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Water policy, climate change and adaptation in South Asia

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Scarcity will affect nearly two-thirds of the world in the near future. The impacts of climate change are likely to exacerbate these problems and unless appropriate adaptation strategies are adopted, resilience is difficult to achieve. The paper surveys the water resources available in South Asian countries and takes into account the projected climate change impacts on these resources. The paper also analyses the water policies and formulates a conceptual water policy framework in which adaptation is central.

Keywords: South Asia; Water; Climate change; Adaptation

Introduction

The spectre of water scarcity is hovering over many parts of the earth. By the beginning of the twenty-first century, a water crisis faced the world and its over six billion inhabitants, merging with poverty, making many vulnerable and insecure [1]. Excessive use of aquifers and river systems is ruining many important food-producing regions of the world. Lack of safe water is linked to food insecurity, improper sanitation, increased cases of waterborne diseases, loss of livelihood and environmental degradation which can provoke regional tensions and conflicts.

Many studies, analysing the status of global water scarcity, conclude that almost two-thirds of the world population will encounter severe water scarcity over the coming decades [2–4]. Many developing countries are facing difficulty in supplying water to their inhabitants and one in four people is likely to live in countries affected by acute or recurring water shortages by the year 2050 [5]. It has been estimated that even without climate change effects, there would be a significant increase in the numbers of those facing the stress of inadequate potable water, inadequate water for agriculture, etc. across the various watersheds of the world [6]. By 2030, one-third of the world's population will live near drainage basins where the water deficit will be larger than 50% [7]. This deficit will be more prominent in Sub-Saharan Africa, North Africa, South Asia, the Middle East and South America where water resources are becoming markedly less adequate [7–8].

The Intergovernmental Panel on Climate Change (IPCC) states that 'water and its availability and quality will be the main pressures on, and issues for, societies and the

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environment under climate change' [9]. With fluctuations in rainfall pattern and distribution and temperature change, the water situation for the poor looks disastrous; with consequences including the loss of livelihood, food insecurity, health insecurity and environmental degradation. The associated uncertainties and risks make the management of water complicated. In addition, water is at the centre of politics between nations; e.g. the risk of conflict over the allocations of the river Nile, the impact of Turkey's dams on Iraq, the injustice of Israel's water grabbing from Palestinians or the dispute over water allocation from River Teesta between India and Bangladesh. These conflicts over the control of flowing waters are evidence of the growing need for water [10].

South Asia or the Indian subcontinent, with contiguous countries to the east and west (e.g. Burma and Afghanistan), is dominated by the Indian Plate and comprises the sub Himalayan countries, but the Himalayan states are also included in the definition. The South Asian Association for Regional Cooperation (SAARC), a contiguous block of South Asian countries established in 1985, comprises Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. In 2006, the association was extended to include Afghanistan as its eighth member country [11]. Water scarcity became alarmingly visible in regions which were once considered to be 'water-rich'. 'Home to over a sixth of the world's population, this region has the lowest level of water resources per capita [12]'. Moreover, through population increase, the per capita availability in South Asia has come down from as high as 3000–1000 l/day in 2002 [13]. The rural population has to compromise their livelihoods by reducing productivity and migrating to urban areas in search of other livelihood options [1]. There are high levels of poverty, illiteracy, poor health conditions, huge numbers of people affected by conflict and low levels of gross national product (e.g. in Pakistan, Afghanistan, Nepal and Bangladesh); eventually making the management of water more difficult with a heavy demand for irrigation purposes.

This paper examines the status of water scarcity in South Asia with an emphasis on climate change impacts. We analyse the existing water policies in the South Asian countries. The last section discusses the need for various adaptive practices and their incorporation in water policies.

Water scarcity: the South Asian picture

The South Asian region harnesses an actual renewable water resource of 2700 m^3/year per capita with total renewable per capita withdrawal of water resources of 666 m^3/year [14]. The stress is heightened by rainfall variability and the uncertainty of dependence over international rivers. India has the highest amount of total renewable water resources in this region (1911 km^3/year), whereas Pakistan has the highest per capita per year withdrawal of total water resources (1057 m^3) followed by Afghanistan. Figure 1 shows South Asia's annual renewable water resources, total withdrawal and sectoral uses.

Afghanistan

Afghanistan's annual surface water resources are estimated at 57 billion m^3, distributed and managed over five river basins [15]. This provides over 2775 m^3 of water per person per year, much higher than the minimum threshold of water scarcity (1700 m^3). Nevertheless, among the basins, the northern river basin is very close to absolute water scarcity but contains high shares of irrigable lands. The Harirod-Murghab and Helmand river basins are within the scarcity threshold and only Panj-Amu and Kabul river basins possess sufficient

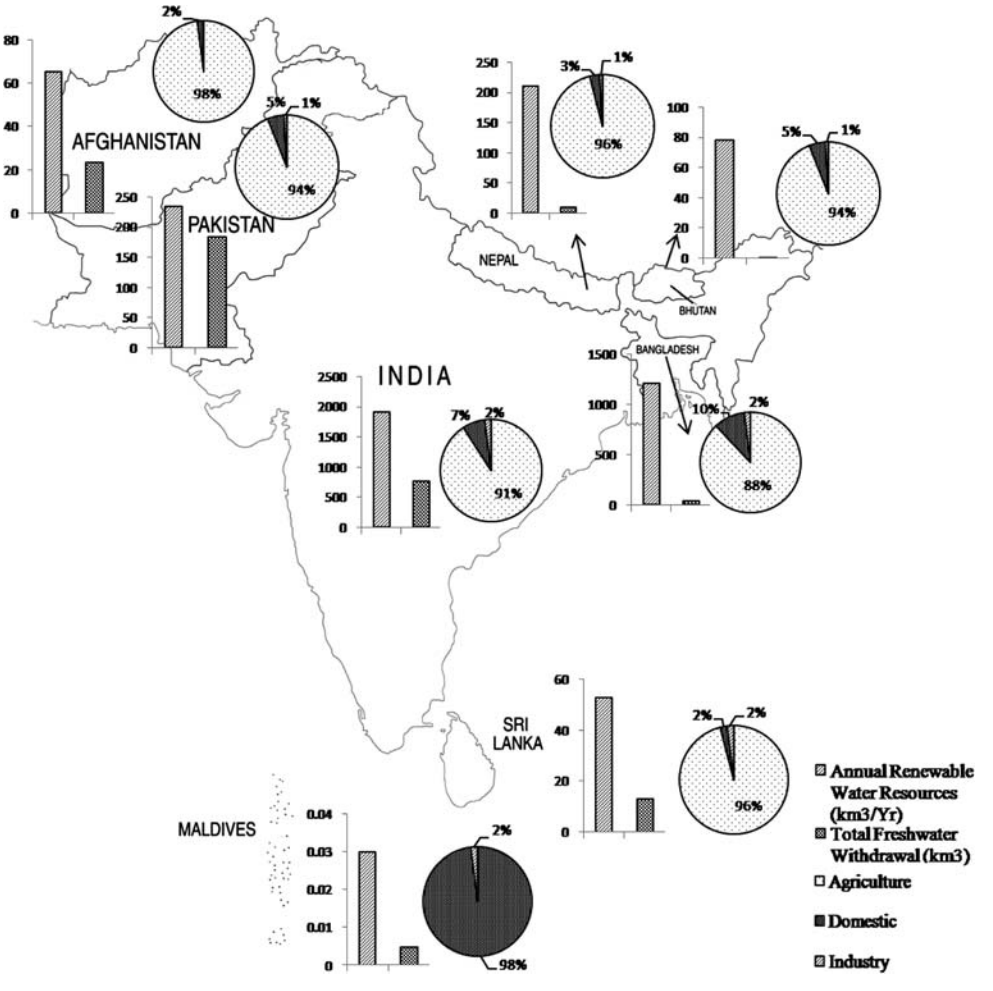

Figure 1. South Asia's annual renewable water resources, total withdrawal and sectoral uses. (*Prepared from the data retrieved from FAO, 2012 on 26 July 2012*).

water resources, but neither has a high population nor large shares of irrigable land. Further, an increasing number of poorly designed and badly located structures (including micro-hydropower units) threaten irrigation water availability for downstream areas; thus, reducing the conveyance capacity of the main canal [16]. Poor access to water and sanitation and low standards of living indicate high levels of poverty in Afghanistan. At a current rate of population growth of 2.6% per year, the country will be water-stressed by 2024 and below water scarce by 2045. A series of conflicts have impeded the development of the country. If not physically water scarce, Afghanistan is economically a water scarce country.

Bangladesh

Bangladesh, with numerous rivers and rivulets, receives annual rainfall of 250 km^3 and the annual inflow from trans-boundary rivers amounts to about 1000 km^3. The total annual run-off in Bangladesh is 1230 billion m^3, of which 85% occurs between June and October.

For the rest of the year, the country remains water-stressed [17]. With a significant portion of available water abstracted for irrigation (88%), Bangladesh suffers from spatial and temporal water shortage which hits the rural population hard. The estimates indicate that Bangladesh already meets the Falkenmark indicator of water scarcity (761 m^3 per capita in 2000). By 2025, Bangladesh will approach the threshold of absolute water scarcity (504 m^3 per capita) and fall well below that threshold by 2050 (412 m^3 per capita) [18]. Bangladesh, literally the end user, has limited control over upstream rivers that reduce water availability during dry seasons. This largely influences flood and drought accompanied with the inflow of low quality water [19]. Moreover, the surface water is extensively polluted and arsenic contamination affects a significant portion of groundwater. Dhaka, the capital, has experienced a sharp decline in the groundwater level; which has fallen more than 20 m lower in the last seven years at a rate of 2.81 m per year.

Bhutan

In Bhutan, total annual internal renewable surface water resources is estimated to be 78 km^3. Groundwater resources are very limited, because of Bhutan's mountainous character. In 2008, total water withdrawal was about 338 million m^3. This represents a mere 0.43% of the annual renewable water resources. In spite of the per capita water availability of 75,000m^3 per annum, the country faces localized and seasonal water shortages for drinking and agricultural purposes [20]. People still walk long distances to fetch water from streams and springs, limiting water use. This is usually the task of women and children. The estimated average annual growth of urban population in Bhutan was 7.3% during 2000–2005 and as high as 12.6% in Thimphu, the capital.

India

In India, the availability of water is very uneven, spatially as well as temporally. The per capita water availability in 1951 was 5177 m^3 per year when the total population was only 361 million. In 2001, as the population increased to 1027 million, the per capita water availability reduced drastically to 1820 m^3 per year. Nearly 71% of the water resources from Ganga-Meghna-Brahmaputra basin and the west flowing rivers are available in just 36% of land area. The rest of the land area (64%) has to survive on the remaining 29% of water resources [21]. As the water available within the country varies widely because of rainfall, ground water reserve and proximity to river basins, most of the Indian states will have reached the water stress condition by 2020 and water scarcity condition by 2025 [22]. A soaring population, rapid urbanization, changing lifestyles and a thirsty farm belt are aggravating India's anaemic water infrastructure.

Maldives

The Maldive Islands (Maldives) have no rivers, lakes or streams. The only freshwater resource exists as groundwater in basal aquifers, unconfined in nature and extending below sea level in the form of a thin freshwater lens [23]. These freshwater lenses are also often heavily depleted and contaminated, as in the capital city of Malé. A rough estimate of the groundwater resources, based on an assumed 0.1 m/year recharge throughout the country (300 km^2), is 0.03 km^3/year. Maldives can no longer rely on freshwater lenses to satisfy their freshwater needs as a result of increasing demands from population growth, saltwater intrusion and pollution of groundwater from release of sewage, industrial effluent and poor

agricultural practices. The water table is found at shallow depths, making it prone to pollution on the surface. It has been estimated that a total of 5.9 million m^3 of water resources have been withdrawn, out of which 5.6 million m^3 were for domestic use and 0.3 million m^3 for industrial [13]. The population depends mainly on rainwater for drinking and groundwater for most other domestic needs. Because of the limitation in available roof catchment area and space for rainwater storage, desalination, although expensive, has become a mainstay of water supply to Malé and the tourist islands that can afford it [23]. The average household spends between US$40 and $60 per month on desalinated water. The average household in Malé earns something like US$668 dollars per month; thus, 6–9% of income goes to the water bill. Maldives has a first-order natural resource scarcity; basic resources, such as land and water, are in short supply.

Nepal

Nepal has abundant water resources. The total renewable water resources, including groundwater, are 210.2 billion km^3/year. This makes Nepal one of the Asian countries with the highest level of water resources. Nevertheless, Nepal faces acute shortage of water and remains one of the poorest countries in the world. For many Nepalese who live in the hills, the water flowing in the large valleys below is out of reach. Families in the mountains have only 5 l per capita per day. Only half of all farm land is irrigated and more than a third of the population has difficulties in obtaining water due to lack of infrastructure and storage capacity [13]. There is uneven spatial distribution of precipitation, increasing sediment load in the rivers, poor management and wide variation between lean season and monsoon flows. Nepal is identified as one of the most severely affected countries because of climate change. The water situation is expected to get worse.

Pakistan

The estimated population of Pakistan is 184.8 million in 2010 which is projected to increase to 265.7 million by 2030. With this upsurge, large volumes of water from the Indus River have been diverted upstream to the Punjab province to satisfy the soaring demand for agriculture and consumption in cities. Pakistan is facing the consequences of water scarcity at an alarming level. Downstream in Sindh, the river has shrunk into a canal. According to the World Bank, Pakistan became water-stressed (water availability less than 1700 m^3) in the year 2000 [24]. Pakistan's current water availability has been estimated to be 1090 m^3 per capita per year, near to being water scarce [25]. Irrigated agriculture consumes nearly 97% of the total surface water allocated, with the remaining 3% available to meet the domestic and industrial requirements for more than 170 million people [26]. Rainfall varies as low as 127 mm per year in Sindh province and less than 100 mm per year in the Balochistan province [26]. Water scarcity in Pakistan comes not only from water shortage but also from its unequal distribution and ineffective management.

Sri Lanka

Sri Lanka has renewable internal freshwater resources of 2530 m^3 per year per capita [27]. Just about 35% of Sri Lanka's 20 million people receive pipe-borne water provided by a state agency. The rest rely on wells, rivers or streams. Irrigation requires 85% of water withdrawn. About 80% of Sri Lanka is a dry zone where more than 90% of the total withdrawals take place; temporal and spatial water scarcity are more common here. But,

because of increased population and industrialization in the wet zone, Sri Lanka is expected to face low to moderate water scarcity in future. Much of the rainfall is concentrated within 3–4 months of the year when a major part of the reservoir inflow takes place. Dry weather flow during the non-rainy season is considerably less with a high variability in flow.

Climate change risks to water resources

To the problems of surging population, industrialization and changing lifestyles, climate change adds another dimension. The global mean surface temperature has been found to increase by 0.6 °C over the last century and it will continue to rise with regional variations. This in turn will affect the hydrological cycle with an increase in global mean sea level and frequency and intensity of precipitation [28]. Climate change not only affects the surface water flow but also affects groundwater recharge rates and depths of groundwater tables. People and ecosystems of already-existing water-stressed areas, mostly the poorest, most vulnerable and marginalized population, are vulnerable to decreasing and more variable precipitation due to climate change [9].

The joint declaration adopted by SAARC in July 2008 stated that 'SAARC is the region most vulnerable to climate change that is seriously affecting our agricultural production, crippling our vital infrastructures, diminishing our natural resources, and limiting our development options for the future' [29]. The high rates of population growth, and natural resource degradation, with continuing high rates of poverty and food insecurity accentuate these trends. An increase in occurrence of extreme weather events including heat wave and intense precipitation events is projected in South Asia along with an increase in the inter annual variability of daily precipitation in the Asian summer monsoon [30].

Water supply in South Asia is vulnerable to the melting of glaciers, since the perennial rivers in India, Nepal, Bangladesh and Pakistan depend on them for their supply. The flow is set to increase as the melting takes place. This carries an increased amount of sediments to the dams and reservoirs; reducing water availability. As the glaciers get depleted, the flow into rivers will decline drastically. There will be less water available downstream. For example, the upper Indus will show an initial increase between +14 and +90% in mean flows over the first few decades and then a decrease between −30 and −90% of the baseline by the end of this century [24]. The basin located in a comparatively drier region is more sensitive to climatic changes.

In India, surface run-off caused by climate change will vary across the river basins and sub basins [31]. With climate change, an increased precipitation is projected for river basins like Brahmini, Ganga, Godavari and Cauvery in India. But, this increase is not expected to increase the total run-off of these rivers; because there will be an increased rate of evapo-transpiration through a rise in temperature or uneven distribution of rainfall. Ampitiyawatta and Guo [32], examining the precipitation changes across the Kalu Ganga River basin of Sri Lanka from 1965–2004, detected a decreasing trend for precipitation, more severe in the downstream area than in upstream area. Ratnayake and Herath [33] found a similar reduction (18–42%) in total rainfall in the last 50 years in the Walawe River Basin of Sri Lanka.

The Asian Development Bank [34] has published evidence of the decreasing trend of rainfall in Bagmati River Basin in Nepal which can be partly attributed to climate change. This reduction is resulting in lower river discharge and stream power. Watersheds in the Karnali River Basin are found to be most vulnerable to climate change followed by the

watersheds in Koshi River Basin in Nepal. Moreover, the frequency of more intense rainfall has increased in this region but the numbers of rainy days and total annual amount of precipitation have decreased significantly [35–38]. Intense rainfall over a few days will fail to recharge the aquifer; the depleted groundwater results in expansion of the area suffering from water shortage. Monsoon dynamics, vital for river systems, are expected to be widely influenced by climate change. The summer monsoon season is crucial to the agriculture, water supply, economics, ecosystems and human health of Bangladesh, India, Nepal and Pakistan. An eastern shift in monsoon circulation was predicted as a result of changing climate. This shift results in more rainfall over the Indian Ocean and Bangladesh and reduced rainfall over India, Nepal and Pakistan. This estimated reduction in winter rainfall would imply less water storage and greater water stress during the lean monsoon period.

South Asia is the most disaster-prone region in the world. This region is highly exposed to extreme climate events and the effect will be gigantic as population increases in South Asia. As the IPCC's A1B scenario makes clear [28], precipitation is projected to show a median change of 11% by the end of the twenty-first century in South Asia. Seasonally, the winter months are expected to have rainfall reduced by 5%, whereas the dry season is anticipated to increase by 11% for this region. According to the IPCC, the most vulnerable ecosystems are being unsustainably managed and are currently water-stressed. By 2050, the annual run-off in the Brahmaputra is projected to decline by 14% and that in the Indus by 27% [39], which will have tremendous downstream consequences including a considerable drop in agricultural productivity and other climate-sensitive sectors. The consequences are unlikely to be confined by political borders.

There are wide disparities in water distribution between and within countries. While there are places with overabundant water resources, there are many that are extremely water-stressed. The drought conditions are expected to worsen and skew water availability in regions that are already water-stressed. Moreover, warming is likely to be above the global mean in South Asia. The temperature projections for South Asia for the twenty-first century suggest a significant acceleration of warming over that observed in the twentieth century [40]. The increase in temperature is least rapid, similar to the global mean warming, in South-East Asia, larger over South Asia and East Asia and greatest in continental (Central, West and North) Asia.

Water management is susceptible to uncertainties, many of which are being augmented by climate change. Some of these uncertainties originate from knowledge deficits about physical conditions; others relate to behavioural and social variability related to water supply. But, policy-making must allow for uncertainties in order to be sensitive, responsive and pragmatic.

The water management principles followed in the South Asian nations generally ignore uncertainties associated with climate change and water resources. Since the prolonged or extreme climate stress affect the livelihoods of poor people in South Asia, and poverty increases the vulnerability to climate change by limiting their available options, water resource managers should aim to reduce climate change vulnerability and uncertainty by including robust adaptive strategies in the decision-making process.

Water policy framework in South Asia

National water policies reflect a government's general direction on water resources. Effective policy processes in the water sector are central to overcoming developmental

challenges facing the region's countries. Water cuts across sectors and national borders; hence, any water policy should take into consideration policies of other related sectors – and of other countries. Moreover, if countries share a river basin like the Ganga, their national water policies should reflect awareness of impact and opportunity beyond national borders, as well as the impact of the neighbouring countries' water policies on their own access to, and use of, the resource.

Figure 2 shows the components of a conceptual water policy and issues to be resolved. The effective implementation and enforcement of water policy requires an adequate institutional and governance framework which is transparent, legitimate and participatory. Sadly, this is not generally apparent in the region. Yet, any National Water Policy for the twenty-first century should recognize water as a national resource for the purpose of national development goals and planning. Demand management policies are a means of coping with increased water scarcity in the future. Water has to be managed in a

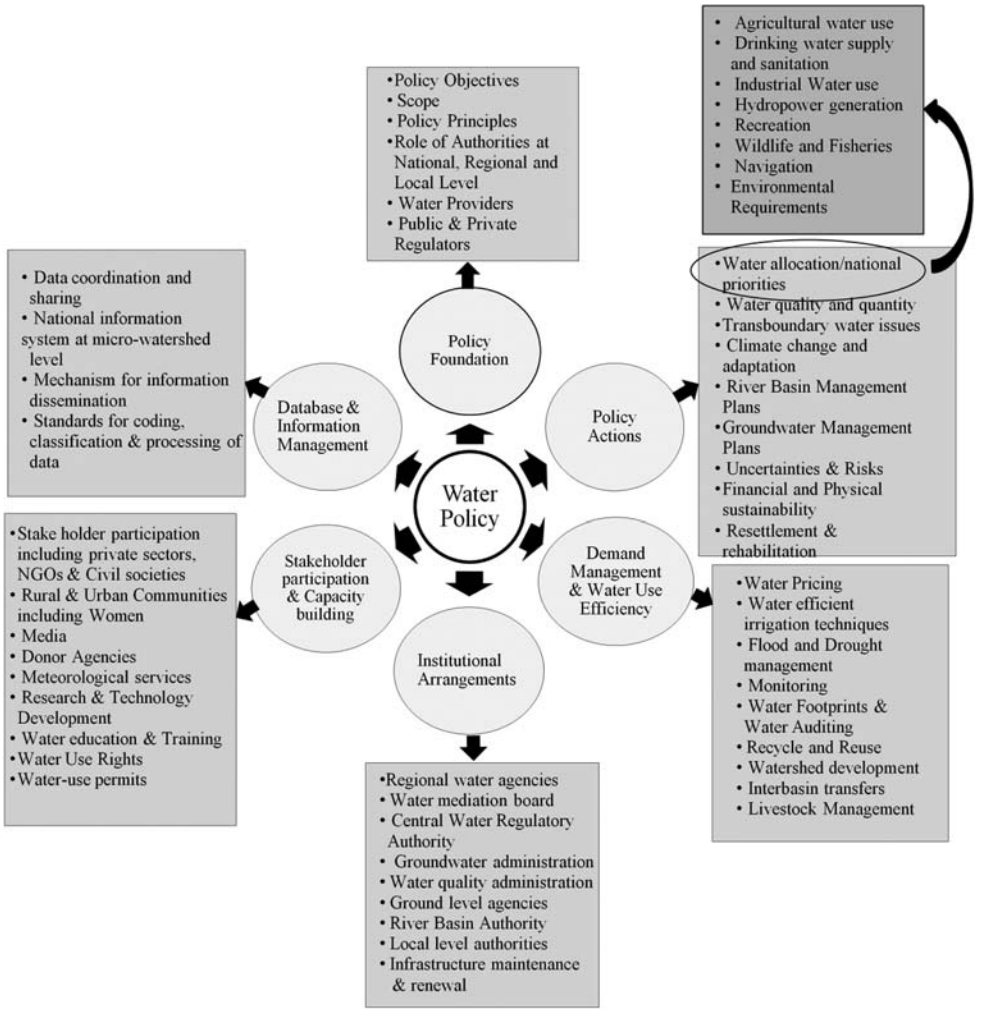

Figure 2. The components of a conceptual water policy and issues to be resolved.
Inner circle: components; outer box: issues; the curved arrow shows the sectoral allocation of water.

decentralized way together with the local communities and the concerned state governments. The situation in each country is very different in terms of water resources and their availability, and expected climate change impacts. Legal and institutional arrangements and water management practices and priorities also vary greatly between and within countries. They include issues of allocation and distribution, equity, conservation, pricing, regulation, education, participation and sustainable use. Projected climate change impacts and the current physical features of the water sector should be the key determinants in defining the necessary adjustments in the existing policy framework.

South Asia has the lowest level of water resources per capita. Its per capita availability of water has dropped by almost 70% since 1950 [12]. This is a menacing prospect. India is the first in the region to develop a National Water Policy in 1987. This was reformulated in 2002. In 2012, water policy was revised again to respond to a number of issues that emerged in the development and management of the water resources [41]. The National Water Mission, though developed to face climate change in India, does not yet ensure sustainable water security for all Indians.

Table 1 discusses the principle objectives and the gaps in the policy. In Afghanistan, the impact of the 24 years of conflict, coupled with four years of persistent drought from 1978–2001, had a devastating consequence on the water sector. In 2008, a Water Sector Strategy was adopted, and in 2009, a new Water Law was published [42]. The water sector strategy aims to integrate water resources management through the establishment of a river basin authority and also aims to promote and encourage the participation of traditional local organizations and water user communities.

Both Nepal and Bhutan have formulated a water plan and water policy to manage it sustainably, efficiently and equitably. Bhutan's water policy considers both the upstream and downstream users while managing water within river basins and aquifers; and it is unique as it covers all form of water including snow, glacier, rivers, lakes, streams, springs, wetlands rainwater, soil moisture and groundwater [43]. Bangladesh, overwhelmingly affected by its rivers, has developed a National Water Policy in 1999 and National Water Management Plan in 2004. The institutional structure for the implementation of both the policy and plan is very well organized in Bangladesh. Table 1 shows a major water policy gap in land use planning.

In contrast, Sri Lanka does not have an exclusive and formally approved water policy. By early 2000, a draft policy document, the National Water Resources Policy and Institutional Arrangements, had been prepared. But, the policy was later withdrawn because of immense protest and agitation against it [44]. The Maldives have no National Water Policy. The draft statement on Water and Sanitation policy, developed in 2006, serves as a background paper. Figure 2 shows that a successful water policy depends on water allocation for livelihoods and ecosystem needs, governed by necessary legal measures, and with adequate institutional support. But, for example, in the case of India's National Water Policy, nothing is clear on the water allocation mechanism. Further, although adaptation to climate change appears in the policy, methods to make the huge existing water infrastructures responsive and adaptable to climate change are lacking; see Table 1.

The sectoral uses of water, institutional arrangements, database and information system and groundwater management are almost common in South Asian water policies, but effective methods for implementation in practice are lacking in most of the policies (Table 1). Communities, both rural and urban, are rarely involved in resource planning and management. Women who are often central to managing water (fetching, apportioning and making do with almost nothing) are scarcely consulted. There is a lack of institutional

Table 1. Brief summary of the National Water Policy and their gaps and challenges in South Asia.

Country	Existing water policy/law/plan	Gap areas and challenges
Afghanistan	Strategic Policy Framework for the water sector: • The goal is to enable most Afghan families to achieve food security and self-reliance, leading to improved livelihoods and economic well-being, subsequently contributing to the national economy. • The Water Law calls for the integration of IWRM and river basin approach to sustain water management.	• A simple water policy that addresses the water issues but fails to give details on their practical implementation. • Waste water treatment, water recycling and reuse and rainwater harvesting are totally overlooked in this policy and law. • Exact way to allocate the water between upstream and downstream users is not given. • Climate change is totally ignored.
Bangladesh	Main objectives of National Water Policy are: • Development and management of both surface- and ground water in an efficient and equitable manner to make it available to all stakeholders including the poor and underprivileged with special emphasis on women and children, • Decentralization, water rights and water pricing. • Consideration of water use for fisheries, navigation, wildlife, hydropower, recreation and environmental requirements. • Develop a state of knowledge and capability to design future water management plans.	• Although the country is highly threatened by the effects of climate variability, National Water Policy totally ignores it. • Drought and flood management, though mentioned in the policy, are not given due importance in spite of their impact on the people of Bangladesh. • The water issues are addressed adequately but the methods to implement them are not discussed. • Needs to address Land use planning and the subsequent demand from it.
Bhutan	National water policy for Bhutan has been formulated in 2003. • The Water Policy views water resources from a broad, multi-sectoral perspective. • It puts water for drinking and sanitation as the primary priority in case of any alteration in quantity or quality. Hydropower generation is another important part of Bhutan's water policy along with water allocation for irrigation and industrial uses. • The National Environment Commission shall ensure effective coordination of water resources management at the national level.	• The national perspective on the water resources sector is missing, leading towards potential conflicts among the sub-sectors. • There is no law on water as such. There is a need for the enactment of a comprehensive law on water. • Procedure for implementation of the policy issues lacks detail. • Climate change issues, threatening the life of Bhutanese people, are totally ignored in this report. • Groundwater issues are not considered in this policy.

(*Continued*)

Table 1. (*Continued*)

Country	Existing water policy/law/plan	Gap areas and challenges
India	The draft of the recently revised water policy has been released and is under consideration [41]. • After meeting the minimum quantity of water required for survival of human beings and ecosystem, water policy emphasizes the use of water as an economic good with higher priority towards basic livelihood support to the poor and ensuring national food security. • Demand management, water reuse and recycling, water footprints and water auditing have been given special priority in the policy to minimize wastage • The draft National Water Policy also highlights the effects of climate change on water sectors and suggests appropriate adaptation strategies to survive the future water crisis.	• Capacity building at different levels within government institutions, also within local communities, to improve the provision and maintenance of water supply services is lacking. • Instead of low impact and low investment coping and adaptation measures, infrastructure heavy interventions like embankments and dams have been emphasized in the draft policy • Uncertainties and risks related to different hydrometeorological parameters are omitted from the policy. • Various issues like watershed management projects, rainwater harvesting, run-off minimization and recharge of aquifers are put in the policy, but there is little discussion on measures and systematic programmes to achieve these ends.
Maldives	A draft 'Water and Sanitation Policy Statement' was developed in 2006 as a background document for the development of National Water Policy. The main points of the statement: • Access to safe water for all people with treated and piped water connections in all households. • Protection of the groundwater and freshwater from over exploitation. • Legal framework to improve sector performance.	• The draft policy statement emphasizes mainly the monitoring and evaluation of the quality of the water available, not the water as such. • It does not provide any information on institutional arrangements or stakeholders participation in decision making process. • The policy statement neglects the climate change issues for Maldives.
Nepal	National Water Plan of Nepal aims at: • Achieving efficiency and effectiveness in water management relying on IWRM, allocating water to the users within the river basin, decentralizing authorities and responsibilities and making participatory approach central in all decision making processes. • Developing a set of specific targets and short-, medium- and long-term action plans including trans-boundary issues, programme and project activities, investments and institutional aspects in a holistic manner.	• All the issues are discussed along with action plans in detail but climate change effects are totally ignored. • The water policy is more on supply side management which is to be reoriented into demand-side management. • Nepal is characterized by its diversity of sector institutions (several working • In parallel with overlapping responsibilities), and a project focus (with a range of project implementation modalities which can undermine one another). • There is a major gap in implementation of the action plans.

(*Continued*)

Table 1. (*Continued*)

Country	Existing water policy/law/plan	Gap areas and challenges
Pakistan	The draft of the National Water Policy has been released for consideration and is yet to be approved by the Federal Government. • The main aim is to provide adequate water, through proper conservation and development by 2025. • Water supplies should be of good quality, equitably distributed to all users through an efficient management, institutional and legal system. • It also emphasizes reduction in groundwater exploitation, flood & drought control measures, wetlands, drainage interventions for increased crop production, salinity intrusion, water rights and institutional reforms.	• Effects of climate change on the water sector have been ignored. • Adaptive measures for climate change or any water related hazards have not been considered. • Uncertainty and risks in water policy planning have not been covered in this policy. • Due to the complex organization of water management authority, there is a lack of implementation of the policy because different authorities and ministries overlap in their functions. • No action plan or procedure to implement the policy issues has been discussed.
Sri Lanka	In March 2000, the water resources policy was approved. • The overall objective of the National Water Policy was to encourage Integrated Water Resources development and management, to ensure that the national water resources are conserved and efficiently managed and equitably allocated.	This water policy no longer exists in Sri Lanka.

Sources: [20,21,41,42,51–53].

capacity to deliver services and manage water resources efficiently; e.g. low pressure in piped water supplies in India. Moreover, such issues as climate change, wastewater treatment and rainwater harvesting are, if not ignored, generally kept at a theoretical level. The policies are intertwined among the functionalities of different departments. This makes the application and modification of the policies further difficult. Hence, national policies and law for water need to be specifically developed in each country; and modified to improve institutional capacities and information management. This must include an effective concern with the needs of the poor. Private sector participation and public–private partnerships should be emphasized to obtain equitable access to water. Moreover, to make the policy effective over time, there needs to be a stronger monitoring system, evaluation, research and learning at all levels, particularly in public sector institutions.

Adaptation in National Water Policy

Human societies have explored various ways to adapt to hydrological regimes and processes in South Asia. The adaptation and coping strategies used by the poor are highly varied and local studies are needed for development policies to be effective [45]. The adaptation measures include setting up local natural resource management bodies, choosing alternative livelihoods and migration in extreme cases. Traditional peasant life is resilient; but it is probable that the hardships (including population movements) which may come out of severe climate change exceed in scale anything which South Asia has known.

In the Mughal period, an independent department with separate budget, the *pulbandi daftar*, was set up to look after the embankments, roads, bridges and river dredging in Bengal [46]. Traditional water collection ponds were built long ago in Nepal with bigger storage ponds built in flat plains and smaller ponds in steeper places. Water collected in these ponds in the monsoon is used in dry seasons for different domestic purposes [47]. Farmers are responsible for local management of many irrigation systems in terms of water acquisition, allocation, distribution, maintenance and operation, decision-making, resource mobilization and often conflict resolution [48]. Selling off seed stock, kitchen utensils and livestock at the time of scarcity and withdrawal of children from school for labouring are common coping strategies for those in poverty. In the desert or semi-desert areas of Pakistan where groundwater is saline, soils sandy, temperatures high and humidity minimal, traditional adaptive processes like rainwater harvesting and storing and saline farming techniques provided for daily needs of man and livestock. Similarly, in the dry areas of Pakistan like Chitral district, water is allotted according to the size of land of different groups; a person having more land has access to more water and *vice versa*. Similarly, use of water between villages is also defined, i.e. some villages use water in the daytime, while some use it at night depending on the geographical location and potential evaporation losses. In Balochistan, for example, *khuskaba* (dry farming with direct use of rainwater) and *sailaba* (flood irrigation from run-off) systems of water management make the best use of available water for irrigation. Small, lengthy and often leaky channels, better known as *kuhls*, are constructed and maintained by the farmers in the high mountainous regions of north and north-west of Pakistan for daily household needs [49]. Micro-irrigation techniques like drip irrigation and sprinkler irrigation are common in parts of India to practise water efficient irrigation and minimize its wastage. The tank system in South India and Sri Lanka is an effective measure against droughts, providing irrigation water and flood protection. The adaptive practices adopted by the poor, like labour migration, using children at work and

increasing reliance on loans are making them more vulnerable and marginal. Communities appear to be struggling to adapt to their changing environment with their limited knowledge, poor assets and inadequate external support.

Adaptation to climate change is indispensable since the climate is already changing and mitigation will take too long to show effects. The challenge is to integrate national policies with scientific data, and make those policies effective. Adaptation strategies need to be incorporated in policy actions; see Figure 2. There must be a future-facing policy. Future projects must reduce vulnerability by including priorities critical to successful adaptation, like ensuring water rights to communities facing water scarcity. Figure 3 delineates the framework for inclusion of adaptation strategies in the National Water Policy.

Adjustments are required in the structure, policy, formulation and implementation phases of the national governance framework. Establishment of a unified water authority is highly desirable in arid regions suffering from water scarcity [8]. Institutional analysis should be the first step to understanding the governance framework before adaptation can occur. Adaptation is necessary [50]. The identification of gaps and factors that can inhibit the effective implementation of the adaptation practices will help in recommending necessary actions. As shown in Figure 3, stakeholder involvement is crucial to adaptation: water-related government bodies, ministries of finance, planning and development, agriculture, health and energy sectors, NGOs and civil society organizations. The next task is to engage them in the formulation phase, to enhance the knowledge and skills. Then, good governance that supports participation, access to information on policies and rights, decentralization, equity, gender balance and accountability of vulnerable communities is required to be established [50]. Technical and financial support is needed to help develop sustainable adaptation solutions. Therefore, current and future climate change impacts need to be taken into account and should be included in national budgets. Various external and internal sources of funding should be identified to carry on the process. Academic and research institutions along with government agencies dealing with various aspects of climate change like monitoring, climate data collection and modelling should be supported.

In addition, as shown in Figure 3, awareness about climate change and necessary adaptation measures must be developed at different levels. National media campaigns and

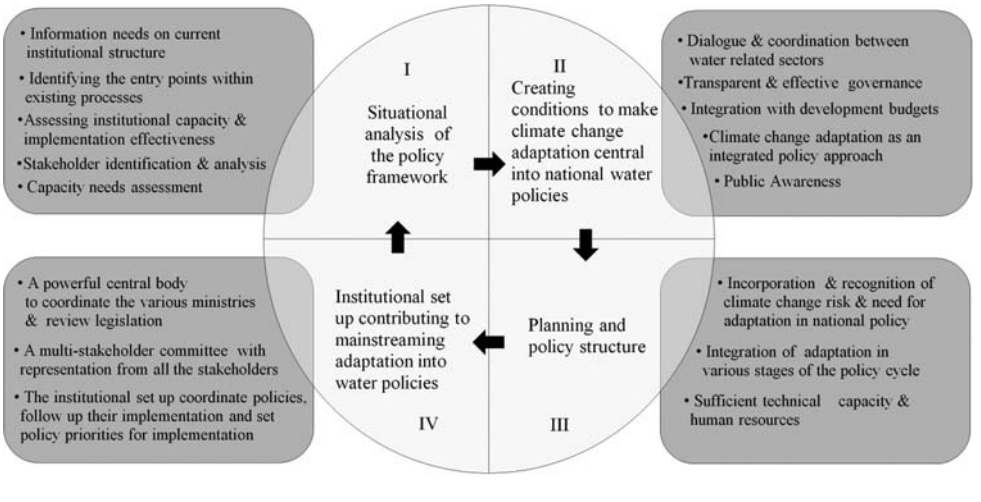

Figure 3. Framework for making adaptation central in National Water Policy.

internal government campaigns on the links between climate change, water and other related sectors will reinforce the process of making adaptation central. As climate change and adaptation is a continuous process, the policy and regulations should be flexible enough to keep it open for future modifications as and when needed. In the European Union, effective policy requires sharing of the information held by Member States to keep track of national implementation measures, as well as to help Member States' evaluation of their own effectiveness [54]. This approach is lacking in all the water policies of South Asia. The European Environment Agency has identified that the right measures and solutions can only be found in a dialogue between the relevant stakeholders on local level. This would apply also to nearly all the countries in South Asia, but there is no evidence of it in their water policies.

In South Asia, there is no evidence that stakeholders feature in assessment of these matters. For example, in Bangladesh, a number of studies have been carried out into impacts, adaptation and vulnerability, culminating in a National Adaptation Programme of Action. But, subsequent action has been limited: a common and dangerously widespread story. There is in general a lack of interest at the highest levels; policy-makers in the Prime Minister's office, Finance and Planning ministries as well as legislators are indifferent to the facts and the implications. The countries have developed national climate change strategies and action plans, including the Bangladesh Climate Change Strategy and Action Plan, the National Climate Change Adaptation for Sri Lanka 2011–2016, the National Action Plan on Climate Change in India and Nepal and the draft National Climate Change Policy in Pakistan. But, these plans and policies have not yet resulted in significant adaptation efforts at the national level. A water policy framework needs to be formulated and implemented that will successfully encompass the climate change impacts, associated uncertainties and the necessary adaptation measures.

Conclusion

This paper considered the evidence for water availability in South Asia and assessed the existing water policies of the region's countries. Amidst significant economic transition along with rapid population growth and urbanization, the extent and severity of the water crisis is obvious in almost all the nations of South Asia. Moreover, climate change is making the water situation worse with the existing water policies; and this in one of the most vulnerable regions of the world. These policies do not fulfil the needs of the people. The conceptual water policy framework sketched in this paper identifies adaptation as a way to answer climate change impacts. This paper has suggested significant policy shifts which make adaptive strategies central.

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