected by both shortage and excess of water. Decrease in precipitation will result in too little water, while an increase in the extent and frequency of floods will result in too much water.
- The forestry sector is differentially sensitive to climate change and therefore, temperature limited biomes will be sensitive to warming and water limited biomes³⁰ will be sensitive to increased droughts and decreased rainfall.
- The fisheries sector will be directly affected by changes in rainfall patterns, glacial and snow melt and rising sea levels, affecting the hydrological cycle and water quality.

Agriculture

The agricultural sector plays an important role as a source of employment and national income. Although its share has considerably declined to about one-fifth of GDP, it employs more than half of the labour force with a majority as small and landless farmers. Water plays a crucial role for both rain-fed and irrigated farming. Irrigation coverage is high in South Asia varying from 80 per cent in Pakistan to 30-40 per cent in India, Afghanistan and Sri Lanka.³¹

Climate change will impact the agricultural sector of South Asia by creating both shortage and abundance of water.

Rising sea level could make 125 million people homeless across India, Pakistan and Bangladesh Increases in temperature and decreases in precipitation will result in too little water, while increases in the extent and frequency of floods will result in too much water. This will negatively affect crop yields with serious implications for food security. In some cases, a decline in yields may be offset by carbon fertilization; however, this effect is likely to be limited.

Too little water will affect crops in both rain-fed and irrigated areas of South Asia. In many parts of Asia, production of wheat, maize and rice has already declined due to water stress arising partly from rising temperatures, increasing frequency of El Nino and reduction in the number of rainy days.³² In non-irrigated areas of South Asia, a temperature increase of beyond 2.5°C is expected to decrease yields of wheat and rice, incurring a loss in farm level net revenue of between 9 to 25 per cent.33 Overall, in irrigated and rain-fed areas of South Asia, increases in temperature and resulting water stress are expected to decrease crop yields by 30 per cent by the mid 21st century.³⁴ The estimates vary within the region with a 49 per cent decline in crop yields in India, 18 per cent in Pakistan, 14 per cent in Bangladesh, 10 per cent in Sri Lanka and Afghanistan and 1 per cent in Nepal.35

Too much water due to heavy precipitation events, soil moisture and heavy floods can also have adverse effects on crop yields, either directly, by affecting social properties and damaging plant growth, or indirectly, by delaying necessary farm operations. For instance, in Bangladesh between 1962 and 1988, about 0.5 million tons of rice were lost annually due to floods. This loss accounted for around 30 per cent of the country's average annual food grain imports.³⁶

Forestry

The total area under forests in South Asia is 79 million hectares, accounting for 19.3 per cent of the land area (see table 4.7). Forests are an important source for energy, housing, national income and livelihoods of millions of rural communities, especially indigenous people. The sector's contribution in GDP is 1 per cent on average for South Asia-ranging from 7 per cent in Bhutan to 0.4 per cent in Pakistan. Between 1990 and 2006, total value added of forests in the region increased from about US\$7.5 billion to US\$9.6 billion. Formal sector employment in forestry also increased from 617 thousands in 1990 to 663 thousands in 2006. However, the informal sector too employs a huge number of people. Both the formal and informal sectors' contribution to forestry related employment in South Asia is about 1.9 million.

Forests are an important determinant of water quantity and quality. Their importance as water sheds may increase in the future due to expected scarcity of freshwater resources. Both afforestation and reforestation may result in increased humidity, decreased temperatures and increased rainfall, while deforestation may lead to decreased rainfall and increased temperatures.

Climate change is expected to have negative impacts on forestry and biodiversity associated with it, with adverse implications for livelihoods of forest dependent poor and marginal communities. Potential climate change impacts for

Table 4.7 Forestry in South Asia						
	Forest area (thousand hectares)	Forest area share of land (%)	Share of forestry in GDP (%)	Change in forest area (%)		
	2010	2010	2006	2005-10		
Bangladesh	1,442	11	1.7	-0.18		
Bhutan	3,249	69	6.9	0.34		
India	68,434	23	0.9	0.21		
Maldives	1	3		0		
Nepal	3,636	25	4.3	0		
Pakistan	1,687	2	0.4	-2.37		
Sri Lanka	1,860	29	1.0	-0.77		
South Asia ^a	80,309T	19	0.9	0.12		

Note: a: It is weighted average or total (T).

Source: FAO 2012.

Table 4.8 Fisheries in South Asia, 2000-07				
	Annual fish production		Fishermen	Exports
	total (in thousand tons)	as a % of GDP	and farmers (thousands)	(US\$ millions)
India	5,962	1.1	2,000	1,900
Pakistan	615	1.5	471	126
Bangladesh	1,477	4.7	4,360	420
Nepal	26.3	1.5	266	
Sri Lanka	259.1	2	350	94
Bhutan	0.3			
Maldives	158.6	11	27	56
South Asia	8,498T		7,474T	2,596T

Note: a: It is weighted average or total (T). *Source:* Vivekanandan 2012.

forestry in South Asia include: the effect of variation in rainfall and temperature on species distribution and biodiversity; increase in incidence and severity of forest fires; increase in incidence of diseases, insect and pest damage; and increased forest clearance for agriculture due to a decrease in agricultural crop yields.

In India, over half of the area under forests is vulnerable to the projected climate change.37 The impact of climate change in the country has been projected in the form of shifts in forest boundaries, changes in forest types, changes in net primary productivity, and losses in biodiversity. This is expected to have adverse socio-economic implications for forest dependent communities and national income. In Pakistan, the impact of climate change on forestry includes changes in forest area, productivity and species composition. In Bangladesh, climate change is expected to have adverse effects on all forest ecosystems, with adverse effects on the Sundarbans which are a source of subsistence for about 3.5 million people.³⁸ Shifts in climate change related water resources and temperature are projected to put pressure on many climate sensitive species and increase erosion of soil quality in upland forest areas of the country. In Nepal, increased temperatures may cause forest damage through migration towards the polar region, changes in their composition, and extinction of species. Resultantly, the tropical wet forest and

warm temperate rain forest will disappear while cool temperate vegetation will turn to warm temperate vegetation. In Sri Lanka, rising temperatures and variability in rainfall is expected to change the composition of forests. It will result in a decrease in tropical wet forests by 11 per cent, and an increase in both tropical very dry forests by 5 per cent and tropical dry forests by 7 per cent.³⁹ And lastly, in Bhutan climate change along with deforestation, land use changes and habitat fragmentation degradation and will present a threat to biodiversity. Forest fire is the biggest threat to forests in the country. About 40 per cent of forests in Bhutan are susceptible to frequent fires.⁴⁰

Fisheries

In South Asia, fisheries and the aquaculture sector have a significant role in ensuring food security and employment (see table 4.8). The sector is a source of employment for about 7.5 million people and produces around 8.5 million tons of fish annually. Its contribution in GDP varies from 11 per cent in the Maldives to 1.1 per cent in India. The sector is also a source of trade with annual exports reaching US\$2.6 billion. Besides this, the sector is an important source of nourishment, especially for poor communities. In Bangladesh, people get 60 per cent of their dietary animal protein from fish. The equivalent value for Sri Lanka is 52 per cent, Pakistan 32 per cent and Nepal 10 per cent.⁴¹

Production from fisheries has remained stagnant over the last decade due to various factors including overexploitation, coastal degradation and pollution. Climate change is expected to exacerbate this situation with largest impact on the poor by threatening their livelihoods and food security. The sector will be affected directly by changes in rainfall, glacial and snow melt and rising sea level. It will also be affected indirectly by changes in vegetation patterns which may alter the food chain and increase soil erosion. According

to IPPC's technical paper on Climate Change and Water, negative impacts of climate change on the fisheries sector would include: stress due to increased temperature and demand for oxygen, uncertain quantity and quality of water, extreme weather events, increased frequency of diseases and toxic events, sea level rise and uncertain supplies of fishmeal and oils from capture fisheries.42 A number of studies have shown that climate change will have the greatest economic impact on the fisheries sector in South Asia. For instance, a vulnerability study of 132 countries to potential climate change impacts on their fisheries found Bangladesh and Pakistan to be in the most vulnerable category.43

Impact of climate change on people's health

People's health depends on an adequate supply of clean water and a safe environment. The health risks related to climate change include risks from extreme weather events such as floods and droughts, salinization of land and freshwater resources due to rising sea levels, and the associated water-borne diseases.44 Water-borne diseases and malnutrition may be the most devastating consequences of such changes. In 2000, the global burden of climate change attributable to diarrhoea and malnutrition was the highest in most South Asian countries including India, Bangladesh, Nepal, Bhutan and the Maldives and is expected to remain the same till 2030.45 The impact of climate change will be most devastating for the poorest sections of the population.

Water-borne and related diseases. Safe and adequate water resources are vulnerable to climate change. Changes in precipitation patterns, frequent floods and rising sea levels are expected to degrade surface water quality, making the provision of clean water and improved sanitation more costly and difficult and increasing the risks of

water-related diseases such as diarrhoea, cholera, malaria and dengue fever.

Diarrhoea is commonly the outcome of drinking unsafe water and lack of improved sanitation facilities. Climate change in the form of droughts and floods is expected to increase the incidence of diarrhoea by reducing the availability of freshwater resources. South Asia will see an increase in diarrhoea related mortality and morbidity primarily associated with droughts and floods due to changes in the hydrological cycle associated with global warming.⁴⁶

Cholera is also associated with floods and contamination of drinking water. Climate change is expected to increase the burden of this disease. In South Asia, the burden and toxicity of cholera has exacerbated due to an increase in coastal water temperature.⁴⁷

Climate change is expected to increase the incidence of malaria in South Asia. Changes in precipitation and rising temperatures are expected to expand the geographic range of malaria into temperate and arid areas of the region. In India and Bhutan, climate attributable malaria vectors have been found for the first time in high elevation areas.⁴⁸ In the Khyber Pakhtunkhwa (KPK) province of Pakistan, climate change has also been found to affect malaria.⁴⁹

Deaths and injuries due to extreme weather events. Climate change is expected to increase the risk of water-related disasters including GLOFs, increased storm surge intensity and changes in flood risks. The health impact of these disasters will range from immediate effects of injuries and mortality to long-lasting effects on mental health due to loss of lives and livelihoods, and unpredictable recovery, relief, rehabilitation and resettlement. There will also be a considerable impact on health in terms of an increase in the disease burden as well as damages to the health infrastructure.

Malnutrition. A decrease in food produc-

Safe and adequate water resources are vulnerable to climate change tion due to droughts, heavy rainfall and floods may lead to malnutrition, micronutrient deficiencies or starvation.

Climate change induced displacement

Climate change is expected to force many people to become displaced or to migrate, affecting both national and international migration patterns. Such movements will have implications not only for displaced people but also for societies at the destination to which they will have to move to. In South Asia, about 75 million people from Bangladesh and 50 million from coastal and other vulnerable parts of India could be displaced by the end of this century due to sea level rises and droughts associated with shrinking water supplies and monsoon variability.⁵⁰

Extreme weather events such as floods and droughts are a major driver of short-term migration and displacement in South Asia. In 2010-11, more than 3.5 million people were displaced in this region by climate-related disasters.⁵¹ Climate change is expected to increase the number of displaced people by increasing the frequency and intensity of extreme weather events. The 2012 floods displaced 1.5 million people in the Northeastern state of Assam in India.⁵² In Bangladesh, over 500,000 people are displaced every year.⁵³ This number is expected to increase due to an increase in floods. In 2007, monsoon floods displaced more than 20 million people in India, Bangladesh and Nepal.⁵⁴ A similar trend was observed in Pakistan after the floods of 2010, 2011 and 2012 (see box 4.3).⁵⁵ Droughts and floods can destroy both rain-fed and irrigated farming and can increase displacement of poor and marginal rural farmers. For instance, in India low precipitation along with adverse economic conditions for farmers is expected to lead to a sudden increase in rural to urban migration.⁵⁶

Low-lying coastal cities in South Asia including Karachi, Dhaka, Mumbai, Kolkata, Chennai and whole of the Maldives could be affected by coastal impacts of climate variability and can result in massive displacement of the urban population. The majority of these displaced people are likely to migrate to other large cities of the region which are already heavily populated with resource constraints. In Bangladesh alone, a one metre rise in the sea level can result in displacement of people from 13 to 40 million.⁵⁷

Glacial melt will affect major agricultural systems in South Asia. In the short term, there is a risk of floods. However, in the medium to longer term there will be shortage of water which will have severe impact on irrigation-fed agriculture, small scale fishing and hydroelectric power generation. In South Asia, glacial-related

Box 4.3 Climate change and floods in Pakistan

Pakistan has faced record temperatures and water shortages in recent years. Droughts are exacerbated by poor water management. The potential consequence of climate change driven disasters has been visible in Pakistan during the recent floods. During the last few years, the country has experienced intense monsoon rains resulting in devastating floods. These events are the evidence that climate change is not just a future concern but a present danger. The vast destruction as a result of these floods reconfirms the country's extreme vulnerability to the adverse impacts of climate change. If greenhouse gases (GHGs) continue to increase, the extreme weather events may even become more frequent and more intense in the future.

Flooding has not only led to widespread destruction of housing, thereby increasing homelessness and creating internally displaced people, but it has also damaged crops and cattle. The floods of 2010 inundated approximately one-fifth of the country, affecting about 20 million people. Again in 2011, heavy monsoon rains caused widespread damage, affecting close to 9 million people and destroying more than 1.5 million houses. Once again the country faced floods in 2012, causing widespread loss of life, livelihoods and infrastructure.

Sources: IPCC 2007, UN-OCHA 2012 and MHHDC staff compilations.
water shortage has a significant association with migration from irrigated land areas. These people will migrate either to small and medium sized cities inland or large megacities along the coasts or on the main branches of river systems.⁵⁸ A study shows that both sea level rise and inland flood from melting of Himalayan glaciers may cause displacement of up to 20 million people in India and about 26 million in Bangladesh by 2050.⁵⁹

Impact of climate change on women

Women's traditional responsibilities including food production, water and fuel gathering and care giving connect them to natural resources and to climate. Their limited access to resources, restricted property rights and insufficient role in decision-making along with their traditional responsibilities make them highly vulnerable to climate change. Climate change, by affecting water availability, can impact women's well-being in many ways:

- Increase in time to manage livelihoods such as collecting water;
- Hunger and food insecurity due to decreased production in agriculture, forestry and fisheries;
- Increased vulnerability to migration and violence due to increased frequency and extent of extreme weather events; and
- Increase in disease burden such as malaria and cholera as well as mental health problems due to the increase in water-related disasters.

Climate change makes it extremely difficult for women to secure local natural resources for which they depend on for cooking, cleaning, heating, etc. In times of drought, they have to spend more time to carry, purify and supply the family's water. This increases their overall work burden and affects their health. For instance, in parts of Gujarat and Rajasthan, India, an increase in women's workload has been observed in a drought situation, as they have to go longer distances to collect water and fuel. 60

Rising temperatures, reducing number of rainy days, falling water tables, interrupted water cycles and droughts will reduce production in agriculture, forestry and fisheries in which rural women are the primary producers of food. This increases food insecurity and hunger with more burden on women in South Asia where traditionally men are favoured over women in the distribution of food.⁶¹

Water-related natural disasters may increase the vulnerability of women more than men. They will affect women more because they have limited access to information and skill for adaptation. Women find it difficult to migrate because of cultural constraints, and face discrimination in the recovery process. In Bangladesh, the death rate was five times higher among women after the cyclone and floods of 1991.⁶² Women in the country have also been found to face more hurdles than men during the process of migration after disasters.63 In India, *dalit* and tribal women have been found to be extremely vulnerable to sexual exploitation in times of economic crisis following floods.⁶⁴ In the aftermath of disasters, women's limited access to property rights may limit their access to credit needed for recovery.

Extreme weather events such as droughts and floods are expected to increase water-related diseases as well as mental health problems among women more than men, as women are more exposed to water-borne diseases through responsibilities including washing and water collection.

Adaptation and mitigation policies and plans at national and global levels

National level adaptation and mitigation policies and plans

South Asian countries have adopted a number of adaptation and mitigation pol-

Water-related natural disasters may increase the vulnerability of women more than men Climate change adaptation and mitigation approaches in South Asia seem to be disconnected from development planning icies and plans. These include national processes like National Adaptation Programmes of Action (NAPAs) and National Appropriate Mitigation Actions (NAMAs) under the United Nations Framework Convention on Climate Change (UNFCCC) as well as countries' own national policies and action plans.

Least developed countries of the region have adopted NAPAs: Bangladesh in 2005, Afghanistan in 2009, Nepal in 2010, Bhutan in 2006, and the Maldives in 2008. In completing a NAPA, these countries identify key priority areas and activities that need to be implemented immediately to address urgent national climate change adaptation needs. However, NAPAs have been found to face various constraints. For instance in Bangladesh, NAPA consultation and planning processes are facing problems of exclusion and a narrow focus.⁶⁵ The solution requires a livelihood-oriented rather than a sectoral approach, focusing on short, medium and long-term impacts of climate variability, ensuring integration of indigenous and traditional knowledge, and procedural fairness through interactive participation and self-mobilization.

During UNFCCC's Copenhagen Accord of 18 December 2009, some developing countries including South Asia agreed to implement NAMAs voluntarily as part of a commitment to reduce GHG emissions. So far 55 developing countries including some South Asian countries (India, Bangladesh, Afghanistan, Bhutan and the Maldives) have worked on NAMAs.⁶⁶ Moreover, the Clean Development Mechanism has also been an important avenue for climate change mitigation. These actions are based on sustainable development, and are supported by developed countries through technology, financing and capacity-building.

Besides these, South Asian countries have formulated their own national level adaptation and mitigation policies and plans. Table 4.9 provides a summary and the main features of these initiatives. They are very comprehensive documents, but have not resulted in significant adaptation practices so far. The evidence is apparent from an increase in the incidence and intensity of climate-related disasters in South Asia such as the 2010, 2011 and 2012 floods in Pakistan. The situation is the same in case of mitigation. It is clear from unsustainable patterns of consumption and production in the region such as a rising proportion of fossil fuels in total energy production. Climate change adaptation and mitigation approaches in South Asia seem to be disconnected from development planning, with most of the policies and plans weakly linked with disaster risk reduction, agricultural and other related polices.⁶⁷ Also, there is a shortage of financial resources for a comprehensive adaptation and mitigation approach to ensure sustainable development.

Regional level adaptation and mitigation initiatives

Climate change is an issue that goes beyond national boundaries. The melting of Himalayan glaciers, the frequency and intensity of extreme weather events, and increasing sea levels transcend national boundaries. National level efforts, though necessary, are not sufficient for adaptation and mitigation. South Asian countries need to find coordinated regional solutions to address climate change threats. This can help in increasing adaptive capacity to climate change. Also, it can benefit the region by improving energy efficiency, increasing economic growth, decreasing poverty and inequality, and reducing vulnerabilities for the poor.

South Asian countries have reaffirmed their commitment to work collectively and have taken several initiatives. This includes formation of plans, establishment of institutions, and adaptation of common regional positions.

In South Asia, three regional level plans have been formulated for adaptation and mitigation. *First*, the South Asian

Table 4.9 A su	ummary of climate chang	ge policies and initiatives in South Asia
Country	Policy/Initiative	Features
India	National Action Plan on Climate Change (NAPCC) 2008	It comprises eight missions: National Solar Mission, National Mission for Enhanced Energy Efficiency, National Mission on Sustainable Habitat, National Water Mission, National Mission for Sustaining the Himalayan Ecosystem, National Mission for Green India, National Mission for Sustainable Agriculture, and National Mission on Strategic Knowledge for Climate Change. The first two missions focus on mitigation while the remaining six focus on adaptation. All the states have also been advised to prepare state level action plans, envisioned as extensions of the NAPCC. Delhi launched a climate action plan for 2009-12 on the lines of the NAPCC.
	National Water Mission 2009	It has been formed as a part of the NAPCC 2008, identifying various strategies to tackle climate change and water related goals. Key strategies are implementation of programmes for groundwater recharge, efficiency improvement of existing facilities, promotion of environmentally friendly solutions and behavioural change, and regulatory mechanisms with differential entitlements and pricing. The main goals include creating a comprehensive water database and proper public awareness and education campaigns, shifting focus on overexploited areas, increasing water use efficiency by 20 per cent, and promote integrated water resource management (IWRM) on a basin level.
Pakistan	Climate Change Task Force 2008 and Climate Change Policy 2011	The documents suggest various adaptation measures to address the climate change threats for water resources, agriculture and livestock, human health, forestry, biodiversity, disaster preparedness, socio- economic measures and women. They highlight a number of climate change threats that can have significant repercussions for water security, food security and energy security.
Bangladesh	Bangladesh Climate Change Strategy and Action Plan 2009	It is a 10 year programme (2009-18) to build the capacity and resilience of the country to meet the challenge of climate change. It consists of six pillars: food security, social protection and health security; comprehensive disaster management; infrastructure; information and research management; mitigation and low carbon development; and capacity building and institutional strengthening. The Climate Change Trust Fund and Bangladesh Climate Change Trust Act 2010 have also been formulated.
Nepal	Climate Change Policy 2011	The main goal is to improve livelihoods by mitigating and adapting to the adverse impacts of climate change, adopting a low-carbon emissions based socio-economic development path and supporting and collaborating in the spirit of the country's commitments to national and international agreements related to climate change. The policy follows various strategies: climate adaptation and disaster risk reduction, low carbon development and climate resilience, access to financial resources and utilization, capacity building, peoples' participation and empowerment, study and research, technology development, transfer and utilization, and climate-friendly natural resources management.
Sri Lanka	National Climate Change Adaptation Strategy for Sri Lanka (2011-16)	The plan mirrors and supports Sri Lanka's national development strategy as articulated in the Mahinda Chintana and is aimed at ensuring its success and sustainability. It aims at systematically moving Sri Lanka and its people towards a future that is resilient to climate change. It is structured into five strategic thrusts: mainstreaming climate change adaptation into national planning and development; enabling climate resilient and healthy human settlements; minimizing climate change impacts on food security; improving climate resilience of key economic drivers; and safeguarding natural resources and biodiversity from climate change impacts.
Bhutan	10 th Five Year Plan Water Act	Adaptation strategies have been included in the plan with a special note for potential adverse impacts on hydrological flows for power plants and irrigation, which may affect energy, food security and glacial lake outburst floods (GLOFs). The Act has been formulated following the principles of IWRM.
Maldives	Strategic Action Plan 2009-13, National Environmental Action Plan 3 and National Sustainable Develop- ment Strategy 2009	They provide the contextual background for environmental management, which highlights climate change as an extraordinary environmental challenge focusing on adaptation and disaster risk mitigation as priority areas.

Source: MHHDC staff compilation.

Some regional countries have adopted common SAARC positions at various international climate change forums Association for Regional Cooperation (SAARC) Action Plan on Climate Change 2009-11 focuses on seven areas of cooperation including adaptation, mitigation, technology transfer, finance and investment, education and awareness, management of impacts and risks, and capacity development for global climate change negotiations. The top priority areas of the Plan are capacity building for Clean Development Mechanism projects, exchange of information disaster responses, on exchange of meteorological data, and exchange of information and capacity building for climate change impacts. Second, the Comprehensive Framework on Disaster Management 2006-15 addresses the specific needs of disaster reduction and management in the region. All the countries are preparing their national plans of action which will be harmonized to formulate a regional plan of action. Third, the Thimphu Statement of Climate Change 2010, adopted during the 16th SAARC Summit, was re-emphasized in the Addu Declaration at the 17th SAARC Summit in 2011. It sets goals for the region to lead the globe in furthering renewable energy, cutting carbon emissions, and reducing poverty while strengthening resilience to climate change.

In addition to plans, four regional level institutions have also been established in South Asia. These include SAARC Forestry Centre 2008 in Thimphu, Bhutan, SAARC Disaster Risk Management Centre 2006 in New Delhi, India, SAARC Coastal Zone Management Centre 2005 in Male, the Maldives, and SAARC Meteorological Research Centre 1995 in Dhaka, Bangladesh. The functioning of these institutions depends entirely on inputs from relevant national organizations, and turf disputes often create obstacles.

Some regional countries have adopted common SAARC positions at various international climate change forums. For instance, Bhutan as the chair of SAARC took a common regional position on climate change at the Conference of the Parties (COP) 16 Conference on Climate Change in Cancun in December 2010. Earlier, Sri Lanka as the chair of SAARC adopted the common position at the COP 15 Conference on Climate Change in December 2009.

These efforts and initiatives are a positive step towards adaptation and mitigation and shows seriousness and commitment of regional countries to work jointly.

International framework and efforts for climate change adaptation and mitigation

The UNFCCC was set up in 1992 at the Earth Summit in Rio and entered into force in 1994. Its establishment was a crucial step towards the institutions and processes for the world's governments to take coordinated, joint and effective actions. Twenty years later, Rio+20 was held as a follow up of the Earth Summit of 1992, to reaffirm the Rio Principles, and to come up with new action plans to address the crises emerging over the last 20 years (see box 4.4).

The UNFCCC has become the main forum for negotiating a collective international response to climate change impacts.⁶⁸ All parties in this convention are committed to understanding national adaptation plans and towards the preparation of responses to climate change. The commitments under the Convention are to be implemented in the form of GHG reductions by developed countries with 1990 as the base year and the provision of financial and technological support to developing countries including South Asian countries for adaptation and mitigation measures.

A number of initiatives have been taken recently to support climate change adaptation and mitigation efforts in developing countries including the formation of a Green Climate Fund (GCF), and developed countries announced US\$30 billion

resilience to the impacts of climate change on water. Also, there is a need to strengthen the carrying capacities, especially of the poor and the marginal-

provision of financing to developing countries are inadequate to address climate change adaptation and mitigation

Recent efforts and

commitments for the

as fast start funds from 2010 to 2012 and US\$100 billion per year as long term finance by 2020.69 Also, it has been agreed in the Rio+20 that there will be a follow up process in finance. A committee of 30 experts will be formed to assess financing needs and related issues and will conclude its work by 2014. This issue was also discussed in the recent annual UN Conference, known as COP 2012. However, the conference faced criticism for the lack of funds to be provided to developing countries for adaptation and mitigation. The timing for the fast start funds has ended in 2012 and there is a gap between 2013 and 2020 with no commitments or a road map of a progressive increase towards the US\$100 billion a year by 2020. The COP 2012 has only encouraged developed countries to provide at least as much as they had in the 2010-12 period which means US\$10 billion a year.

Recent efforts and commitments for the provision of financing to developing countries are inadequate to address climate change adaptation and mitigation. For instance, the UNFCCC has estimated an additional worldwide annual investment of US\$60-182 billion for adaptation in 2030, inclusive of US\$28-67 billion in developing countries.⁷⁰ Similarly, an additional worldwide annual investment of US\$200-210 billion is required in 2030 to return GHG emissions to current levels. The annual investment estimate for climate change adaptation in South Asia has been found to be US\$13-18 billion between 2020 and 2029.71

An evaluation of global level climate change efforts indicates that such initiatives have resulted in the provision of some resources, information and capacity building to developing countries. However, they still have to facilitate significant implementation, technology access, or the establishment of strong national institutions to carry out the climate change adaptation and mitigation agenda forward.72 The next COP and follow up of Rio+20 are expected to accelerate progress and deliver

more concrete results.

Conclusion

Climate change is a daunting reality and one that cannot be ignored by policy makers, stakeholders and the people of South Asia. Its negative effects on people through the alteration of water resources and systems make South Asia one of the most vulnerable regions in the world that will face water-related impacts due to climate variability. The reasons are high population densities, massive poverty and food insecurity, more dependence on agricultural sector, poor governance and weak institutional system for climate adaptation change and mitigation techniques. The impact of climate change on the water supply and demand for water can exacerbate existing development problems and at the same time increase pressure on the key resources needed to sustain growth in the region.

While human activities have been attributed to climate change, developing countries including those in South Asia have contributed little to GHG emissions. However vulnerable people, especially the poor and the marginalized living in these countries, will face the most serious threats. They are not only highly exposed to climate change risks and vulnerabilities through the melting of glaciers, variation in monsoon rains, extreme weather events and rising sea levels, but they also lack sufficient adaptation capacity. The region has a formidable and

overbearing challenge to reduce poverty and deprivation and promote human development in the face of climate change. For this, they have to focus on inclusive and sustainable development. This will require both climate change adaptation and mitigation measures. Adaptation will require building

> Impact of Climate Change on Water in South Asia 65

Box 4.4 From the Earth Summit 1992 to the Rio+20 Summit on Sustainable Development

The Earth Summit in Rio in 1992 was a landmark event. It initiated the concept of sustainable development along with its three dimensions: economic, social and environmental. A series of negotiations resulted in the Rio Principles on the environment, development and equity. These included the environmental precautionary and polluter pays, the right to development, and the common but differentiated responsibilities (CBDR). The CBDR principle was of crucial importance for developing countries, as it implied that developed countries had to take the leading role in environmental protection, as they contributed the most towards environmental problems and that they should also support developing countries with finance and technology in their sustainable development efforts. The Commission on Sustainable Development (CSD) was set up as a main body for a follow-up of the Summit. The Commission worked well in its initial years, but has not performed well in recent years. The problem was mainly in its design: it meets only two to three weeks a year and has a small secretariat. After the emergence of so many crises, it could not effectively address the three pillars of sustainable development.

Twenty years later, the UN organized a Conference on Sustainable Development in 2012, known as the Rio+20. The objective was to celebrate the Earth Summit of 1992, to reaffirm the Rio Principles, and to come up with new action plans to address the crises emerging over the last 20 years. Though the event could not meet the expectations, it was a step towards the right

direction. The Brazilian President Dilma Rousseff called the outcome document as a historic step for sustainable development. She believed that it was a 'starting point' and not a 'threshold or ceiling' for implementing the path to sustainable development.

The summit adopted a 53-page document, 'The Future We Want'. It reaffirmed the principles agreed upon 20 years ago. It stated that the talks should continue at the UN to strengthen sustainable development and environmental institutions, to examine how and whether to provide finance and technology to developing countries, and to establish new Sustainable Development Goals (SDGs).

Reaffirmation of original Rio Principles: The Summit reaffirmed the 1992 Rio principles, including the principle of CBDR. It also recalled that the UNFCCC provides that parties should protect the climate system "on the basis of equity and CBDR and respective capabilities."

Technology and finance: It was agreed that there would be a follow-up process in the key areas of finance and technology after the event. On finance, an intergovernmental process will start under the UN General Assembly to assess financing needs. existing frameworks and additional initiatives, to prepare a report towards a Sustainable Development Financing Strategy in order to mobilize resources for sustainable development. On the technology front, UN agencies have been requested to identify options

for a facilitation mechanism to promote development, transfer and dissemination of environmentally sound technologies by assessing technological needs of developing countries and options to address them, in addition to capacity building.

Sustainable Development Goals: It has been decided that the SDGs will be formulated through a 30-member working group under the UN General Assembly. The SDGs will be based on Agenda 21 and the Johannesburg Plan of Action, respect the Rio principles, build upon commitments already made, and incorporate the three dimensions of sustainable development.

The Green Economy: It was agreed at the Summit that the green economy is one important tool for achieving sustainable development, providing options, but not a rigid set of rules. The text also contained 16 points of what the green economy should or should not be.

Institutional Framework for Sustainable Development: It was decided at the Summit that the CSD should be replaced with a high level political 'Forum on Sustainable Development'. The participants also agreed to launch an intergovernmental process under the General Assembly to define the forum's format and organizational aspects. Moreover, it was decided that the United Nations Environment Programme (UNEP) would be strengthened and updated through universal membership of its governing council and increased, stable and adequate financing.

Sources: Khor 2012, The Economist 2012b and Watts and Ford 2012 and MHHDC staff compilations.

ized. This requires the need to institutionalize good practices for adaptation to climate change and incorporate them into sustainable development planning.

Mitigation will require countries in the region to reduce emission intensity of growth while simultaneously improving the access of people to cleaner energy, and better infrastructure and services for poverty reduction.

The region does not necessarily have to take climate change as a challenge, but rather as an opportunity to address issues of poverty, inequality, deprivation and underdevelopment which are inextricably linked to various aspects of climate change.



Transboundary Water Resource Management in South Asia

South Asia is one region that has had to deal with some of the most difficult disputes over international rivers, yet at the same time it has been successful in designing some interesting ways of cooperation.¹ This chapter focuses on the challenges and opportunities for transboundary water management in South Asia. Countries sharing river systems, lakes and aquifers in the region are vulnerable to tensions and conflict, which is further exacerbated by climate change. As the chapter will show, in some instances cooperation for transboundary water management is a missed opportunity because of political mistrust or lack of institutional arrangements between riparian countries. In other instances, countries have successfully tapped into the potential of shared river basins by choosing to cooperate through 'hydro-diplomacy' rather than resorting to conflict. The chapter will delineate the nature of transboundary water conflicts in the region and discuss the underlying determinants of the political economy of such conflicts. The analysis points to the need for making water an instrument for cooperation and unity rather than of conflict. With rising water demand and declining water availability along with the pressures of increasing climatic variation and climate change, riparian countries² in South Asia will need to work towards collaboration in their governance systems, beginning with joint monitoring and assessment of shared waters and eventually moving towards the implementation of some form of an integrated river basin management framework for optimizing and sustaining the use of available water resources.

South Asia's water profile

Nearly 20 major international rivers flow through South Asia, mostly originating in the Tibetan plateau of the Himalayas, the largest of which are the Brahmaputra, Ganges and Indus (see table 5.1 and map A 5.1). The river systems of the Himalayan region can be divided into three The western Himalayan sub-regions. sub-region includes the Indus system to which belong the Jhelum, Chenab, Ravi, Bias and Sutlej rivers. The Indus River system is shared between Pakistan and India, as well as China and Afghanistan. The Central Himalayan sub-region includes the Ganges system of which the Yamuna, Ramganga, Mahakali, Karnali, Gandaki and Kosi rivers are a part. The Ganges River system is shared by India, Bangladesh, Nepal and China. The eastern Himalayan sub-region includes the Brahmaputra system, which includes the Teesta, Raidak and Manas rivers. The Brahmaputra system is shared between India, Bangladesh, Bhutan and China.

The South Asian region is with considerable endowed water resources, and high potential for hydropower development. However, the available water resources are unevenly distributed, spatially as well as temporally. Moreover, sharp seasonal variations in the volume of water flows due to climatic phenomena, such as monsoons and droughts in some countries, add to the difficulty of finding equitable and durable water sharing arrangements. Among the South Asian countries, India, the largest country in the region, has one sixth of the world's population, but only one-twenty--

In some instances cooperation for transboundary water management is a missed opportunity because of political mistrust or lack of institutional arrangements between riparian countries

Table 5.1 Shared river b	oasins in Sout	th Asia	
River basin	Total		Area division
	area		(%)
Ganges-Brahmaputra-	1,634,900	India	58.01
Meghna (GBM)		China	19.65
		Nepal	9.01
		Bangladesh	6.55
		India, claimed by China	4.11
		Bhutan	2.44
		Indian control, claimed by China	0.07
		Myanmar (Burma)	0.00
		Pakistan	52.48
		India	33.51
Indus	1,138,800	China	6.69
		Afghanistan	6.33
		Chinese control, claimed by India	0.84
		Indian control, claimed by China	0.14
		Nepal	0.00

Source: UNEP 2002.

fifth of the world's available water resources. Pakistan depends on the Indus River as its primary source of water. Bangladesh is the downstream and the deltaic portion of a huge watershed. All of Bangladesh's rivers originate outside its borders, thus making it vulnerable to the quantity and quality of water that flows into it from upstream. The Ganges and Brahmaputra are the most important rivers for Bangladesh, supplying 85 per cent of all surface water during the dry season.³ Only Bhutan and Nepal are considered water rich from among the countries in the South Asian region. The Maldives has achieved remarkable success in rainwater harvesting, with only 25 per cent of its population dependent on groundwater for drinking and the remainder using rainwater and desalinated water for this purpose. Sri Lanka, a country that is apparently water rich, is also experiencing rapid declines in water availability, which is estimated to decline to 1,900 cubic metres per capita by 2025. Though Afghanistan is located in an arid environment, it is rich in water resources because of the series of high mountains covered by snow.⁴

The per capita water availability in most countries is experiencing a declining trend due to a range of climatic and demographic factors. For instance, in India, the per capita water availability is expected to decline below 1,000 cubic metres by 2025.5 An overwhelming majority of the region's water use is limited to the agricultural sector, with almost 90 per cent of the water withdrawn used for agriculture, compared to the world average of 70 per cent.⁶ As mentioned earlier in the Report, population growth and exploitation of resources has resulted in many parts of the region coming under water stress.7 In addition, poor water management practices have also compounded the negative impact on water availability, quality and the region's ecosystems in general.

There is a need to understand the human consequences of the 'hydrological interdependence' that binds countries in South Asia. Transboundary water management has profound impacts on human development. The way one country uses water transmits effects to other countries. "Because water is a flowing resource rather than a static entity, its use in any one place is affected by its use in other places, including other countries."8 For instance, the retention of water upstream in India for energy generation restricts flows downstream for Pakistani farmers. Apart from affecting the quantity of water that downstream countries receive, upstream countries can also affect its quality. Industrial and human pollution is transmitted through rivers to other countries as seen in the case of the Ganges River that flows from India to Bangladesh. Moreover, the timing of water flows is another transboundary issue for human development. Secure livelihoods depend on a predictable supply of water. The use of water in one country can affect the timing of delivery for downstream users, even if the volume of water is unchanged.9

The nature of transboundary water issues in South Asia

Most international rivers do not recognize political boundaries, flowing freely across

countries, cities, and villages, across fields and industrial belts. In terms of hydrography, South Asia's international rivers bind its landscape, with different countries sharing common river basins. India, Pakistan and Afghanistan share the Indus Basin whereas India, China, Nepal, Bangladesh and Bhutan share the Ganges-Brahmaputra-Meghna (GBM) Basin (see table 5.1). For some countries, the lack of resilient institutions and effective water sharing arrangements in the face of climate change and rising demand for water is what gives rise to transboundary water sharing issues. For others, the roots of transboundary water conflicts can be traced back to the political divisions created between riparian States. One such example is the partition of British India, which by defining political boundaries succeeded in the creation of independent States, but was less successful in dividing up the water resources of the region (see box 5.1).

The following section highlights the nature of transboundary water issues between different sets of riparian countries in South Asia: India-Pakistan, India-Bangladesh, India-Nepal, India-Bhutan, Afghanistan-Pakistan, and also China's importance for South Asia's water security in the future. The discussion focuses on the historical water sharing agreements and bilateral treaties where they exist between countries, and their evolution (or the lack thereof) over time in the face of new challenges confronting the water insecure region. The analysis sketches the backdrop for pinning down the determinants of transboundary water issues that plague the region and the possible solutions for managing them as discussed later in the chapter.

India-Pakistan

The two largest economies of the South Asian region share six rivers—Indus, Chenab, Jhelum, Sutlej, Beas and Ravi—that flow through northern India into Pakistan. The Indus Water Treaty of 1960 sets out the legal framework for the sharing of these rivers: the Indus, Chenab and Jhelum, which pass through Jammu and Kashmir are to be used by Pakistan, while India has rights to the Sutlej, Bias and Ravi before these enter the Pakistani territory.

When Pakistan and India became

Box 5.1 Partition, nationalism and water

Many of the water disputes between countries in South Asia have their genesis in the political divisions created at the time of partition. The partition of the subcontinent into India and Pakistan in 1947 was not just a partition of land and people, but also of its waterways. In the west, the line of partition (Radcliffe line) ran right through Punjab but in effect cut the Indus River system, disrupting its well integrated irrigation canals. Many of the canals were severed from their headworks. For instance, the existing canal headwork of Upper Bari Doab Canal and the Sutlej Valley Canal fell in India, while the land being irrigated by their water fell in Pakistan, which led to water disputes immediately after partition. In addition,

Source: Singh 2008.

while the Indus was the main source of water for Pakistan's cultivable land, the source of the rivers of the Indus basin remained with India, adding another dimension of insecurity for Pakistan.

Similarly, in the east, the Radcliffe line not only partitioned Bengal (into West Bengal and East Pakistan, later to declare independence as Bangladesh), but in effect it divided the delta region of the Ganges Basin, severing river networks of the Ganges, Brahmaputra and Meghna, and severing ports (Calcutta and Chittagong) from their water sources. Hence, East Pakistan as a lower riparian was left with little control over fifty-four of its rivers, including the Ganges and the Brahmaputra. India was left with the only port in the east, the Calcutta port catering to a vast hinterland, and inundated by problems of heavy siltation that was affecting its navigability. In addition, the partition line in Bengal had not factored in two distinct features of the rivers in this one region: the fact that the rivers tended to be extremely 'wayward' and frequently changed course; and they formed chars (strip of land rising from the river bed above the water level). Both these factors then became sources of border disputes between the two nations. Many of these chars, like the ones on River Padma, are inhabited by people (char dwellers) who have since got caught in these border conflicts and faced untold suffering.

Increasingly both countries have started to regard the issue of control over transboundary waters as important for national security independent countries in 1947, the boundary was drawn right across the Indus, making Pakistan the lower riparian State and giving India the control of the headwaters of the Indus in general and the Chenab in particular. The Chenab is seen as a critical water resource in Pakistan, as it combines the waters of the four rivers. Jhelum, Sutlej, Beas and Ravi to form a single water system which then joins the Indus in Pakistan. Indian control over the Chenab along with the fact that all the three western rivers assigned to Pakistan under the Indus Water Treaty originate or flow through the volatile disputed region of Jammu and Kashmir are some of the key drivers of transboundary water issues between India and Pakistan.¹⁰

The current water discourse between India and Pakistan is being shaped by the increased demand for water in both countries coupled with its inefficient and wasteful use and the growing need for hydropower development for economic growth. Increased water stress in the two countries, which is further reinforced and exacerbated by climate change, has contributed to escalating tensions on the issue of water.

The Indus Water Treaty has created a legal framework for governing transboundary water resources between India and Pakistan and is largely regarded as a successful framework for cooperation on shared water resources, having survived three wars and other hostilities between the two neighbours. However, several important areas of concern fall outside the ambit of the Treaty and are increasingly becoming a source of hydro-conflict between the two riparians. The major points of contention include: numerous hydropower projects planned by India on western rivers and Pakistan's apprehensions about the control potential of these dams; technical specification of Indian hydropower projects, especially the legitimacy of the storage component; and data sharing and exchange of information.

Although no official data has been

released by the Indian government on the number of dams the country has planned on the western rivers allotted to Pakistan, the Permanent Indus Water Commission (PIWC) has listed about 155 planned hydropower projects on the Indus, Jhelum and Chenab rivers.¹¹ The major Indian projects that have become controversial from time to time and involved issues around the compliance of the Indus Water Treaty include the Salal, Wullar Barrage/ Tulbull Navigation project, Baglihar, Kishanganga, Dul Hasti, Bursar Dam, Uri II and Nimoo Bazgo and some others.

Pakistan's objections to Indian projects on western rivers have centred on India's ability to store water, which goes against Pakistan's rights to these western rivers as provided by the Indus Water Treaty. What fuels Pakistan's contention over these projects is India's policy of limited or no information sharing on the design of these projects. Some of these projects, like the Bursar Dam, apart from being a serious violation to the Indus Water Treaty (as it will have the ability to store 2.2 million acre feet of water which is much beyond permissible limits), also pose considerable environmental hazards.

Although almost all Indian projects on the western rivers are run-ofthe-river projects as allowed under the Indus Water Treaty, they entail serious consequences downstream in Pakistan both individually and cumulatively. Pakistan fears that the cumulative live storage of these projects would have adverse impacts both in terms of causing floods, and running the Chenab and Jhelum dry in the lean periods when Pakistan needs water the most for its agriculture.

Increasingly both countries have started to regard the issue of control over transboundary waters as important for national security. This has undermined the extent to which hydrological data is generated and shared between the two countries. The clauses of the Indus Water Treaty also allow room for disagreements between the two countries in the face of new technology and changes in water availability due to the effects of climate change in the region.

An analysis of the Indus Water Treaty: Contentious issues and way forward

The Indus Water Treaty of 1960 is regarded as one of the most successful water sharing arrangements, especially in the context of sensitive political relations between the two riparian countries-India and Pakistan. However, increasingly the Treaty is coming under stress. Some critics contend that the Indus Water Treaty is more of a static technical arrangement that treats the Indus as a mute volume of water. In recent years, numerous hydropower projects have become contentious between the two countries, yet the clauses of the Indus Water Treaty fail to provide conclusive answers to the issues raised on either side of the border. According to the Treaty, while India is not permitted to build dams for water storage purposes¹² (dams are allowed only if they involve use of water for 'nonconsumptive purposes') on the western rivers passing through India, it is allowed to make limited use of water including 'run-of-the-river'13 hydroelectric power projects. The Baglihar, Kishanganga, Bursar and Tulbull (Wullar) projects that come under this category have been opposed by Pakistan on the grounds that these will enable India to store enough water and hence make Pakistan vulnerable in case India decides to shut off supplies.

One of Pakistan's key concerns over India's hydropower projects on the western rivers is whether the project is 'run-of-the-river' as claimed by India and allowed by the provisions of the Indus Water Treaty. Due to lack of storage facilities downstream, Pakistan is apprehensive that the projects built by India on the western rivers involve storage, whereas India claims that these are run-of-the-river projects with only 'pondage' and not storage. Even though the run-of-the-river projects are allowed by the Treaty, it does not specify an upper limit on the number of these projects by each country. According to the 2011 US Senate Foreign Relations Committee Report, the cumulative effect of so many projects planned by India could give her the ability to store enough water to limit the supply to Pakistan at crucial moments in the growing season. This breeds insecurity in Pakistan, magnifies distrust between the two countries and hence impedes the implementation of solutions for effective water sharing for the benefit of both.¹⁴

In all of the hydroelectric projects objected to, Pakistan has brought in the dimension of security and strategic considerations, which are strictly outside the ambit of the Indus Water Treaty. Moreover, the Indus Water Treaty only incorporates the provision of data exchange six months before the actual construction of the dam.¹⁵ The countries are not liable to exchange information during the planning stage. This has also heightened apprehensions on the part of Pakistan as India has a plethora of projects planned up for which it has not shared information.

The Indus Water Treaty does not include any clause regarding the usage of groundwater resources. Groundwater, pumped by tubewells, has become a substantial supplementary source of irrigation water in the subcontinent. However, India is in a much better position to harness this resource as the three eastern rivers under India's control are the primary source of recharge of the groundwater in the basin area. India's rapid promotion of tubewells at subsidized electricity tariffs for agriculture usage has affected the yield potential of downstream aquifers in western Punjab in Pakistan. This has ramifications for groundwater availability along the border areas of Pakistan.

The Indus Water Treaty does not address the effects of climate change on water availability in the Indus Basin. Over the years both India and Pakistan have realized that climate change is a reality that The Indus Water Treaty of 1960 is regarded as one of the most successful water sharing arrangements Fifty-four big and small rivers are shared between India and Bangladesh, with Bangladesh being the lowest riparian for all of them has far-reaching implications for water scarcity in each country. As the rate of glacier melting increases due to climate change, this brings the dangers of flooding becoming more frequent and severe. Climate change in the region is also expected to affect monsoon dynamics in some countries-a shift in the monsoon circulation could result in less rainfall for India and Pakistan. This could be disastrous as summer monsoon rainfall provides 90 per cent of India's total water supply. Moreover, the basin's watershed area has suffered tremendous environmental degradation in both parts of Kashmir. This, along with massive deforestation, has decreased the annual water yield.

The Treaty also does not provide conclusive solutions for the issue of water pollution. In Article IV, Clause 10 of the Treaty, it does refer to the intent of each riparian to conserve quality of waters of the Indus Basin, but does not provide for an appropriate monitoring and surveillance mechanism to ensure this.

Given the various contentious issues that the Treaty does not adequately address, a key question remains: *Can India* and Pakistan move forward on the issue of transboundary water management using the existing framework of the Indus Water Treaty, or do the two countries need to go beyond the Treaty's provisions?

The Indus Water Treaty may not be as static as some critics contend. Article VII of the Treaty does provide a clause for 'future cooperation' between the two countries for optimizing the potential of the Indus River system. However, very little attention has been paid to areas of cooperation that could potentially fall in the ambit of Article VII.

Such lack of cooperation is in part due to the trust deficit between the two countries. Experts suggest that advance information to the lower riparian (Pakistan) about planned interventions such as dams and barrages, and exchange of real time hydrological data can bridge these issues. Article VI of the Indus Water Treaty incorporates the exchange of hydrological data between the two parties. In addition to this, the Treaty stipulates the provision of "any data relating to hydrology of the Rivers, or to canal, or to any provision of this Treaty" to be made available if requested by either country.¹⁶ Thus, given that the Indus Water Treaty clearly spells out the details on information exchange, making it incumbent upon both parties to share any information available, makes it a perfect platform to take the issue of cooperation forward.

Another area where collaborative work should be urgently undertaken is on groundwater aquifers, especially near the border areas of Pakistan and India. The Indus Water Treaty only considers sharing of surface water discharge from the rivers. A study conducted by the International Union for Conservation of Nature, using analysis from National Aeronautics and Space Administration (NASA's) Gravity Recovery and Climate Experiment, found that the aquifers of Pakistan are going to be affected with the disproportionate abstraction of groundwater in India.¹⁷ It concludes that "the issue of transboundary groundwater with India has to be addressed and an addendum has to be negotiated between the basin States for inclusion in the Indus Water Treaty." In this regard, Pakistan and India can learn from the Israel-Jordan Treaty of 1994 on amicable sharing of both ground and surface transboundary water.¹⁸

India-Bangladesh

Fifty-four big and small rivers, including the three large ones, the Ganges, the Brahmaputra and the Meghna are shared between India and Bangladesh, with Bangladesh being the lowest riparian for all of them. Despite the presence of a large number of transboundary rivers between the two countries, the only international water treaty that exists between India and Bangladesh is the Ganges Treaty of 1996. The Treaty governs sharing of water from the Ganges at the Farakka Barrage in India, located 18 kilometres upstream from the western border of Bangladesh.¹⁹ Prior to this Treaty there were several short-term agreements and Memoranda of Understanding between the two countries for sharing the Ganges waters.²⁰

The major water dispute between India and Bangladesh revolves around sharing of the Ganges water during the lean period since the Indian plan for the construction of the Farakka Barrage has been implemented. The barrage was designed to divert water from the Ganges to the Hooghly River in India to solve siltation problems at the Kolkata port in India.²¹ The sharing of the Ganges water at Farakka between India and Bangladesh is based on 10-day periods during the dry season starting from 1 January to 31 May every year. Since the construction of the barrage in 1975, the sharing and controlling of the Ganges water has become a source of controversy between the two nations.

One of the main objectives of the Ganges Treaty of 1996 was to govern the dry season flow of the Ganges as well as to seek ways to augment flows. The efficacy of the Treaty in enhancing the dry season water availability in the Ganges at Farakka (India) and Hardinge Bridge (Bangladesh) is rather questionable. It has been found that the dry season flow at Hardinge Bridge has dropped significantly after commissioning of Farakka Barrage in India. Moreover, research indicates that there is a sharp declining trend in the flow reaching Hardinge Bridge since 1975.22 At present, the downstream effects of the Farakka Barrage include harm to fisheries, lower quantities of freshwater for domestic and agricultural uses during the dry season, reduced navigability of the Ganges and damage to the Sundarbans mangrove ecosystem.23

Thus, the Farakka Barrage has been the focal issue between India and Bangladesh and the point around which their hydrological relationship has evolved. Apart from the Farakka, a number of other Indian projects have intensified the hydropolitics between the two countries. The Teesta River is another source of conflict between India and Bangladesh. In the late 1980s, India constructed the Gazoldoba Barrage 60 kilometres north of the Bangladesh border to divert water toward irrigation projects in northern West Bengal. In 1998, Bangladesh constructed the Teesta Barrage 20 kilometres south of the Indian border. Bangladesh has raised concerns about the distribution of the Teesta's waters. In particular, Bangladesh contends that India is increasingly diverting more water to the Gazoldoba at the expense of its downstream riparian.24

Recently, the unilateral construction of the Indian dam on the Barak River at Tipaimukh has also been a major cause for concern for Bangladesh as the lower riparian.²⁵ There is a strong opposition to this 1,500 megawatt project from both within and outside India. The major likely impacts of this project inside India include loss of homes, lands, and livelihoods, loss of state and reserve forests, submergence of wildlife sanctuaries, and adverse impacts on fisheries, biodiversity, and navigation. Construction of the dam will also have long term adverse impacts on the river system of Surma and Kushiyara in the Northeastern region of Bangladesh which will result in damage to the ecology, environment, agriculture, biodiversity and fisheries in Bangladesh. In a study by Bangladesh Water Development Board (BWDB) it has been noted that obstruction to the natural flow of the Surma and Kushiyara as a result of the Tipaimukh Dam will seriously hamper hydrology, agriculture etc., in at least seven districts of Sylhet, Moulvibazar, Habiganj, Sunamganj, Brahmanbaria, Kishoreganj and Netrokona in Bangladesh that produce bulk of the country's rice crop. India and Bangladesh are also in the early stages of a dispute over the proposed Indian Interlinking of Rivers (ILR) Project (see box 5.2).

The Farakka Barrage has been the focal issue between India and Bangladesh

The hydro-politics of India and Bangladesh is complex. The fact that the two countries share 54 rives makes it a staggering challenge for water management in both countries. Managing transboundary waters requires cooperation, not just between India and Bangladesh, but there is also a need to include Nepal, Bhutan and China in the greater GBM collaborative basin management. Adopting a basin wide approach to management of transboundary waters should not only fous on the issue of quantitative sharing of waters but also other areas such as hydropower generation, water pollution and joint watershed management.

India-Nepal

Nepal has three categories of rivers flowing into India: the first are those originating from the Himalayas such as the Kosi, Gandaki, Karnali and Mahakali, which are perennial with a substantial water flow. Mega projects and dams on these rivers have often been at the centre of water tension between India and Nepal. The second set of rivers originates from the Mahabharat, and the third from the Chure range. These rivers have less or no flow in the dry season, but during the monsoons, particularly rivers from the Chure range can become turbulent, capable of bringing about massive destruction. Embankments on some of these rivers have been yet another point of dispute.

Since the beginning of the twentieth century, a number of agreements have been signed between India and Nepal starting with the Sarada Barrage Agreement in 1920, followed by several interim agreements through 1950s (Kosi River Agreement in 1954; Gandak Agreement in 1959); and finally the Mahakali Treaty of 1996 (see box 5.3).

Even though India and Nepal have been successful in generating three bilateral water sharing agreements to date, real progress in using water as a catalyst for economic development and poverty alleviation for both countries has been minimal. The history of negotiations regarding water projects on the Nepalese rivers has been dominated by controversies due primarily to a perceptional difference and lack of trust between the citizens and governments of the two countries. Nepal essentially suffers from the small country

Box 5.2 Indian Interlinking of Rivers (ILR) Project

The ILR Project, that may well be the largest infrastructure project ever undertaken in the world, aims to transfer water from the surplus river basins to ease the water shortages in western and southern India while mitigating the impacts of recurrent floods in eastern India. The project's basic idea is to take water from areas where authorities believe it is abundant and divert it to areas where there is less water available for irrigation, power and human consumption. The project would necessitate linking 30 canals totaling about 10,000 kilometres and constructing 33 dams.

Since the project was announced in 2002, it has not only become controversial within India due to its possible environmental consequences, but also has transnational implications for upstream and downstream countries sharing the rivers that India aims to divert. Controversy has arisen between Nepal, India and Bangladesh regarding the project. Being the lower riparian, Bangladesh fears that vast quantities of water would be diverted from the Ganges and the Brahmaputra rivers to India's southern states, thus directly threatening the livelihoods of the people as well as the environment in Bangladesh. Bangladeshi officials state that it would lead to flooding in Bangladesh and intensify the country's dry season. The country further argues that the project violates the International Law Association's 1966

Helsinki Rules on the Uses of Waters of International Rivers which provided a framework for the 1997 UN Convention on the Law of the Non-Navigational Uses of International Watercourses (UNCIW).

Nepal and Bhutan as upstream countries also have a stake in the ILR Project. Nepal has ideal locations for the infrastructure required to make the mammoth Indian project happen. Bhutan too has similar locations and some of its rivers are tributaries to the Brahmaputra, a major river system in the region included in India's river-linking project. However, both Nepal and Bhutan were not included in the feasibility discussions of the ILR project.

Sources: Babel and Wahid 2008, Khadka 2012 and Shah et al. 2012.

syndrome and most Nepalese are convinced that they have not been dealt with fairly by the treaties.²⁶

Historical water sharing agreements between India and Nepal have not always emphasized equitable sharing of the benefits from the concerned international rivers. Nepal, as a result, has remained dormant for long and also evasive about starting new projects, at a huge cost to its own development needs. Also internally, for the same reasons, the exploitation of water resources in Nepal has been influenced by independent development rather than joint development philosophy.

Nepal's experience with political turmoil over the last few decades has impacted the development of a well thought out transboundary hydro-policy. Major decisions have been put on the backburner for a very long time. Nepal has been importing electricity from India since 1965 and is still a net importer.²⁷ In contrast, neighbouring Bhutan has been able to finance much of the country's economic growth and social development in recent years through revenues from Indian designed hydroelectric projects that provide power to both Bhutan and India's Northeast (see box 5.4).

Nepal and India have been planning joint multipurpose projects, some being studied as early as 1967 but most of these projects are far from the implementation stage. These include the Sapta Kosi High Dam and the Kankai, Kamala, Sunkosi-Kamala and Bagmati Multipurpose projects. Many feasibility

Box 5.3 History of Indo-Nepalese water sharing agreements

The Sarada Barrage Letter of Exchange was the first international treaty between the British Indian government and the Government of Nepal in 1920 for the diversion of the Mahakali-Sarada water for irrigation of what is currently Uttar Pradesh in India. This agreement was the historical precursor for all subsequent agreements, treaties and projects between India and Nepal. It provided Nepal with a canal and 460 cusecs of free water for irrigation, and, subject to availability of surplus water, up to an additional 1,000 cusecs during the planting season. The agreement was mainly related to the use of Nepali land for the construction of the barrage and, in return for cooperating with the British-Indian government, Nepal got 'free' water.

The second treaty was the Kosi Agreement of 1954 in which Nepal's prior right to withdraw water from the Kosi River and/or its tributaries as and when required was preserved. However, within Nepal the dominant view was that the Treaty was partial towards India with respect to sharing of irrigation and hydropower. Some rectifications were made in the revised agreement of 1966 to provide a few more benefits for Nepal.

The third agreement was the 1959 Gandak Agreement, which was similar to the original 1954 Kosi Agreement in terms of benefits to Nepal. Nepal was to receive 15,000 kilowatts of power and 20 cusecs of water for irrigation from each of the western and eastern canals. The rest of the power and water went to India. Unlike the Kosi Agreement, Nepal's right to withdraw water from the Gandak and its tributaries was restricted to ensure the maintenance of minimum water flow for the project.

Each of these treaties evoked strong protests and unrest in Nepal and had to be subsequently amended, but resentment over the treaties, particularly over the Mahakali Treaty, persists in Nepal.

In 1975 Nepal, with the aid of the World Bank, completed construction of the Mahakali Irrigation project. This project enabled Nepal, for the first time, to utilize its share of water specified in the Sarada Agreement way back in 1920. In 1977 both India and Nepal agreed to jointly investigate the possibility of harnessing the Mahakali water further. Problems began when India unilaterally went ahead and began construction of the Tanakpur Barrage in 1983 on land that was transferred to India under the Sarada Agreement. Nepal feared that this would affect the Mahakali Irrigation project, as well as its land and people living across the border river. Some changes were made in the design of the barrage, but the Tanakpur Barrage became a point of confrontation between India and Nepal.

The Mahakali Treaty of 1996 subsumed all other Indo-Nepalese agreements related to the downstream projects on the Mahakali River including the Sarada Barrage and the revival of the defunct Tanakpur Barrage. In addition to this, the Treaty's centrepiece was the construction of the multipurpose Pancheswar Dam. Under the Treaty, the Pancheswar project was to be executed and operated by joint entities established by both countries, monitored by the Mahakali Commission. Even though the Mahakali Treaty tried to address past grievances between India and Nepal, it eventually became the most contentious due to a lot of ambiguities in its interpretation and enforcement.

studies for these projects have been conducted time and again, but with no real progress. Projects involving storage of monsoon water in Nepal to manage floods in downstream countries like India entail some adverse consequences for Nepal in terms of loss of agricultural and forest land and displacement of population. It is thus essential that the hydro-relationship between India and Nepal should not only progress bilaterally, but also expand to involve other co-basin countries that could potentially benefit from the shared projects.

Afghanistan-Pakistan

Afghanistan has many water resources and its geography provides significant opportunities for their exploitation. However, most of these water resources are unequally distributed.²⁸ Moreover, insufficient infrastructure, lack of capacity along with a history of 30 years of war and unrest compound the water availability issue especially for irrigation in rural areas where more than 75 per cent of the population lives.

Four out of Afghanistan's five river basins are shared with its neighbours both in South Asia and Central Asia: the Kabul Basin (part of the greater Indus Basin), the Helmand Basin, the Amu Darya Basin and the Harirud-Murghab Basin (see table 5.2). Despite the fact that the country shares the aforementioned four transnational river basins with five countries—Turkmenistan, Iran, Pakistan, Uzbekistan and Tajikistan—Afghanistan has only one existing bilateral treaty: a sixty-yearold agreement with Iran concerning the Helmand River.

Out of the 57 billion cubic metres of average river flow, only less than 30 per cent is consumed in Afghanistan, the remaining water flowing out to neighbouring countries. Within South Asia, Afghanistan and Pakistan share the Kabul River that flows in eastern Afghanistan and North-western Pakistan. The Kabul River Basin, including the important tributary Kunar River, is the most important river basin representing approximately 26 per cent of the available water resources in Afghanistan and containing almost half of the country's urban population. It is crucial to the livelihoods of the millions of people sharing its water resources for drinking sanitation, agriculture, power water. generation, and industry. A major tributary of the Kabul River, the Kunar, originates in Pakistan and then it joins the

Box 5.4 A case of constructive collaboration on transboundary water management in South Asia

The collaboration between Bhutan and India provides an excellent example as to how transboundary water bodies can be used as an engine for economic development of an impoverished region with concomitant benefits to each country. Bhutan is a landlocked country with very limited agricultural potential. Its high mountainous location, however, provides the country with unique special advantages, especially in terms of its hydropower potential, which is estimated at 20,000 megawatts, slightly less than one-quarter of the potential of its western neighbour, Nepal. Since Bhutan's main natural resource was water, the country

decided to harness this resource for economic development. Limited investment capital and lack of technical and management expertise convinced Bhutan that the optimal solution to developing its transboundary waters would be to engage in close collaboration with its southern riparian, India.

Around 1980, Bhutan initiated a plan to develop the hydropower potential of the Wangchu Cascade at Chukha, in close cooperation with India. Before the construction of the Chukha plant, electricity was generated by diesel and mini-hydro plants. Thus, total electricity generated was very limited. Transporting diesel to a landlocked and mountainous country was an expensive and complex process. As a result of the Chukha project, Bhutan's per capita energy consumption has steadily increased over the years. In addition, the cost of electricity generation has declined due to the reduced use of diesel and fuelwood being imported from India previously. The success of the Chukha project has made Bhutan and India collaborate on successive projects: Kuri Chu (45 megawatts), Chukha II (1,020 megawatts) and Chukha III (900 megawatts).

Source: Biswas 2011.

Table 5.2 Four internation	Table 5.2 Four international river basins shared by Afghanistan and neighbouring countries				
Name of the basin	Riparian States	Water sharing treaties			
Kabul River Basin (part of the Greater Indus River Basin)	Afghanistan and Pakistan	Both countries have not been able to reach a water sharing agreement after several attempts. The World Bank is currently leading an initiative to establish an agreement that will focus on the Kabul River Basin by creating the Kabul River Basin Manage- ment Commission modeled after the 1960 Pakistan-India Permanent Indus Commission, which is considered by many to have been successful in avoiding water-based disputes.			
Helmand River Basin	Afghanistan, Iran and Pakistan	In 1973, Afghanistan and Iran signed a bilateral treaty. As a result of significant political and regime changes in Afghanistan and Iran in the 1970s and subsequent wars in both countries, the bilateral treaty has barely been applied, and disputes over the terms of agreement persist.			
Harirud-Murghab River Basin	Afghanistan, Turkmenistan (Murghab and Harirud) and Iran (only Harirud)	Afghanistan has not established direct agreements concerning the Harirud-Murghab River Basin either with Turkmenistan or with Iran. However, the Harirud-Murghab Basin forms part of the wider Amu Darya Basin, which is the subject of several regional frameworks (see below). Such agreements could be interpreted as having implications for the Harirud-Murghab Basin.			
Amu Darya River Basin (part of the Aral Sea Basin)	Afghanistan, Tajikistan, Pakistan, Uzbekistan and Turkmenistan	The existing agreements signed by Afghanistan with the Soviet Union focus solely on the river as an international boundary; these date from 1873, 1946, 1958 and 1978. Afghanistan has not signed any treaty establishing water quantity and quality param- eters, though it has agreed to a protocol that includes provisions concerning joint management of the river and its tributaries. Central Asian countries and the interna- tional community have set up several cooperation frameworks, however no successful steps have been taking to existing or new regional frameworks.			

Source: Palau 2011.

Kabul River closer to Jalalabad. It again enters Pakistan and joins the Indus River at Attock. $^{\rm 29}$

The most important issue driving hydro-politics between Pakistan and Afghanistan is the fact that there is no basin treaty with regard to water sharing between the two countries. What further exacerbates riparian water issues between the two countries is the rapid and persistent decline recorded in the flow of the Kabul River at Attock in Pakistan.³⁰ This could be the result of a myriad of factors ranging from climate variability, persistent droughts or the enhanced use of water by Afghanistan. Water issues between Afghanistan and Pakistan are also confounded by the decades long, still unresolved border dispute between the two countries (see section 3 of the chapter).

The need for an effective water sharing arrangement between riparian

States sharing river basins with Afghanistan is vital for any positive development in transboundary water management in the region. Water is a critical issue not only for Afghanistan but also for its riparian States. Pakistan gets about 17 per cent water supply from the Kabul River when Indus flows decline in winter and its recent energy crisis has served to further its dependence on Afghan water.³¹ Iran is the only country with which Afghanistan has a water treaty. If Afghanistan tries to build major dams to hold more of its own water, both Pakistan and Iran are likely to object and to hold up the projects.³²

China: Why it needs to be factored into the South Asian water equation

China is the largest source of transboundary river flows to much of South Asia. More importantly, China's plans to harness It is clear that territorial disputes cannot be extricated from water issues

the immense water resources of the Tibet region are crucial to the hydro-politics of the South Asian region. Tibet's massive glaciers, deep alpine lakes, and innumerable water bodies feed the river systems that enter South Asia. According to the Intergovernmental Panel on Climate Change (IPCC), the region's warming climate is already causing glaciers to withdraw almost one metre per annum, portending substantial impacts on future water flows.³³ The waters of Tibet may prove to be one of its most important resources in the long run-for China and for much of Southern Asia. Figuring out how to sustainably manage that water will be a key to reducing political conflicts and tensions in the region.

China only has 8 per cent of the world's freshwater resources, but is home to 20 per cent of world population. The Chinese government has been considering a plan to dam or redirect the southward flow of water from the Tibetan plateau, which is the starting point of many international rivers, including major rivers like the Brahmaputra, the Yangtze, and the Mekong. In the context of transboundary flow in South Asia, the important rivers include the Brahmaputra, the Indus, the Sutlej, the Arun, and the Karnali. The plan includes diverting the waters of the Yangtze, Yellow, and Brahmaputra rivers to China's drought-prone northern areas, through huge canals, aqueducts, and tunnels. One of the water diversion routes, more specifically the southern component of the route cutting through the Tibetan mountains, will divert waters of the Tsangpo for a large hydroelectric plant and irrigation use. The planned water diversion is estimated to have adverse consequences in the downstream areas, resulting in loss of land and ecosystems due to the submergence of a huge area in the Tibetan region. Flow control for power generation and irrigation during the dry season, and water release during the flood season is also expected to pose a serious threat to flood management, dry season water availability,

and ecosystem preservation of northern India and Bangladesh.³⁴

Water issues between China and India, both rising powers in the region, are growing particularly acute especially because of their interaction with political and territorial disputes (see section 3 of the chapter). China's territorial claim on the Indian state of Arunachal Pradesh had been a major bone of contention between the two countries. One of India's largest rivers, the Brahmaputra (Tsangpo in China), flows south from the Tibetan plateau and into Assam in India not far from the disputed land. Interestingly, most rivers flowing through Arunachal Pradesh have been identified as possessing enormous potential for hydropower to the tune of 49,126 megawatts of electricity.³⁵ It is clear that territorial disputes cannot be extricated from water issues. A quarrel over rivers in the region could serve as a focus for wider disputes about territory.

Determinants of transboundary water conflicts in South Asia

Hydro-diplomacy throughout Bangladesh, India, Nepal, Pakistan and Afghanistan has been acrimonious at best. There are a number of factors that have been driving the region's 'hydro-politics'. Understanding these factors is essential before one can suggest any bilateral or multilateral solution for resolving them. Issues of climate induced water variability, increasing water scarcity, degrading water quality, rapid population growth, unilateral water development, and uneven levels of economic development are commonly cited as potentially disruptive factors among riparian countries in the region. It is interesting to see how these factors interact with and reinforce the issues of political economy and assymetrical power relationships between countries, notably in the case of India's relationship with most of its riparian countries in the region.

Of all the determinants of coriparian water relations cited in existing literature, the institutional determinants play a vital role (see figure 5.1). The presence or absence of institutions has proven to be one of the most important factors influencing co-riparian water relations, exceeding such traditionally cited variables as climate, water availability, population density, political orientation, and levels of economic development. In addition, the historical record the world over indicates an increased likelihood of conflict in basins lacking institutions that can accommodate changing political, hydrological, or other basin conditions. Where international water institutions exist, however, relations among riparian States are generally more cooperative than in basins without treaties or other cooperative management mechanisms.

Population growth and water scarcity

Population and development pressures are placing increasing strains on water supplies the world over. This is also a major concern for South Asia, which is projected to contain about 30 per cent of the world's total population growth between the years 2008 and 2100, according to an estimate by United Nations World Water Development Report.³⁶ As the demand for the scarce resource continues to grow, competition over both the quantity and quality of shared water supplies will likely expand, which could result in tensions and often conflict, between users and across political boundaries.³⁷

All of the eight South Asian countries combined cover 3.3 per cent of the world's area, but support more than onefifth of its inhabitants. The region's population will rise by another 653 million people by 2050.38 Historically, the South Asian region has been perceived as having plentiful water resources, including the magnificent Himalayan snows, a vast network of perennial rivers, high monsoon rainfall, and rich groundwater aquifers. However, with the rapid population growth during the last century, pressure on these water resources has reached alarming proportions. With the exception of Bhutan and Nepal, South Asia's per capita water availability falls below the world average.³⁹ Annual water availability has plummeted by nearly 70 per cent since 1950, and from around 21,000 cubic metres in the 1960s to approximately 8,000 in 2005. If such patterns continue, the region could face widespread water scarcity (that is, per capita water availability under 1,000 cubic metres) by 2025.40

Agriculture intensification, increasing industrialization and expanding



Most of the water resources identified for supply side augmentation structures are transboundary in nature, requiring the consent and approval of riparian countries

urbanization have inevitably followed the rapid population growth in the South Asian region, putting a strain on water resources. Agriculture is a key determinant of the increase in the demand for water in India and Pakistan, the two largest economies in the region. Pakistan's agricultural performance is closely linked with the supply of irrigation water, which uses 94 per cent of the water of its rivers. Nearly 64 per cent of the country's population resides in rural areas, being directly or indirectly dependent on agriculture for their livelihood.⁴¹ The gap between demand for and supply of water in Pakistan, which currently stands at about 12 million acre feet, is projected to reach about 31 million acre feet by 2025.42 India's rapidly growing economy also means a substantial increase in the demand for water. India is currently the largest groundwater user in the world, accounting for more than a quarter of the global total. It is projected that India's demand for water for agriculture will be the largest in the world by 2030.43 India's water supply as estimated in 2009, stood at 740 billion cubic metres whereas demand in the year 2030 is expected to reach 1,500 billion cubic metres.44

While demand for water has been steadily increasing due to population growth, efforts at augmenting supply have not followed suit. Countries like India, Pakistan and Afghanistan emerge at the lower end of the spectrum when compared to US and Canada in terms of their storage capacity. At a national level, countries have attempted to increase storage capacity and generate hydroelectricity by building dams and reservoirs. However, most of the water resources identified for supply side augmentation structures are transboundary in nature, requiring the consent and approval of riparian countries—something that hardly comes through.

Climate change and water resources

Climate change adds a new dimension to the transboundary water management

challenge. The impact of climate change on rainfall patterns, river flows dependent on glacial melt, and sea levels is being felt throughout South Asia.

The primary sources of water for the major river systems of the region (Indus, Ganges and Brahmaputra) are the snowmelt from the Himalaya and Hindu Kush mountain ranges and the cyclical monsoons. According to the IPCC, global mean temperatures have been rising at 0.6 degrees celsius over the last 100 years and will continue to rise during the current century, with regional variations.⁴⁵ Due to global warming, glaciers in the Himalayas are receding and thinning faster than in any other part of the world and, if the present rate continues, the likelihood of them disappearing by the year 2035 and perhaps sooner is very high if the earth keeps warming at the current rate. Between 1842 and 1935, the glacier was receding at an average of 7.3 metres every year; the average rate of recession between 1985 and 2001 is about 23 metres per year. The current trends of glacial melts suggest that the Ganges, Indus, Brahmaputra and other rivers in the region could likely become seasonal rivers in the near future as a consequence of climate change and could likely affect the economies in the region.⁴⁶

Monsoon activity is also a major source of water availability in the region. The Southwest Monsoon accounts for 70 to 90 per cent of the annual rainfall over most of the region. For Sri Lanka and the Maldives, the Northeast Monsoon is the dominant factor. Climate change in the region is also expected to affect monsoon dynamics in some countries—a shift in the monsoon circulation could result in less rainfall for India and Pakistan. This could be disastrous keeping in mind that summer monsoon rainfall provides 90 per cent of India's total water supply.

South Asian water supplies are quite vulnerable to shifts in glacier melting. In the short run, melting glaciers would supply more water to the dependent perennial rivers in India and Pakistan. The same process, however, would also bring more sedimentation into dams and reservoirs, thereby reducing their economic life. Accelerated glacial retreat would also increase the risks of glacier lake outburst floods in Bhutan and Nepal, as melting ice would open breaches in the ice walls. In the longer term, upstream flows would greatly diminish as the glaciers decline, posing serious problems to water supplies for drinking, agriculture, and other livelihoods, as well as reducing hydropower potential.⁴⁷

Internal water governance issues

When dealing with transboundary waters, the river basin rather than individual countries, is deemed as the most important level of analysis. While the river basin as a whole is central to transboundary water management, the nation States that share it as riparian neighbours cannot be ignored. The way water resources are managed domestically can either exacerbate water insecurity or serve to ameliorate it. Moreover, domestic mismanagement of river water affects the quantity and quality of water available to downstream countries.

National level policies such as pricing and distribution of water impact the efficiency of water use, especially for agriculture. For instance, India and Pakistan both emerge at the lower end of the spectrum when comparing agricultural productivity per unit of water with countries like Canada, US and China. Poor water sector infrastructure and governance issues in Pakistan make it a country with one of the highest conveyance losses in the irrigation sector. Moreover, water wastage in Pakistan also occurs in urban and municipal sectors as well due to poorly maintained supply pipelines. Water management in India is also poorly governed, extremely decentralized and virtually unregulated, according to the US Senate Foreign Relations Committee report of 2011.48 Multiple government ministries have established water use guidelines at the national level, but with little result. Water management is constitutionally delegated to India's constituent states, which have limited capacity to coordinate among themselves. This has led rapidly to diminishing available surface water and groundwater.

Domestic water policies vary across countries in South Asia (see chapter 3). It is important to remember that national policies need to be aligned and are instrumental in achieving any transboundary initiative. Domestic policies can play an important part in demand management and increased efficiency of use of existing resources, which is more economical than developing new resources altogether.

Water quality and environmental degradation

The way an upstream country uses water affects the environment and the quality of water that arrives in a downstream country. Uncoordinated dam development can cause silting in reservoirs, preventing the rich sediment from reaching low-lying plains. Similarly, industrial or human pollution can be transported through rivers to people in other countries.⁴⁹

The Ganges River sustains the livelihood of millions of people in India and Bangladesh. Upstream in India, it is one of the holiest rivers, where millions of people practice 'holy dips' for religious purposes and where ashes of a large number of dead bodies are scattered. In addition to this, the river picks up untreated sewerage and industrial waste from about 114 cities in India.⁵⁰ Downstream in Bangladesh the same river is a major source of fishery apart from being an important source of transportation. The quality of waters that come through India directly affects the livelihood of people in Bangladesh who depend on the Ganges for sustenance.

Water management interventions by upstream countries in the form of river diversions, dams, barrages and other infraWhen dealing with transboundary waters, the river basin rather than individual countries, is deemed as the most important level of analysis Political economy issues between riparian States can complicate the development of joint management frameworks for transboundary water management structure can also cause environmental degradation and upset the natural ecosystems in downstream countries. In South Asia, the Ganges water diversion at the Farakka Barrage built by India is a classic example of this. The barrage has caused adverse impacts on the Ganges dependent areas in Bangladesh downstream, primarily by causing heavy siltation and reducing dry season flow in Gorai, the main distributary of the Ganges in Bangladesh. Reduction in river flow has in turn caused the salinity front to move further inland resulting in crop damage, water shortage in industries and adverse health effects. Reduced river flow and increased salinity in turn cause adverse impacts on ecosystems, fisheries, forestry and livelihoods.

Environmental consequences of proposed Indian projects in the future can also be quite devastating for Bangladesh as the lower riparian. The ILR Project, which aims to transfer water from the Ganges and Brahmaputra basins to the water deficit areas of Western and Southern India, will inevitably lead to a reduction in the flow of the Ganges in Bangladesh. This is expected to worsen the existing environmentally stressed condition of the Southwest region of Bangladesh. Similarly, the unilateral construction of the Tipaimukh Dam on the Barak River by India is expected to alter natural flow regimes, water quality, nutrient and sediment load and affect ecosystems and biodiversity in Bangladesh.

Issues of political economy

Regional politics can exacerbate the already formidable task of understanding and managing transboundary water resources. Political economy issues between riparian States—whether in the form of territorial disputes, disparities in economic development levels, asymmetric power relationships, differences in infrastructural capacity, political orientation or cultural values—can complicate the development of joint management frameworks for transboundary water management the world over.⁵¹

Territorial disputes

Analysing South Asia's history of transboundary water interactions between riparian States, one finds that political issues often serve to make even the smallest of water issues intractable. In particular, territorial disputes that plague most of the region have worked to exacerbate the trust deficit and further emphasize water as a national security issue for individual countries sharing common water resources (see box 5.5).

In the case of the India-Bangladesh relationship, the issue of illegal immigrants, Chakma refugees, insurgency operations and border demarcation issues all make any resolution of the water issues harder. Often the two countries are in a deadlock over water disputes because one or the other wants a resolution of political issues before they cooperate on the water issue. As explained earlier, the Farakka Barrage has been the centrifugal issue in the Indo-Bangladeshi water conflict so far. In addition to this, the Teesta water sharing, the proposed Tipaimukh Dam and the ILR Project are highly emotive issues between the two countries. Recently, India and Bangladesh have made efforts to reach a land boundary agreement on the demarcation of the border between the two countries. Many experts suggest that resolution of territorial disputes between the two neighbours is almost a pre-requisite to moving forward on water cooperation, especially in the case of the Teesta River Treaty that has been in the pipeline for so long. Even in the case of India and Pakistan riparian relations, the Kashmir dispute and the water dispute cannot be ignored. Some experts believe that State level cooperation between the two countries on the waters of the Indus has often faced deadlock levels largely due to a lack of progress on the Kashmir issue.

Box 5.5 Territorial disputes complicate transboundary water management in the Indus and Ganges-Brahmaputra-Meghna (GBM) basins

Disputed borders are both a cause and a symptom of tensions between big neighbours in the Indus and GBM basins of South Asia. When the colonial power, Britain, withdrew from India it left a dangerous legacy of carelessly or arbitrarily drawn borders.

Tensions between India and China flare along India's far Northeastern border, along the state of Arunachal Pradesh. In recent years, Chinese officials have taken to calling part of the same area 'South Tibet' to Indian fury.

Portions of the boundary between Bangladesh and India are also indefinite. Much of the boundary between the two countries is based on administrative units that do not shift with the rivers as they change course or level over time. Alluvial or 'char' land that is exposed as a river shifts often leads to dispute as the land is highly valued for agriculture.

There is also a dispute between India and Nepal involving about 75 square kilometres of land in Kalapani, where China, India and Nepal meet, that has been lingering for many years. Indian forces occupied the area in 1962 after the Sino-Indian border war. The Kalapani River borders the Nepalese zone of Mahakali and the Indian state of Uttarakhand. A Treaty signed by Nepal and British India in 1816 (Sugauli Treaty) described the Mahakali River as Nepal's western boundary with India. Subsequent maps drawn by the British surveyors showed the source of the boundary river at different places. India and Nepal differ as to which stream constitutes the source of the river. It is this discrepancy in locating the source of the river that has

led to a boundary dispute between India and Nepal, with each country producing maps supporting its own claims.

In the Indus Basin, disputed boundaries between China and India include approximately 25,900 square kilometres in the regions of Sang, Demchok and Aksai. India and Pakistan dispute the status of Jammu and Kashmir region, an area approximately 220,000 square kilometres. Thus, no river basin in South Asia is free of territorial disputes. Claims and counter claims by riparians over the disputed territories has an inextricable relationship with the water disputes. A quarrel over rivers in the region could serve as a focus for wider disputes about territory. In some cases, for instance Kashmir, the quest for the claimed territory is in large part a quest for its precious water resources.

Sources: The Economist 2012a, UNEP 2009 and Upreti and Salman 2011.

Asymmetrical power relationships

Most transboundary water resources of the world are dominated by regional economically, militarily or politically powerful countries that have a significant existing use of the water resources or intend to unilaterally develop the resources in their country at the expense of other less developed riparian countries. In many cases, these powerful countries do not actively engage in transboundary initiatives, tend to postpone meaningful bilateral and multilateral engagement, use soft power to subvert the terms of agreements with less powerful riparians.52 Examples of such 'hydro-hegemony' abound in most international river basins the world over. For instance, all Israeli governments have maintained the asymmetrical water allocation over their Palestinian co-riparians. The economically and miltarily powerful China has also carried out infrastructural development upstream on the Mekong River

outside of spaces that were attempted to be claimed by States with less hard power, thus effectively limiting options for countries downstream.

In South Asia too, asymmetrical power relationships have served to preclude effective transboundary water cooperation. In the Indus and GBM basins that cover the region, India's economic and military position with respect to other countries has created less favourable conditions for transboundary water cooperation. instance, taking the case For of Bangladesh's bargaining power with India, the former's negotiating power is considerably circumscribed by the economic, political, and military disparities between the two countries. Bangladesh is bounded almost entirely to the west, north, and east by India, and to the south by the Bay of Bengal.

In developing the waters of the Ganges River, India has avoided a multilateral treaty and signed individual bilateral treaties with Nepal and Bangladesh, notwithstanding the benefits of a multilateral water sharing framework.⁵³ In the Ganges Basin, the Tipaimukh Dam and the ILR Project are of particular concern to Bangladesh and Nepal and may spark conflict in the future. In the Indus Basin, several Indian planned projects on shared waters have been unilaterally initiated fueling water issues with neighbouring Pakistan.

Securitization of water and lack of sharing of hydrological information

Control over water resources is increasingly regarded as important for national security by various South Asian countries. In the case of India and Pakistan's shared transboundary waters, a number of analysts have even gone as far as to say that the dispute over Kashmir is really about the control of the headworks of the Indus. India's strategic control over the Indus headworks as the upper riparian leads to apprehensions downstream in Pakistan that the former may withhold water for an extended period, especially during the dry season. Planned Indian hydroelectric projects such as the Baglihar and Kishenganga in Kashmir contribute towards further emphasizing water as a national security issue for Pakistan.

A major factor that contributes to and even reinforces the securitization of the water issue in the South Asian region is the classification of hydrological data as 'secret' information and its consequent removal from the public domain. In Nepal, Bangladesh, and Pakistan, a common complaint has been that India maintains utmost secrecy about any data regarding transboundary water (box 5.6).⁵⁴

Lack of economic interdependence

Another issue is the fact that South Asia is the least integrated region in the world. Intra-regional exports as a percentage of total exports in South Asia only stands at 7.5 per cent, in comparison with 25 per cent for Southeast Asia.⁵⁵ It is a known fact that two nations who traffic with each other tend to become reciprocally depend-

Box 5.6 Importance of sharing hydrological information between riparians in South Asia

South Asia does not have a regional mechanism for sharing hydrological data between riparian countries. What is worse, data sharing arrangements between riparians that have been incorporated in the few treaties that govern water use in the region are either ambiguous or have hardly been implemented.

Take the case of India and Bangladesh. The Ganges Treaty of 1996 determines each country's share taken at Farakka. However, because water flows are measured at Farakka, any water India may divert upstream is not taken into consideration. It is a constant complaint in Bangladesh that India does not share any information about river flow upstream of Farakka, which is taken to be proof that India is diverting much of the

Source: Akhtar 2010.

water before it reaches the dam, thus 'cheating' Bangladesh of its fair share.

Even with Pakistan and India, a key issue that complicates transboundary water resource management is the lack of timely sharing of information on planned hydropower projects upstream in India. Pakistan's objections to Indian projects on western rivers have centred on India's ability to store water, which goes against Pakistan's rights to these western rivers as provided by the Indus Water Treaty. The Indus Water Treaty only incorporates the provision of data exchange six months before the actual construction of the dam. The countries are not liable to exchange information during the planning stage. This increases Pakistan's apprehensions and further reinforces water as a national

security issue.

The future of effective transboundary water management depends in large part on the accuracy and availability of data. Transboundary water arrangements in South Asia vary in the level of collaboration they involve, from datasharing mechanisms to collective financing and ownership of infrastructural projects. The lack of timely information sharing can pose significant hurdles to transboundary water cooperation. Interestingly, the condition of bilateral political ties also influences the extent to which countries want to withhold or share information with other riparians as seen in the case of India and Pakistan.

ent. However, this is absent in the South Asia region. The lack of mutual ties that bind the riparian countries in South Asia aggravate the hydrological conflicts.

Brazil and Paraguay provide an example of the potential benefits that countries in the region can gain through trade and cooperation. In 1973, the two countries ended a 100-year long boundary dispute, resulting in the Brazilian public investment financing the Guaira-Itaipu hydroelectric project. The project not only meets energy needs of the two neighbours, but is also the largest source of foreign exchange earnings for Brazil.⁵⁶

Effectiveness of water sharing arrangements in South Asia

Despite the existence of many transboundary rivers flowing through South Asia, the region was only able to secure five major water sharing agreements between riparian countries-between India and Bangladesh for the Ganges River; between India and Nepal for the Kosi, Gandaki, and Mahakali rivers; and, between India and Pakistan for the Indus River. The lack of water sharing agreements is one of the most glaring mistakes of the management of transboundary waters between countries in the region. As already mentioned in section 2 of the chapter, there is no water treaty between Pakistan and Afghanistan on the Kabul River, even though Pakistan draws as much as 17 per cent of its water supply from the Kabul River. Moreover, none of the South Asian countries have a water sharing agreement with China, where the source of all major rivers in South Asia lies.

The few water treaties that exist in the region are all bilateral. India has worked out individual bilateral treaties on the Ganges River with Nepal and Bangladesh, rather than engaging in any multilateral framework for effective management of this transboundary river basin. Moreover, most countries in the region have not subscribed to principles of international water law. India and Pakistan abstained from the 1997 UN Convention on the Law of the Non-Navigational Uses of International Watercourses (UNCIW), Bhutan absented itself. Only Bangladesh and Nepal voted in favour of it. Due to regional imbalances in power among the South Asian countries, mutual hostility, suspicion and the absence of a universally binding international legal regime, sharing transboundary rivers and simultaneously ensuring the health of the riparian ecosystem has become complex. Multilateral attention to the problems of South Asia's transboundary rivers is also ad hoc and rarely comprehensive in focus.

The few existing treaties for water sharing in the region are anything but comprehensive. Annex table 5.1 shows a historical record of all transboundary water sharing accords to date between countries in South Asia. As can be seen from the annex table 5.1, most of the treaties in the region lack substantive references to water quality management, monitoring and evaluation, conflict resolution and flexible allocation methods. In addition, none of the treaties have been climate-proofed.

Another disconcerting trend followed in all the treaties in the region to date is the glaring omission of groundwater management, distribution and allocation. This is problematic keeping in mind that groundwater economy has become central to South Asia's food security and agrarian livelihoods. It is understandable that semiarid regions in India and Pakistan are large groundwater users in agriculture. However, inappropriate government policies in the form of power subsidies offered to farmers create perverse incentives for the overuse of groundwater. Even in humid areas in India like Assam, coastal Orissa, eastern Uttar Pradesh, North Bihar and West Bengal groundwater has emerged as the mainstay of agriculture. Even Nepal and Sri Lanka have seen a rapid expansion in the use of groundwater for irrigation purposes.

The anarchic and pervasive groundwater economy for the region as a whole, The few existing treaties for water sharing in the region are anything but comprehensive particularly for India and Pakistan, is a challenge. A study by NASA⁵⁷ highlighted that Indian border states with Pakistan are overusing groundwater, which might affect aquifers of Pakistan because of depression created by farmers due to subsidized power policy in India.⁵⁸ Both countries need to conduct studies and create regulatory frameworks for managing and recharging groundwater.

Research on conflicts over transboundary waters suggests that a change in resource environments, which outpaces the capacity of existing institutions to deal with that change, is one major cause of tension. Clearly, water sharing mechanisms and institutions in South Asia are rather rigid instruments that can be modified only under difficult circumstances. There is a need to incorporate hydrological flow variability and flexibility in such mechanisms. Flexibility can mean either the ability to change the rules of the game (for instance, allowing for the incorporation of new scientific knowledge), or the option to apply a variety of policies in the face of changing conditions (as it was in the case of Baglihar).59

The existing treaties were signed before the issue of climate change got prominence, thus they do not provide for an in-built mechanism to deal with the situation. As such. therefore, the co-riparian countries may have to start thinking of managing the emerging problems, associated with climate change, with flexibility, adaptability, and perhaps, re-negotiation or re-interpretation. Moreover, there is a need to expand the coverage of the treaties to include other issues of basin wide significance. Specifically, there is a need to incorporate groundwater management in these agreements.

Reforming the treaties to improve upon their flexibility and coverage is not sufficient to ensure smooth riparian relations in South Asia. Equally crucial is the implementation of these agreements. It has been seen that riparian countries continue to experience water issues even after a treaty has been signed as was the case of India and Bangladesh for the Ganges Treaty (see box 5.7). Monitoring a treaty's implementation, ensuring timely information sharing between all stakeholders and a clear dispute resolution mechanism are a pre-requisite for effective, longterm basin management.

Regional cooperation for enhanced water security in South Asia

Conceptualizing the need for cooperation

Traditionally, riparian countries in South Asia have focused on 'dividing the resource', with transboundary water management largely involving allocating water shares between the concerned countries. The few water allocation treaties that exist in the region, including the more successful cases like the Indus Water Treaty of 1960, follow this rather disconcerting trend. As seen in the previous sections, finite water allocations tend to make countries conceptualize transboundary water management as a 'zero-sum game'-riparian countries perceive water sharing in a win-lose framework with no compromise and little incentive for basin wide management.63

Even though physical water resources are finite, the quantity of available water resources can be enhanced through effective river basin management. For example, good watershed management can effectively increase the water resource by minimizing erosion, maximizing water infiltration into the soil, and slowing run-off; by providing over-year storage to buffer rainfall variability and reserve water in abundant years that would otherwise be lost; and by locating these storage reservoirs in areas of the basin with the least evaporation losses and environmental disruption. A well-managed watershed also offers many non-consumptive benefits, such as fisheries, navigation, recreation, biodiversity habitat and in some cases hydropower generation. The 'use' of water

Reforming the treaties to improve upon their flexibility and coverage is not sufficient to ensure smooth riparian relations in South Asia

Box 5.7 The Ganges Water Treaty 1996: Implementation issues

The Ganges Water Treaty is the only agreement that governs transboundary water sharing between India and Bangladesh, despite the fact that the two countries share 54 transboundary rivers. The Treaty was signed in 1996, and will expire in 2026. The Joint River Commission (JRC) is charged with implementation and evaluation of the Treaty. As per the initial agreement, the Treaty is subject to a five-year review cycle. The Treaty is based on historic average flow at Farakka during the 1949-88 period. According to the Treaty, the water of the Ganges would be distributed between the two countries from Farakka in the dry season, and India is expected to maintain the historic average flow at Farakka. However, should the flow at Farakka fall below the historic average flow then the available water would be divided as per agreed upon equations. At certain critical periods, both Bangladesh and India would get a guaranteed flow of 35,000 cusecs. It has been 15 years since signing of the Treaty, but no review has been done. Moreover, Bangladesh has complained frequently about receiving less than her fair share of water, a fact that has been corroborated by flow data available by the Joint Rivers Commission Bangladesh.

One of the key objectives of the Ganges Treaty was cooperation between the two riparians for augmenting the flow of the Ganges during the dry season.⁶⁰ However, it is clear that the augmentation issue has taken a back seat. It should also be added that a number of its provisions are ambiguous. The Treaty does not include clear dispute resolution and arbitration mechanisms. In case of conflicts arising out of implementation of the Treaty, the two governments are expected to resort to political means not arbitration to resolve the dispute.⁶¹ In addition the Treaty does not bind any party to resolve the dispute if the disagreement persists.

The Treaty failed to address a number of pressing problems surrounding the Ganges Basin, particularly flood and environmental degradation. Even though the preamble to the Treaty mentions flood management as one of the areas of cooperation, no provisions for flood control have been included in the main body of the Treaty itself.62 Bangladesh's periodic floods are hence frequently blamed on India's lackluster flood management as the upper riparian. The Treaty also does not address the environmental situation of the Ganges with as many as 114 cities in India pouring untreated sewerage into the Ganges. The heavy population concentration, the absence of strict environmental rules for the use of the river, and the failure to enforce whatever rules that exist, have resulted in the Ganges being one of the most polluted rivers in the world today.

Sources: Rahaman 2009 and Salman and Uprety 2003.

for these purposes will not necessarily diminish the water available in the system for other uses.

Considering the agrarian nature of most economies in South Asia and its growing energy needs, water is important for national development. Each sovereign country in South Asia has its own national agenda for deriving maximum benefits out of an international river. Clearly, these countries are starting to realize that following national agendas for maximizing the economic benefits from water systems have proved to be unsustainable. River basins, rather than political boundaries, are now recognized as the most appropriate unit for holistic water management. Integrated management strategwater resource ies-processes that promote the coordinated development and management of water, land, and related resources at the river basin level-are widely accepted as

the most sustainable, efficient and equitable.

"Given the principle that States seek to pursue rational and legitimate self-interest as a starting point, cooperation will occur only if the anticipated benefits exceed the costs of non-cooperation"64 and when the distribution of these net benefits is perceived to be fair. The choice between cooperation and non-cooperation will be made based on perceptions of which alternative will provide greater benefits to individual nation States. These benefits can be multidimensional: environmental benefits to the river (improved water quality, conserved biodiversity), economic benefits from the river (e.g., increased food and energy production), reduction of costs because of the river (reduced geo-political tensions, enhanced flood management) or even broader benefits beyond the river cooperation (catalyzing wider and economic integration).

Institutional framework for transboundary water management

Despite the growing importance of cooperation for transboundary water management for economic growth, social development and environmental sustainability, there has been limited progress in improving water resource management in an international context generally, and in a regional context specifically. Part of the reason for slow progress in realizing an effective framework for cooperation has to do with governance and capacity issues at the country and transboundary level, while the other part has to do with shortcomings in the international legal and institutional architecture for transboundary water management.

Sustainable international water management can be achieved through resilient water institutions, specifically transboundary water institutions. These are persistent and predictable arrangements for transboundary water management and can take various forms—such as treaties, laws, or organizational structures dealing with transboundary water resources. Resilient transboundary institutions that can respond to uncertainties and navigate competing interests of riparian

Table 5.3 Institu	itions for transboundary water management
Global	 The 1997 UNCIW and UN Economic Commission for Europe Convention on Protection and Use of Transboundary Watercourses and International Lakes (1992) International financing and development institutions (World Bank) Institutions for dispute resolution (International Court of Justice, Permanent Court of Arbitration)
Regional	 Regional economic and coordination institutions (SAARC) Regional non-governmental organizations (NGOs) Regional development banks [Asian Development Bank (ADB)]
Transboundary	 Multilateral basin organizations Bilateral treaties (Indus Water Treaty, Ganges Treaty) Bilateral issue based organizations (Indus River Commission, Joint Rivers Commission) Informal dialogue/Track II initiatives
National	Ministries responsible for waterWater infrastructure and development agencies

Source: MHHDC staff compilation.

countries are key to sustainable water management in the region. Table 5.3 maps out the types of institutions working for transboundary water management at all levels—from global to regional, transboundary and finally at the national level.

International legal and institutional architecture

At an international level, currently there are no mandatory international legal instruments that bind sovereign States to cooperate for transboundary water management of shared watercourses. The 1997 UNCIW lays out the rules and principles for transboundary water management, however it is not in effect yet as it has not been ratified by the required number of State parties (see box 5.8).

The broad idea underlying these legal principles is that governance of international watercourses should be developed by taking into account the effects of use on other countries, the availability of alternative water sources, the size of the population affected, the social and economic needs of the watercourse States concerned, and the conservation, protection and development of the watercourse itself.⁶⁵

These principles, though intuitively appealing, are difficult to operationalize and implement. These principles of water use seeking to ensure cooperation in the abstract, can often be contradictory in reality. Upstream users can cite social and economic needs as grounds for constructing dams for hydropower, for example. Downstream States can oppose these measures, citing their own social and economic needs and existing use. Moreover, there is no practical enforcement mechanism to back up the convention's guidance. The International Court of Justice hears cases only with the consent of the parties involved, and only on specific legal points.

Apart from the international legal framework governing the use of transboundary waters, there are numerous global institutions working for enhancing

Box 5.8 International legal architecture for transboundary water management

Many principles of international law and diplomacy have been proposed to guide allocation of water within a basin and thereby avoid or resolve international water disputes. The UN Law on Non-Navigational Uses of International Water Courses (1997) suggests a framework for management and allocation of international waters among users and uses, based on criteria such as equitable and reasonable utilization.

- a) *Theory of Limited Territorial Sovereignty:* Every State is free to use shared rivers flowing through its territory as long as such utilization does not prejudice the rights and interests of the co-riparians. This principle simultaneously recognizes the rights of both upstream and downstream countries because it guarantees the right of reasonable use by the upstream country in the framework of equitable use by all interested parties.
- b) *Principles of Equitable and Reasonable Utilization:* This principle is a subset

Sources: Kilgour and Dinar 2001 and Rahaman 2009.

of the theory of limited national sovereignty. It entitles each basic State to a reasonable and equitable share of water resources for beneficial uses within its own territory. Equitable and reasonable utilization does not necessarily mean an equal share of waters. Rather, in determining an equitable and reasonable share, relevant factors such as the geography and hydrology of the basin, population, economic and social needs of each riparian, climatic and ecological factors and the availability of other resources, etc., are all taken into account.

c) An Obligation Not to Cause Significant Harm: This principle is also a subset of the theory of limited national sovereignty. According to this principle, no State is allowed to use an international watercourse in its territory in such a way that would cause significant harm to other basin States or to their environment, including harm to human health and safety, to the use of waters for beneficial purposes or to the living organisms of the watercourse systems.

- d) *Principles of Notification, Consultation and Negotiation:* Every riparian State in an international watercourse is entitled to prior notice, consultation and negotiation in cases where the proposed use by another riparian of a shared watercourse may cause serious harm to its rights and interests.
- e) *Principles of Cooperation and Information Exchange:* It is the responsibility of each riparian State to cooperate and exchange data and information regarding the state of the watercourse as well as current and future planned uses along the watercourse. Article 8 and 9 of the UN Watercourses Convention make it an obligation.
- f) Peaceful Settlement of Disputes: This principle advocates that all States in an international watercourse should seek a settlement of disputes by peaceful means in case States cannot reach an agreement by negotiation.

transboundary cooperation. These range from institutions like United Nations Educational, Scientific and Cultural Organization (UNESCO), World Water Council and Global Water Partnership (GWP) that provide research, technical support and awareness to financing and development institutions like the World Bank and Asian Development Bank (ADB) that promote and fund transboundary initiatives and infrastructure as third party facilitators. In addition, there are some dispute resolution institutions at the global level, including the International Court of Justice and the Permanent Court of Arbitration. These initiatives by the international community have helped reinforce its commitment to sustainable

water management and providing international best practices guidelines that States may wish to adopt, but have not been able to bind States to implement them.

Regional initiatives for cooperation on transboundary waters

While international legal systems can generally create a framework for national and international cooperation to address common problems, water governance is highly contextual and excessively dynamic in nature. The rather vague international principles advocated by the UN convention and other exported water laws may not be entirely suitable for resolving South Asia's specific water issues. In addition, the The international legal structure for transboundary water management can often conflict with the interests of sovereign States and national elites international legal structure for transboundary water management can often conflict with the interests of sovereign States and national elites. The main difficulty in implementing the international legal principles in South Asia is the fact that all riparian countries need to be signatories in order for any meaningful and effective cooperation. The biggest riparian countries in the Indus and GBM basins— China and India—have voted against the UN Convention and instead have focused on engaging in bilateral water sharing arrangements with co-riparians in the region.

Regional institutions for transboundary water management in South Asia mostly take the form of bilateral water sharing treaties or dispute resolution mechanisms to guide water allocation between riparian countries. Section 3 of the chapter analyses the few water sharing agreements that exist in South Asia and reasons for their overall lack of robustness. Most water treaties in the region lack clearly delineated water allocations, ignore hydrological variations in water, effective implementation and dispute resolution mechanisms. In addition, the glaring omission of management of groundwater resources from these treaties complicates problems for transboundary water management in the region. The bilateral focus of the current transboundary water management institutions in South Asia has also precluded holistic river basin management for enhancing water security.

Recent years have witnessed a proliferation of regional level initiatives for transboundary water management, with several institutional structures and research centres developed for the purpose (see table 5.4). However, these institutions have mostly worked on an informal level to inform and coerce riparian countries to develop a cooperative basin wide framework for sustainable water use in the region. The efficacy of these 'informal dialogues', policy advocacy institutes, and track II level initiatives in helping to shape a concrete regional framework for managing South Asia's transboundary waters has been rather limited.

Towards a regional institutional framework for river basin management in South Asia

South Asia is at the cross roads of the water resources issue. Clearly the management of shared river systems needs to grow beyond the sphere of national sovereignty and bilateralism, and must be addressed at the regional level to achieve the best possible use of available water. A region-wide institution for shared water resources should have mechanisms and processes for exchange of data and information to improve the current trust deficit between countries; help the region forge more robust water sharing treaties especially with regard to climate change and hydrological variability particularly in the case of Afghanistan and many rivers in Bangladesh where there is an absence of any water sharing agreement; be able to address issues of pollution and degradation especially in the context of arsenic in aquifers in India and Bangladesh; promote better flood management; and be able to manage contentious hydroelectric projects on the shared watercourses.

Some analysts suggest that the South Asian Association for Regional Cooperation (SAARC) could provide such a regional forum for sustainable river basin management. However, the SAARC has bypassed the issue of water management so far. Moreover, taking up the water issue at the SAARC level would ignore the importance of China as the largest source of transboundary flows to much of South Asia.

An effective regional institution must involve all stakeholders in the Indus and GBM basins, including Afghanistan and China, both of which have no water sharing treaty with any of the other South Asian countries. This could be done on the lines of the Nile Basin Initiative or the

Himalayan and Peninsular Hydro-ecological Network (HYPHEN)	The HYPHEN was established in 2007 and aims to work on dam projects in Afghanistan, Bangladesh, Burma, Bhutan, China, India, Nepal, Pakistan, Sri Lanka and the Maldives. Hyphen conducts research, training, litigation and campaigns for the conservation of Himalayan and Peninsular rivers, coasts, and wetlands, as well as addressing the problem of climate change by promoting community-managed eco-friendly development activities and livelihoods.
Imagine a New South Asia (INSA)	The INSA has evolved over the years as a regional network to advance a shared sense of the South Asian vision to promote increased policy convergence on key issues including transboundary water management, more regional cooperation, the joint initiative of the government as well as at the civil society level.
South Asia Water Initiative (SAWI)	The SAWI enhances knowledge and capacity on issues of regional, and in particular transboundary water resources management and climate adaptation. It facilitates multi-stakeholder dialogue and policy deliberation and promotes cooperative actions such as policy reforms, institutional development and investment in water resources management in the Indus and GBM basins. Projects: <i>Abu Dhabi Dialogue:</i> The Abu Dhabi Dialogue is a process involving senior members of government, academia and civil society from the seven countries that share the rivers of the Greater Himalayas, namely Afghanistan, Bangladesh, Bhutan, China, India, Nepal, and Pakistan. It was initiated in 2008 to promote cooperation between the States in fairly managing and developing the Himalayan river systems to bring economic prosperity, peace and social harmony, and environmental sustainability.
International Centre for Integrated Mountain Development (ICIMOD)	Regional institution working to develop an economically and environmentally sound mountain ecosystem to improve the living standards of mountain populations and to sustain vital ecosystem services in the HinduKush mountain region. Transboundary water management and river basin management are a core thematic area.
International Water Management Institute South Asia (IWMI)	Research Centre with offices in India, Pakistan and Nepal, working to improve the management of land and water resources in South Asia.

Source: MHHDC staff compilation.

Mekong River Commission, covering all aspects of water governance with a robust, binding dispute resolution mechanism.

A potential challenge in carving out a transboundary institutional framework to address the region's requirement is the power asymmetry that persists between the countries. A regional power like India, which also has an upstream riparian position has considerable leverage to implement projects, sometimes unilaterally, which may become flashpoints for regional conflict. To be able to be effective for transboundary water management, an institutional framework must address the power asymmetry in the region. The inclusion of China will not only ensure a more holistic basin wide approach, and may also mitigate power asymmetry issues to some extent.

Conclusion

A shortage of water resources, exacerbated by population growth and climate change, could spell increased conflicts in the future. Riparian countries in South Asia have been able to engage in institutional cooperation over water related issues in the past. The treaties over the Indus between India and Pakistan; over the Ganges between India and Bangladesh; and over the Mahakali between India and Nepal have stood the test of time despite fluctuating political relations between the concerned countries. However, these treaties are far from holistic and by no means establish an integrated system for the optimum development of shared water resources.

Political economy factors, mistrust between countries and power asymmetry issues have played a major role in precluding the development of an effective regional framework for holistic basin wide management. India's position both as an upper riparian and a lower riparian, will be at the epicentre of carving out the new regional institutional framework for transboundary water management and hydrodiplomacy in South Asia. The friction in bilateral relations will only increase if a mutually acceptable framework for transboundary water management is not developed involving all stakeholders.

A central factor in all regional or

transboundary agreements between countries is the degree to which the policies, legislation, resources and management practices of each country can be aligned and implemented in harmony with those of its neighbours. Successful implementation of such agreements will be difficult to achieve where there is little or no alignment, or where one part is unable to deploy adequate human, economic and technical resources to meet its commitments. For the benefits of transboundary regional cooperation to accrue, it must go hand in hand with overhauling internal water management within each country. Even if increased transboundary cooperation results in a better allocation of water for a downstream riparian, the extra water could just go to waste if internal water governance and infrastructure are faulty.

For the benefits of transboundary regional cooperation to accrue, it must go hand in hand with overhauling internal water management within each country

GBM Basin: India-Pakistan							
Document name	Year	Water Allocation	Hydropower sharing clause	Groundwater sharing clause	Irrigation clause	Monitoring clause	Joint management clause
Indus Water Treaty 1960 between the government of India, the government of Pakistan and the International Bank for Reconstruction and Development	1960	India: 100 per cent of eastern Rivers. Pakistan: 100 per cent of western Rivers.	:	No	Yes	Yes	Yes
GBM Basin: India-Nepal							
Agreement between the government of India and the government of Nepal on the Kosi project	1954	The Union will have the right to regulate all the water supplies in the Kosi River at the Barrage site and to generate power at the same site for the purposes of the project.	Fifty per cent of hydropower generated goes to each party.	No	Yes	°Z	°Z
Agreement between His Majesty's government of Nepal and the government of India on the Gandak Irrigation and Power Project	1959	Enough water to irrigate 40,000 acres (20 cusecs minimum) goes to Nepal. Similar amount goes to India, except the water will irrigate 103,500 acres. India has minimum 5,000 kilowatt usage of the 15,000 kilowatt plant, but India may charge an agreed-upon rate for the electricity.	India has minimum 5,000 kilowatt usage of the 15,000 kilowatt plant, but India may charge an agreed-upon rate for the electricity.	Ŷ	Yes	°Z	No
Amended agreement between His Majesty's government of Nepal and the government of India concerning the Kosi Project	1966	Nepal "shall have every right to withdraw for irrigation and for any other purpose in Nepal water from the Kosi River and from [the basin] as may be required from time to time." India regulates the supplies in the river to produce power.	Nepal and India will get up to 50 per cent of the total hydroelectric power gener- ated by any power house situated within a 10 mile radius from the barrage site.	° Z	Yes	°Z	Yes
Agreement between Nepal and India on the renovation and extension of Chandra Canal, Pumped Canal, and distribution of the western Kosi Canal	1978	Nepal: 300 cusecs (in addition to the 64 already allocated).	÷	:	÷	:	:

Annex table 5.1 Transboundary water sharing agreements in South Asia

Continued							
Document name	Year	Water Allocation	Hydropower sharing clause	Groundwater sharing clause	Irrigation clause	Monitoring clause	Joint management clause
Treaty between His Majesty's govern- ment of Nepal and the government of India concerning the integrated development of the Mahakali River including Sarada Barrage, Tanakpur Barrage, and Pancheshwar Project	1960	Nepal gets 1,000 cusecs from the Sarada Barrage in the wet season and 150 cusecs in the dry season. India will maintain a flow of not less than 350 cusecs to maintain the natural ecosystems. Nepal gets a similar quantity (1,000 cusecs) in the wet season and 300 cusecs in the dry season from a separate dam. India supplies 350 cusecs of water for an area of Nepalese territory. Nepal receives primary consid- eration in the use of the Mahakali waters.	Nepal gets 70 million kilowatt per hour free of charge annually, and half of the energy from the Tanak- pur power station and Pancheshwar, in exchange for half the costs of operation and capital costs of generation.	ÔZ	Yes	Yes	Yes
GBM Basin: India-Bangladesh							
Statute of the Indo-Bangladesh Joint Rivers Commission	1972	Created a commission to "maintain liaison between the participating countries in order to ensure the most effective joint efforts in maximizing the benefits from common river systems to both the countries," among other flood control responsibilities.	:	°Z	°Z	° Z	Yes
Provisional conclusion of the treaty of April 18, 1975 on the division of the waters of the Ganges	1975	India gets an average of 11,000 cubic metres per second during the 10 final days of April, reaching 16,000 cubic metres per second at the end of the month.	:	:	:	°Z	:

	: management clause	Yes	Yes	Yes	:
	Joint				
	Monitoring clause	Yes	Yes	° Z	ź
	Irrigation clause	oN	°Z	No	:
	Groundwater sharing clause	°V V	Ŷ	°Z	:
	Hydropower sharing clause	:	:	:	:
	Water Allocation	Seventy five per cent of the average historic flows will be allocated; these Q-values are in ten-day increments from 1948-73. Each 10-day period has its own allocations. India receives approximately 40 per cent of that 75 per cent. If the flow dropped below 80 per cent of the expected flow, Bangladesh will never receive less than 80 per cent of that portion. If the flow exceeds the 75 per cent, the water shall be shared in proportion. India has the option to use 200 cusecs below the barrage but no more.	Overrides 1977 (158) agreement. Detail- ed in treaty Annex A are released for sharing the flow available at Farakka every 10 days during the next 2 dry seasons from date of document. Amounts are in cusees based upon month and day.	During dry season, 36 per cent for Bangladesh, 39 per cent for India, and 25 per cent unallocated of the flows of the Teesta/Tista waters.	÷
	Year	1977	1982	1983	1986
Continued	Document name	Agreement between the government of the People's Republic of Bangladesh and the government of the Republic of India on sharing of the Ganges waters at Farakka and on augmenting its flows	Indo-Bangladesh Memorandum of Un- derstanding on the sharing of Ganga waters at Farakka	Agreement on ad hoc sharing of the Teesta waters between India and Bangla- desh reached during the 25 th meeting of the Indo-Bangladesh Joint Rivers Com- mission held in July 1983, at Dhaka	Summary record of discussions of the first meeting of the Joint Committee of Experts held in Dhaka between January 16-18, 1986

	int management clause	Yes
	Monitoring Jo clause	Yes
	Irrigation clause	Yes
	Groundwater sharing clause	°Z
	Hydropower sharing clause	:
	Water Allocation	India and Bangladesh each shall receive guaranteed 35,000 cusecs of water in alternative three 10-day periods during the period March 1 to May 10. In addition: India: 50 per cent flow at 70,000 cusecs or less, balance of flow at 75,000 cusecs or more; Bangladesh: 50 per cent of flow at 70,000 cusecs or less, 35,000 cusecs at 70,000 cusecs or less, balance of flow at 75,000 cusecs or more.
	Year	1996
Continued	Document name	Treaty between the government of the Republic of India and the government of the People's Republic of Bangladesh on sharing of the Ganges waters at Farakka

Source: Oregon State University 2012 and MHHDC staff compilations.
Annex Map 5.1 The Indus and Ganges-Brahmaputra-Meghna basins



b) Ganges-Brahmaputra-Meghna River Basin



Notes

Chapt	er 1
1.	Gorbachev 2000.
2.	UN 2012.
Chapt	er 2
1.	UNICEF and WHO 2012a.
2.	UNDP 2006.
3.	Ibid.
4.	UNICEF and WHO 2012b.
5.	WHO 2011.
6.	UNDP 2006.
7.	WWAP 2012.
8.	Hall and Lobina 2012.
9.	Water Aid 2011.
10.	Swaroop 2011.
Chapt	er 3
1	MUUDC 2012 House Doubter
1.	MAADC 2013 Human Development
2	FAO 2013a and MHHDC 2013 Profile of
2.	Water in South Asia
3	WALLY IN SOULD ASIA. $W/W/\Delta P = 2012$
5. 4	GOP 2012
ч. 5	GOI 2012a.
). 6	MHHDC 2013 Human Development
0.	Indicators for South Asia
7.	Agarwal and Kumar 2011.
8.	Sankar <i>et al.</i> 2010.
9.	International Rivers 2008 and Sankar et
	<i>al.</i> 2010.
10.	Sharma and Sharma 2008.
11.	World Bank 2005b.
12.	PILDAT 2003.
13.	FAO 2013a, World Bank 2013 and
	MHHDC staff computations.
14.	MHHDC 2013 Profile of Water in South
15	Asia. FAO 2013a
16	Vaidvanathan and Sivaauharmaniman
10.	2004.
17.	FAO 2013a.
18.	Jha and Sinha 2009.

19. ADB 2009c.

20.	GOP 2012b.
21.	UNDP 2006.
22.	GOP 2012b.
23.	Ibid.
24.	UNDP 2006.
25.	Atapattu and Kodituwakku 2009.
26.	UNEP 2001.
27.	Azizullah <i>et al.</i> 2010.
28.	Subramanian 2004.
29.	Ueno <i>et al.</i> 2004.
30.	Rajaram and Das 2007.
31.	John 2011.
32.	Li <i>et al.</i> 2009.
33.	John 2011.
34.	Ibid.
35.	Ibid.
36.	Poudyal 2011.
37.	Rajaram and Das 2007.
38.	ADB 2009c.
39.	FAO 2013a and MHHDC staff compila-
	tions.
40.	Bengali 2003.
41.	Ibid.
42.	World Bank 2005a.
43.	Bandyopadhyay 2007.
44.	International Rivers 2008.
45.	GOI 2012.
46.	World Bank 2008.
47.	International Rivers 2008.
48.	Ibid.
49.	Ibid.
50.	Ibid.
51.	WWAP 2012.

Chapter 4

Bates et al. 2008.
Mirza and Ahmed 2005.

- UNDP-APRC 2012, WRI 2012 and MHHDC staff computations.
 - Coal, oil and gas release various levels of carbon dioxide (CO_2) . Oil releases 50 per cent more CO_2 than natural gas while coal releases twice as much CO_2 than natural gas.
- 5. World Bank 2012.
- 6. ADB 2009b.

- 7. Herroero and Thornton 2009.
- 8. GOP 2011.
- UNDP-APRC 2012. 9.
- 10. GOI 2012.
- World Bank 2009. 11.
- Eriksson et al. 2009. 12.
- 13. Oin 2002.
- UNEP 2008. 14.
- 15. Eriksson et al. 2009.
- 16. Shah and Lela 2011.
- World Bank 2009. 17.
- Sterrett 2011. 18.
- IPCC 2007. 19.
- 20. Eriksson et al. 2009.
- 21. MHHDC 2013 Profile of Water in South Asia.
- 22. IPCC 2007.
- 23. UNEP 2008.
- 24. World Bank 2009.
- IPCC 2007. 25.
- 26. Bates et al. 2008.
- 27. Sterrett 2011.
- 28. UNDP-APRC 2012.
- 29. IPCC 2007 and Spijkers 2012.
- A large area that shares the same weather 30. patterns and plant species is known as a biome.
- 31. Dev 2011.
- 32. UNEP 2008.
- 33. IPCC 2007.
- 34. Jianchu et al. 2007.
- 35. World Bank 2009.
- Kelkar and Bhadwal 2007. 36.
- 37. Ravindranath et al. 2012.
- Ibid. 38.
- 39. Ibid.
- 40. World Bank 2009.
- World Fish Centre 2009. 41.
- 42. Bates et al. 2008.
- 43. Edward et al. 2009.
- UNDP 2011. 44.
- IPCC 2007. 45.
- 46. Rahman 2008.
- 47. Ibid.
- 48. Dhimal and Bhusal 2009.
- 49. Grasso et al. 2010.
- 50. Rajan 2008.
- 51. ADB 2012a.
- 52. Arpita and Werz 2012.
- Fritz 2010. 53.
- 54. World Bank 2009.
- 55. Arpita and Werz 2012.
- 56. IPCC 2007.
- 57. Arpita and Werz 2012.
- 58. Warner et al. 2009.
- 59. ADB 2012a.

13.

Ariyabandu and Wickramasinghe 2003.

- UNDP-APRC 2011.
- UNDP 2007.
- UNDP-APRC 2011.
- Murthy 2009.
- Hug and Khan 2006.
- **UNFCCC 2012.**
- Sterrett 2011.
- Bell et al. 2012.
- 69. TWN 2012.
- 70. GOI 2012.
- Khatun 2011. 71.
- 72. Burton et al. 2006.

Chapter 5

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- Salman and Uprety 2003.
 - Riparian: An area near or on the banks of a river or other major body of water. Also referred to in the context of 'upper' and 'lower' riparians, which designate the country in which a certain transboundary river originates. Condon et al. 2009.
 - RSIS, NTU 2011.
 - Babel and Wahid 2008.
- Bates et al. 2008.
 - Babel and Wahid 2008.
 - According to the 'Falkenmark indicator' or 'water stress index', if the amount of renewable water in a country is below 1,700 cubic metres per person per year, that country is said to be experiencing water stress; below 1,000 cubic metres it is said to be experiencing water scarcity; and below 500 cubic metres, absolute water scarcity. As measured by this index, Pakistan and India are both water stressed countries. Falkenmark et al. 1989.
- UNDP 2006.
- Ibid. ORF and LUMS 2011.
- Bhutta 2011.
- 11. 12.
 - Article IV of the Indus Water Treaty: "Each Party agrees that anv Non-Consumptive Use made by it shall be so made as not to materially change, on account of such use, the flow in any channel to the prejudice of the uses on that channel by the other Party under the provisions of this Treaty." Non-Consumptive Use entails any control or use of water, provided that the water (undiminished in volume) remains in, or is returned to, the same river or its tributaries. World Bank 1960. Run-of-the-river hydroelectricity (ROR)

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is a typ	be of hydroelectric generation whereby little or	36.
	no water storage is provided. Run-of-the-	37.
	river power plants may either have no	38.
	storage at all, or a limited amount of	
	storage referred to as 'pondage'.	39.
14.	GOU 2011.	40.
15.	Haq and Khan 2010.	41.
16.	Article VI, Indus Water Treaty 1960.	
	World Bank 1960.	42.
17.	IUCN 2010a.	43.
18.	Gardezi 2011.	44.
19.	Siddiqui and Kheli 2004.	45.
20.	The two countries signed treaties in 1977	46.
	and 1996 and two Memoranda of Under-	47.
	standing in 1983 and 1985 to share the	48.
	Ganges water.	49.
21.	Salehin <i>et al.</i> 2011.	50.
22.	Tanzeema and Faisal 2001.	51.
23.	Wirsing and Jasparro 2007.	52.
24.	Ibid.	53.
25.	Khan <i>et al.</i> 2005.	54.
26.	Salman and Uprety 2003.	55.
27.	Haider 2011.	56.
28.	The Amu Darya Basin, including the	57.
	Harirud and Murghab Basin and	58.
	non-drainage areas, covers about 37 per	59.
	cent of Afghanistan's territory but contains	60.
	about 60 per cent of the water flow. The	
	Helmand Basin covers about 49 per cent	
	of the territory and holds only 11 per cent	
	of water flow. The Kabul-eastern River	
	Basin, with area coverage of about 12 per	
	cent, holds around 26 per cent of the	
	water flow. King and Sturtewagen 2010.	61.
29.	IUCN 2010b.	62.
30.	Ibid.	
31.	Kiani 2011.	
32.	Mashal 2012.	63.
33.	IPCC 2007.	64.
34.	IDFC 2011.	65.
35.	GOAP, India 2012.	

	WWAP 2012.
	Giordano and Wolf 2003.
	MHHDC 2013 Human Development
	Indicators for South Asia.
	Babel and Wahid 2008.
	Jaitly 2009.
	MHHDC 2013 Profile of Water in South
	Asia.
	Bakshi and Trivedi 2011.
	ORF and LUMS 2011.
	The 2030 Water Resources Group 2009.
	IPCC 2007.
	Ibid.
	Jaitly 2009.
	GOU 2011.
	UNDP 2006.
	Salman and Uprety 2003.
	Giordano and Wolf 2003.
	WWF and DFID 2010.
	Zeitoun and Jägerskog 2011.
	Singh 2008.
	UNCTAD 2013.
	UNDP 2006.
	NASA 2009.
	IUCN 2010a.
	Upreti and Salman 2011.
	The wording of Article VIII of the Ganges
	Treaty that "The two Governments
	recognize the need to cooperate with each
	other in finding a solution to the
	long-term problem of augmenting the
	flows of the Ganga/Ganges during the dry
	season." World Bank 1960.
•	Article VII of the Ganges Treaty. Ibid.
•	The treaty only governs water sharing and
	management in the five dry months of the
	year, with no relevance to the wet months.
	Sadoff <i>et al.</i> 2008.
	UNDP 2006.

Ibid.

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Contents

Note on Statistical Sources for Water Tables

Table 1: Summary of Key Water Data	
Land and population	Water use
Total land area	Total water withdrawal
Cultivated area	Total water withdrawal per capita
Total population	Water withdrawal by sector
Population density	Area equipped for full control irrigation
Rural population	Total area equipped for full control irrigation
Economically active population	By source of water
Population economically active in agriculture	Percentage of population with access to improved
Water resources	Water resources
Total internal renewable water resources	Sanitation facilities
Total external renewable water resources (actual)	Climate change
Total renewable water resources (actual)	Greenhouse gas emissions
Total renewable water resources per capita (actual)	Change in forest area
Dependency ratio	Population living in coastal zones
Table 2: Water Resources	
Precipitation	Total internal renewable water resources per capita
Long-term average annual precipitation in depth	Total external renewable water resources
Long-term average annual precipitation in volume	Groundwater: entering the country (actual)
Total renewable water resources	Groundwater: leaving the country (actual)
Total renewable surface water (actual)	Surface water: entering the country (natural)
Total renewable groundwater (actual)	Surface water: total entering and bordering
Total renewable water resources (actual)	the country (actual)
Total renewable water resources per capita (actual)	Surface water: leaving the country (natural)
Total internal renewable water resources	Surface water: total external renewable (actual)
Surface water produced internally	Total external renewable water resources (actual)
Groundwater produced internally	Dam capacity
Overlap between surface water and groundwater	Total dam capacity
Total internal renewable water resources	Dam capacity per capita
Table 3: Water Use	
Water withdrawal	Fresh groundwater withdrawal (primary and

Total water withdrawal
 Total water withdrawal per capita
 Total water withdrawal (% of total renewable internal freshwater resources)
 Water withdrawal by sector
 Agriculture
 Industry
 Municipalities
 Water withdrawal by source
 Fresh surface water withdrawal (primary and secondary)

Table 4: Water Pollution

Emissions of organic water pollutants Thousand kilogrammes per day Per day per worker Industry shares of emissions of organic water pollutants Primary metals Paper and pulp Chemicals Fresh groundwater withdrawal (primary and secondary) Total freshwater withdrawal (primary and secondary) Pressure on water resources Freshwater withdrawal (% of total actual renewable water resources) Agricultural water withdrawal (% of total actual renewable water resources)

Water productivity

Total water productivity

Food and beverages Stone, ceramics and glass Textiles Wood Other Wastewater

Produced municipal wastewater

Table 5: Irrigation and drainage development

Area under agricultural water management Irrigation potential Agricultural water managed area Area equipped for full control irrigation Total By irrigation technique By source of water

Table 6: Water and Sanitation

Use of drinking water sources Urban Rural National Use of sanitation facilities Urban Rural National

Table 7: Climate change and sustainable development

Greenhouse gas emissions Greenhouse gas emissions total Greenhouse gas emissions per capita Greenhouse gas emissions by type Share of greenhouse gas emissions by economic activity Energy

> Energy use intensity per US\$1,000 Energy supply by source Access to electricity

Climate variability

Change in annual temperature degrees

Irrigated crop area and cropping intensity Total harvested irrigated crop area Irrigated cropping intensity Drainage and environment Cultivated area drained Number of hydrological events

Water, sanitation and hygiene-related disability-adjusted life years (DALYs) By cause Total % of total DALYs Water, sanitation and hygiene-related deaths By cause Total % of total deaths

Change in annual cool days/cold nights Change in annual hot days/warm nights Natural disasters Number of natural disasters Number of deaths from natural disasters Number of people affected by natural disasters Estimated damage cost Marine and coastal areas Population living in coastal zones Marine protected area The water data for this Report have been collected from numerous international sources. Principally, international sources include the Food and Agriculture Organization of the United Nations (FAO), United Nations Development Programme (UNDP), United Nations Children's Fund (UNICEF), United Nations Children's Fund (UNICEF), United Nations Population Division (UNPD), United Nations Statistics Division (UNSD), World Health Organization (WHO), Centre for International Earth Science Information Network (CIESIN), World Resource Institute (WRI) and the World Bank. Since data obtained from national sources limits international level comparability, serious effort has been made to use international data. Although data from international sources are not as current as that available in national sources, preference has been given to the former due to the nature of the data required. There is, however, scarcity of international and national data for both Bhutan and the Maldives.

Extra care has also been taken to ensure that information provided in the tables is both reliable and consistent.

1. Summary of Key Water Data

	- I.								South Asia
	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	(weighted
									average)
Land and population									
Total land area (million l	hectares)								
2009	328.7	79.6	14.40	65.22	14.72	6.56	3.84	0.03	513.1T
Cultivated area									
total (million hectares)									
2009	169.6	21.3	8.55	7.91	2.52	2.17	0.10	0.01	212.2T
% of total area cultivated	l								
2009	51.6	26.7	59.4	12.1	17.1	33.1	2.6	23.3	48.0
Total population (million	ns)								
2011	1,241	177	150	35	30.5	20.9	0.74	0.32	1,656T
Population density (inha	bitant per k	ilometre ²)							
2011	378	222	1,045	50	207	321	19	1,067	411
Rural population (% of t	otal populat	tion)							
2011	69	64	72	76	83	85	64	59	69
Economically active pop	ulation								
% of total population									
2011	41	37	48	32	44	45	47	49	41
Population economically	active in ag	riculture							
% of total economically a	active popul	ation							
2011	54	39	44	59	93	42	93	15	52
% female									
2011	68	69	49	68	52	63	65	61	65
% male									
2011	32.5	30.7	51.4	32.5	48.3	37.3	34.7	39.1	34.7
Water resources									
Total internal renewable	water resou	rces (cubic ki	lometres)						
2011	1.446	55	105	47	198	53	78	0.03	1.982T
Total external renewable	water resou	rces (actual) (cubic kilometre	es)			, -		
2011	464.9	191.8	1,122.0	18.2	12.0	0.0	0.0	0.0	1.808.9T
Total renewable water re	sources (acti	ual) (cubic ki	lometres)						-,,-
2011	1.911	247	1.227	65	210	53	78	0	3.791T
Total renewable water re	sources per	capita (actual) (cubic metres	per inhabitant)			, -		- ,, , , , , , , ,
2011	1.539	1.396	8.153	2,019	6.895	2,509	105.691	94	2,292
Dependency ratio (%)	-,-07	-,0,0	-,-/0	_,,	-,-, /	_,,,,,,			
2011	31	78	91	29	6	0	0	0	40
	5.	,0	<i>,</i> .	_/	5	0	Ū.	0	

Continued

	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	South Asia (weighted
Water use									average)
Total water withdrawal	(cubic kilom	netres)							
2008	761 0ª	183.5	35.9		9 5 ^b	13 0°	0 338	0.006	1 003 2T
Total water withdrawal	per capita (c	rubic metres n	er inhabitant)	•••).)	15.0	0.550	0.000	1,005.21
2008	613.0ª	1 038 0	238.3		334 7 ^b	638 8°	458.0	18 4	618.8
Water withdrawal by se	ector, 2008	1,050.0	250.5		55117	050.0	190.0	10.1	010.0
agriculture	90.4	94.0	87.8	98.6	98.1 ^b	87.3	94.1	0.0	90.8
industry	2.2	0.8	2.1	0.6	0.31 ^b	6.4	0.9	5.1	2.1
municipalities	7.4	5.3	10.0	0.8	1.6	6.2	5.0	94.9	7.2
Area againmad for full	control inti	action							
Total area equipped for	full control	irrigation (the	ousand hectares)					
2008	66,334	19,270	5,050	3,208 ^d	1,168 ^d	570 ^b	32ª	0 ^e	95,632T
By source of water (% of	of total)								
surface water									
2008	36.3 ^f	35.9	21.0	82.0^{d}	79.6 ^d	99.8 ^g	100.0 ^g		37.2
groundwater									
2008	63.7 ^f	21.4	79.0	18.0^{d}	19.2 ^d	0.2 ^g	0.0 ^g		57.9
mixed surface water and	d groundwate	er							
2008	0.0^{f}	42.7	0.0	0.0^{d}	1.3 ^d	0.0 ^g	0.0^{g}		4.9
Percentage of populat	ion with acc	ess to improv	red, 2010						
Water resources		-							
urban	97	96	85	78	93	99	100	100	95
rural	90	89	80	42	88	90	94	97	88
national	92	92	81	50	89	91	96	98	90
Sanitation facilities									
urban	58	72	57	60	48	88	73	98	60
rural	23	34	55	30	27	93	29	97	28
national	34	48	56	37	31	92	44	97	38
Climate change Greenhouse gas emissio	ons								
total [metric tons of CO	O ₂ equivalent	$(MtCO_2e)]$							
2005	1,859.0	239.7	142.2	14.0	40.4	26.1	1.8	0.7	2,323.9T
per capita (tons $\rm CO_2 e$)									
2005	1.7	1.5	0.9	0.5	1.5	1.3	2.8	2.5	1.6
Change in forest area (%)								
2005-10	0.21	-2.37	-0.18		0.00	-0.77	0.34	0.00	0.12
Population living in co	astal zones (tl	hat are 10 me	tres higher from	n the sea level), (% of total	population)			
2000	6.27	2.94	45.56	0.00	0.00	11.79	0.00	100.00	9.43

Notes: a: Data refer to 2010. b: Data refer to 2006. c: Data refer to 2005. d: Data refer to 2002. e: Data refer to 1998. f: Data refer to 2001. g: Data refer to 1995. *Sources:* Row 1: FAO 2013a, UNPD 2013 and MHHDC staff computations. Rows 2-4: FAO 2013a and MHHDC staff computations. Row 5: UNICEF and WHO 2012b and MHHDC staff computations. Row 6a: UNDP-APRC 2012, WRI 2012 and MHHDC staff computations. Row 6b: FAO 2012 and MHHDC staff computations.

2. Water Resources

	T 1.	D 1 :	D 111	A.C.1 .	NT 1	C · L 1	DI	1.6.1.1:	South Asia				
	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	(weighted				
									average)				
I ong term average appu	al precipita	tion in depth	(millimetres)										
Long-term average annu							2 2 2 2	1 072					
2011	1,083	494	2,666	32/	1,500	1,712	2,200	1,9/2	1,164				
Long-term average annu	al precipitat	tion in volum	e (cubic kilome	tres)	221	112	0.4	0.502	2 755				
2011	3,360	393	384	213	221	112	84	0.592	2,/33				
Total renewable water	Total renewable water resources												
Total renewable surface water (actual) (cubic kilometres)													
2011	1,869	239	1,206	56	210	52	78	0	3,710T				
Total renewable ground	water (actua	al) (cubic kilor	metres)										
2011	432	55	21	11	20	8	8	0	554T				
Total renewable water re	esources (act	tual) (cubic ki	lometres)										
2011	1,911	247	1,227	65	210	53	78	0	3,791T				
Total renewable water re	esources per	capita (actual) (cubic metres	per inhabitant)									
2002	1,755	1,641	9,139	2,651	8,223	2,759	133,663	106	2,628				
2011	1,539	1,396	8,153	2,019	6,895	2,509	105,691	94	2,292				
Total internal renewab	le water res	ources											
Surface water produced	internally (c	cubic kilometr	es)										
2011	1,404	47	84	38	198	52	78	0	1,901T				
Groundwater produced	internally (c	cubic kilometr	es)										
2011	432	55	21	11	20	8	8	0.03	554T				
Overlap between surface	water and	groundwater (cubic kilometre	es)									
2011	390	47	0	1	20	7	8	0	473T				
Total internal renewable	e water resou	urces (cubic ki	lometres)										
2011	1,446	55	105	47	198	53	78	0.03	1,982T				
Total internal renewable	e water resou	urces per capit	a (cubic metres	per inhabitant)									
2002	1,328	366	782	1,914	7,753	2,759	133,663	106	1,376				
2011	1,165	311	698	1,457	6,501	2,509	105,691	94	1,199				
Total external renewab	le water res	sources											
Groundwater: entering t	the country	(actual) (cubi	c kilometres)										
2011	0.0	0.0	0.032	0.0	0.0	0.0	0.0	0.0					
Groundwater: leaving th	e country (actual) (cubic	kilometres)	0.0	0.0	0.0	0.0	0.0					
2011	0.0		0.032			0.0		0.0					
Surface water: entering t	he country	(natural) (cub	ic kilometres)			010		010					
2011	635.2	265.1	1,122.0	10.0	12.0	0.0	0.0	0.0					
Surface water: total ente	ring and bo	rdering the co	ountry (actual) (cubic kilometres	5)								
2011	635.2	191.8	1,122.0	19.0	12.0	0.0	0.0	0.0					
Surface water: leaving th	e country (1	natural) (cubio	c kilometres)										
2011	1,385.0	10.7	0.1	42.2	210.2	0.0	78.0	0.0					
Surface water: total exter	rnal renewal	ble (actual) (ci	ubic kilometres))									
2011	464.9	191.8	1,122.0	18.2	12.0	0.0	0.0	0.0					
Total external renewable	e water resou	urces (actual)	(cubic kilometr	es)									
	464.9	191.8	1,122.0	18.2	12.0	0.0	0.0	0.0	1,809T				

	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	South Asia (weighted average)			
Dam capacity												
Total dam capacity (cub	oic kilometres)										
1995	178.0ª	27.0	20.3 ^b	3.7	0.1	5.9ª			235.0T			
2010	224.0°	27.0	20.3 ^d	3.7	0.1				275.1T			
Dam capacity per capita	Dam capacity per capita (cubic metres per inhabitant)											
1995	177.9ª	201.3	184.2 ^b	171.7	3.8	322.4ª			179.7			
2010	190.8°	152.9	141.0 ^d	113.0	2.8				176.3			

Notes: a: Data refer to 1996. b: Data refer to 1991. c: Data refer to 2005. d: Data refer to 2007. *Sources:* Rows 1-5: FAO 2013a and MHHDC staff computations.

3. Water Use

									South Asia	
	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	(weighted	
									average)	
Water withdrawal										
Total water withdrawal (cubic l	kilometres)									
2000	610.4	172.6		20.3	9.6	13.0			825.9T	
2008	761.0ª	183.5	35.9		9.5 ^b	13.0°	0.338	0.006	1,003.2T	
Total water withdrawal per capita (cubic metres per inhabitant)										
2000	560.7	1148.0		823.1	374.1	679.9			506.3	
2008	613.0ª	1038.0	238.3		334.7 ^b	638.8°	458.0	18.4	618.8	
Total water withdrawal (% of t	otal renewa	able internal	freshwater res	ources)						
2002	42.2	313.8		43.0	5.0	24.6		11.3	72.4	
2011	52.6	333.6	34.2	43.0	4.9	24.5	0.4	19.7	79.4	
Water withdrawal by sector. 2	2008									
Agriculture										
value (cubic kilometres)	688.0ª	172.4	31.5	20.0 ^d	9.3 ^b	11.3°	0.3	0.0	932.8T	
% of total water withdrawal	90.4	94.0	87.8	98.6	98.1 ^b	87.3	94.1	0.0	90.8	
Industry										
value (cubic kilometres)	17.0	1.4	0.8	0.1	0.03°	0.8	0.0	0.0	20.2T	
% of total water withdrawal	2.2	0.8	2.1	0.6	0.31 ^b	6.4	0.9	5.1	2.1	
Municipalities										
value (cubic kilometres)	56.0	9.7	3.6	0.2	0.15°	0.8	0.0	0.0	70.4T	
% of total water withdrawal	7.4	5.3	10.0	0.8	1.6	6.2	5.0	94.9	7.2	
Water withdrawal by source.	2008									
Fresh surface water withdrawal	(primary a	nd secondai	ry)							
value (cubic kilometres)	510.0ª	121.8	7.4	17.3 ^e			0.3		656.8T	
% of total freshwater withdraw	als 78.8	66.4	20.6	85.0			100.0		72.2	
Fresh groundwater withdrawal	(primary a	nd secondar	v)						,	
value (cubic kilometres)	251.0ª	61.6	28.5	3.1°			0.0		344.1T	
% of total freshwater withdraw	als 38.8	33.6	79.4	15.0			0.0		37.8	
Total freshwater withdrawal (p	rimary and	secondary)	(cubic kilomet	tres) ^f						
-	647.5ª	183.5	35.9	20.4 ^e	9.5 ^b	13.0°	0.3	0.0	910.0T	
Pressure on water resources										
Freshwater withdrawal (% of to	otal actual 1	enewable w	ater resources)							
2000	31.9	69.9		31.0	4.5	24.6			35.6	
2008	33.9ª	74.4	2.9		4.5 ^b	24.5°	0.4	15.7	34.7	
Agricultural water withdrawal (% of total	actual renev	vable water res	ources)						
2000	29.2	65.9		30.6 ^e	4.4	22.7			32.9	
2008	36.0ª	69.9	2.6		4.4 ^b	21.4°	0.4	0.0	35.7	

	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	South Asia (weighted average)
Water productivity Total water productivi	ty (constant 2	000 US\$) (G	DP per cubic n	netre of total free	shwater wi	thdrawal)			
2002	0.9	0.5			0.6	1.3		201.6	0.8
2011	1.4	0.7	2.5		0.9	2.3	3.2	218.7	1.4

Notes: a: Data refer to 2010. b: Data refer to 2006. c: Data refer to 2005. d: Data refer to 2000. e: Data refer to 1998. f: Total freshwater withdrawal (surface water + groundwater)] = [total water withdrawal (summed by sector)] - [desalinated water produced] - [direct use of treated wastewater] - [direct use of agricultural drainage water]. g: Data refer to 2008. h: Data refer to 2002.

Sources: Rows 1a, 1b and 2-4 : FAO 2013a and MHHDC staff computations; Rows 1c and 5: World Bank 2013e and MHHDC staff computations.

4. Water Pollution

			n Danaladada Afabanianan Manalasa	val Sei Lanka Bhuta			South Asia				
	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	(weighted		
									average)		
Emissions of organic was	ter pollutan	ts									
Thousand kilogrammes pe	er day (thous	ands)									
2006		153.68		0.24ª	26.81ª	266.11					
Per day per worker (kilogi	ammes)										
2006		0.17		0.21ª	0.16ª	0.19					
Industry shares of emissions of organic water pollutants, % of total											
Primary metals											
2006		2.23			1.58ª	2.63					
Paper and pulp											
2006		1.95		19.74ª	3.87ª	4.33					
Chemicals											
2006		9.12		27.95ª	7.25ª	8.96					
Food and beverages											
2006		15.06		14.15ª	19.15ª	22.42					
Stone, ceramics and glass											
2006		4.34		11.70^{a}	29.89ª	6.32					
Textiles											
2006		55.63		23.32ª	29.43ª	43.56					
Wood											
2006		0.43			1.99ª	2.48					
Other											
2006		11.25		3.14ª	6.83ª	9.30					
Wastewater											
Produced municipal waste	ewater (cubi	c kilometres)								
2000	14.0 ^b	3.1ª	0.5			0.4	0.0	0.0	11.5		

Notes: a: Data refer to 2002. b: Data refer to 2008.

Sources: Rows 1-2: World Bank 2013e and MHHDC staff computations. Row 3: FAO 2013a and MHHDC staff computations.

									South Asia	
	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	(weighted	
									average)	
Area under agricultura	l water man	agement								
Irrigation potential (tho	usand hectar	es)								
2011	139,500	21,300	6,933		2,178	570			170,481T	
Agricultural water mana	ged area									
total (thousand hectares)									
2008	66,334	21,240	6,595	3,208ª	1,168ª	570 ^b	32°	0^{d}	99,147T	
% of agricultural water managed area equipped for irrigation (%)										
2008	100	94	77	100ª	100ª	100 ^b	100 ^c		97	
Area equipped for full	control irrig	ation								
Total (thousand hectare	s)									
2008	66,334	19,270	5,050	3,208ª	1,168ª	570 ^b	32°	0^{d}	95,632T	
By irrigation technique	(% of total)									
surface irrigation										
2008	96.8°	100.0	100.0		100.0^{f}	100.0^{b}	100.0 ^g		97.6	
sprinkler irrigation										
2008	2.3 ^e	0.0	0.0		0.0^{f}	0.0^{b}	0.0^{g}		1.7	
localized irrigation										
2008	0.9 ^e	0.0	0.0		0.0^{f}	0.0^{b}	0.0 ^g		0.7	
By source of water (% o	f total)									
surface water										
2008	36.3 ^h	35.9	21.0	82.0ª	79.6ª	99.8 ⁱ	100.0^{i}		37.2	
groundwater										
2008	63.7 ^h	21.4	79.0	18.0ª	19.2ª	0.2^{i}	0.0^{i}		57.9	
mixed surface water and	groundwate	r								
2008	0.0^{h}	42.7	0.0	0.0^{a}	1.3ª	0.0^{i}	0.0^{i}		4.9	
Irrigated crop area and cropping intensity										
Total harvested irrigated	l crop area (f	ull control irr	igation) (thous	and hectares)						
2008	87,259	21,452	5,977	2,176 ^j		744 ^b	28^{f}		117,636T	
Irrigated cropping inten	sity (harveste	ed irrigated cr	op area as a %	of area equipped	l for full co	ontrol irrigatio	n)			
2008	131.5	111.3	118.4			130.5 ^b	103.3 ⁱ		128.0	

									South Asia
	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	(weighted
									average)
Drainage and environment									
Cultivated area drained									
total (thousand hectares)									
2008	5,800 ^k	15,140	1,5011					0.0^{k}	22,441T
% of total cultivated area draine	ed								
2008	3.4^{k}	71.2	19.0 ^f					0.0^{d}	13.3
Number of hydrological events									
number of events									
1990-2000	67	20	31	16	14	19	2	0	169T
2001-11	117	48	25	51	21	20	1	1	284T
fatalities									
1990-2000	16,727	4,375	2,987	2,629	2,909	175	222	0	30,024T
2001-11	13,412	5,176	2,482	1,619	1,987	450	0	0	25,126T
persons affected (thousands)									
1990-2000	329,122	15,181	59,927	164	793	1,919	1	0	407,107T
2001-11	204,048	35,353	58,135	484	2,320	3,849	0	2	304,191T

Notes: a: Data refer to 2002. b: Data refer to 2006. c: Data refer to 2010. d: Data refer to 1998. e: Data refer to 2004. f: Data refer to 1994. g: Data refer to 2007. h: Data refer to 2001. i: Data refer to 1995. j: Data refer to 2011. k: Data refer to 1991. l: Data refer to 1993.

Sources: Rows 1-3 and 4a: FAO 2013a and MHHDC staff computations; Row 4b: UNSD 2013.

									South Asia
	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	(weighted
									average)
Use of drinking water	sources (%	of total popu	lation), 2010						
Urban									
. piped on premises	48	58	20	16	53	67	81	96	46
. other improved	49	38	65	62	40	32	19	4	49
total improved	97	96	85	78	93	99	100	100	95
. surface water	0	0	0	5	3	0	0	0	0
. other unimproved	3	4	15	17	4	1	0	0	4
total unimproved	3	4	15	22	7	1	0	0	5
1									
Rural									
. piped on premises	12	23	1	0	10	23	44	1	12
. other improved	78	66	79	42	78	67	50	96	76
total improved	90	89	80	42	88	90	94	97	88
. surface water	1	5	2	11	6	2	5		2
. other unimproved	9	6	18	47	6	8	1	3	10
total unimproved	10	11	20	58	12	10	6	3	12
1									
National									
. piped on premises	23	36	6	4	18	29	57	39	22
. other improved	69	56	75	47	71	62	39	59	68
total improved	92	92	81	51	89	91	96	98	90
. surface water	1	3	1	10	5	2	3		1
. other unimproved	7	5	18	39	6	7	1	2	8
total unimproved	8	8	19	49	11	9	4	2	10
Use of sanitation facili	ities (% of t	atal populati	an) 2010						
Urban		stai populatio	JII), 2010						
total improved	58	72	57	60	48	88	73	98	60
shared	19	6	26	00	36	7	21	2	18
other unimproved	9	18	15	38	3	3	5	2	11
open defecation	1/	10	2	2	13	2	1	0	11
total unimproved	14 42	- 28	2 //3	2 40	52	12	1 27	2	40
total unimproved	42	20	-15	40)2	12	27	2	40
Rural									
total improved	23	34	55	30	27	93	29	97	28
shared	4	6	25	50	9	3	28	2	6
other unimproved	6	26	15	48	7	4	38	-	10
open defecation	67	34	5	22	57	0	5	0	56
total unimproved	77	66	45	70	73	7	71	3	72
total animproved		50	•)	, 0	, 5	/	, .	5	, -
National									
total improved	34	48	56	37	31	92	44	97	38
. shared	9	6	25		14	4	26	2	10
. other unimproved	6	23	15	46	6	4	26	1	9
. open defecation	51	23	4	17	49	0	4	0	42
total unimproved	66	52	44	63	69	8	56	3	62

Continued

	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	South Asia (weighted average)
Water, sanitation and hygiene	-related disa	bility-adjust	ed life years (DALYs), 2004					
By cause (thousands)									
. diarrhoeal diseases	15,375.1	1,845.1	2,196.6	2,216.6	459.0	23.5	8.8	1.8	22,126.5T
. intestinal nematode infections	610.5	104.7	77.2	15.3	16.3	15.5	0.4	0.2	840.0T
. protein-energy malnutrition	1,485.5	202.5	207.6	205.5	55.2	7.7	0.7	0.2	2,164.9T
. consequences of malnutrition	5,312.5	801.9	583.6	901.1	121.2	5.0	1.8	0.3	7,727.6T
. trachoma	62.6	3.5	0.1	14.9	20.2	0.0	0.0	0.0	101.2T
. schistosomiasis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0T
. lymphatic filariasis	2,150.8	0.1	319.7	0.1	96.9	21.5	0.0	0.0	2,589.1T
. malaria	253.4	23.8	102.7	3.7	0.5	0.0	0.4	0.1	384.6T
. dengue	183.7	18.8	78.6	1.5	3.8	4.3	0.5	0.0	291.1T
. onchocerciasis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0T
. japanese encephalitis	339.5	0.0	44.0	0.0	10.1	0.0	0.3	0.1	394.1T
. drownings	1,400.1	157.9	193.9	64.7	38.9	14.0	0.7	0.3	1,870.3T
. other infectious diseases	1,423.3	213.8	262.4	226.3	66.4	9.2	1.3	0.1	2,202.8T
Total	28,597.0	3,372.2	4,066.4	3,649.6	888.6	100.8	14.8	3.0	40,692.5T
% of total DALYS	9.4	8.3	10.2	19.8	11.3	2.2	9.9	5.2	9.8
Water sanitation and hygiene	-related deat	hs 2004							
By cause (thousands)	Telatea aca								
d:h	151.1	50.2	(5.0	667	12.0	0.8	0.2	0.0	660 2T
. diarrnoeal diseases	454.4	59.2	0.2	00./	15.9	0.8	0.5	0.0	2 oT
. Intestinal nematode infections	2.8	0./	0.2	0.0	0.1	0.0	0.0	0.0).01
. protein-energy mainutrition	4.8	1.0	0.6	4.0	0.)	0.0	0.0	0.0	200 7T
. consequences of malnutrition	142.8	22.4	15./	25.5	<i>3.3</i>	0.1	0.1	0.0	209.71
. trachoma	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11 0.0T
. schistosomiasis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.01
. lymphatic filariasis	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11 10.0T
. malaria	6./	0.6	2./	0.0	0.0	0.0	0.0	0.0	10.01
. dengue	5.0	0.5	2.1	0.0	0.1	0.1	0.0	0.0	/.81 0.0T
. onchocerciasis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.01
. japanese encephalitis	5.7	0.0	0.7	0.0	0.2	0.0	0.0	0.0	6.61
. drownings	51.3	5.6	6.6	1.9	1.3	0.6	0.0	0.0	67.21
. other infectious diseases	71.1	7.9	10.8	6.6	2.9	0.9	0.1	0.0	100.41
Total	744.6	97.9	104.4	105.3	22.2	2.5	0.4	0.1	1,077.4T
% of total deaths	7.2	7.7	8.5	20.6	9.3	1.2	8.7	3.5	7.8

Sources: Rows 1 and 2: UNICEF and WHO 2012b and MHHDC staff computations; Rows 3 and 4: WHO 2010 and MHHDC staff computations.

	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	South Asia
			8	0	1				average)
Greenhouse gas emis	sions								0.
Greenhouse gas emissi	ions total [met	tric tons of CO	⊃₂ equivalent (№	MtCO ₂ e)]					
1990	1,106.0	144.1	90.1	12.8	30.6	17.2	1.2	0.2	1,402.2T
2005	1,859.0	239.7	142.2	14.0	40.4	26.1	1.8	0.7	2,323.9T
Greenhouse gas emissi	ons per capita	(tons CO ₂ e)							
1990	1.3	1.3	0.8	0.7	1.6	1.0	2.2	0.8	1.2
2005	1.7	1.5	0.9	0.5	1.5	1.3	2.8	2.5	1.6
Greenhouse gas emissi	ions by type (9	%), 2005							
carbon dioxide	66.0	52.8	27.4	5.0	8.4	53.8	31.6	100.0	60.8
methane	29.5	40.8	37.7	75.9	63.1	39.2	52.6	0.0	32.1
nitrous oxide	3.8	6.1	34.9	19.1	28.6	6.9	15.8	0.0	6.5
other	0.7	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.6
Share of greenhouse ga	as emissions b	y economic ad	ctivity (%)						
energy									
1990	59.0	47.4	19.9		8.8	21.5			52.8
2005	66.9	54.4	29.5		13.4	51.0			60.9
industry									
1990	2.5	2.6	0.2		0.3	1.2			2.2
2005	4.6	3.8	1.9		0.5	2.7			4.1
agriculture									
1990	29.8	40.1	66.3		83.7				35.2
2005	21.7	32.9	56.4		78.0				27.3
waste									
1990	8.5	9.9	13.7		7.5				9.1
2005	6.7	8.8	12.2		8.2				7.5
Energy									
Energy use intensity p	er US\$1,000	(purchasing p	ower parity) GI	OP					
2007	203	218	139		343	116			200
Energy supply by sour	rce (%)								
fossil fuel									
2001	65.0	58.6	61.3		12.4	43.4			62.7
2010	72.7	61.6	71.4		11.6	43.9			69.9
renewable sources									
2001	35.0	41.4	38.7		87.6	56.6			37.3
2010	27.3	38.4	28.6		87.8	56.1			30.1
Access to electricity									
2009	66.3	62.4	41.0	15.6	43.6	76.6			62.2

7. Climate Change and Sustainable Development

Continued

									South Asia
	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	(weighted
									average)
Climate variability, 204	45-65								
Change in annual tempe	erature degre	es (Celsius)							
minimum	1.9	2.4	1.7	2.3	2.2	1.5			
maxmimum	2.6	3.4	2.4	3.6	3.4	1.8			
Change in annual cool d	ays/cold nig	hts							
cool days	-2.0	-1.8	-1.7	-1.4	-2.1	-2.8			
cold nights	-2.2	-1.9	-2.1	-1.5	-2.1	-2.9			
Change in annual hot da	ays/warm nig	ghts							
hot days	4.6	3.4	3.4	3.1	2.5	7.9			
warm nights	13.3	8.1	11.8	7.0	8.0	23.9			
Natural disasters									
Number of natural disas	ters								
1980-89	113	20	54	6	22	17	1	1	234T
2000-09	186	68	84	83	27	24	4	2	478T
Number of deaths from	natural disas	ters							
1980-89	32,268	1,074	32,195	583	2,567	536	41	0	69,264T
2000-09	59,462	77,282	9,576	8,012	2,665	36,212	223	102	193,534T
Number of people affect	ed by natura	l disasters (th	iousands)						
1980-89	593,115	1,321	166,371	264	4,667	7,554	0	0	773,293T
2000-09	608,611	19,720	72,500	5,939	3,019	6,330	1	29	716,149T
Estimated damage cost (US\$ million	s)							
1980-89	5,917	5	3,411	269	1,046	39	0	6	10,693T
2000-09	23,739	7,784	5,884	25	69	1,352	0	470	39,322T
Marine and coastal area	15								
Population living in coas	stal zones (th	at are 10 me	tres higher from	n the sea level)					
total (millions)			U						
2000	63.19	4.16	62.52	0.00	0.00	2.23	0.00	0.291	132T
% of total population									
2000	6.27	2.94	45.56	0.00	0.00	11.79	0.00	100.00	9.43
Marine protected area (%	% of territori	al waters)							
2009	1.7	1.8	0.8	0.0	0.0	1.1	0.0		1.5

Sources: Rows 1a and 1b: UNDP-APRC 2012, WRI 2012 and MHHDC staff computations; Rows 1c and 1d: WRI 2012; Rows 2a and 5b: UNSD 2013; Rows 2b and 2c: World Bank 2013e and MHHDC staff computations. Row 3: World Bank 2012; Row 4: UNDP-APRC 2012 and MHHDC staff computations; Row 5a: CIESIN 2007 and MHHDC staff computations.

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Note on Statistical Sources for Human Development Indicators

The human development data presented in these tables have been collected with considerable effort from various international and national sources. For the most part, standardized international sources have been used, particularly the UN system and the World Bank data bank. The UNDP and World Bank offices made their resources available to us for this Report.

Countries in the indicator tables are arranged in descending order according to population size. Data for South Asia is the total(T)/weighted average value of eight countries, India, Pakistan, Bangladesh, Afghanistan, Nepal, Sri Lanka, Bhutan and the Maldives. While most of the data have been taken from international sources, national sources have been used where international data were not available. Such data have to be used with some caution as their international comparability is still to be tested.

Several limitations remain regarding coverage, consistency, and comparability of data across time and countries. The data series presented here will be refined over time, as more accurate and comparable data become available.

In certain critical areas, reliable data are extremely scarce: for instance, for employment, income distribution, public expenditure on social services, military debt, foreign assistance for human priority areas, etc. Information regarding the activities of NGOs in social sectors remains fairly sparse.

	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	South Asia (weighted average)	Developing countries
Total estimated popula	tion (mil	lions)								
2001	1,07	1 148	132	27	25.0	18.8	0.59	0.28	1,422T	5,139T
2011	1,24	i 177	150	35	30.5	20.9	0.74	0.32	1,656T	5,839T
2050	1,69	275	194	76	46.5	23.2	0.96	0.41	2,309T	7,994T
Annual population gro	wth rate	(%)								
1991-2001	1.9	2.5	2.0	3.1	2.5	0.9	0.6	2.1	2.0	1.6
2001-11	1.5	5 1.8	1.3	2.8	2.0	1.1	2.3	1.4	1.5	1.3
Life expectancy at birth										
2001	62	63	65	46	62	72	62	71	62	65
2011	65	65ª	69	48ª	69	75ª	67	77	65	68ª
Adult literacy rate (% a	aged 15 a	nd above)								
2001	61	50 ^b	48		49	91	53 ^b	96°	59	78
2010	63	d 55°	57		60	91		98^{d}	62	81
Female literacy rate (%	aged 15	and above)								
2001	48	35 ^b	41		35	89	39 ^b	96°	46	72
2010	51	40°	52		48	90		98 ^d	50	76
Gross combined 1st, 2nd and 3rd level enrolment ratio (%)										
2001	51	37 ^f	48 ^b	42 ^f	58 ^g		54 ^b	78	49	60
2011	62 ¹	¹ 44	49 ^h	54 ^e		77ª	68		59	67
Infant mortality rate (p	per 1,000	live births)								
2001	62	. 74	59	93	59	16	63	36	63	54
2011	47	59	37	73	39	11	42	9	47	40
GDP growth (%)										
2001	4.9	2.0	5.3	8.4^{f}	4.8	-1.5	8.2	3.5	4.6	3.1
2011	6.9) 3.0	6.7	5.7	3.9	8.3	5.6	7.5	6.4	6.4
GDP per capita (PPP ⁱ ,	constant	2005 intern	ational US\$)							
2001	1,77	78 1,843	1,003	615 ^g	927	3,007	2,885	4,519	1,693	3,356
2011	3,20)3 2,424	1,569	1,006	1,106	4,929	5,162	7,834	2,910	5,537
Human Development	Index (H	DI)								
2000	0.40	63 0.419	0.433	0.236	0.401	0.653		0.592	0.453	
2012	0.55	64 0.515	0.515	0.374	0.463	0.715	0.538	0.668	0.543	
Gender Inequality Ind	ex, 2011									
2005	0.6	37 0.614	0.586	0.746	0.627	0.446		0.419	0.629	
2012	0.6	10 0.567	0.518	0.712	0.485	0.402	0.464	0.357	0.594	

Notes: a: Data refer to 2010. b: Data refer to 2005. c: Data refer to 2000. d: Data refer to 2006. e: Data refer to 2009. f: Data refer to 2003. g: Data refer to 2002. h: Data refer to 2007. i: PPP means purchasing power parity.

Sources: Rows 1, 2: UNPD 2013 and MHHDC staff computations; Row 3, 7 : World Bank 2013d; Rows 4, 5, 6: World Bank 2013a; Rows 8, 9: World Bank 2013e; Rows 10, 11: UNDP 2013.

Highlights

Population growth rate has declined in all countries of the region over the last decade. By the middle of 21st Century, the growth rate of population will further decline.

Life expectancy has improved in all countries with the highest rate of increase in Nepal and the lowest rate of increase in Pakistan.

Literacy rates and gross combined enrolment ratio have increased in all countries with the lowest latest values in Pakistan.

GDP growth is the lowest in Pakistan, while GDP per capita value is the lowest in all countries of the region compared to the average for developing countries except for Bhutan and the Maldives.

HDI value has improved for all countries with the highest rate of improvement in Afghanistan. However, HDI value is still the lowest in Afghanistan and the highest in Sri Lanka followed by the Maldives, India and Bhutan. Moreover, recently only Sri Lanka is in the category of 'high human development', while the Maldives, India and Bhutan are in the category of 'medium human development'. The remaining four countries are in the classification of 'low human development'.

Gender inequality has decreased in all countries of the region with the highest rate of decline in Nepal followed by the Maldives, Bangladesh and Sri Lanka. Recently, gender inequality is the highest in Afghanistan and the lowest in the Maldives.

									South Asia	
	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	(weighted	Developing
									average)	countries
Adult literacy rate (%	aged 15 a	ind above)								
2001	61	50ª	48		49	91	53ª	96 ^b	59	78
2010	63°	55 ^d	57		60	91		98°	62	81
Male literacy rate (%	aged 15 a	nd above)								
2001	73	64ª	54		63	92	65ª	96 ^b	71	84
2010	75°	69 ^d	61		73	93		98°	73	86
Female literacy rate (9	% aged 15	and above)								
2001	48	35ª	41		35	89	39ª	96 ^b	46	72
2010	51°	40^{d}	52		48	90		98°	50	76
Youth literacy rate (%	6)									
2001	76	65ª	64		70	96	74ª		74	85
2010	81°	71 ^d	77		83	98		99°	80	88
Gross primary enroln	nent (%)									
2001	94	71	94ª	64 ^e	111	108	80	130	92	99
2010-2011 ^f	116 ^g	92	95 ^d	97		99	111	106	111	107
Net primary enrolme	nt (%)									
2001	79	58	87ª			100	61	97	78	82
2010-11 ^f	92 ^g	72	86 ^d			94	88	96	89	88
Gross secondary enro	lment (%)									
2001	46	28 ^h	49	11	38	85°	44	63	44	56
2010-11 ^f	63	35	51	46	44°	100	70		59	66
Net secondary enrolm	nent (%)									
2010-11 ^f		35	47	24 ⁱ			54	49°	39	59
Gross combined 1st,	2nd and 3	rd level enro	lment ratio							
2001	51	37 ^h	48ª	$42^{\rm h}$	58°		54ª	78	49	60
2011	62 ⁱ	44	49 ⁱ	54 ^d		77 ^j	68		59	67
Enrolment in technic	al and voc	ational educ	ation (%)							
2001	0.7	2.3 ^h	1.2	0.5^{h}	1.4		1.7	6.2	0.9	8.7
2010	0.8 ^g	4.0	3.8	0.6	0.7 ^g	5.3	1.6°		1.5	10.1
Pupil teacher ratio (p	rimary leve	el)								
2001	40	35	47ª		37	26	39	23	40	29
2010-11 ^f		40	43	44	30	24	25	12	40	27
Percentage of children	n reaching	grade five (9	% of grade one s	students)						
2010	68.5°	52.2	66.2 ^d		61.7 ⁱ	98.6°	95.5	94.0 ^d	66.7	
Children not in prim	ary school	s (in millions	s)							
2001	20.306	8.399	1.639ª			0.003	0.042	0.001	30.4T	96.8T
2010-11 ^f	2.278 ^g	5.436	1.835 ^d			0.102	0.011	0.001	9.7T	59.1T

Continued

	India								South Asia	Developing
	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	(weighted	countries
									average)	
School life expectancy	(years)									
primary to secondary										
2001	7.8	5.6 ^h	7.7ª	1.8	8.2	12.3 ^e	7.6	12.3	7.5	8.6
$2010-11^{f}$	10.0 ^g	7.1	7.5 ^g	8.6		13.0	11.9		9.5	9.9
primary to tertiary										
2001	8.3	5.8 ^h	8.0ª	1.9	8.4		9.6ª	12.4	7.9	9.3
2010-11 ^f	10.7 ^g	7.5		8.1 ^d		13.8	12.4	•••	10.3	10.9
Researchers per million inhabitants										
2005-09 ^f	136	162			59°	96			137	574
R&D expenditures (%	of GDP)								
2001	0.75	0.17				0.18^{k}		•••	0.67	0.70
2007-09 ^f	0.76	0.46			•••	0.11			0.71	1.07
Public expenditure on	education	n (% of GD	P)							
2001	3.6 ^h	1.9^{h}	2.5		3.7		5.9	6.4°	3.3	3.7
2010	3.3	2.4	2.2 ^d		4.7	2.1 ^d	4.0	7.8 ^d	3.1	3.9°
Public expenditure on	education	n (% of total	government e	expenditure)						
2001	$10.7^{\rm h}$	6.4 ^k	15.7		13.0	•••	12.9	•••	10.7	
2010	10.5	9.9	14.1 ^d		20.2	8.1 ^d	9.4	16.0^{d}	10.9	

Notes: a: Data refer to 2005. b: Data refer to 2000. c: Data refer to 2006. d: Data refer to 2009. e: Data refer to 2002. f: Data refer to most recent year available. g: Data refer to 2008. h: Data refer to 2003. i: Data refer to 2007. j: Data refer to 2010. k: Data refer to 2004.

Sources: Rows 1-15: World Bank 2013a and MHHDC staff computations; Row 16-18: World Bank 2013e and MHHDC staff computations.

Highlights

All countries in South Asia have performed well in education indicators.

Literacy rate shows a positive trend in countries of the region over the last ten years. However Pakistan has the lowest recent values, while the Maldives has the highest recent values.

Enrolment ratios have increased for all countries of the region with few exceptions: primary enrolment ratios have decreased in Sri Lanka, while technical and vocational enrolment ratio has decreased in Nepal and Bhutan. Like literacy rates, enrolment ratios are also the lowest in Pakistan with the exception of net secondary and technical and vocational enrolment which are the lowest in Afghanistan.

Pupil teacher ratio has deteriorated in Pakistan only, but is lower than in Bangladesh and Afghanistan.

The percentage of *children reaching grade-five* is also the lowest in Pakistan.

Over the last ten years, the number of *out of school children* have

decreased in South Asia by about three times due to significant reduction in India, with highest recent value in Pakistan.

School life expectancy has increased in all countries of the region with slight decrease in Bangladesh. However, it is the lowest in Pakistan and the highest in Sri Lanka in the latest year.

Public expenditure on education has decreased in India, Bangladesh and Bhutan over the last ten years.
									South Asia	
	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	(weighted	Developing
									average)	countries
Population with access	to safe wa	ter (%)								
2001	82	89	79	26	84	81	86	96	81	80
2010	92	92	81	50	89	91	96	98	90	86
Population with access	to sanitati	on (%)								
2001	26	39	47	32	21	83	40	82	30	48
2010	34	48	56	37	31	92	44	97	38	56
Child immunization ra	te									
One-year-olds fully imp	nunized a	gainst mea	sles (%)							
2001	55	61	77	37	71	99	78	98	58	71
2010	74	86	94	62	86	99	95	97	77	84
One-year-olds fully imp	nunized a	gainst DP7	. (%)							
2001	60	65	85	33	72	98	88	98	63	72
2010	72	88	95	66	82	99	91	96	76	84
Physicians (per 1,000 p	eople)									
2001	0.60ª	0.66	0.23	0.19	0.05	0.55ª	0.05ª	0.92ª	0.56	
2010	0.65	0.81	0.30	0.21		0.49	0.02	1.60	0.62	1.12
Maternal mortality ratio	o (per 100	,000 live b	irths)							
2000	390	380	400	1,000	360	58	430	190	396	350
2010	200	260	240	460	170	35	180	60	213	230
Contraceptive prevalen	ce rate (%	of women	aged 15-49)							
2000-01 ^b	46.9	27.6	53.8	4.9	39.3	70.0	30.7	39.0ª	44.9	59.2
2008-10 ^b	54.0	27.0	52.6	22.8		68.4°	65.6	34.7	49.5	61.1
People with HIV/AIDS	6									
people living with HIV	/AIDS (ac	lults and cl	nildren) (thousa	nds)						
2001	2,500	39	1.1		60.0	1.3	0.2	0.1	2,602T	
2009	2,400	98	6.3		64.0	2.8	1.0	0.1	2,572T	
people with HIV/AIDS	5 adults (%	aged 15-4	i9)							
2001	0.4	0.1	0.1		0.5	0.1	0.1	0.1	0.3	
2009	0.3	0.1	0.1		0.4	0.1	0.2	0.1	0.3	0.9
Public expenditure on l	nealth (%	of GDP)								
2001	1.3	0.6	1.2	3.0	1.2	1.7	4.8	3.9	1.3	2.5
2010	1.2	0.8	1.2	0.9	1.8	1.3	4.5	3.8	1.2	2.9
Public expenditure on l	nealth (%	total gover	nment expendit	ure)						
2001	4.0	2.3	8.1	28.5	6.6	6.4	10.2	10.4	4.7	8.5
2010	3.6	3.6	7.4	1.6	7.9	5.8	10.5	8.6	4.0	

Notes: a: Data refer to 2004. b: Data refer to most recent year available. c: Data refer to 2007.

Sources: Rows 1-7: World Bank 2013d and MHHDC staff computations; Rows 8, 9: World Bank 2013e and MHHDC staff computations.

Highlights

Population with access to safe water, improved sanitation, child immunization rate and maternal mortality rate have improved in all countries of South Asia, with significant improvement in Afghanistan. Contraceptive prevalence rate, people with HIV/AIDS and public expenditure on health have deteriorated in most of the countries in the region over the last decade. The highest decrease in contraceptive prevalence rate is in the Maldives. Population with HIV/AIDS has increased in Pakistan, while public expenditure on health has decreased in Afghanistan.

4. Human Deprivation Profile

	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	South Asia (weighted average)	Developing countries
Population below in	come pover	ty line (%)								
. Population below	US\$1.25 a c	lay (PPP)								
number (millions)										
2002	474.3ª	54.0	71.0ª		13.9 ^b	2.6	0.2 ^b		615.9T	1,604.2T
2010	400.4	35.2°	64.4		7.4	1.4^{d}	0.1		508.9T	1,259.9T°
%										
2002	41.6ª	35.9	50.5ª		53.1 ^b	14.0	26.2 ^b		41.7	30.8
2010	32.7	21.0°	43.3		24.8	7.0 ^d	10.2 ^d		32.0	22.4°
. Population below	US\$2 a day	(PPP)								
number (millions)										
2002	861.9ª	111.2	112.9ª		20.2 ^b	7.5	0.3 ^b		1,113.9T	2,786.6T
2010	841.3	100.8°	113.7		17.2	5.8 ^d	0.2^{d}		1079.1T	2,418.5T°
%										
2002	75.6ª	73.9	80.3ª		77.3 ^b	39.7	49.5 ^b		75.4	53.5
2010	68.7	60.2°	76.5		57.3	29.1 ^d	29.8 ^d		67.8	43.0°
. Population below	national pov	verty line								
number (millions)										
2005	424.1ª	51.9	56.2ª	9.9ª	8.3°	4.3	0.2 ^b		554.8T	
2010	364.9	36.0 ^f	46.8	11.7°	7.7 ^g	1.8	0.2^{d}		469.2T	
%										
2002	37.2ª	34.5	40.0ª	33.0ª	30.9°	22.7	31.7 ^b		36.8	
2010	29.8	22.3 ^f	31.5	36.0°	25.2 ^g	8.9	23.2 ^d		29.0	
Population without	access to sa	fe water								
number (millions)										
2001	193	16.2	27.7	19.8	4.0	3.6	0.08	0.01	264T	1,028T
2010	98	13.9	28.3	17.2	3.3	1.9	0.03	0.01	162T	807T
% of total population	n									
2001	18	11	21	74	16	19	14	4	19	20
2010	8	8	19	50	11	9	4	2	10	14
Population without	access to sa	nitation								
number (millions)										
2001	793	90.0	69.9	18.2	19.7	3.2	0.35	0.05	994T	2,672T
2010	808	90.3	65.4	21.7	20.7	1.7	0.41	0.01	1,008T	2,537T
% of total population	n									
2001	74	61	53	68	79	17	60	18	70	52
2010	66	52	44	63	69	8	56	3	62	44

	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	South Asia (weighted average)	Developing countries
Illiterate adults										
number (millions)										
2001	274	49.1ª	43.8		7.6	1.3	0.21ª	0.006^{h}	376T	775T
2010	287^{f}	49.5 ⁱ	44.1		7.6	1.4		0.003^{f}	390T	760T
% of total adult popula	ation									
2001	39.0	50.1ª	52.5		51.4	9.3	47.2ª	3.7 ^h	41.3	22.2
2010	37.2 ^f	45.1 ⁱ	43.2	•••	39.7	8.8		1.6 ^f	38.3	19.2
Illiterate female adults										
number (millions)										
2001	177	31.1ª	24.1		4.9	0.8	0.12ª	0.003^{h}	238T	495T
2010	187^{f}	32.1 ⁱ	24.2		5.1	0.8		0.002^{f}	249T	488T
% of total adult female	e populati	on								
2001	52.2	64.6ª	59.2		65.1	10.9	61.3ª	3.6 ^h	53.9	28.4
2010	49.2 ^f	59.7 ⁱ	47.8		51.7	10.0		1.6 ^f	49.7	24.5
Malnourished children	ı (weight f	for age) (% o	of children une	der age-five)						
2006-11 ^j	44	31	41	33°	29	22	13	18	41	17
Under-five mortality ra	ate (per 1,	000 live bir	ths)							
2001	85	93	80	133	79	18	85	45	85	77
2011	61	72	46	101	48	12	54	11	61	56
People with HIV/AID	S adults (% aged 15-4	í9)							
2001	0.4	0.1	0.1		0.5	0.1	0.1	0.1	0.3	
2009	0.3	0.1	0.1		0.4	0.1	0.2	0.1	0.3	0.9

Notes: a: Data refer to 2005. b: Data refer to 2003. c: Data refer to 2008. d: Data refer to 2007. e: Data refer to 2004. f: Data refer to 2006. g: Data refer to 2011. h: Data refer to 2000. i: Data refer to 2009. j: Data refer to most recent year available.

Sources: Row 1: World Bank 2013e; Rows 2, 3: UNPD 2013, World Bank 2013d and MHHDC staff computations; Rows 4, 5: World Bank 2013a; Rows 6-8: World Bank 2013d.

Highlights

During the last one decade, population living *below US\$1.25 a day, US\$2 a day* and *the national poverty line* for each country has decreased in most of the countries in the region, with the highest rate of decline in Bhutan and Sri Lanka.

The absolute number of people without access to *safe water* has increased in Bangladesh, while without access to *sanitation* has increased in India, Pakistan, Afghanistan, Nepal and Bhutan.

The number of *illiterate*

adults, both male and female, has decreased in Nepal and the Maldives.

Under-five mortality rate has decreased in all countries of the region over the last ten years with the highest rate of decrease in the Maldives and the lowest rate of decrease in Pakistan.

5. Gender Disparities Profile

	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	South Asia (weighted average)	Developing countries
Female population										
number (millions)										
2001	516	72	64	12.9	12.5	9.4	0.29	0.14	688T	2,531T
2011	600	87	74	17.0	15.4	10.6	0.35	0.16	805T	2,878T
% of male										
2001	93	95	95	93	101	101	96	96	94	97
2011	94	97	98	93	102	103	89	99	95	98
Adult female literacy (% o	of male)									
2001	65	55ª	76		56	97	60ª	100 ^b	65	85
2010	68°	59 ^d	85		66	97		100 ^c	69	87
Youth literacy rate (% of	male)									
2001	80	69ª	90		75	101	85ª		80	92
2010	84°	78 ^d	104		89	101	•••	100 ^c	86	94
Female primary school gr	oss enroli	ment (% of 1	male)							
2001	85	67	104ª	47°	84	98	89	100	85	92
2010-11 ^f	100 ^g	82	104^{d}	69	•••	100	101	96	98	97
Female primary school ne	t enrolm	ent (% of m	ale)							
2001	85	67	106 ^a				91	101	85	92
$2010-11^{\mathrm{f}}$	99 ^g	82	108 ^d			100	103	100	98	98
Female 1st, 2nd and 3rd	level gros	s enrolment	ratio (% of ma	le)						
2001	79	73 ^h	102ª	54 ^h	80 ^e		98ª	100	80	91
2011	90 ⁱ	80	103 ⁱ	61 ^d		105 ^j	101		90	97
Female life expectancy (%	of male))								
2001	103	102	100	102	102	112	105	101	103	105
2011	105	103 ^j	103	100 ^j	103	108 ^j	106	103	104	106 ^j
Female economic activity	rate (age	d 15+) (% o	f male)							
2001	42	19	64	17	91	48	71	55	42	65
2010	36	27	67	19	92	45	86	72	39	64
Female professional and t	echnical	workers (%	of total)							
2006		26	22		20	48			25	
Seats in the Parliament (I	Lower Ho	ouse) held by	women (% of	total)						
2001	9.0	22.0 ^h	9.0	27.3ª	6.0	$4.0^{\rm h}$	9.0	6.0	10.7	12.5
2011	10.8	22.2	18.6	27.7	33.2	5.8	8.5	6.5	13.4	18.2
Women in ministerial lev	el positic	ons (% of tot	tal)							
2008	10.3	3.6	8.3	3.7	20.0	5.7	0.0	14.3	9.4	
Female legislators, senior	officials a	and manager	rs (% of total)							
2008		3.0	10.0°		14.0°	23.9	11.2 ^d	14.3°	7.2	

	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	South Asia (weighted average)	Developing countries
Gender Inequality In	ndex									
2005	0.637	0.614	0.586	0.746	0.627	0.446		0.419	0.629	
2010	0.610	0.567	0.518	0.712	0.485	0.402	0.464	0.357	0.594	
Female unemployme	ent rate (%)									
$2000-01^{\mathrm{f}}$	4.1	16.4°	3.3		10.7	11.5	3.2	2.7	5.6	
2009	5.1ª	8.7 ^g	7.4	9.5ª	2.4 ^g	7.7 ^j	5.3	23.8°	5.8	

Notes: a: Data refer to 2005. b: Data refer to 2000. c: Data refer to 2006. d: Data refer to 2009. e: Data refer to 2002. f: Data refer to most recent year available. g: Data refer to 2008. h: Data refer to 2003. i: Data refer to 2007. j: Data refer to 2010.

Sources: Row 1: UNPD 2013 and MHHDC staff computations; Rows 2-6: World Bank 2013a; Rows 7-12, 14: World Bank 2013d. Row 13: UNDP 2013.

Highlights

Female *population* has increased in all countries of the region during the last ten years with the highest rate in Afghanistan and the lowest in Sri Lanka. The ratio of female to male population has also improved, but it is still less than 100 in most countries.

Gender gaps in terms of

literacy rate and *enrolment ratios* have decreased in all South Asian countries over the last one decade.

Female *economic activity rate* as a percentage of male has increased in Pakistan, Bangladesh, Afghanistan, Nepal, Bhutan and the Maldives.

The share of female *legislators, senior officials and managers* is the lowest in Pakistan.

Gender Inequality Index (GII) shows the highest inequality in Afghanistan and the lowest in the Maldives.

Female *unemployment rate* has increased in South Asia slightly due to increase in India, Bhutan and the Maldives, while in other countries it has decreased.

	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	South Asia (weighted average)	Developing countries
Population under-18 number (millions)										
2001	402	70	63	11	11.2	6.1	1.05	0.15	565T	1,894T
2010	447	73	56	17	12.9	6.2	0.26	0.11	613T	1,954T
% of total population										
2001	39	48	45	50	47	32	49	51	41	38
2012	37	42	38	53	43	30	36	34	38	35
Population under-five										
number (millions)										
2001	116	23	19	4	3.6	1.6	0.33	0.05	167T	548T
2010	128	21	15	6	3.5	1.9	0.07	0.03	175T	564T
% of total population										
2001	11	16	13	17	15	8	16	16	12	11
2010	10	12	10	18	12	9	10	8	11	10
Infant mortality rate (per	1,000 liv	e births)								
2011	62	74	59	93	59	16	63	36	63	54
2011	47	59	37	73	39	11	42	9	47	40
Under-five mortality rate	(per 1,00	0 live births	;)							
2001	85	93	80	133	79	18	85	45	85	77
2011	61	72	46	101	48	12	54	11	61	56
One-year-olds fully immu	nized aga	ainst tubercu	ılosis (%)							
2001	74	78	94	43	74	98	81	98	76	81
2010	87	95	94	68	94	99	96	97	88	91
One-year-olds fully immu	nized aga	ainst measles	s (%)							
2001	55	61	77	37	71	99	78	98	58	71
2010	74	86	94	62	86	99	95	97	77	84
One-year-olds fully immu	nized aga	ainst polio (⁶	%)							
2001	61	68	85	35	72	98	88	97	64	73
2010	70	88	95	66	83	99	92	97	75	85
Births attended by trained	l health p	ersonnel (%	o)							
2000-01 ^a	43	23	12	12	11	96	24	70	38	59
2008-10 ^a	53	39 ^b	27	24	19°	99 ^b	65	95	49	65
Low birthweight infants (%)									
2006-10ª	28	32	22		21	17	10	22 ^d	28	16 ^e
Children in the labour for	rce (% ag	ed group 5-	14)							
2000-10 ^{°°}	12		13	13	34		18		13	17

6. Child Survival and Development Profile

Notes: a: Data refer to most recent year available. b: Data refer to 2007. c: Data refer 2006. d: Data refer 2001. e: Data refer 2000.

Sources: Rows 1, 2: UNICEF 2002, 2012 and MHHDC staff computations; Rows 3-9: World Bank 2013d; Row 10: UNICEF 2012.

Highlights

Population under-five numbers has increased in India, Afghanistan and Sri

Lanka only, while its share in total population has increased in Afghanistan and Sri Lanka. Similarly, the number of *people under-18* has decreased in Bhutan and the Maldives only, while its share in total population has decreased in all countries of the region except in Afghanistan. Infant and under-five *mortal-ity rates* have also decreased in all countries, with the highest rate of decline in the Maldives.

Child *immunization rates* have improved in all countries of the region except the Maldives. Despite the highest improvement rate, child immunization is the lowest in Afghanistan, while it is the highest in Sri Lanka.

7. Profile of Military Spending

	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	South Asia (weighted average)	Developing countries
Defence expenditure (at 2	2010 prices	s) (US\$ mill	lions)							
2001	26,741	4,487	888	186ª	123	1,277			33,702T	
2011	44,282	5,685	1,367	781	241	1,403	•••		53,759T	
Defence expenditure ann	ual increas	e (%)								
1991-2001	5.0	0.8	5.8		5.7	7.4			4.5	
2001-11	5.2	2.4	4.4	15.4 ^b	7.0	0.9			4.8	
Defence expenditure (% o	of GDP)									
2001	2.9	4.0	1.3	2.0ª	1.1	4.3			2.8	2.2
2011	2.6	3.0	1.4	4.4	1.4	2.6			2.5	2.0
Defence expenditure (% o	of central g	government	expenditure)							
2001	19.1	24.8	14.9	8.7°	12.3 ^d	18.0			18.9	15.1°
2011	17.9 ^f	16.9	10.8 ^g	7.2^{f}	8.9	19.4^{h}			16.8	12.2 ^h
Defence expenditure per	capita (at 2	2010 prices)	(US\$)							
2001	25.0	30.4	6.7	7.0	4.9	67.9			23.7	
2011	35.7	32.2	9.1	22.1	7.9	67.2			32.5	
Armed forces personnel										
number (thousands)										
2001	2,353	908	200	120 ^e	86	210			3,877T	21,959T
2010	2,626	946	221	307	158	223			4,481T	22,381T
% of total labour force										
2001	0.6	2.1	0.3	1.7^{e}	0.7	2.7			0.8	1.0
2010	0.6	1.6	0.3	3.4	1.0	2.6			0.8	0.8
Arms imports (at 1990 pr	rices) (US\$	millions)								
2001	1,271	406	266	34 ^e	11	160		15°	2,163T	10,833T
2011	3,582	1,675	164	835	3	10		$4^{\rm f}$	6,273T	18,114T
Global militarization inde	ex (GMI) ⁱ	(rank out of	f 135 countries)						
2011	71	52	121	56	107	41				

Notes: a: Data refer to 2003. b: Data refer to 2003-11. c: Data refer to 2006. d: Data refer to 2004. e: Data refer to 2002. f: Data refer to 2010. g: Data refer to 2009. h: Data refer to 2008. i: The GMI represents the relative weight and importance of the military apparatus of a State in relation to society as a whole. Militarization is defined, in a narrow sense, as the resources (expenditure, personnel, heavy weapons) available to a State's armed forces. For further information please see www.bicc.de. *Sources:* Rows 1, 2: SIPRI 2013 and MHHDC staff computations; Rows 3, 4, 6, 7: World Bank 2013e; Row 5: SIPRI 2013, UNPD 2013 and MHHDC staff computations; Rows 8: BICC 2013.

Highlights

Defence expenditure as a percentage of GDP and government expenditure has decreased in most countries of the region. However, defence expenditure per capita as well as total has increased in all countries of the region with the highest rate of increase in Afghanistan.

Per capita defence expenditure has decreased slightly in Sri Lanka. During the last two decades the rate of increase in total defence expenditure has increased in India, Pakistan and Nepal. *Armed forces personnel* have increased in all countries with the highest rate of increase in Afghanistan. *Arms imports* in US\$ have increased in Afghanistan, Pakistan and India.

Global Militarization Index (GMI) shows that Sri Lanka is the most militarized country while Bangladesh is the least militarized country in South Asia.

									South Asia	Developing
	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	(weighted	countries
									average)	countries
Total GDP (US\$ billions)									
2001	492.4	72.3	47.0	2.5	6.0	15.7	0.5	0.8	637.2T	5,942.3T
2011	1,848.0	210.2	111.9	19.2	18.9	59.2	1.7	2.1	2,271.2T	23,504.5T
GDP per capita (PPP ^a , co	nstant 200	95 internatio	onal US\$)							
2001	1,778	1,843	1,003	615 ^b	927	3,007	2,885	4,519	1,693	3,356
2011	3,203	2,424	1,569	1,006	1,106	4,929	5,162	7,834	2,910	5,537
GNI per capita (US\$)										
2001	460	480	380	170°	230	830	810	2,310	450	1,131
2011	1,410	1,120	780	470	540	2,580	2,130	5,720	1,302	3,648
GDP per capita growth (9	%)									
2001	3.2	-0.1	3.4	5.4 ^d	2.4	0.1	5.1	1.8	2.9	1.7
2011	5.4	1.1	5.4	2.9	2.1	7.1	3.8	6.1	4.8	5.1
Gross capital formation (% of GDP)								
2001	25.7	17.0	23.1	38.8 ^d	22.3	22.0	60.4	21.9	24.7	23.8
2011	36.6	13.1	25.2	25.4	32.5	29.9	41.2 ^e	40.4^{f}	32.7	29.9
Gross domestic savings (9	% of GDP)									
2001	24.2	15.9	17.0	-23.3 ^d	11.7	15.8	42.0	22.9	21.4	24.4
2011	31.1	8.0	16.4	-19.8	8.6	15.4	24.7°	1.7 ^f	25.6	29.6
Sectoral composition of C	GDP (% o	f GDP)								
agriculture value added										
2001	23.0	24.1	24.1	38.5 ^b	37.2	20.1	26.1	7.1	23.7	11.9
2011	17.2	21.6	18.3	20.8	31.8	12.1	15.9	5.5	18.0	9.8
industry value added										
2001	25.2	24.0	25.9	23.7 ^b	17.8	26.8	37.9	13.6	25.0	34.1
2011	26.4	24.9	28.2	22.5	15.3	29.9	43.9	12.7	26.2	35.6
services value added										
2001	51.8	51.9	50.0	37.8 ^b	45.0	53.1	36.0	79.3	51.3	54.0
2011	56.4	53.4	53.5	56.6	52.9	58.0	40.2	81.8	55.8	54.6
Trade (% of GDP)										
2001	25.6	30.4	36.9	97.8 ^b	50.0	80.9	76.2	114.7	29.7	51.3
2011	54.5	33.4	54.5	81.5	41.7	60.7	92.4	224.0	52.7	60.6
Tax revenue (% of GDP)										
2001	8.0	10.0	7.6	6.9 ^g	8.8	14.6	8.5	10.7	8.2	11.4 ^b
2011	$9.7^{\rm h}$	9.3	8.6 ^e	9.1 ^h	13.2	12.4	9.2 ^e	$11.0^{\rm h}$	9.6	13.0°
Exports of goods and serv	rices (% of	GDP)								
2001	12.4	14.7	15.4	32.4 ^b	20.8	37.3	28.9	57.9	13.8	26.0
2011	24.6	14.2	22.9	18.1	8.9	23.1	36.6	113.5	22.9	30.2
Total net official develope	nent assista	ance receive	d							
total (US\$ millions)										
2001	1,732	1,943	1,044	1310 ^b	390	341	60	25	5,535T	51,894T
2010	2,806	3,013	1,415	6,426	818	580	131	111	15,300T	130,269T
% of GNI										
2001	0.4	2.7	2.1	32.1 ^b	6.5	2.2	12.7	3.3	1.5	0.9
2010	0.2	1.6	1.3	40.9	5.1	1.2	8.6	6.3	1.4	0.7

Continued

	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	South Asia (weighted average)	Developing countries
Total (external) debt serv	icing (%	of exports of	f goods, services	s and income)						
2001	17.9	28.0	9.6		7.9	11.8	2.8 ^g	4.6	17.6	19.9
2011	6.5	9.2	5.5		9.5	9.3	11.1	8.9 ^h	6.7	8.8
Total external debt (US\$	billions)									
2001	99.5	31.9	14.9	0.969 ^g	2.743	8.750	0.722 ^g	0.235	2,159.1	2,148.7
2011	334.3	60.2	27.0	2.423 ^h	3.956	23.984	1.035	$1.007^{\rm h}$	2,461.5	4,876.2
Total (external) debt serv	icing (%	of GNI)								
2001	2.4	4.2	1.4	0.2 ^g	1.6	4.8	1.2 ^g	2.9	2.5	5.7
2011	1.6	1.3	1.2	0.1^{h}	1.1	2.2	5.1	4.8 ^h	1.5	2.8
Income share (ratio of hig	ghest 20%	to lowest 2	20%)							
2010	4.9^{f}	4.2 ⁱ	4.7	4.0 ⁱ	5.0	6.9 ^j	6.8 ^j	6.8°	4.8	
Population below US\$1.2	25 a day (PPP) (%)								
2002	41.6^{f}	35.9	50.5 ^f		53.1 ^d	14.0	26.2 ^d		41.7	30.8
2010	32.7	21.0 ⁱ	43.3		24.8	7.0 ^j	10.2 ^j		32.0	22.4 ⁱ
Population below income	poverty	line (%)								
urban population below i	ncome po	overty line (%)							
2002	25.7 ^f	22.7	28.4^{f}	21.1^{f}	9.6°	7.9	4.2 ^d	•••	25.0	
2010	20.9	13.1 ^g	21.3	29.0 ⁱ	15.5 ^k	5.3	1.7 ^j		20.0	
rural population below in	come pov	verty line (%	b)							
2002	41.8^{f}	39.3	43.8^{f}	36.2^{f}	34.6°	24.7	38.3^{d}		41.3	
2010	33.8	27.0 ^g	35.2	37.5 ⁱ	27.4 ^k	9.4	30.9 ^j		32.9	
Public expenditure on ed	ucation (% of GDP)								
2001	3.6 ^d	1.9^{d}	2.5		3.7		5.9	6.4 ^b	3.3	3.7
2010	3.3	2.4	2.2 ^e		4.7	2.1°	4.0	7.8 ^e	3.1	3.9 ^g
Public expenditure on he	alth (% o	f GDP)								
2001	1.3	0.6	1.2	3.0	1.2	1.7	4.8	3.9	1.3	2.5
2010	1.2	0.8	1.2	0.9	1.8	1.3	4.5	3.8	1.2	2.9

Notes: a: PPP means purchasing power parity. b: Data refer to 2002. c: Data refer to 2004. d: Data refer to 2003. e: Data refer to 2009. f: Data refer to 2005. g: Data refer to 2006. h: Data refer to 2010. i: Data refer to 2008. j: Data refer to 2007. k: Data refer to 2011.

Sources: Rows 1-10, 15-19: World Bank 2013e and MHHDC staff computations; Row 11: World Bank 2013c and e; Rows 12-14: World Bank 2013c and MHHDC staff computations.

Highlights

GDP has increased in all countries with the highest increase in Afghanistan and the lowest increase in Bangladesh, while the growth rate of *GDP per capita* has been the highest in India and the lowest in Nepal during the last decade. The growth rate of *GNI per capita* is the highest in Sri Lanka and the lowest in Bangladesh.

Gross capital formation has

decreased in Pakistan, Afghanistan and Bhutan, whereas *gross domestic savings* increased only in India.

With regard to *sectoral share of GDP*, the share of agriculture has decreased while that of services has increased. The share of industry increased in India, Pakistan, Sri Lanka and Bhutan and decreased in other countries of the region.

Tax to GDP ratio has decreased in Pakistan and Sri Lanka

over the last decade.

Total net official development assistance as a percentage of GNI has decreased in all countries except Afghanistan.

External debt has increased in all countries with the highest rate of increase in the Maldives and India and the lowest rate in Bhutan and Nepal. However, *external debt servicing* as a percentage of exports and GNI has decreased in most countries.

									South Asia	Developing
	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	(weighted	countries
									average)	countries
Total population (million	ns)									
2001	1,071	148	132	27	25.0	18.8	0.59	0.28	1,422T	5,139T
2011	1,241	177	150	35	30.5	20.9	0.74	0.32	1,656T	5,839T
Annual population grow	h rate (%))								
1991-2001	1.9	2.5	2.0	3.1	2.5	0.9	0.6	2.1	2.0	1.6
2001-11	1.5	1.8	1.3	2.8	2.0	1.1	2.3	1.4	1.5	1.3
Rural population (million	ns)									
2001	772	98	100	21	21.5	15.9	0.43	0.20	1,029T	3,028T
2011	853	113	108	27	25.3	17.7	0.48	0.19	1,144T	3,121T
Urban population (millio	ons)	-						-		- /
2001	300	49	32	6	3.4	2.9	0.16	0.08	393T	2,111T
2011	389	64	43	8	5.2	3.2	0.26	0.13	512T	2,718T
Annual growth rate of ur	ban popul	ation (%)								
1991-2001	2.7	3.4	3.8	4.4	6.6	0.0	5.0	3.3	2.9	2.8
2001-11	2.6	2.6	3.0	4.1	4.2	0.7	5.4	5.1	2.7	2.6
Crude birth rate (per 1,0	00 live bir	ths)	-				-	-		
2001	25	30	26	50	32	18	26	21	26	23
2011	22	27ª	20	44ª	24	18ª	20	17	23	21ª
Crude death rate (per 1,0	00 live bi	rths)								
2001	9	8	7	19	8	7	8	4	9	9
2011	8	7ª	6	16ª	6	7ª	7	4	8	8ª
Total fertility rate										
2001	3.1	4.3	3.0	7.6	3.9	2.2	3.5	2.7	3.3	2.8
2011	2.6	3.4ª	2.2	6.3ª	2.7	2.3ª	2.3	1.7	2.7	2.6ª
Dependency ratio (deper	dents to v	vorking-age	population)							
2001	63	81	69	101	80	48	76	75	66	62
2011	54	64	55	94	66	50	51	45	56	54
Total labour force (millio	ons)									
2001	420	44	59	7	13	8	0.24	0.10	551T	2,308T
2010	473	60	72	9	16	9	0.36	0.15	639T	2,669T
Male labour force (millio	ns)									
2001	302	37	37	6	6	5	0.15	0.06	397T	1,402T
2010	353	47	43	8	8	6	0.21	0.09	470T	1,626T
Female labour force (mil	ions)									
2001	118	7	22	1	6	3	0.10	0.03	153T	906T
2010	120	12	29	1	8	3	0.15	0.06	169T	1,043T
Annual growth in labour	force (%)									
1991-2001	2.2	3.1	2.3	2.6	2.8	1.5	1.8	4.7	2.3	1.8
2001-11	1.2	3.0	2.1	3.1	2.4	0.8	4.1	4.9	1.5	1.5
Unemployment rate (%)										
2000-01 ^b	4.3	7.2	3.3		8.8	7.9	1.9	2.0	4.6	5.3
2008-10 ^b	4.4°	5.0	5.0	8.5°	2.7	4.9	4.0	14.4^{d}	4.6	6.0°

Notes: a: Data refer to 2010. b: Data refer to most recent year available. c: Data refer to 2005. d: Data refer to 2006. Sources: Rows 1-5: UNPD 2013 and MHHDC staff computations; Rows 6-8: World Bank 2013d; Rows 9-13: World Bank 2013d and MHHDC staff computations; Row 14: World Bank 2013e.

Highlights

Population increased in all countries of the region with the highest growth rate in Afghanistan and the lowest growth rate in Sri Lanka. However, the growth rate of population has decreased over the last two decades due to decline in fertility rates which is still very high in Afghanistan and Pakistan. There has been more population growth in urban areas and less in rural areas, indicating an increase in urbanization in South Asia.

A decline in the fertility rate across South Asia has resulted a

concomitant decline in the dependency ratio.

Labour force including male and female has increased in the region, the average regional growth for male labour force is higher than the developing countries' average and for female labour force lower.

	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	South Asia (weighted average)	Developing countries
Food production net per	capita inde	x (2004-20	006 = 100)							
2001	101	93	93	90	97	98	77	86	99	
2010	114	104	125	104	104	117	78	75	114	
Food exports (% of merc	chandise exp	oorts)								
2001	13.3	10.9	6.1		20.6ª	21.2	10.6 ^b	57.4	12.6	10.4
2011	9.0	19.5	6.5°	40.0^{d}	19.1^{d}	25.7	7.2 ^d	96.8	11.0	10.9
Food imports (% of mer	chandise im	iports)								
2001	5.8	12.5	17.4		17.3ª	14.4	14.5 ^b	23.0	7.9	8.1
2011	3.7	12.0	22.5°	13.7 ^d	13.6 ^d	13.3	11.5 ^d	21.0	6.8	7.6
Cereal production (thou	sand metric	tons)								
2001	242,964	27,048	38,029	2,108	7,120	2,728	114	0.12	320,111T	
2010	260,163	34,811	51,875	5,957	7,763	4,470	144	0.14	365,183T	
Cereal imports (thousand	d metric tor	ns)								
2001	9	167	2,930	1,598	47	941	24	39	5,754T	
2010	205	261	4,569	803	254	1,137	68	48	7,344T	
Cereal exports (thousand	l metric ton	s)								
2001	5,432	3,347	1.5	0.0	7.2	4.0	2.1	0.0	8,793T	
2010	4,889	4,422	3.9	0.0	6.0	397.8	1.1	0.0	9,720T	
Forest production (thous	sands cu. m)								
roundwood (thousands c	cu. m)									
2001	296,679	34,194	28,387	3,074	14,004	6,534	4,418	13	387,303T	
2011	331,969	32,650	27,410	3,415	13,724	5,747	5,025	16	419,955T	
fuelwood (thousands cu.	m)									
2001	277,380	31,515	27,799	1,314	12,744	5,840	4,284	13	360,889T	
2011	308,776	29,660	27,128	1,655	12,464	5,136	4,897	16	389,731T	
Crop production index (2004-2006	= 100)								
2001	95	84	89	73	88	93	62	78	662	
2010	123	101	132	131	114	120	84	77	882	
Land area (thousand hec	tares)									
2001	297,319	77,088	13,017	65,223	14,335	6,271	4,008	30	477,291T	
2009	297,319	77,088	13,017	65,223	14,335	6,271	3,839	30	477,122T	
Land use										
arable land (% of land an	rea)									
2001	53.9	27.9	64.1	11.8	16.4	14.6	3.2	13.3	50.2	
2009	53.1	26.5	58.1	11.9	16.7	19.1	2.0	13.3	48.8	
permanent cropped area	(% of land	area)								
2001	3.2	0.9	3.5	0.1	0.8	15.9	0.6	20.0	3.1	
2009	3.9	1.1	7.5	0.2	0.8	15.5	0.7	10.0	4.0	

10. Profile of Food Security and Natural Resources

	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	South Asia (weighted average)	Developing countries
Irrigated land (% of a	cropland)									
2001	32.2	65.6	51.3°	5.7	27.6				37.0	
2009	35.1	73.9	52.6 ^f	4.8	27.7 ^g				40.1	
Daily dietary energy	consumpti	ion (kcal/per	son/day)							
2001	2,227	2,334	2,378		2,267	2,375		2,553	2,255	
2009	2,321	2,423	2,481		2,443	2,426		2,720	2,351	
Undernourished peop	ple									
number (millions)										
2000-02	231	35	22	12	6	5		0	311T	905T
2010-12	217	35	25	12	5	5		0	299T	852T
% of total population	1									
2000-02	21.6	23.9	17.0		24.0	28.6		10.2	21.5	18.2
2010-12	17.5	19.9	16.8		18.0	24.0		5.6	17.8	14.9

Notes: a: Data refer to 2003. b: Data refer to 2005. c: Data refer to 2007. d: Data refer to 2010. e: Data refer to 2004. f: Data refer to 2006. g: Data refer to 2008. Sources: Rows 1, 4-11: FAO 2013b and MHHDC staff computations; Rows 2, 3: World Bank 2013e; Rows 12, 13: FAO 2013c.

Highlights

Food production has increased in most countries of the region with the highest increase in Bangladesh. *Food exports* as a percentage of merchandise exports increased in Pakistan, Bangladesh, Sri Lanka and the Maldives, while *food imports* increased only in Bangladesh.

Cereal production has increased in all countries with the highest

growth rates in Afghanistan, Sri Lanka and Bangladesh. However, cereal exports decreased in Bhutan, Nepal and India, while *cereal imports* increased in all countries except Afghanistan.

Forest production decreased in Sri Lanka, Pakistan, Bangladesh and Nepal, while *crop production* decreased in the Maldives only.

With regard to land use, the

share of arable land decreased in India, Pakistan, Bangladesh and Bhutan, while the share of permanent cropped area decreased in Sri Lanka and the Maldives. The *irrigated crop* as a percentage of cropland decreased in Afghanistan only.

Daily dietary energy consumption and the proportion of undernourished population have improved in all countries of the region.

	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	South Asia (weighted average)	Developing countries
Energy use per capita	(kg of oil	equivalent)								
2001	434	437	153		335	428	280ª	859ª	406	904
2010	566	487	209		341	478	354 ^b	985 ^b	519	1,210
Total electricity prod	uction (kw	/h billions)								
2001	579.9	72.4	17.4		1.9	6.8			678.4T	5,790.7T
2010	959.9	94.5	42.3		3.2	10.8			1,110.7T	10,344.7T
Motor vehicles per ki	lometre of	road								
2010	5°	12	22	11 ^d	8 ^b		7 ^e	50 ^f	8	
Annual average num	per of disas	ster-affected j	people (thousai	nds)						
1991-2001	39,856	2,040	7,749	305	94	424	6	2	50,476T	
2001-11	47,800	3,938	6,564	470	289	650	2	3	59,716T	
Annual average econo	omic losses	from natura	l disasters (US	\$ millions)						
1991-2001	1,818	146	752	8	22	26	0	3	2,775T	
2001-11	2,402	1,785	489	15	6	178	0	43	4,918T	

Notes: a: Data refer to 2004. b: Data refer to 2007. c: Data refer to 2008. d: Data refer to 2006. e: Data refer to 2009. f: Data refer to 2005. Sources: Rows 1-3: World Bank 2013e; Rows 4, 5: CRED 2013.

Highlights

Total electricity production has increased in all countries of the region with the highest growth rate in Bangladesh and the lowest in Pakistan. In comparison, the increase in *energy use per capita* has been lower.

During the last two decades, annual average number of *disasteraffected people* has increased in most countries of South Asia with the highest rate of increase in Nepal and Pakistan. The increase in annual average *economic losses from natural disasters* has been the highest in the Maldives, Pakistan and Sri Lanka.

12. Governance

	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	South Asia (weighted average)	Developing countries
Average annual rate of inf	lation (200	00=100) (%)							
2001	4.3	4.4	1.9	11.9ª	2.4	14.2	3.4	0.7	4.3	
2011	8.4	13.7	8.8	13.7	12.1	6.7	8.9	6.6 ^b	9.1	
Annual growth of food pr	ices (1999	-2001=100)) (%)							
2001	2.9	3.6	1.4	9.1ª	-2.3	15.2	1.5	10.2	3.0	
2011	6.3	18.0	11.3	13.9	17.5	8.8	10.2	5.2 ^b	8.4	
Annual growth of money	supply (%)								
2001	14.3	11.6	42.6	42.4°	16.8	13.6	7.9	7.8	17.3	
2011	16.1	12.0	16.9	21.3	18.7	19.1	4.3	20.0	15.9	
Total revenue (% of GDI	P)									
2001	9.7	12.2	9.6	2.9 ^d	11.1	16.3	21.7	23.5	9.9	
2011	9.0	14.3	12.5	10.8 ^b	15.2	14.3	22.9	27.8	10.1	
Total expenditure (% of G	GDP)									
2001	15.9	17.5	14.8	7.7 ^d	18.1	25.9	46.6	29.6	16.0	
2011	14.9	19.1	15.2	20.6 ^b	21.4	20.9	38.7	41.8	15.7	
Budget deficit/surplus (%	of GDP)									
2001	-6.2	-4.3	-4.1	-1.2 ^d	-5.5	-10.2	-10.6	-3.7	-5.7	
2011	-5.9	-4.6	-2.9	0.4 ^b	-2.3	-6.9	19.3	-10.2	-5.3	
Tax revenue (% of GDP)										
2001	8.0	10.0	7.6	6.9 ^e	8.8	14.6	8.5	10.7	8.2	11.4 ^d
2011	9.7 ^b	9.3	8.6 ^f	9.1 ^b	13.2	12.4	9.2 ^f	11.0 ^b	9.6	13.0 ^f
Tax revenue by type (% o	of total taxe	es)								
taxes on international trac	le									
2001	21.5	15.4	43.2	47.7 ^e	32.3	12.7	4.9	63.2	23.5	
2011	15.4 ^b	10.3	32.1 ^f	41.6 ^b	20.2	19.5	3.6 ^f	70.1 ^b	17.1	
taxes on income, profits a	nd capital	gains								
2001	36.8	29.0	16.0	18.0 ^e	21.9	16.8	62.2	5.0	33.1	
2011	56.5 ^b	37.1	25.4 ^f	27.4 ^b	23.8	19.4	58.0 ^f	6.9 ^b	49.9	
taxes on goods and service	es									
2001	41.5	47.9	34.6	24.3°	42.7	66.4	28.5	30.6	41.5	
2011	28.0 ^b	46.9	37.9 ^f	27.3 ^b	53.3	50.2	37.9 ^f	21.7 ^b	31.7	
other taxes										
2001	0.2	7.7	6.2	10.1 ^e	3.1	4.1	4.4	1.1	1.9	
2011	0.1^{b}	5.7	4.5 ^f	3.7 ^b	2.7	11.0	0.5 ^f	1.3 ^b	1.4	

	India	Pakistan	Bangladesh	Afghanistan	Nepal	Sri Lanka	Bhutan	Maldives	South Asia (weighted average)	Developing countries
Public expenditure per ca	pita (US\$))								
defence										
2001	13.6	18.6	4.6	3.4 ^g	2.6	35.9			13.2	
2011	39.4	35.6	9.5	24.8	8.6	74.5			35.9	
interest payments										
2001	11.0	20.3	5.0	0.4 ^e	3.8	39.5	11.0	78.2	11.4	63.1
2011	23.5	16.7	9.9	0.3	6.7	62.9	114.7	293.4	21.3	106.3
education										
2001	20.1 ^g	10.3 ^g	8.9		8.9		47.8	188.0^{d}	17.9	42.8
2010	45.4	24.4	13.4^{f}		25.1	43.2^{f}	87.3	485.5^{f}	39.9	82.6°
health										
2001	6.0	2.8	4.2	2.8	2.9	14.6	39.2	113.5	5.6	28.4
2010	16.3	8.6	7.9	4.0	9.8	31.6	98.5	251.6	14.6	102.8
Imports of goods and serv	vices (% of	GDP)								
2001	13.2	15.7	21.5	65.4 ^d	29.2	43.6	47.3	56.8	15.9	25.3
2011	29.8	19.2	31.6	63.4	32.8	37.6	55.8	110.5	29.7	30.4
Net inflow of FDI (US\$	millions)									
2001	5,472	383.0	78.5	0.7	20.9	171.8	2.5 ^g	20.5	6,150T	158,729T
2011	32,190	1,308.8	797.5	83.4	94.0	955.9	16.4	281.6	35,728T	645,522T
Total external debt (% of	GNI)									
2001	20.4	44.7	30.7	11.8°	45.5	56.6	79.3°	31.3	24.6	37.6
2011	18.3	27.3	22.6	16.0 ^b	20.8	41.0	65.0	50.8 ^b	20.0	21.5
Total (external) debt serv	icing (% o	f GNI)								
2001	2.4	4.2	1.4	0.2 ^e	1.6	4.8	1.2 ^e	2.9	2.5	5.7
2011	1.6	1.3	1.2	0.1 ^b	1.1	2.2	5.1	4.8^{b}	1.5	2.8

Notes: a: Data refer to 2005. b: Data refer to 2010. c: Data refer to 2007. d: Data refer to 2002. e: Data refer to 2006. f: Data refer to 2009. g: Data refer to 2003. Sources: Rows 1-6: ADB 2012b; Rows 7, 8, 9b, 10, 11: World Bank 2013e; Row 9a: SIPRI 2013, UNPD 2013, World Bank 2013e and MHHDC staff computations; Row 9c: UNPD 2013, World Bank 2013a, e and MHHDC staff computations; Row 9d: World Bank 2013d, e and MHHDC staff computations; Rows 12, 13: World Bank 2013c.

Highlights

In 2011, *inflation*, both general and food, has increased in most countries of the region with the highest inflation rate in 2011 in Pakistan. However, food prices have decreased in Sri Lanka and the Maldives.

Growth rate of *money supply* decreased in Afghanistan, Bangladesh and Bhutan.

Total revenue as a percentage of GDP increased in all countries except in India while tax revenues as a percentage of GDP decreased in Sri Lanka and Pakistan. *Total expenditure* as a percentage of GDP increased in Pakistan, Bangladesh, Afghanistan, Nepal and the Maldives. Overall, *budget deficit* as a percentage of GDP increased in Pakistan and the Maldives.

Taxes on international trade have decreased in the region with the exception of Sri Lanka and the Maldives. Taxes on goods and services have also decreased in the region except in Bhutan, Nepal, Afghanistan and Bangladesh. Taxes on income, profits and capital gains have increased in the region with the exception of

Bhutan.

Public expenditure per capita on defence, interest payments on external debt, education and health has increased in all countries except in Afghanistan and Pakistan.

Imports as a percentage of GDP have decreased in Sri Lanka and Afghanistan only.

Foreign direct investment has increased in the region with the highest rate of increase in Afghanistan and the lowest in Pakistan.

Glossary for Statistical Profile of Water in South Asia

Agricultural water managed area: The sum of total area equipped for irrigation and areas with other forms of agricultural water management.

Area equipped for full control irrigation: The sum of surface irrigation, sprinkler irrigation and localized irrigation.

Area equipped for full control irrigation, by groundwater: The portion of the full control irrigation area that is irrigated from wells or springs.

Area equipped for full control irrigation, by localized irrigation system: The portion of the full control irrigation area that is irrigated from water that is distributed under low pressure through a piped network, in a pre-determined pattern, and applied water as a small discharge to each plant or adjacent to it.

Area equipped for full control irrigation, by mixed surface water and groundwater: The portion of the full/partial control irrigation area that is irrigated from mixed surface water and groundwater.

Area equipped for full control irrigation, by sprinkler irrigation system: The portion of the full control irrigation area that is irrigated from piped network, through which water moves under pressure before being delivered to the crop via sprinkler nozzles.

Area equipped for full control irrigation, by surface irrigation system: The portion of the full control irrigation area that is irrigated with the principle of moving water over the land by simple gravity in order to moisten the soil.

Area equipped for full control irrigation, by surface water: The portion of the full control irrigation area that is irrigated from rivers or lakes.

Cool days/cold nights, change in: Projected changes in the annual number of cool days and cold nights during the period specified, relative to the control period 1961-2000.

Cultivated area drained: The sum of the drained portions of area equipped for irrigation and

non-irrigated land area.

Dam capacity: Total cumulative storage capacity of all dams in each country.

Dependency ratio: The percentage of total renewable water resources originating outside the country.

Emissions of organic water pollutants: They are measured as biochemical oxygen demand, or the amount of oxygen that bacteria in water will consume in breaking down waste, a standard water treatment test for the presence of organic pollutants.

Emissions of organic water pollutants by industry: They are emissions from manufacturing activities.

Energy supply by fossil fuel and renewable sources: *Fossil fuel* comprises coal, oil, petroleum and natural gas products. *Renewable energy* is generated from solar, wind, biomass, geothermal, hydropower and ocean resources, and biofuels and hydrogen derived from renewable resources.

Energy use: It refers to the use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport.

Freshwater withdrawal, groundwater: Annual gross amount of water extracted from aquifers.

Freshwater withdrawal, surface water: Annual gross amount of water extracted from rivers, lakes and reservoirs.

Freshwater withdrawal, total: The sum of surface water withdrawal and groundwater withdrawal.

Greenhouse gas emissions: Greenhouse gases include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. They absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds.

Hot days/warm nights, change in: Projected

changes in the annual number of hot days and warm nights during the period specified, relative to the control period 1961-2000.

Hydrological disasters: Events caused by deviations in the normal water cycle and/or overflow of bodies of water caused by wind set-up.

Irrigated crop area, total harvested: Crops grown under full control irrigation.

Irrigation potential: The area of land which is potentially irrigable.

Land area, cultivated: The sum of arable land area and the area under permanent crops.

Land area, total: Total area of the country, including area under inland water bodies.

Municipal wastewater, produced: Annual volume of domestic, commercial and industrial effluents and storm water run-off, generated within urban areas.

Population density: The number of inhabitants per square kilometre of total area.

Population economically active in agriculture: The part of the economically active population engaged in or seeking work in agriculture, hunting, fishing or forestry.

Population, economically active, total: The number of all employed and unemployed persons.

Population, total: All persons physically present within the present geographical boundaries of countries at the mid-point of the reference period.

Precipitation, long-term average annual precipitation in depth or volume: Long-term average (over space and time) of annual endogenous precipitation (produced in the country) in depth or volume.

Renewable water resources, external groundwater entering the country (actual): Long-term average annual quantity of groundwater annually entering the country, taking into consideration eventual treaties. A distinction can be made between *natural inflow*, which is the inflow under natural conditions, and *actual inflow*, which is the inflow taking into consideration both inflow not submitted to treaties and inflow secured through treaties.

Renewable water resources, external groundwater leaving the country (actual): Long-term average annual quantity of groundwater leaving the country not submitted to treaties and secured through treaties.

Renewable water resources, external surface water entering and bordering the country (actual): The sum of the surface water inflow not submitted to treaties, the surface water inflow secured through treaties, the actual accounted flow of border rivers and the actual accounted part of border lakes.

Renewable water resources, external surface water entering the country (natural): Long-term average quantity of water annually entering the country through transboundary flow.

Renewable water resources, external surface water leaving the country (natural): Average quantity of water annually leaving the country.

Renewable water resources, external surface water, total (actual): The sum of the actual inflow not submitted to treaties, actual inflow secured through treaties, the accounted flow of border rivers and the accounted part of shared lakes, minus the outflow reserved for downstream countries through treaties.

Renewable water resources, external total (actual): The part of a country's annual renewable water resources that are not generated in the country.

Renewable water resources, internal groundwater: Long-term annual average groundwater recharge, generated from precipitation within the boundaries of the country.

Renewable water resources, internal overlap between surface water and groundwater: The part of the renewable freshwater resources that is common to both surface water and groundwater.

Renewable water resources, internal surface water: Long-term average annual volume of surface water generated by direct run-off from endogenous precipitation (surface run-off) and groundwater contributions.

Renewable water resources, internal total: Longterm average annual flow of rivers and recharge of aquifers generated from endogenous precipitation. Double counting of surface water and groundwater resources is avoided.

Renewable water resources, total (actual): The sum of internal renewable water resources and external actual renewable water resources.

Renewable water resources, total groundwater: The sum of internal renewable groundwater resources and total external actual renewable groundwater resources.

Renewable water resources, total surface water: The sum of internal renewable surface water resources and total external actual renewable surface water resources.

Sanitation, population with access to improved: The percentage of the population with at least adequate access to excreta disposal facilities (private or shared, but not public) that can effectively prevent human, animal, and insect contact with excreta.

Water, population with access to improved: The percentage of the population with reasonable access to an adequate amount of water from an improved source, such as piped water into a dwelling, plot, or yard; public tap or standpipe; tubewell or borehole; protected dug well or spring; and rainwater collection.

Water productivity: It is calculated as GDP in constant prices divided by annual total water withdrawal.

Water, sanitation and hygiene-related disabilityadjusted life years (DALYs) and deaths: The disease burden attributable to unsafe water, inadequate sanitation, insufficient hygiene and inadequate management of water resources. DALYs measure the years of life lost to premature mortality and to disability.

Water withdrawal, agricultural sector: Annual quantity of self-supplied water withdrawn for irrigation, livestock and aquaculture purposes.

Water withdrawal, industries: Annual quantity of water withdrawn for industrial uses.

Water withdrawal, municipalities: Annual quantity of water withdrawn primarily for direct use by the population.

Water withdrawal, total: Annual quantity of water withdrawn for agricultural, industrial and municipal purposes.

Temperature, change in: Projected change in annual temperature during the period specified, relative to the control period 1961-2000.

KEY TO INDICATORS

Indicator	Indicator table	Indicator	Indicator table
A, B, C		Death rate, crude	9
Agricultural water managed area,		Debt external,	
% of agricultural water managed area		% of GNI	12
equipped for irrigation	5w	total	8
total	5w	Debt servicing,	
Area equipped for full control irrigation,		% of exports	8
by irrigation technique,		% of GNI	8,12
localized irrigation	5w	per capita expenditure	12
sprinkler irrigation	5w	Defence expenditure,	
surface irrigation	5w	per capita	7,12
by source of water,		%, annual increase	7
groundwater	5w	% of central government expenditure	7
surface water	5w	% of GDP	7
mixed surface water and groundwater	r 5w	total	7
total	5w	Dependency ratio (age)	9
Armed forces personnel,		Dependency ratio (water)	1w
number	7	Dietary energy consumption,	
% of total labour force	7	daily, kcal per person	10
Birth rate, crude	9	Disaster, natural,	
Births attended by trained health staff	6	affected people	11
Birthweight, low	6	economic losses	11
Budget, public sector, % of GDP,			
deficit/surplus	12	E	
expenditure, total	12	Economic activity rate, female (% of male)	5
revenue, total	12	Education expenditure, public,	
Cereal,		per capita	12
exports	10	% of GDP	2,8
imports	10	% of government expenditure	2
production	10	Electricity,	
Children,		population with access to	7w
one-year-olds fully immunized,		production	11
against DPT	3	Emissions of organic water pollutants,	
against measles	3,6	by industry,	
against polio	6	chemicals	4w
against tuberculosis	6	food and beverages	4w
in the labour force	6	other	4w
mortality rate, infant	1,6	paper and pulp	4w
mortality rate, under-five	4,6	primary metals	4w
not in primary school	2	stone, ceramics and glass	4w
reaching grade five, % of grade one students	2	textiles	4w
Cool days/cold nights, change in	7w	wood	4w
Contraceptive prevalence rate	3	per day per worker	4w
Crop production index	10	thousands kilogrammes per day	4w
Cultivated area drained,		Energy supply by,	
% of total cultivated area drained	5w	fossil fuel	7w
total	5w	renewable sources	7w
D		intensity	7w
Dam capacity,		per capita	11
per capita	2w	Enrolment, %,	
total	2w	combined 1st, 2nd and 3rd level, gross ratio),

Indicator	Indicator table	Indicator I	ndicator table
female	5	industry	7w
total	1,2	energy	7w
primary level, gross,	,	waste	7w
female	5	by type,	
total	2	carbon dioxide	7w
primary level, net,		methane	7w
female	5	nitrous oxide	7w
total	2	other	7w
secondary level,		per capita	7w
gross	2	total	7w
net	2	Gross capital formation, % of GDP	8
technical and vocational	2	Gross domestic savings. % of GDP	8
Exports. % of GDP	8		
F		H, I, J Health expenditure, public	
FDI net inflow	12	per capita	12
Fertility rate total	9	% of GDP	3.8
Food	<i>,</i>	% of government expenditure	3
exports % of merchandise exports	10	HIV/AIDS affected	5
imports % of merchandise imports	10	adult population % aged 15-49	34
prices average annual growth	12	population, total	3
production, net per capita index	10	Hot days/warm nights, change in	5 7w
Forest production	10	Human Development Index	1
fuelwood	10	Hydrological events	1
roundwood	10	fatalities	5
Freebwater withdrawal	10	number	5.00
groundwater		number persons affected	5w
% of total freshwater withdrawal	3	Illiterate adults) vv
value	3w	total	
% of total actual renewable water resources	3w	number	4
surface water	5.00	% of adult population	4
% of total freshwater withdrawal	3w	females	1
value	3w	number	4
total	3w	% of adult (female) population	4
	511	Immunization one-year-olds fully immunized	1
G		against DPT	3
GDP		against measles	3.6
growth rate	1	against polio	6
per capita growth	8	against tuberculosis	6
per capita	1.8	Imports.	0
sectoral composition, value added %	1,0	arms	7
agriculture	8	goods and services	12
industry	8	Income share: ratio of top 20 per cent to bottom 20 per cen	nt 8
services	8	Inflation, average annual rate.	
total	8	consumer prices	12
Gender Inequality Index	1.5	food prices	12
Global Militarization Index	7	Irrigated crop area, total barvested	5w
GNI per capita	8	Irrigated cropping intensity	5w
Greenhouse gas emissions.	Ŭ	Irrigation potential	5w
by economic activity			2
agriculture	7w		
ugitouture	,	l de la constante de	

Indicator	Indicator table	Indicator	Indicator table
K, L		density	1w
Labour force,		economically active,	
annual growth rate	9	agriculture,	
child	6	female	1w
female	9	male	1 w
male	9	total	1w
total	9	female,	
Land,		number	5
area	10,1w	% of male	5
area cultivated,		rural	9,1w
% of land area	1w	total	1,9,1w
total	1w	under-five,	
irrigated, % of cropland	10	number	6
Land use,		% of total	6
arable, % of land area	10	under-18,	
permanent cropped area, % of land area	10	number	6
Life expectancy at birth,		% of total	6
female	5	urban,	
total	1	annual average growth rate	9
Literacy rate,		number	9
adult,		Poverty, income,	
female	1,5	population below national poverty line,	
female, % of male	5	rural	8
male	2	total	4
total	1,2	urban	8
youth,		population below US\$1.25 a day,	
female, % of male	5	number	4
total	2	%	4,8
Legislators, senior officials and managers, female	5	population below US\$2 a day,	
		number	4
M, N, O		%	4,8
Malnourished, weight for age (children under-five)	4	Professional and technical workers, female	5
Money supply, average annual growth	12	Pupil teacher ratio	2
Mortality rate,		R&D expenditures, % of GDP	2
infant	1,6	Researchers, per million inhabitants	2
maternal	3		
under-five	4,6	S	
Motor vehicle, per km of road	11	Sanitation,	
Municipal wastewater, produced	4w	population using improved,	
Official development assistance (ODA) received, net,		with access,	
% of GNI	8	national	3,6w
total	8	rural	6w
		urban	6w
P, Q, R		without access,	
Parliament, seats held by women	5	number	4
Physicians, per 1,000 people	3	%	4
Precipitation,		population using unimproved,	
depth	2w	with access,	
volume	2w	national,	
Population,		rural,	
annual growth rate	1,9	urban,	
		• · · · · · · · · · · · · · · · · · · ·	

Indicator	In	dicator table	Indicator	Indicator table
	open defecation	6w	total	1w,2w
	other unimproved	6w	Water resources, external renewable,	
	shared	6w	groundwater,	
	total	6w	entering the country	2w
School life expectancy,			leaving the country	2w
primary to secondary		2	surface water,	
primary to tertiary		2	entering and bordering the	
			country	2w
T, U, V			entering the country	2w
Tax revenue,			leaving the country	2w
by,			total	2w
goods and services		12	total	1w.2w
income, profits and c	capital gain	12	Water resources, internal renewable,	,
international trade	suprim guin	12	groundwater	$2_{\rm W}$
other taxes		12	overlap between surface water and	2.00
% of CDP		8.12	groundwater	2
Temperature change in		0,12 7m	groundwater	2 w 2 w
Trade % of CDP		2 W	per capita	2 w 2 w
Lader ourishment		0	sufface water	2 w 1 2
		10		1 w,2 w
number		10	water, sanitation and hygiene-related,	(
% of total population		10	deaths, total,	6W
Unemployment rate,		-	disability-adjusted life years (DALYs)	/
female		5	total,	6w
total, %		5,9	by cause,	
			consequences of malnutrition	6w
W, X, Y, Z			dengue	6w
Water,			diarrhoeal diseases	6w
population using improved,			drowning	6w
with access,		3	intestinal nematode infections	6w
national,			japanese encephalitis	6w
rural,			lymphatic filariasis	6w
urban,			malaria	6w
	other improved	6w	onchocerciasis	6w
	piped on premises	6w	other infectious diseases	6w
	total	6w	protein-energy malnutrition	6w
without access,			schistosomiasis	6w
number		4	trachoma	6w
%		4	% of total	6w
population using unimproved,			Water withdrawal,	
with access,			agricultural sector,	
national,			% of total actual renewable	
rural,			water resources	3w
urban,			% of total water withdrawal	1w,3w
	other unimproved	6w	value	3w
	surface water	6w	industries,	
	total	6w	% of total water withdrawal	1w.3w
Water productivity total	cotur	3w	value	3w
Water resources total renewable		5.11	municipalities	
aroundwater		2337	06 of total water with drawal	1 w 3w
per capita		∠ w 1 xx 2xx	value	1 W, J W 2 M
pu capita surface water	2	1 vv,∠w	value	J w 1 w 3 w
surface water	∠w		per capita	1W, JW

Indicator In	dicator table	Indicator	Indicator table
% of total renewable internal freshwater resources total Women in ministerial level positions	3w 1w,3w 4		

Note: 'w' is added to table numbers which appear in Profile of Water in South Asia.

Theme of	the Reports on Human Development in South Asia				
1997	The Challenge of Human Development				
1998	The Education Challenge				
1999	The Crisis of Governance				
2000	The Gender Question				
2001	Globalization and Human Development				
2002	Agriculture and Rural Development				
2003	The Employment Challenge				
2004	The Health Challenge				
2005	Human Security in South Asia				
2006	Poverty in South Asia: Challenges and Responses				
2007	A Ten-year Review				
2008	Technology and Human Development in South Asia				
2009	Trade and Human Development				
2010/11	Food Security in South Asia				
Published for Mahbub ul Haq Human Development Centre by Oxford University Press, Karachi.					
Published	by Mahbub ul Haq Human Development Centre				
1999 2000 2012	Profile of Poverty in Pakistan First Mahbub ul Haq Memorial Lecture Governance for People's Empowerment				

Mahbub ul Haq Centre's Report on *Water for Human Development* addresses the issue of water in South Asia from the perspective of human development. The Report analyses the impact of water on people's ability to survive and prosper in the context of reduced supply of and increased demand for water because of growing population, increased economic activities and the effects of climate change. The economies of most South Asian countries are growing, but are the people, facing inadequate health, education and food insecurity benefitting from these economies? Can this growth be sustained without efforts to mitigate the impact of climate change? And in view of reduced water supply, can this region afford not to cooperate with its neighbours on water sharing? These are some of the issues the Report tries to analyze and address. The high quality of analytical work and the wealth of data on water and human development in South Asia collected for this Report will be valuable for policy makers and the academic community.

Human Development in South Asia 2013 has been prepared under the supervision of Khadija Haq, President of Mahbub ul Haq Centre. Research was conducted by a team consisting of Nazam Maqbool, Umer Malik, Fazilda Nabeel and Amina Khan.



