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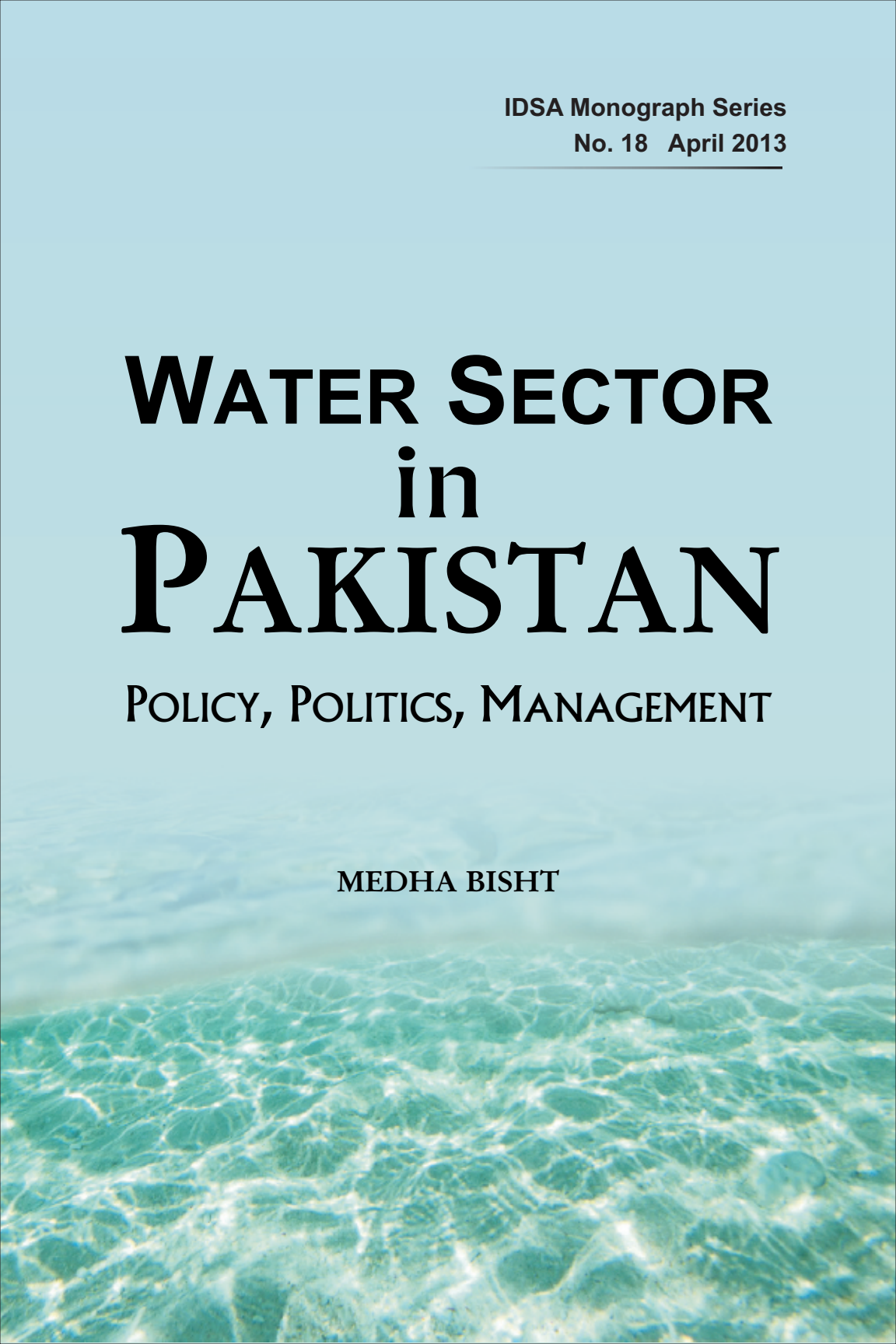
No. 18 April 2013

WATER SECTOR in PAKISTAN

POLICY, POLITICS, MANAGEMENT

MEDHA BISHT



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Water Sector in Pakistan
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Medha Bisht

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Medha Bisht

INTRODUCTION

This monograph explores and assesses the status of the water sector/ resources in Pakistan. The purpose is to understand and delineate Pakistan's water policies, politics, and management practices. An attempt is also made to gauge the impact of climate change and environmental degradation on Pakistan's water sector.

I have taken a four-pronged approach within this broad framework: First, an assesment of the existing water management policies in Pakistan is undertaken; second, the broad contours that shape the politics of water in Pakistan are explored; the third, identifies the specific issues related to water management and distribution, lastly, an analyses on the impact of climate change on Indus- Pakistan is undertaken. The monograph also attempts to trace the continuity between the past, present and future in Pakistan's water sector. While, at the outset, linkages are established between the colonial legacy - the creation of canal colonies in west Punjab and the impact of partition and the Indus Water Treaty on Pakistan's water practices; the conclusion makes a futuristic assessment, regarding the path that the water sector can instigate Pakistan to follow.

Significantly, therefore, the background analysis, which constitutes the first part of this monograph, is informed by a historical overview of the colonial legacy of the British who created 'canal colonies' in West Pakistan in the 19th century. An attempt is made to examine the relevance of water issues while partition lines were being drawn by Cyril Radcliffe, along with the importance of the irrigation system of undivided India for both countries. Such an analysis is useful for understanding the rationale behind the practices adopted for designing the existing water infrastructure in Pakistan, which is examined in the second chapter. The second part of this monograph, focuses on the impact of internal (policy, politics, management) and external (climate change) dynamics on the water sector. Based on these analyses, the third part studies the

future trends and patterns, that could be discerned in Pakistan over the next 20-30 years.

The specific research questions are:

1. What is the status of fresh surface water and ground water resources in Pakistan?
2. What is the infrastructure (dams, barrages, link canals, tubewells etc.) in place to utilise these resources?
3. What are the existing policies for water distribution and management in Pakistan? And what is the relationship between policy and the politics of water.
4. What is the nature and scope of the water management approaches adopted in Pakistan?
5. How is climate change and environmental degradation impacting the Indus river in Pakistan?

Chapters

The first chapter assesses the historical importance of water resources for India and Pakistan. The chapter highlights factors which made an arid region highly dependent on water resources. Since the history of hydrological exploration can be traced to British India, the canal colonies established by the British are the focal point for this chapter.

The second chapter provides a contemporary overview of water resources in Pakistan. Along with a general survey of the existing resources, the water potential of the four provinces of Pakistan is profiled. The chapter also outlines the status of water use and availability in Pakistan and studies the impact of climate change on the Indus—nationally and across provinces.

The third chapter focuses on the existing *policies* for water distribution amongst and between provinces. Pakistan's water vision, policies, strategic vision, and the existing institutional structures are also discussed.

The fourth chapter analyses the *politics* of water issues. The chapter focuses on the issues and actors that politicise the water discourse.

Inter and intra provincial claims are examined in order to assess the politics of water rights.

The fifth chapter focuses on the management of water issues. While it deals with the allocation and distribution challenges of water; the coping strategies employed for the management of water resources are also highlighted. The chapter also examines the gaps and the challenges faced by Pakistan in water resource management.

The sixth chapter studies the impact of climate change and environmental degradation on Pakistan's water sector and how climate change could further affect the existing water management practices. The chapter also analyses the security challenges—both traditional and non-traditional, posed by climate change to Pakistan.

The seventh chapter offers some key concluding thoughts that include: the future trajectory of the water sector in Pakistan and how issues might play out and impact national, regional and international politics.

Part I

Tracing the Footprints of History

Chapter One

Back to History

This chapter discusses the historical importance of the Indus water basin in shaping the contours of the existing water discourse in Pakistan. It also attempts to flag the linkages between water resources and the territorial claims of Pakistan on the Kashmir Valley. Though much has been written about the partition of India, including its impact on the hydrology of the region, there is a lack of systematic understanding in tracing the causality of water discourse to the history of irrigation development in Pakistan. In this chapter, the water discourse in Pakistan is studied in two distinct but related phases. While the first phase revisits the developments in the undivided subcontinent in the 19th and 20th centuries; the second phase attempts to understand the water discourse through the lens of the partition.

The Pre-Partition Years

In an interview published in the *Global Insider* on June 10, 2010, John Briscoe made the following statement[1]:

> At partition in 1947, the line between India and Pakistan was drawn on religious grounds, paying no attention to hydrology. As a result, more than 85 per cent of the irrigated area of the Punjab — the breadbasket of the subcontinent — was included in Pakistan, while the headwaters of the Punjab rivers were in what subsequently became Indian-held Kashmir.

Briscoe's statement implies that the delinking of the division of river waters from the Indo-Pakistan partition was indeed a

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[1] Karl Lipschutz, *India-Pakistan Water Dispute*, Buenos Aires, Argentina, June 12, 2010. at: http://www.worldpoliticsreview.com/trend-lines/5756/global-insider-the-india-pakistan-water-dispute, accessed on November 23, 2010.

historical mistake, that perhaps needs to be revisited in order to solve the protracted India-Pakistan impasse. Similar views have also been voiced by scholars like Robert Wirsing[2] who have argued for a 'hydro-political model' in order to resolve the Kashmir dispute between India and Pakistan. Significantly, in a book entitled, *The Final Settlement*,[3] explicit linkages have been made between Kashmir and water. One of the main arguments advanced by, Pervez Musharraf, the former President of Pakistan, was that 'the river holds the key to future conflict...the issue (Indus waters) has the germ of future conflict.'[4] The Chenab formula suggested that the river be designated as the border between India and Pakistan in order to resolve the Kashmir dispute.[5] But this proposal does not have official sanction and has been criticised even by Kashmiri separatist groups, who have been demanding 'azadi' for the state of Jammu and Kashmir as a whole.[6]

Given these contending claims, it would perhaps be pertinent to examine the extent to which water issues were taken into account while Cyril Radcliffe was partitioning the country, and the importance of the irrigation system of British India for both countries.

The Annexation of Punjab

The story of the development of irrigation in undivided Punjab can be traced back to 1849, when Punjab was annexed by the British. As many Punjabis had supported the British in the 1857-58 war — they were honoured as 'the martial race of India'. Also as an

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2 Robert Wirsing "The Kashmir Territorial Dispute: The Indus Runs through It,"*Brown Journal of World Affairs*, Fall/Winter 2008, Brown University, USA.

3 Strategic Foresight Group, *The Final Settlement: Restructuring India-Pakistan Relations*, Strategic Foresight Group, Mumbai, 2005, at http://www.strategicforesight.com/finalsettlement/index.htm, accessed November 28, 2010.

4 Ibid.

5 Zafar Abbas, "Dividing Kashmir by Religion," *BBC News*, May 21, 2003, at http://news.bbc.co.uk/2/hi/south_asia/3048215.stm,accessed November 25, 2010.

6 The Future of Kashmir, *BBC Special Report*, 2004, at http://news.bbc.co.uk/2/shared/spl/hi/south_asia/03/kashmir_future/html/7.stm, accessed November 25, 2010

acknowledgement of their services and to secure their allegiance in future, the British rewarded the Punjabis large tracts of land in west Punjab.

While the Punjabis happily secured the ownership rights for themselves, the British for their part had their own strategic calculations. For instance, the British wanted to open an agrarian frontier in west Punjab as a defensive measure to deter the Russians who were marching towards Central Asia. In addition, Punjab was also envisioned as an economic hub providing raw material for the industries in Great Britain. Consequently, by the latter half of the 19th century, proposals for developing irrigation channels between the Ravi, Beas, Sutlej, Jhelum and Chenab rivers were in the pipeline.

Another reason which contributed to the development of surface irrigation in Punjab was the recurrent famines in the eastern provinces, which were jeopardising millions of lives thus posing an internal security threat to British India. Thus, developing Punjab as a source of grain for the food-deficit areas was also an important reason for the colonial administration to develop surface irrigation.[7]

Emergence of Canal Colonies

Irrigation infrastructure development reached its pinnacle after mid –nineteenth century when Punjab was annexed in 1849.[8] The nine colonies that were built, not only transformed waste land in west Punjab into fertile land, but also made the region highly dependent on a continuous supply of water, thus creating vested interests and stakes for the landholding class in the process. Given the nature of dependence on canal waters, Aloys pointed out that, no water dispute would have ensued, in the absence of canal colonies because without the modern irrigation system, the value of water

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[7] I would like to thank Shahid Javed Burki, Former Finance Minister, Pakistan for highlighting this point and bringing it into focus.

[8] For a detail on canal colonies in Punjab see, Administrative Report of the Punjab Public Works Department, 1945-46, cited in Imran Ali, *The Punjab under Imperialism 1885-1947*, Princeton: Princeton University Press, 2003.

would have been minimal and the prospect of diverting the flows non-existent.[9]

The extensive canal network also highlighted the growing dependence on water resources. For instance, the dependence and value of water for the co-riparians became evident in the late nineteenth century when Sindh opposed the building of the Bhakra Dam. This dispute between Sindh and Punjab was settled only by mid twentieth century (1941), by the Rao Commission which decided on "equal apportionment" citing the rule that an "upper riparian can take no action that will interfere with the existing irrigation of the lower riparian." The objection raised by Sindh suggests that lower riparian awareness was not alien to the subcontinent. It could also be argued that such fears and claims that underlined the geographical importance of headwaters could have played on the minds of the people during the partition years.

As a result of the inter-dependencies that the canal colonies had created, the canal network and Sikh sentiments influenced the drawing of partition lines. Understanding the complexities embedded in the contiguous irrigation system, Radcliffe himself suggested that the Punjab water system should be a joint venture run by both countries. However, this suggestion was turned down by both Jinnah and Nehru. While, Jinnah responded by saying that he would rather have a Pakistan that was a desert rather than a fertile fields watered by the courtesy of Hindus, Nehru retorted that what India did with India's rivers was India's affair. These statements reveal that, during the initial years water was delinked from territorial aspirations. Perhaps also because Jinnah was expecting that Ferozepur and Gurdaspur with the two headworks would come to Pakistan. Even though F.J. Fowler in 1959 wrote that for Pakistan the most important question in relation to Kashmir was the threat of India interfering with vital water supplies and that reservoirs built in the upper valleys of the Chenab and Jhelum could be used to store surplus summer flow for use in autumn and winter; this linkage between Kashmir and water was

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[9] Michel A. Aloys, *The Indus Rivers: A Study of the Effects of Partition*, Yale University Press, New Haven, 1967, p. 12

never articulated in the public domain.[10] The linkage however gained importance during the term of President Pervez Musharraf and thereafter has been articulated often and linked more vehemently with India's plans to construct run of the river projects.

The Issue of Headworks

When the province of Punjab was partitioned, most of the land in western Punjab, which was claimed by the Sikhs went to Pakistan. Two important headworks, Madhopur on the River Ravi and Ferozepur on River Sutlej, went to India because of which Radcliffe was accused by Pakistan of partisanship. The main allegation was that none of the non-Muslim majority areas were given to Pakistan, while some Muslim areas were given to India. The accession of Gurdaspur and Ferozepur to India on these grounds was considered unfair.[11] However analysts have addressed the dynamics which influenced the decisions made by Cyril Radcliffe in 1948. The findings reveal that both decisions were guided by strategic factors such as, administrative issues, religious sensitivities and communications facilities.[12]

For instance, Ferozepur, which was given to India, had two Muslim majority sub districts –Zira and Ferozepur. Both these sub districts, which were east of the River Sutlej, were transferred to India.[13] Ferozepur was a district of some strategic consequence. It was not only a cantonment that was next only in standing to Rawalpindi but was also a major junction, where four railway lines and three highways met to cross the barrage-cum-bridge to Kasur and Lahore. According to analysts the rationale for giving the Ferozepur headworks to India, was because it had been the policy in the

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[10] F. J. Fowler, "Some Problems of Water Distribution between East and West Punjab", *Geographical Review*, 40(4), October 1950, p.598.

[11] Chaudhri Muhammad Ali, *Emergence of Pakistan*, Columbia University Press,New York, 1988, p. 213.

[12] Shereen Ilahi, "The Radcliffe Boundary Commission and the Fate of Kashmir", *India Review* 2(1), January 2003, p. 85.

[13] Chaudhri Muhammad Ali, no. 11, p . 213.

united Punjab to develop irrigation in the western part, where large tracts of the crown wastelands yielded quick financial returns. This had delayed the development of eastern Punjab, where the land was privately owned and no major irrigation project after the opening of the Sirhind canal had been developed.[14] On the other hand, many of those disputing the transfer of Ferozepur to India, have questioned Radcliff's decisions. While the limited time available to Radcliffe has been underlined as an important factor, his proximity to Mountbatten is also highlighted. Many analysts believe that Mountbatten's close relationship with Nehru, and his uneasy relationship with Jinnah, must have influenced the boundary award in favour of India.[15] Similarly, the bestowal of Madhopur headworks in Gurdaspur district to India has also been an issue for debate and discussion. Though many scholars consider this as having been unfair to Pakistan, an explanation has again been framed under the rubric of "other factors". It is argued that the possession of Gurdaspur was important for India for strategic reasons, as Kashmir would have had no contiguous link to India without Gurdaspur district (specifically Pathankot tehsil)[16].

The loss of important headworks to India greatly influenced Pakistan's perceptions of its riparian vulnerability. Some analysts claim that the fears were strengthened after the termination of the Standstill Agreement in April 1948 which affected the Central Bari Doab and the Dipalpur canal systems, and the Bahawalpur state distributaries.[17]After this development, the urgency for Pakistan to secure assurances for a continuous water supply from river waters only increased. Links have also been made between the termination of Standstill Agreement and the decision of the

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[14] F.J. Fowler, " Some Problems of Water Distribution between East and West Punjab," *Geographical Review*, 40(4), October 1950, p. 588.

[15] Shereen Ilahi, "The Radcliffe Boundary Commission and the Fate of Kashmir," *India Review* 2(1), January 2003, p.82.

[16] Srinath Raghavan, *War and Peace in Modern India: A Strategic History of the Nehru Years*, Permanent Black, Ranikhet, 2010, p. 103.

[17] Rasul Bux Palijo, *Sindh-Punjab Water Dispute: 1859-2003*, Centre for Peace and Civil Society, Sindh, August 2010, at http://www.cpcs.org.pk/docs/bookshelf/Sindh-Punjab%20Water%20Dispute.pdf, pp. 33, accessed December 12, 2010

Pakistani army to invade Kashmir in 1948, and seizing control of the territory now known as Pakistan Occupied Kashmir or Azad Kashmir by those in Pakistan. According to Aloys, by occupying parts of Kashmir and Gilgit, Pakistan secured the remainder of the Indus course and the vital reach of the Jhelum leading to Mangla headworks.[18] However, on the Indian side, the possession of Jammu and Kashmir, post the Indus Water Treaty, 1960, gave it the riparian advantage over Pakistan, as the two rivers Chenab and Jhelum were under Indian control.

While history can be interpreted in many ways, the phrase —*India is stealing water from Pakistan Rivers*- has become common in Pakistan's national water discourse over the past few years. While the rift between Sindh and Punjab has become manifest, highlighting the looming water shortages at the provincial level, many farmer organisations in Pakistan have been rallying against India's 'water aggression'. The significance of water politics in Pakistan can be gauged from the statement made by Pakistan's foreign minister, Shah Mehmood Qureshi that two issues - water and Kashmir - would dominate Indo-Pak relations. These oft repeated remarks are pointers to the elevation of water as the core issue in the corridors of decision-making in Pakistan and reflect the growing linkage between water and Kashmir.

On similar lines, in March 2009, *The Telegraph* pointed out that:

> Last summer, farmers in agricultural heartland of Pakistan began to notice the levels of both the river and groundwater starting to fall. Pakistan has blamed India, saying it is withholding millions of cubic feet of water upstream in Indian-administered Kashmir and storing it in the massive Baglihar dam in order to produce hydro-electricity. Asif Ali Zardari, Pakistan's President, said: "The water crisis in Pakistan is directly linked to relations with India. Resolution could prevent an environmental catastrophe in

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[18] Michel A. Aloys, no.9.

> South Asia, but failure to do so could fuel the fires of discontent that lead to extremism and terrorism."[19]

While this excerpt can be termed as a curtain raiser for the existing water discourse in Pakistan, which appears to be directed towards India, the political narrative in Pakistan can be appropriately understood by studying the discourse which has revolved around the construction of dams on the western rivers – the Indus, Chenab, and Jhelum.[20] The irrigation works which Pakistan has most objected to are the Wullar Barrage and the Salal, Dulhasti, Baglihar, Kishenganga Nimoo Bagzoo dams amongst others. Most of the recent objections allude to the run-of-the-river projects on the western rivers.

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[19] "Pakistan accuses India of 'stealing' water," *Telegrah,* March 26, 2009, at http://www.telegraph.co.uk/news/worldnews/asia/pakistan/5052150/Pakistan-accuses-India-of-stealing-water.html, accessed December 5, 2010

[20] Perceptions are being shaped that India has plans to construct 62 dams/hydro-electric units on rivers Chenab and Jhelum thus enabling it to render these rivers dry by 2014. The reports argue that hydroelectric plants both built or under construction would enable India to block entire water of Chenab for 20-25 days. India has also started construction of three dams Nimoo Bazgo, Dumkhar and Chutak on river Indus, will have devastating impact (sic)on Pakistan's northern areas. Chutak is under construction on River Suru. Lower riparian fears loom high as analysts argue that in case any of these dams collapse or large quantity of water is deliberately released, it would endanger Bhasha dam but also submerge Skardu city and airport. Stating that Karakorum Highway (KKH) between Besham and Jaglot would also be washed away, these reports also argue that India has persuaded Afghanistan to create a water reservoir on the River Kabul, another tributary of river Indus. Zahid Malik, "Is Pakistan Ready for Water War," *Pak Observer,* at http://pakobserver.net/detailnews.asp?id=20374, accessed on December 12, 2010. Also see Tufail Ahmed, "Water Disputes between India and Pakistan: A potential Casus Belli, *The Henry Jackson Society,* July 31, 2009, at http://www.henryjacksonsociety.org/stories.asp?id=1230, accessed on December 12, 2010. The Indian arguments apropos the hydel projects are that, hydro-electric projects on Western rivers do not store water as the mentioned hydel projects are run of the river projects. The most recent argumentation on the impact of Indian plans to build dams on the Western rivers has been argued by Danish Mustafa. Mustafa argues that the proposed Indian projects could give India the cumulative storage capacity to reduce substantively the water flows to Pakistan during low flow winter months. India however does not recognize this fear as legitimate. See Danish Mustafa, "Hydropolitics in Pakistan's Indus Basin," Special Report 261, United States Institute of Peace, November 2010, p. 7.

It needs to be however noted that these dams are not storage dams and therefore the possibility of flooding of Pakistan is a non-option. While the environmental issues posed by the dams could be a matter for concern, these can be addressed within the framework of the Indus Water Treaty by the two countries by sitting across the table.

While bilateral talks on water are an important confidence building measure, this monograph delinks the bilateral from the domestic. The next few chapters therefore will focus on the policy, politics and management of water issues inside Pakistan. The second chapter offers an overview of the available water resources in Pakistan. As would be made evident by the description in the following chapter, the footprint of the canal colonies is clearly visible in the design and structure of the existing water infrastructure in Pakistan.

Chapter Two

Water Resources in Pakistan: an Overview

Primarily classified as an arid and semi-arid country, Pakistan has been endowed with both —surface and groundwater resources, which together cater to approximately 80 per cent of Pakistan's agricultural needs. According to Pakistan's Water and Power Development Authority (WAPDA), the rivers which emanate from the glaciers of the greater Himalayas, Hindukush and Karakoram ranges, constitute a total flow of about 155 million acre feet (MAF), of which 105 MAF is diverted annually for irrigation; while approximately 48 MAF is pumped from groundwater.[21] The Indus is the main water channel flowing through Pakistan Occupied Kashmir, Punjab and Sindh. The largest contiguous irrigation system in the world, the total length covered by the river before flowing into the Arabian Sea is 2,880 kms. The river is joined by various tributaries flowing from India in the east and others joining it from Khyber-Pakhtunkhwa and Balochistan in the west. While the water flow from western rivers (Indus, Jhelum and Chenab) is nearly 143.18 MAF, from the eastern rivers (Sutlej, Beas, Ravi) it is 4.41 MAF, with 3.99 MAF being generated within Pakistan[22].

As the Indus system has been formed by the deposition of water transported sediments of the Himalayan waters, the soil in Pakistan is rich in alluvium, sediments and salts. It has sufficient capacity to store water within its layers. As a result, the plains of the Indus basin have large quantities of groundwater.[23] However, due to

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[21] Hydro-Potential in Pakistan, Pakistan Water and Power Development Authority, May 2010, at http://www.wapda.gov.pk/pdf/BrchreHydrpwerPotJuly2010.pdf , accessed on December 10, 2010

[22] "Pakistan's Water Sector Strategy", Ministry of Water and Power Office of the Chief Engineering Advisor/Chairman Federal Flood Commission, Vol 4, 2002, p. 82, at http://cms.waterinfo.net.pk/pdf/vol4.pdf, accessed July 10, 2012.

[23] Kaiser Bengali (ed.), *The Politics of Managing Water*, Oxford University Press, Karachi, 2003, p. 8.

over-exploitation of groundwater through excessive tube well usage, groundwater in Pakistan is now becoming more saline, thus adversely affecting the quality of crops. Pakistan's groundwater resources mainly lie in the irrigated areas of the Indus basin. It is only in the Balochistan province that groundwater resources are outside the basin. In Balochistan, monsoon rains in the summer and western rains in the winter are the source of groundwater recharge. According to Pakistan Institute for Legislative Development and Transparency (PILDAT), the total annual ground water potential in Pakistan is 56 MAF. While a century ago, the groundwater table was 30.4 metres below the surface, as per recent estimates groundwater can be found within a range of 1.5 to 3 metres below the surface.[24]

Hydro-Profile

Given that the 1960 Indus Water Treaty was a water partition treaty, three western rivers (Indus, Jhelum, Chenab) were given to Pakistan while the three eastern rivers (Sutlej, Beas, Ravi) were given to India. The Indus river is joined by Sutlej and Ravi in southern Punjab (Pakistan), which is also the main catchment area of the Indus Basin.

Meanwhile other rivers which flow from the west into the Indus are the Kabul, Swat, Dasht, amongst others. These rivers flow from Afghanistan, Khyber-Pakhtunkhwa (KP) and Balochistan. Recent figures, published in a PILDAT (2011) study reveal that the average water availability from 1922-23 to 2001-2002 was 144 MAF— 139 MAF from western rivers and 5 MAF from western rivers. There is great variation in the flows of western rivers, the maximum being 186 MAF and minimum being 96 MAF.[25]

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[24] M. Amin, "Pakistan's Groundwater Reservoir and Its Sustainability," Proceedings of the 2nd ICID Asian Regional Conference on Irrigation and Drainage, Moama NSW, Australia, March, 14-17 2004, p.1. http://www.watertech.cn/english/amin.pdf, accessed on December 10, 2010

[25] "Inter-provincial Water Issues in Pakistan", PILDAT Background Paper, January 2011, at http://www.pildat.org/publications/publication/WaterR/Inter-ProvincialWaterIssuesinPakistan-BackgroundPaper.pdf, accessed on March 12, 2011.

Lakes are another source of surface water in Pakistan. Most of the lakes in the Balochistan province are saline. The two fresh water lakes in Balochistan are: the Hanna lake near Urak, which is a few miles from Quetta and Band Khushdil Khan near Pishin. Other smaller lakes include the Marav Lake near Dera Bugti and Siranda Lake north of Sonmiani.

There are two lakes in the Kaghan valley in Khyber-Pakhtunkhwa—the Saif-ul-Malik and the Lulusar. The Kunar river drains into and out of Lulusar. The source of the Ushu river is in Lake Mahudand and the Ushu and Gabral join near Kalam to form the river Swat.[26]

Lakes in Punjab are found on Potwar plateau: Kallar Kahar in Chakwal; Uchhaliand Khabeki and Namal near Musakhel tehsil in district Mianwali are some of the lakes in Punjab.

Sindh meanwhile has large lakes of tectonic origin. The Manchhar lake is situated 19.3 km west of Sehwan Sharif and covers an area of 200 km. The Kinjhar near Thatta is another big lake in Sindh. In 1955, after the completion of Kotri Barraghe, the Kalri Begar feeder was connected to Kinjhar lake for supply of fresh water to Karachi.

Water Infrastructure in Pakistan

As far as the physical water infrastructure is concerned, there were 3 large dams, 86 small and medium dams, 45 canals, 12 barrages and 10 link canals in Pakistan in 2011. The total contribution of hydel resources to the power sector of Pakistan is 33.6 per cent, which is the largest in the power generation mix. The Karachi Electricity Supply Corporation (KESC) contributes 8.3 per cent, the Pakistan Atomic Energy Commission, (PAEC) 3.6 per cent, Kot Addu Power Company (KAPCO) 6.2 percent and the Hub Power Company (HUBCO) 9.1 per cent to total electricity

[26] Kaiser Bengali, no. 23

generation. Independent Power Producers (IPPs) contribute almost 25 per cent.[27]

As reflected by the above figures, power is generated from three sources: thermal, hydel and nuclear. There are 13 hydroelectric facilities, with installed capacity of 6481 MW, that are owned and operated by WAPDA, while thermal power plants are owned by both public and private companies. The public sector operates 13 thermal plants with installed capacity of 4900 MW. About one third (5987 MW) of the power is provided by private sector companies—the Independent Power Purchasers. The KESC operates plants with a total capacity of 1955 MW. Out of the total 19, 252 MW, of national installed generation capacity, dependable generation amounts to about 17, 523 MW in summer and 14, 640 MW in winter—depending on the annual hydrology.[28]

Dams: Large, Medium and Small

The Tarbela is a large dam on the Indus, which is located about 50km north west of Islamabad. The dam was completed in 1976 and was designed to store water from the Indus for the purpose of irrigation, flood control and for the generation of hydro-electric power. It is a part of Indus Basin project that followed the water treaty signed in 1960 between India and Pakistan. The generating capacity of Tarbela is 3478 MW, its height is about 143 metres and it is 2743 metres wide. The Tarbela dam is a major source of Pakistan's total hydro-electric power. A fourth extension project of Tarbela dam (1410 MW) has been initiated, which will increase the power production capacity of Tarbela to 4828 MW.[29]

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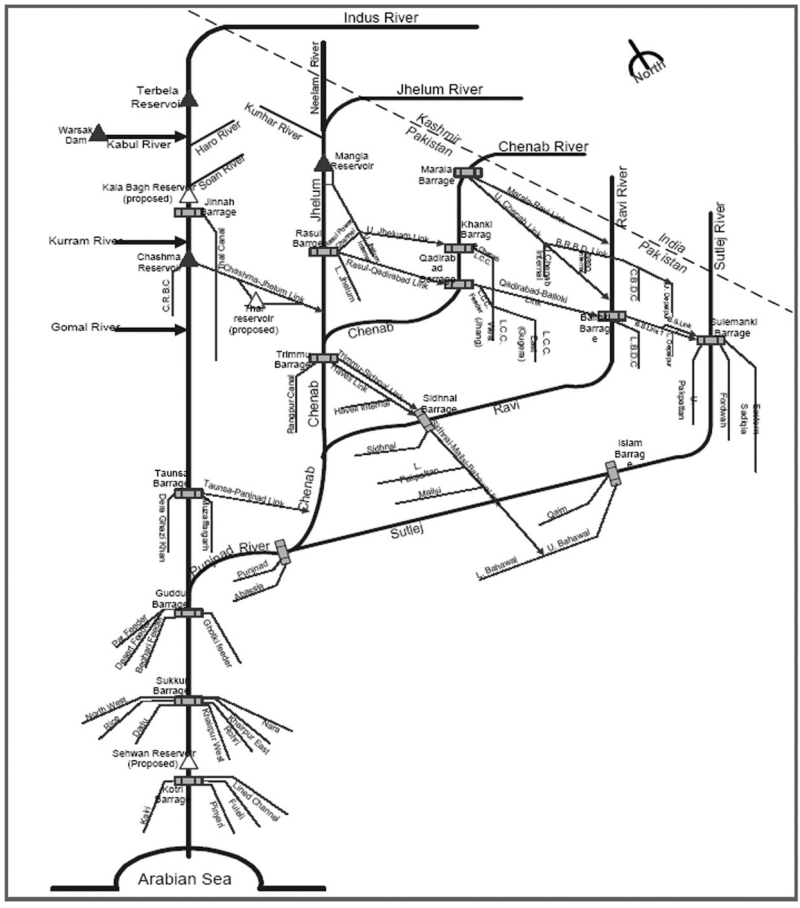
[27] *Economic Survey of Pakistan 2011-2012*, Finance Division, Government of Pakistan, Islamabad, 2012, p. viii, at http://www.finance.gov.pk/survey/chapter_12/ExecutiveSummary.pdf, accessed July 17, 2012.

[28] *Economic Survey of Pakistan 2011-2012*, Finance Division, Government of Pakistan, Islamabad, 2012, p. 208, at http://www.finance.gov.pk/survey/chapter_12/ExecutiveSummary.pdf, accessed on July 17, 2012.

[29] Qamar for completing Tarbela Dam's extension project by 2012, *Dawn*, July 8, 2011, at http://www.dawn.com/2011/07/08/qamar-for-completing-tarbela-dams-extension-project-by-2012.html, accessed on December 22, 2010. Also see, *Economic Survey of Pakistan 2011-2012*, Finance Division, Government of Pakistan, Islamabad, 2012, p. 195, at http://www.finance.gov.pk/survey/chapter_12/ExecutiveSummary.pdf, accessed on July 17, 2012.

Map 1 - Indus Basin Irrigation System



Source: World Bank, *Pakistan Water Economy: Running Dry*, World Bank, 2005, p. 4

The Mangla dam is located 160.9 km south east of Islamabad, the capital of Pakistan. It is the twelfth largest dam in the world. It is built across the Jhelum river, and is 10,300 ft (3140 metres) in length and is 454ft (138 metres) in height. The generating capacity is 1000 MW. The original storage capacity was 1,234 feet, but has been reduced to 1,210 feet due to silting. They are plans to raise the height of the dam to 1,242 ft. As per the latest available information, almost 96 per cent work on the main dam at Mangla,

the spillway and allied facilities has been completed and resettlement work is in progress[30].

The Warsak Dam is situated 30 km north west of Peshawar and has the capacity to irrigate 1,10,000 acres of land. The project was completed in 1960 and its generating capacity at that point was 160 MW. During the second phase, in 1980-81, the total generating capacity was increased to 243 MW by installing two more generating units. The Warsak Dam, according to reports has since completely silted up and there is no available storage. Power is being generated primarily from the natural flow of the river Kabul, so much so that Zahir Baig, considers it to be a 'run-of-the-river' project.[31]

Canals in Pakistan

Pakistan has 60,000 km of canals and according to 2008 figures (FAO) the total water withdrawal is estimated at 148.6 MAF, of which surface water withdrawal accounts for 98.7 MAF (66.4 per cent) and groundwater withdrawal accounts for 49.9 MAF (33.6 per cent).[32] There are 45 canals, that arise from rivers, dams and barrages. Pakistan has one of the largest canal irrigation systems in the world. The inundation canals originate from rivers and they receive water only when the water level in the rivers is high during floods. The perennial canals are taken from dams and barrages and supply water to the fields through out the year.

Punjab

The hydrology of rivers in Punjab amongst all the four provinces in Pakistan is most suited for canal construction. The Bari Doab was the first canal to be built in 1859 and irrigated about 1,000,000

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30 Ibid., p. 214.

31 Z.A. Baig, "Role of Nuclear Energy in Pakistan's Future Energy Mix", Henry L. Stimson Centre, June 2011, at http://www.stimson.org/summaries/role-of-nuclear-energy-in-pakistans-future-energy-mix-/accessed June 12, 2011.

32 "Pakistan 2010",Food and Agricultural Organisation of the United Nations (FAO), at http://www.fao.org/nr/water/aquastat/countries/pakistan/index.stm, accessed March 12, 2011.

acres of land in the pre-partition districts of Gurdaspur, Amritsar and Lahore.

The Sirhind canal at Ropar was completed in 1872. The Sidhnai canal for the Sidhnai weir on the Ravi became operational in 1886 and irrigated areas around Multan. Some Pakistani analysts claim, all of these canals demobilized and disabled soldiery. Working as water obstacles they helped in providing a defensive disadvantage to Pakistan.[33] These canals historically were the main trigger for the British policy to develop vast tracts of non-proprietary barren lands in west Punjab.

The Chenab canal, completed in 1892, forms the Khanki headworks on the river Chenab and irrigated barren tracts in central Rechna doab. Most of the settlers in the Chenab colony, as it is known, were from the Amritsar, Jalandhar and Hoshiarpur districts of eastern Punjab and they developed new lands in the districts of Gujranwala and Jhang. New colonies and towns were also established at Gojra and Lyallpur (Faisalabad).

The triple canal project involved construction of three headworks and three canals—the Upper Jhelum Canal[34] Upper Chenab Canal[35], and the Lower Bari Doab[36] canal. The triple canal project facilitated the transfer of the surplus water of the Jhelum at Mangla to the Ravi at Balloki through link canals.

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[33] Bashir A. Malik, *Indus Water Treaty : In Retrospect*, Bright Books, Lahore, 2005, p. 19.

[34] Upper Jhelum Canal runs south ward and then turns east passing close to lower Jhelum canal at Rasul Headworks. Its waters are harnessed to generate electricity by construction of Rasul power station which was commissioned in 1952.

[35] Upper Chenab Canal takes off from Marala headworks on river Chenab. It was opened in 1912 and delivered surplus Chenab water to Ravi above the Balloki headwork. Its command area extends to Sialkot, Gujranwala and Sheikhpura districts.

[36] Bari Doab Canal takes off from Balloki headworks on the Ravi and was opened in 1913. It irrigated the crown wastelands of Lower Bari Doab and led to the establishment of colonies and towns like Montogomery (Sahiwal), Okara and Renala Khurd. The Sukkur barrage in Sindh was built on the lines of Balloki, as it was a barrage with large gates.

The Sutlej Valley Canal project was a large scale project consisting of four barrages and 11 canals. Its command area was south eastern Punjab, Bikaner and Bahawalpur— after partition, the canals in Bahawalpur state went to Pakistan. The command area of the Bahawalpur canal in Pakistan is 6,500,000 acres. Presently, the three canals which cater to the state of Bahawalpur and adjoining areas and draw water from the Sutlej are: Sulemanki, Islam and Panjnad.[37] A list of all the 23 canals in Punjab is given in Annexure One.

Unlike the other provinces, which primarily depend on the Indus for their water supply, Punjab is divided into three zones for purpose of water regulation[38] the Jhelum Chenab Zone; the Tributary zone and Indus zone. Jhelum Chenab Zone draws water from Jhelum and Chenab rivers, Indus Zone from river Indus and the Tributary Zone from Indus, Jhelum and Chenab. The waters of the Indus are used primarily by the Thal Canal, the Chashma Right Bank Canal, the Dera Ghazi Khan Canal, and the Muzaffargarh Canal; and partly in Tributary Zone through the Chashma Jhelum and the Taunsa-Panjnad link canals. Whenever water is diverted from the Indus, inter-provincial feuds follow. Punjab argues that as its share of the Indus waters is established by the IRSA, it can use Indus waters according to the provisions, especially 14 (e) of the 1991 Accord. Sindh on the other hand argues that Punjab cannot use Indus waters and transfer them to the Tributary Zone even if it has a right on the Indus waters, as long as there are water shortages in Sindh.[39]

Sindh

The Indus river is the main water channel in Sindh, and is confined within protective dykes (flood protection embankments). According to estimates, 5 mha of land in Sindh is irrigated by 14 main canals from the three barrages-Guddu, Sukkur and Kotri. The larger canals split into branch canals. The Rohri and Nara canals are largest canals not only in Sindh but in the world. Both

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[37] Sutlej Valley Project Scheme, at http://www.prlog.org/10586822-sutlej-valley-project-scheme.html, accessed March 10, 2011.

[38] "Inter provincial Water Issues in Pakistan", PILDAT Background Paper, no.25.

[39] Ibid

serve a command area of close to one million hectare. The canal water is then channelled into distributary canals, which provide water to some 15-30 watercourses. In some areas pumps are used to lift water from canals.

Direct outlets from canals are another type of watercourses that are connected to the main canal. Very popular with landowners, as they benefit from the main canal, often the direct outlet is detrimental to the water cycle per se and as well as the tail-enders. Direct outlets make it very difficult to control canal hydraulics and manage water levels between head regulators. The World Bank report notes that:

> The cumulative effect of the steady increase in these direct outlets has been to increase the command area without a major increase in diversion and a change in rotational methods of water distribution among the distributaries since outlet discharges become unreliable if the flow in the canal is outside the range of 70- 110 % of the design discharge.

It further notes that large amounts of money changes hands for the sanctioning of these direct outlets.[40]

On the right bank of Sukkur Barrage, are three main canals- the Main Khair Thar Canal, Dadu Canal and Rice Canal. On the left bank, the four main canals are the Nara Canal, Rohri Canal, Khairpur East Canal and Khairpur West Canal. On the right of the Kotri Canal, is located the Kalri Baghar or the KB Feeder; and on its left are three main canals—the Phuleli, Pinjari and Akram Wah.[41] Annexure Two gives details of canals in Sindh.

As Sindh has a flat terrain, *sailaba* is another common indigenous practice for utilising the flood plains in the area. In the summer the Indus overflows its banks inundating low lying areas. After its retreat in late summer, wheat, barley and other crops are sown to

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[40] World Bank, *Pakistan Water Economy: Running Dry*, World Bank, 2005, p. 38

[41] Massacre of Sindh Forests continue unabated, *Daily Times*, January 15, 2009, at http://www.dailytimes.com.pk/default.asp?page=2009%5C01%5C15%5Cstory_15-1-2009_pg12_10, accessed November 10, 2010.

benefit from the residual soil moisture. Crop yields on lands irrigated by inundation canals depend upon winter rains and well irrigation. Some 3,00,000 acres benefit from the Sailaba along the Indus in the Sindh.[42]

Khyber-Pakhtunkhwa

Khyber-Pakhtunkhwa is a province rich in water resources, as is evidenced from the number of rivers flowing through its various districts. The various rivulets that flow through the region are the Kabul[43], Swat[44], Chitral[45], Panjgora[46], Bara[47],

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[42] Basir A. Malik, no. 33, p. 17.

[43] Kabul river rises in the Sanglakh Range in Afghanistan, separated from the watershed of the Helmand by the Unai Pass. It is the main river in the eastern part of Afghanistan. It flows 700 km before joining the Indus River near Attock. It passes through the cities of Kabul, Chaharbagh, Jalalabad, and (flowing into Pakistan some 30 km north of the Khyber Pass) Nowshera. The major tributaries of the Kabul River are the Logar, Panjshir, Kunar, Alingar and Bara rivers.

[44] Swat River is a river in North West Frontier Province, Pakistan. Its source is in the Hindukush Mountains, from where it flows through the Kalam Valley and Swat District. It then skirts the Lower Dir District and flows through Malakand District to enter the Kabul River at Charsadda in the Peshawar valley.

[45] Chitral River is a tributary of the Kunar River which is about 480 km long , located in eastern Afghanistan and north-western Pakistan. The Kunar river system is fed from melting glaciers and snows of the Hindu Kush mountains. The Lutkho River joins the Mastuj River just north of the important regional centre of Chitral in Pakistan and is then called the Chitral River, before flowing south into the upper Kunar Valley in Afghanistan, where it is referred to as the Kunar River. The Kunar River empties into the Kabul River just east of the city of Jalalabad in Afghanistan. The combined rivers then flow eastwards into Pakistan, joining the Indus River at Attock.

[46] Panjgora is a river in northern Pakistan. It rises high in the Hindu Kush at lat. 35.45, flows south through Upper Dir and Lower Dir Districts and joins the Swat River near Chakdara, Malakand, NWFP.

[47] Bara River which flows right in the middle of the village, of Akbarpura, which is one of the dense populated villages in District Nowshera. The Bara River originates from Terah Valley of Tehsil Bara and is thus named the Bara River. It is a normal flowing river with a high activity of flood in monsoon. A well maintained flood control wall has been constructed to stop the water from entering the populated area of village. Some three decades ago this river had crystalclear water, but due to high growth in population the river has become a sanitation channel and most of the waste water of the village has been diverted into the Bara which has destroyed its purity and presently it looks like a drainage canal. Kabul River or Abaseen is a symbol of NWFP Province, and flows on the northern edge of the village. This is a famous for migratory birds, and hunters from Peshawar gather in winter for hunting these. Fishing is also popular on the River Kabul.

Karam[48], Gomal and Zhob.

Major canal systems in KP include Upper Swat Canal System, Lower Swat Canal System, Pehur Main Canal System, Warsak Canal System, Kabul River Canal System, Tanda Dam Canal System, the Marwat Canal System, the Chashma Right Bank Canal System and the Bannu Canal System. The total length of the canals is 3840 kms and a number of storage dams are being constructed on them. Amongst the most well-known is the Warsak Hydro Electric Power Project which is located on the Kabul river about 30 kms from Peshawar. The project consists of a mass concrete gravity dam with integral spillway, power tunnel, power station, a concrete lined 10 feet diameter irrigation tunnel on right bank and a three feet diameter steel pipe irrigation conduit on the left bank of the reservoir. The 76.2 metres high and 140.2 metres long dam with reservoir of four square miles has a live storage capacity of 25,300 acre-feet of water for irrigating 119,000 acres of land and meeting power generation requirements. A spillway with 9 gates has the capacity to discharge 540,000 cusecs of flood water. However the Warsak Dam has now completely silted up and there is practically no storage.[49] The Gomal Zam Dam, Munda Dam, Kurram Tangi Dam Project, Gandyali Dam, Chanda Fateh Khan Dam, Azakhel Dam, Naryab Dam, Sharki Dam, Chunguz Dam along with others are part of the irrigation schemes in KP.

In Balochistan, small rivers flowing between the ridges and ranges have developed three drainage patterns. The north east region has the longest river- the Zhob[50], which flows with other rivulets into

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[48] Karam river also known as the Kurram river, lows in the Kurrum Valley, stretching across the Afghan-Pakistani border west to east (crosses from the Paktia Province of Afghanistan into the Kohat border region of Pakistan), about 150 km west-to-south-west of the Khyber Pass.

[49] Warsak Dam, at http://forum.urduworld.com/f112/warsak-dam-329049/, accessed November 10, 2010.

[50] Zhob river is located on Zhob city in Balochistan, Pakistan. The meltwater from the Sulaiman Mountains forms Zhob Rivers and it flows through Balochistan and drains into Gomal River near Khajuri Kachadd.

the Gomal[51] river. The Gomal joins the Indus just a little below Dera Ghazi Khan. One can say that north eastern Balochistan thus is a part of the Indus Basin. In West Balochistan lies a vast area of inland drainage— the Kachi plain which has seven small rivers namely the Mula[52], Bolan[53], Sukleji, Nari, Chakkar, Lahri and Ghatter.[54] South Balochistan rivers originatein the central mountain range. The important rivers are the Hub[55], Porali, Hingol[56] Basol, Shadi, Sawwad and Dasht.[57]

Groundwater from the natural springs that originate in the limestone mountain ranges is the most reliable means of irrigation, along with open dug wells and man-made k*arezes*, an ingenious system of water conservation that has been prevalent in the region for centuries. Developments in the last couple of decades, particularly the proliferation of tubewells, have led to a drastic fall in the water table, triggering a water crisis. A similar case has also been made for dams being constructed in Balochistan, as according to some reports concrete constructions would require a

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51 Gomal River is a river in Afghanistan and Pakistan. Gomal's headwaters are located south east of Ghazni (Afghanistan). The river flows for 177 km before it merges with the Zhob River, its major tributary, near Khajuri Kach. It is about 160.9 k,m from the Zhob River junction to the Indus River junction.

52 Mula River is located in Balochistan, Pakistan. The Naulong Dam project is proposed to be constructed on Mula River at Sunt about 30 km from Gandawa city in Jhal Magsi District of Balochistan to store 1,24,000 MAF water for irrigation of 25,337 acres (102.54 km^2) land in Balochistan.

53 The Bolan river rises from the village of Kolpur, which is near Bolan pass and is 24 km South of Quetta.

54 Azam Ali, "Controversy Ober Kachi Canal Route," *Dawn*, July 23, 2003, at: http://archives.dawn.com/2003/06/23/ebr10.htm, accessed December 15, 2010.

55 Hub River forms the provincial boundary between Sindh and Balochistan, west of Karachi. Hub Dam is a large water storage reservoir constructed in 1981 on the Hub River in the arid plains north of Karachi.

56 Hingol river is 563.2 km long, the longest river in Balochistan and is located in Makran, Balochistan. The river flows all year long, unlike most other streams in Balochistan which only flow during rare rains

57 Dasht river is located in Gwadar District, Balochistan, Pakistan. Mirani Dam is being built on Dasht river to provide drinking water to Gwadar city. Kech river is a tributary of the Dasht River which flows from Iran into Balochistan. The city of Turbat is located along this river.

complete redesigning of the traditional system of water distribution and even the rethinking demarcation of property rights in Balochistan.[58] Some of the mega water projects in Balochistan are the Mirani Dam, the Kachhi Canal, the Sabakzai Dam etc.

The Mirani Dam project in district Kech, north of Gwadar is an irrigation project on Dasht river. The Dasht brings water from Nihang River and flood waters to irrigate the Dasht river basin in the Kech area. Before the dam, land was brought under crop by the construction of terraces and bunds. According to some reports the local people fear that the Mirani Dam is not actually for irrigation but is meant to store fresh water meant for the Gwadar port. Some confidential documents have mentioned the supply of 1.5 million gallonsa day from Mirani andAkra Kaur Dams to Gwadar.[59]

The Kachi Canal is the largest project in the region and is supposed to irrigate 71,2750 acres in Dera Bugti, Nasirabad, Bolan and Jhal Magsi districts in eastern Balochistan. The canal takes off from Indus River at Taunsa Barrage in the Dera Ghazi Khan district of Punjab. The total length of the canal is 500 kms, of which 300 kms are in Punjab and rest in Balochistan. The Kachi canal is 5 kms away from the route to the Pat Feeder Canal, which emanates from the Guddu barrage. It has a capacity of 3,180 cusecs and irrigates 352000 acres in the Nasirabad and Jaffarabad districts of Balochistan. A major component of the Kachi canal is that a remodelling and capacity expansion of the Taunsa barrage could lead to remodelling of Guddu barrage and thus expand the capacity of Pat Feeder Canal upto Sui, thus acting as a feeder for the Kacchi canal. It is of some political consequence that Taunsa was chosen for the Kachi canal off-take instead of the Guddu, which was more economically feasible. It would have been a matter of concern for Sindh if the expansion capacity of Taunsa barrage were used as a

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[58] "Mega Water Projects in Balochistan: Claims and Reality", *South Asian Network for Dams, Rivers and People,* April 2007.

[59] Ibid.

pretext by the upper riparian to store more water than its legal entitlement. That the Kachhi takes off from Taunsa rather than Guddu increases the overall volume of water over which the upper riparian exercises control. The choice of Taunsa instead of Guddu has raised many questions as it suggests that the large expenditure on Kachi canal is not for the benefit of Balochistan, but to benefit other political and economic interests such as the upper riparian, large landowners along the canal route and the construction industry.[60]

Barrages

Barrages are built on flat surfaces and supply water for irrigation, industrial and domestic purposes. Twelve barrages have been constructed in Pakistan since independence. These are:

The Ghulam Muhammad Barrage also known as the Kotri Barrage was built in 1956. It has been built near Hyderabad and has a total length of 3000 feet. It provides water for 28,00,000 acres of land which grows wheat, rice and cotton. The Kotri canal on the right bank of the river supplies additional water to the city of Karachi. The Kalri-Bhagar feeder canal supplies water to the Kinzhar lake. The Kotri Barrage irrigates Fuleli, Pinyari and Akram Wah on the left bank and connects to Kalri Lake through Kalri Baghar for providing drinking water to Karachi

Chashma Barrage is a water storage reservoir with a series of embankments (serving as flood bounds) which divide the reservoir into five shallow lakes. It is located south west of Mianwali in Punjab province and also includes areas located in Khyber-Pakhtunkhwa-Dera Ismail Khan District.

The Jinnah Barrage has been built on the Indus river near Kalabagh. The canals carry water from the barrage, and irrigate about 15,00,000 acres of the Thal wasteland.

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[60] Ibid.

Map 2 - Pakistan: Rivers and Water Infrastructure

Source:http://upload.wikimedia.org/wikipedia/commons/thumb/0/0d/Pakistan_Rivers.PNG/300px-Pakistan_Rivers.PNG

The Taunsa Barrage is situated on Indus River near Taunsa at a distance of 189.6 kms from the Jinnah barrage. It provides the rail link betweenKot Addu on the left bank and DG Khan, Rajanpur and Kashmore on the right bank of Indus River.

The Guddu Barrage is the uppermost barrage in Sindh and was commissioned in 1962. The canals that branch out from here irrigate about 31,00,000 acres of land in the Sukkur, Jacobabad and Shikarpur areas. The main canals are the Desert Pat Feeder and Begari Sindh Feeder on the right bank and the Ghotki Feeder on the left bank. The Desert Pat Feeder also carries a share of the Pat Feeder canal to Balochistan.

The Sukkur Barrage is a one mile long barrage near Sukkur and provides water for seven canals, four flowing on its right bank and three on its left bank. These irrigate 50, 00,000 acres of land. It was commissioned in 1932 and is the largest irrigation network in the world.

The Rasul Barrage is located on the Jhelum River, four kms downstream of the Rasul Weir and 72 kms from the Mangla Dam. It was constructed in 1968 and water is diverted from this point to the Rasul-Qadirabad Link Canal for ultimate transfer to the Suleimanki Barrage on the Sutlej River.

The Marala Barrage is located on the Chenab River near the city of Sialkot, Punjab, Pakistan. It is a massive hydroengineering project and is used to control the water flow of the Chenab.

The Khanki Barrage is located on the Chenab River, 274.3 downstream of the existing Khani headworks in the Wazirabad Tehsil in Gujranwala district in the Punjab province.

The Qadirabad Barrage on the Chenab river is 32 kms away from the Khanki headworks. The Qadirabad Balloki Link Canal was taken out from the barrage in 1967. The link is fed by water from the Jhelum river carried through the Rasul Qadirabad Canal.

The Trimmu Barrage is a flood control mechanism which was constructed to protect the city of Jhang from floods in the early 1940s. The arched gridiron's bridge section is integrated with several protective bands. It is situated some 25 km away from the city of Jhang at the famous town of Atharan Hazari the location of the confluence of rivers Chenab and Jhelum.

The Balloki Barrage is on Ravi. The BS Link emanates from Ravi at Balloki Headworks with a design discharge of 524 m3/s and is divided on the way into BS-I for 453 m3/s and BS-II for 184 m3/s. The lower Depalpur Canal takes off from BS-I for a design discharge of 113 m3/s after which BS-I, parallel to BS-II, falls in the Sutlej river.

The Sidhnai Barrage is on Ravi river, appropriately at the confluence of Chenab and Ravi while Sulaimanki and Islam Barrage

are on the Sutlej river.The Sidhnai-Mailsi (SM) link passes through Mailsi Siphon downstream of Islam headworks. The Sulemanki and Islam headworks were transferred to the Bahawalpur zone and Sidhnai-Mailsi Link Canal to the Multan zone in 2004.[61] In order to feed the three canals that take off from the Suleimanki Barrage inter river link canal. The Baloki-Suleimanki Link (B.S Link) was constructed with an initial discharge capacity of 15,800 cusecs for delivery into the Sutlej river upstream of the Suleimanki Barrage. The Islam Barrage, located about 9 km north west of Hasilpur town, was constructed across River Sutlej during 1922-1927 as a component of Sutlej Valley Project for feeding the Bahawal Canal (5,400 cusecs) and the Qaim Canal (558 cusecs) on the left bank; and the Mailsi Canal (4,883 cusecs) on the right bank. It was designed for a maximum discharge of 300,000 cusecs. After the implementation of Indus Water Treaty, the head regulator of the Mailsi Canal at Islam Barrage was abandoned and the canal started receiving supplies from the new Sidhnai-Mailsi Link Canal constructed in 1965. Similarly the capacity of Bahawal Canal was reduced to 1,000 cusecs by shifting lower areas of the canal on to the new Mailsi-Bahawal link.[62]

The Panjnad Barrage is a river head in Punjab, which is the confluence point for the five rivers of Punjab i.e. the Jhelum, Chenab, Ravi, Beas and Sutlej. The Jhelum and the Ravi join the Chenab; the Beas joins the Sutlej; and then the Sutlej and the Chenab join to form the Panjnad near Uch Sharif. The Panjnad provides water for the irrigation channels of Punjab and Sindh provinces south of the Sutlej and east of the Indus river.

Link Canals

The function of link canals is to transfer water from one river to the other.

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[61] "Bahawalpur gets control of barrages", *Dawn*, Lahore, August 7, 2004, at http://www.dawn.com/2004/08/07/local24.htm, accessed November 10, 2010

[62] Tariq Altaf, "Islam Barrage Project," at http://tariqaltaf.com/islam.html, accessed November 10, 2010.

There are ten link canals in Pakistan:

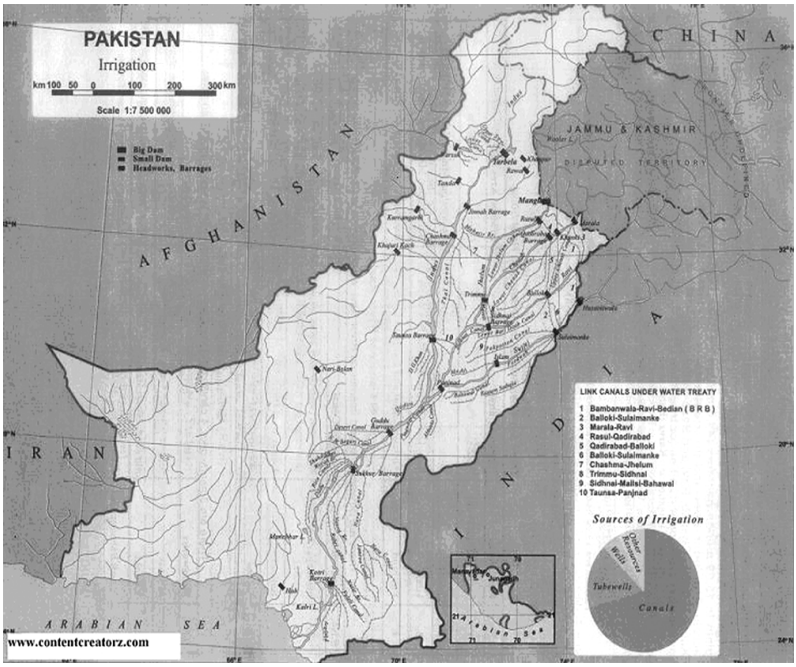
1. Balloki-Sulalmanke which links the Ravi- Sutlej
2. Bambanwala-Ravi-Bedian-Dipalpur, which links the Chenab Ravi, Sutlej
3. Chashma-Jhelum which links the Indus-Jhelum
4. Marala-Ravi, which links the Chenab-Ravi
5. Qadirabad-Balloki which links the Chenab- Ravi
6. Rasul-Qadirabad which links the Jhelum-Qadirabad river
7. Sidhnai-Mailsi which links the Ravi-Sutlej
8. Taunsa-Panjnad, which links the Indus-Chenab
9. Trimmu-Sidhnai which links the Chenab-Ravi
10. Upper Chenab-Balloki Link which links the Chenab-Ravi

As shown above, the first canal link between Indus and Jhelum rivers takes place past the Salt Range via the Chashma-Jhelum link canal originating from the Chashma Barrage on Indus River near the town of Kundian. The first barrage at River Jhelum is located near the town of Rasul from where it is linked with the next lower river, Chenab, via the Rasul-Qadirabad Link Canal.

The Jhelum ultimately falls into the Chenab near the town of Mudduki where the Trimmu headworks are located.

The Chenab enters Punjab near the town of Akhnur in Jammu and Kashmir.The Marala headworks are located on the Chenab near the town of Dhallewali. Khanki is the next headworks on the Chenab near the town of the same name. Next is the Qadirabad Barrage on Chenab near the town of Rasulnagar. Each one of these three headworks/barrages plays a significant role in the river-canal link system in Punjab.

Map 3 - Pakistan: Rivers and Water Infrastructure



Source: http://pakistan360degrees.contentcreatorz.com/wp-content/uploads/2010/01/Pakistan-Irrigation-Map.JPG

Ravi river between Maddoke and Sidhanwali in Punjab roughly zigzags between Pakistan and India before entering firmly into Pakistan. The first link between Chenab and Ravi is via the Marala-Ravi Link Canal and the Bambanwala-Ravi-Bedian (B.R.B) Link Canal joining the Ravi at Sidhanwali above the town of Shahdara and Lahore, the capital of Punjab. The first headworks on the Ravi are at Balloki. The Upper Chenab Canal starting from the Marala headworks ultimately falls into Ravi at Balloki headworks. At the same time the Qadirabad-Balloki Link Canal also connects the two rivers at the same location. The last canal link between Chenab and Ravi, before they merge together is via Trimmu-Sidhnai Link Canal ending at the Sidhnai Barrage on the Ravi. From this merging point the river continues as the Chenab where the Taunsa Barrage on the Indus links the Indus and Chenab for the first time via the Taunsa-Panjnad Link Canal near the historical city of Multan.

The B.R.B Link Canal from Ravi is extended to meet the Sutlej along the Pakistan-India border. Sulaimanke is the first headworks on River Sutlej. Here Ravi and Sutlej are linked for the second time via the Balloki-Sulaimanke link Canal. While the Islam headworks, also on Sutlej, do not provide any link, the next and the last link between Ravi and Sutlej is at Mailsi via the Sidhnai-Mailsi link canal. Ultimately the Sutlej joins the Chenab and together form a body of water commonly known as Panjnad. Just below the Panjnad headworks the waters from the lower four rivers join the Indus River to complete the merger of the five rivers and their tributaries. From this point on the story of the five waters and their link canals in Punjab is passed on to the, mighty Indus river, which continues its journey through Sindh and Pakistan empties itself into the Arabian Sea.[63]

The position of canals greatly affects the distribution of water between the canal head and tail end users. It has in many ways created hierarchies and aggravated the politics of water rights in Pakistan, thus exacerbating inter provincial fault lines. "A major factor behind the severity of the Pakistani water crises is a historical legacy of bad policies, misgovernance, and corruption." This statement by Feisal Khan, aptly summarises the political undertones in the water sector in Pakistan. While the ordering principle for provincial water management in Pakistan (as would be discussed later) is the Water Accord of 1991, which operates through the IRSA, the iniquitous intra-provincial faultlines greatly complicate the water distribution and management process.

Given the nature of the water infrastructure -overtly dependent on engineering solutions for water - it would be useful to study the present water availability and the competing uses of water in Pakistan.

Precipitation and river flows are the two major sources of surface water that meet the agricultural needs of the country. While the

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[63] P.M. Alvi, "Rivers and Link Canals in Pakistan", *All Things Pakistan*, October 30, 2006, at http://pakistaniat.com/2006/10/30/punjab-link-canal-irrigation/, accessed December 20, 2010.

mean annual rainfall in Pakistan varies from less than 100 mm in Balochistan and in parts of Sindh provinces, it is over 1500 mm in the foothills and northern mountains –areas in Pakistan Occupied Kashmir. Approximately 21 per cent of the GDP comes from the agricultural sector. Pakistan is an agriculture based economy, which provides employment to approximately 47 per cent of the population. The agricultural sector contributes approximately 60 per cent of annual national foreign exchange earnings .

As far as the hydrology of the Indus river system is concerned, it is highly variable- both season-wise and year-wise. While the flow is abundant during the summer months, the average river flow decreases drastically in winter.[64] Moreover the demand of agriculture - which consumes 95-97 per cent of the flow - experiences seasonal surpluses during the summer and shortages during the winter.[65] Table Ishows the volume of the western river waters in million acre feet.

Table I - Western River Flows in Million Acre Feet (Post- Shortage Period, 1968-1996)

	Kharif (summer)	Rabi (Winter)	Annual Total (MAF)
Minimum	94.0	19.9	113.9
10 % Probability	111.6	20.4	135.5
50 % Probability	136.0	27.1	162.1
90 % Probability	159.7	32.8	189.8
Maximum	182.0	37.8	206.0

Source: Water Resource Management Directorate, WAPDA. Adapted from Shams ul Mulk, p 168.

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[64] Shams ul Mulk , "Pakistan's Water Economy, The Indus River System and its Development Infrastructure, and the relentless struggle for sustainability," in Kugelman and Hathaway (eds.), *Running on Empty: Pakistan's Water Crises,* Woodrow Wilson International Centre for Scholars, Washington D. C., 2009, p. 68

[65] Ibid.

According to a WAPDA report, approximately 48 MAF is pumped from groundwater. Shams-ul-Mulk agrees with the WAPDA figures on groundwater extraction of 48.6 MAF. Another source states that approximately 25 per cent (15.19 MAF) of the water diverted to the canal system disappears as 'line losses'. In order to use or store water Pakistan has various dams (big and medium) and canals and barrages in place. The total storage capacity in the reservoirs of Pakistan is 15 MAF, representing 13 per cent of the annual flows.[66] There are three large dams, 85 medium/ small dams, 14 barrages, 12 inter-link canals, 45 canals, which are 64,000 kms in length for harnessing water. A total of 7,00,000 tubewells meet the commercial, domestic and irrigation needs of Pakistan.[67]

Water Today

The World Bank notes that water availability has dropped in Pakistan from 5000 cubic metres per capita during the early 1950s to less than 1500 cubic metres per capita in 2009. It is estimated that Pakistan is expected to become water scarce by 2035, though many project that this may happen as early as 2020.[68] Apart from witnessing high stress symptoms, water availability per person in Pakistan is also reduced. According to official figures, 50 million people in Pakistan do not have access to safe drinking water and 74 million have no sanitation.[69] According to many water experts the real reason for the inequitable distribution of water lies in the multiple uses of water. According to Simi Kamal, irrigation and

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[66] Hydro Potential In Pakistan, Pakistan Water and Power Development Authority, November 2011, at: http://www.wapda.gov.pk/pdf/BroHydpwrPotial April2011.pdf, accessed p. 1.

[67] Canal Systems of Pakistan, January 31, 2010, at http://pakistan360degrees.contentcreatorz.com/canal-system-of-pakistan/, accessed December 13, 2010.

[68] Michael Kugelman, "Introduction" in Kugelman and Hathaway (eds.), *Running on Empty: Pakistan's Water Crises,* Washington: Woodrow Wilson International Centre for Scholars, 2009, p.5

[69] Simi Kamal, "Pakistan's Water Challenges: Entitlement, Access, Efficiency, and Equity", in Kugelman and Hathaway (eds.), *Running on Empty: Pakistan's Water Crises,* Washington: Woodrow Wilson International Centre for Scholars, 2009, pp.28

agriculture use up to 97 per cent of Pakistan's allocated surface water resources, while only 3 per cent is available for other uses. According to some other sources, in 2010 the estimated urban consumption of water for industrial use was 1.1 MAF. Domestic water use in the rural sector was 0.8 MAF. Water use in the industrial sector was 1.18 MAF/year.[70] Asthemineral base in Pakistan is yet to develop,the industrial sector in Pakistan is primarily agro-based with cotton being the major export and also the largest contributor to the economy. A decline in the production of any of the major crops adversely impacts the Pakistani economy especially in terms of depleting foreign exchange reserves. Cotton for instance is an important foreign exchange earner, its contribution being $19.26 million in 2009-10.[71] Pakistan is also a major rice exporter annually exporting about 1.8 million tons (2009).[72] Cotton manufactures, leather and rice made up 61 per cent of the total exports during July-March 2011-12. Given the select dependence on exports, floods or natural calamities in Pakistan, as were experienced in 2010 and 2012, can increasingly distort Pakistan's trade balance.

As per official figures 20 million people were affected by the 2010 floods, and when the 2011 floods struck Pakistan; many were still in the recovery phase. The agriculture sector received a major blow followed by housing, education, the financial and private sector and industries. While economic growth is projected to decline in the coming months, the minimum reconstruction costs amounted to a total, of Rs 239 billion ($2747 million). Sector-wise breakdown of flood damages and reconstruction cost estimates is given in the Table II.

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70 "Pakistan's Water Dependence and Requirements", June 8, 2010, http://viewstonews.com/index.php/pakistans-water-dependence-and-requirements/pakistan, accessed December 18, 2010

71 Razi Syed, "Floods claim over Rs 75 bn loss to cotton crop," *Daily Times*, September 7, 2010, at http://www.dailytimes.com.pk/default.asp?page=2010\09\07\story_7-9-2010_pg5_10, accessed December 18, 2010

72 Mobin Nasir, "Pakistan to lead global rice exports in 2010: FAO ," *The Express Tribune*, July 16, 2010, at: http://tribune.com.pk/story/28117/pakistan-to-lead-global-rice-exports-in-2010-fao/, accessed December 18, 2010.

Table II - Flood Damage and Reconstruction Cost by Sectors

Sectors	Damages		Reconstruction Costs	
	Rs. Million	USD Million	Rs. Million	USD Million
Irrigation and Flood Management	4,763	55	9,526	109.5
Housing	85,465	982.4	91,510	1,051.8
Agriculture, Livestock and Fisheries	1,60,107	1840	26,590	305.6
Transport and Communication	26,468	304	33,902	388
Energy	1,240	14	292	3.4
Social and Gender	44	1	65	0.7
Financial, Private Sector and Industries	2,7254	313	8,178	94
Education	12,014	138.1	22,589	259.7
Health	1,258	14	864	9.9
Water Supply and Sanitation	1,204	14	1,900	22
Governance	1,953	22	4,768	54. 8
Environment	2,763	32	2,874	33
Disaster Risk Management	-	-	1,827	21
Social Protection	-	-	34,126	392.3
Total	3,24,533	3730	2,39,011	2747

Source: World Bank and Asian Development Bank (ADB) Damages and Need Assessment Report 2011

(Adapted From Economic Survey of Pakistan, 2011-2012)

While agriculture is an important source of foreign exchange it is dependent on water availability, while the overall economic growth is dependent on energy. In FY2010 power shortages in Pakistan restricted growth to 4.1 per cent. The energy shortfall is estimated to have reduced GDP growth by 2.0-2.5 per cent.[73] Pakistan has been growing at a rate of 3 per cent in the past two years. The bulk of the electricity produced by the Indus system, comes from two dams—the Mangla on the Jhelum and the Tarbela on the Indus. Matching energy demand with energy supply will be one of the most critical issues that Pakistan will have to address in the coming years. According to the former finance minister Shahid Javed Burki energy availability is expected to increase at the rate of 5.75 per cent per year from 2005 to 2020. He argues that without efforts to increase energy supply, GDP per capita would possibly increase by $1,175, which would amount to a loss of average income of $ 225 per head in 2015, significantly affecting the incidence of poverty, distribution of inter-personal income and distribution of regional incomes.[74]

Given that about 70-80 per cent of the Indus river flows originate from melting snow and glaciers, climate change will be a determining variable that will impact the water sector in Pakistan. Studies have shown that climate change will increase the variability of monsoon rains and enhance the frequency and severity of extreme events such as floods and droughts.[75] This could cost Pakistan hugely in economic terms. Research has also confirmed the fact that the Hindu Kush Himalayan (HKH) glaciers are retreating at a pace that is much faster than the global average. The International Centre for Integrated Mountain Development (ICIMOD) notes that a majority of the studies show that the Hindu

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[73] Dawn Elizabeth Rehm and Farzana Noshab, *Pakistan*, Asian Resident Mission, ADB, 2010 at http://www.sacc.ch/upload/Pakistan_528.pdf, accessed March 2011.

[74] Shahid Javed Burki, "The Weight of History: Pakistan's Energy Problem", in Hathaway et. al (eds.), *Fuelling the Future: Meeting Pakistan's Energy Needs in the 21st Century*, Woodrow Wilson International Centre for Scholars, Washington D. C., 2007, pp. 47

[75] "WAPDA presentation on climate change", WAPDA, 2011, at http://www.wapda.gov.pk/pdf/climate.pdf, accessed July 4, 2012.

Kush-Himalayan glaciers are retreating, especially in China, India, Nepal, and Pakistan[76]. The impact of climate change in Pakistan—nationally and across provinces includes[77]:

- Uncertainty regarding the fate of Upper Indus Basin glaciers and future water availability.
- Heightened risk of floods and droughts. Climatic zones with a hyper arid climate like Balochistan would be worst hit. Floods would also cause damage to property, livestock, crops and agricultural. The whole geographical space from Khyber-Pakhtunkhwa to Sindh could be affected.
- Severe water and heat stress in arid and semi arid regions, leading to reduced agricultural productivity and power generation.
- Punjab province could be severely hit by the impact of climate change as 71 per cent of the total land is dependent on irrigation. Climate change can lead to water logging and also the increase in soil salinity. Punjab is the bread basket of Pakistan and any such changes could adversely the food production of the country. The land could degrade due to water logging and salinisation, water and wind erosion.
- Increased upstream intrusion of saline water in the Indus delta, adversely affecting coastal agriculture (particularly Badin and Thatta in Sindh district), mangroves and breeding ground for fish.
- Threat to coastal areas, including the city of Karachi, due to sea level rises and increased cyclonic activity on account of higher sea surface temperatures.

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[76] Hindu Kush Himalayan Glaciers, at http://www.icimod.org/?q=1179#hkhglaciers, accessed July 6, 2012

[77] "WAPDA presentation on climate change", WAPDA, 2011, at http://www.wapda.gov.pk/pdf/climate.pdf, accessed July 5, 2012; Also see, Iqbal and Khan, "Climate Change Challenges faced by Agriculture in Punjab," Global Change Impact Studies Centre, Islamabad, August 30, 2008, at http://envirocivil.com/climate/effects-of-climate-change-on-thatta-and-badin/;http://cmsdata.iucn.org/downloads/pk_cc_mohsin.pdf, accessed July 6, 2012.

There would be multiple impacts of climate change in Pakistan, as its economy is heavily reliant on climate sensitive sectors like agriculture and forestry—especially mangrove forests which are the source of fuel wood and food for local inhabitants and the breeding ground for 90 per cent of Pakistan's shrimps, its main fisheries export. Issues like food security and energy security would also be impacted by water scarcity.

Given the importance of water for Pakistan's economy, it is important to study the management and internal politics and policies of the water sector in Pakistan. These aspects are discussed in detail in the second part of this monograph. Meanwhile, in order to assess the impact of external factors on the water sector in Pakistan , the impact of global warming and climate change has also been studied.

Part II

The Internal and External Dynamics

Chapter Three

Pakistan's Water Policy: The Vision and Ambition

Understanding the undercurrents of the water policy is important as it affects the overall structure of water sector in Pakistan. The factors which have influenced the existing water policy of Pakistan can be understood in three broad phases. First, the pre-partition years, which provide useful insights into the genesis of the inter-provincial water dispute between lower riparian-Sindh and upper riparian-Punjab. Second, the Indus Water Treaty, which provided the broad structural framework, within which Pakistan crafted its policies and institutional structures for water distribution and management[78] and third, the water laws and policy documents which determine the broad contours and direction of the existing 'water' framework in Pakistan.

The First Phase: Punjab-Sindh Dispute

Riparian disputes are common in shared trans-boundary rivers. The Indus basin, which is the largest contiguous basin in the world, initially had two riparian partners— united Punjab and Sindh. Sindh, for its part had started asserting its water rights as early as the 1850s, when Punjab started diverting water much against the claims put forward by Sindh province.[79] Sindh had objected to the building of the Bari Doab Canal on the Ravi in 1859, and later the construction of Sidhnai Canal, the lower Chenab Canal and the lower Jhelum Canal. because canal construction was adversely affecting the functioning of its inundation canals.[80] In response to these recurring objections from Sindh, the Indus Irrigation

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[78] For instance, the Indus Basin Project provided the broad framework on which Pakistan institutionalised its water infrastructure and policies at the federal and the provincial level.

[79] Rasul Bux Palijo, "Sindh-Punjab Water Dispute: 1859-2003", Centre for Peace and Civil Society, Sindh, August 2010, at http://www.cpcs.org.pk/docs/bookshelf/Sindh-Punjab%20Water%20Dispute.pdf, p. 5.

[80] Ibid.

Commission was established in 1901, by the British government, which directed Punjab to seek prior permission from the Sindh with regard to the construction of future projects on shared rivers. However, Punjab continued with its canal projects, and the dispute between both provinces exacerbated in 1930s, when Punjab started the Sutlej Valley project. This facet of Sindh –Punjab dispute needs to be underlined, primarily because its resolution set the precedent for establishing the rights of the lower riparian which was based on equitable apportionment.

While Punjab is often described as the "fair child" of the British, Sindh has often been termed as a "step child". This statement by Michel Arthur Aloys, appropriately describes the differentiated treatment given to Sindh during British rule. Although irrigation development in Sindh formally started much later in the 1920s, almost a century after it was initiated in Punjab, a canal department was established in Sindh as early as 1851. The Begari canal and Fuleli canal in Sindh were restored in 1852-53 (above Sukkur) and in 1856 (below Hyderabad) respectively. Water use in Sindh gradually increased and by 1900 Sindh possessed 11,975 km of canals, commanding 9.5 million acres almost irrigating 2.5-2.7 million acres of land per year.[81]

However, demands and proposals from Sindh to expand and develop its usage capacity were often put down by the British, given the flat terrain in Sindh, which was prone to frequent flooding. Also, it was argued by the British that since Sindh was dependent on a single river water channel i.e. the Indus river, its source of supply was uncertain and that Sindh's existing capacity was sufficient to tap the inflowing water considering its present requirements.[82] The British also argued that as Sindh was far from famine prone districts in contrast to Punjab, which was better placed to supply food in times of need, constructing canals in Sindh could prove costly in the long term. Notwithstanding these arguments, pressures from Sindh only increased. In 1920, Sindh

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[81] Michel A. Aloys, no. 9, p. 104.

[82] Ibid, p. 106.

obtain permission to build barrages in three sites: Guddu, Sukkur and Kotri. This was also the time, when Punjab was contemplating the Sutlej Valley Project (SVP), Thal project and Timmur barrage.

Sindh objected to the building of the SVP, claiming that it would adversely affect the functioning of its projected canal systems. Mohammad Ali Chowdhary writes "... this transformation in Sindh's interest in 1920s marks the inception of the Indus Water Dispute."[83] These developments were therefore important, as in many ways they set the agenda for water rights in Pakistan. For instance, in 1919, the Cotton Committee stated that Punjab should not be given any waters from the Indus river system, till the Sukkur barrage is completed.[84] Similarly the Government of India Act, 1935, Section 131(6), stated that no province can be given an entirely free hand in respect of a common source of water, such as an inter-provincial river. It also upheld the principle of the "equitable apportionment" of the river waters, stating that, "the rights of states having a common river basin, includes the rule that an upper riparian can take no action that will interfere with the existing irrigation of the lower riparian."[85] However, it was in 1945 that the equitable solution was accorded legal sanction , when the 'Sindh-Punjab Agreement' was signed. The agreement allocated 75 per cent of the water flow from Indus River to the Sindh, with the remainder going to Punjab. Also it allocated 94 per cent of the water from the five eastern tributaries of the Indus River to Punjab, with the residual water going to Sindh.[86] The partition of the subcontinent and the subsequent Indus Water Treaty - signed by India and Pakistan in 1960- allocated most of, what was Punjab's share of the Indus Basin waters as per the 1945 Sindh-Punjab Agreement, to India and also provided for the construction of

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83 Imran Ali, no. 8, p. 117.

84 Rasul Bux Palijo, no. 79, p. 7

85 Cited in Rasul Bux Palijo, Ibid, p. 8

86 Danish Mustafa, "Social Construction of Hydropolitics: The Geographical Scales of Water and Security in the Indus River Basin," *Geographical Review*. 94(4), 2007, p. 492.

storage and link canals from the western half of the Indus Basin to the eastern half to compensate for the water lost to India. The Sindhis widely perceived the compensatory water and the storage on the Indus and Jhelum rivers as a way of compensating Punjab at the expense of Sindh.[87] Thus in the first phase, the foundations of the water infrastructure were laid, and were perpetuated in the second phase. The inter-provincial claims also got highlighted, only to be resolved later in 1991.

The Second Phase

However, the agreement was short lived as the Indus Water Treaty divided the rivers between India and Pakistan. Not only did Sindh find itself marginalised with the allocation of the eastern rivers to India, but the Pakistani Punjab also had to engineer the sharing of the waters of the three western rivers amongst all the other three provinces in Pakistan. The Indus Water Treaty, therefore in many ways laid the foundation of a technocratic paradigm for managing the water resources in Pakistan.

Thus, it would not be an exaggeration to state that the turning point in Pakistan's water policy came with the partition of the sub-continent and the partition of the rivers through the Indus Water Treaty. As is widely known, the Indus Water Treaty was negotiated under the good offices of the World Bank. Three western rivers (Indus, Jhelum, Chenab) which flowed from Pakistan Occupied Kashmir and Jammu and Kashmir were given to Pakistan, while the three eastern rivers (Sutlej, Ravi Beas), which flowed from Indian Punjab and Himachal Pradesh were given to India. With the Pakistan was compensated for the loss of eastern rivers - on which South Punjab and Sindh depended,- in material terms by both India and the World Bank and other developed countries like the US, Germany, France, Canada, Italy amongst others, for building tubewells, dams, link-canals and barrages, so that its western rivers could be harnessed and diverted to the

[87] Ibid.

required areas. The following points were decided upon by both parties during the implementation phase:

Table III: Indus Water Treaty

System of Works approved by the IWT in Pakistan	Location	Capacity
Dams and Related Work	Jhelum River	Live Storage of 4.75 MAF
	Hydro-electric	3,00,000 kw generating facilities
	Indus River	Live Storage of 4.2 MAF
Link Canals (Construction and remodeling)	Rasul –Qadirabad	19,000 cusecs
	Qadirabad-Balloki	18,600 cusecs
	Balloki-Suleimanki	18,500 cusecs
	Marala-Ravi	22,000 cusecs
	Bambanwala-Ravi-Bedian-Dipalpur	5,000 cusecs
	Trimmu Islam	11,000 cusecs
	Kalabag Jhelum	22,000 cusecs
	Taunsa-Panjnad	12,000 cusecs
Barrages	Qadirabad	
	Ravi	
	Sutlej	
Tubewells and Drainage Works	About 2,500 tubewells to contribute to the lowering of the water table, some of which will yield additional water supplies for irrigation use	
	A system of open drains to lower the water table in about 2.5 million acres of land now under cultivation but seriously threatened by water-logging and salinity.	
Other Works	Ancillary irrigation works directly related to the foregoing, including remodelling of existing works.	

Source: Michel. A. Aloys, *The Indus Rivers: A Study of the Effects of Partition*, (New Haven: Yale University Press, 1967, p. 169-70

The Indus Basin Project, as it has been termed, thus included 643 kms of major link canals with a total discharge capacity of 1,50,000 cusecs[88]. It was clearly stated in a WAPDA report that amongst all the canal projects, priority should be given to the main stem projects, i.e. Sindh and South Punjab. In order to compensate for the loss of eastern rivers, two link canals were constructed from the River Indus-the Chashma-Jhelum Canal and the Taunsa-Panjnad Canal to compensate for the water loss in southern Punjab. Commenting on the current infrastructure, the PILDAT report states[89]:

> If there are shortages at Panjnad, i.e. if the Indus flows cannot meet the requirements of the trans-Thal (Chashma-Jhelum) links in addition to the main stem needs, these shortages are to be met by the Jhelum -Chenab flow through Trimmu-Sidhnai (links Chenab-Ravi) before diversion into Haveli (links Chenab-Ravi) and Trimmu-Mailsi-Bahawal (links Ravi-Sutlej). However, if the Indus cannot supply the non-main-stem projects in the Indus Zone, their burden is to be transferred to the Jhelum-Chenab Zoneg[90] and ultimately to the Jhelum storage dams at Mangla. Thus as far as the Indus main stem is concerned, Punjab, primarily diverts water through Thal Canal, Chashma Right Bank canal, Dera-Ghazi Khan Canal and Muzzaffargarh Canal.

Thus, as is evident the Indus Basin Project laid down the basic framework for present water infrastructure, on which Pakistan based its institutions and bureaucratic management for managing water resources. The partition proved costly for Pakistan, as not

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88 Michel A. Aloys, no. 9, p, 270.

89 "Inter-provincial Water Issues in Pakistan", PILDAT Background Paper, no. 25.

90 Mangla Reservoir is linked to Chenab through Upper Jhelum Link. Upper Jhelum Link is attached to Khanki Barrage, Chenab river. Rasul barrage on river Jhelum is linked through Khanki Barrage and Qadirabad Barrage on River Chenab through Upper Jhelum and Rasul-Qadirabad link. Qadirabad Barrage on River Chenab is linked to Ballolki Barrage on Ravi River through Qadirabad –Ballolki Link Canal. Ballolki-Suleiman Link links Ballolki Barrage and Suleimanki Barrage on the Sutlej.

only its options were severely curtailed due to the secession of Kashmir to India but also the sites which were previously ignored in undivided India, due to ecological concerns had to be exploited for fulfilling Pakistan's domestic, industrial and industry needs.[91]

An important fallout of the water engineering projects in Pakistan was the competing claims of different provinces over allocation of water flows and the socio and environmental impact of reservoirs on Punjab's downstream neighbours. The single point agenda of water resource development was thus broadened to include other issues such as: equality in the distribution of water resources; water management; environmental quality; and domestic water supply and sanitation.[92] WAPDA and a group of engineers, who laid emphasis on engineering solutions with careful attention to hydraulic principles and mathematical measurements of slope, gained importance post partition.[93] This prominence of engineers was a colonial legacy! In the process of mechanising the irrigation system, many local practices were lost. The role of indigenous labour (*chher*) in canal maintenance was also slowly lost.[94]

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[91] The dam at Mangla for instance was never perceived initially. In fact there were plans for the Wular lake scheme on the Jhelum river, though with a condition of no storage. It was feared that the lake would inundate the valley. On similar grounds the Indus was also not exploited for any projects, because of the heavy sedimentation in the flow of the river. See Michel A. Aloys, no. 9, p. 284.

[92] Danish Mustafa, no. 86, p.498.

[93] David Gilamartin, "Scientific Empire and Imperial Science: Colonialism and Irrigation Technology in the Indus Basin," *Journal f Asian Studies*, 53 (4), November 1994, p. 1136.

[94] The system of *chher* (indigenous) labour illustrates this point. Initially canal sharers were responsible for the annual clearing of silt from the canals. However due to engineering solutions, the distribution of water which was taken care of was disturbed. Consequently with the passage of Canal and Drainage Act 1873, the limitation in the number of outlets from each channel and the careful fixing of the area to be irrigated by each had already begun to emerge in the name of efficiency. Further, increased departmental control over outlets restricted local irrigating communities to the irrigating units defined by each outlet. This had critical political implications. See, David Gilamartin, no. 93, pp. 1130-1138.

While local practices changed and a distinct state-society relationship developed during the colonial times, post-independence a unique irrigation infrastructure came into being. Commenting on the consequences of infrastructure development in Pakistan, a World Bank study published in 1994, argued that the large investment in surface irrigation infrastructure has not only transformed the economy and landscape of Pakistan, but also has had a huge impact on ground water, particularly in terms of water logging. Thus while there was an evident physical expansion of the irrigation system, it had an adverse impact on the quality and distribution of water. In order to cope with these rising challenges, series of reforms in Pakistan were undertaken in the years that followed. Though the issue pertaining to the management of water sector would be dealt with in another chapter, this section would primarily focus on the institutional response to the water sector.

The Third Phase

Thus it can be stated that Pakistan's water policy is a culmination of two distinct factors: legal and institutional. The legal framework is governed by the Canal and Drainage Act, 1873. The Indus Water Treaty could also be included in the legal framework as it defines the distribution of the rivers and determines the total water flow into Pakistan. The legal framework would also include Pakistan's water policy envisaged through its water vision 2025, Five Year Plans and the devolution policy initiated in 1990s. The institutional framework consists of the various federal and provincial departments of agriculture and irrigation management. Given the latest development the 18th amendment can also be incorporated within the institutional framework.

The Legal Framework

The Canal and Drainage Act of 1873 is the key legislation, which regulates water policy in Pakistan. While the Act has been amended over time (the latest being 1967), it is essentially a legacy of the British colonial policy. The 1873 Act favours the state, recognising its strong right to administer water policies. Danish Mustafa writes that the Preamble of the Act, specifically mentions that public purposes may supersede any pre-existing rights of any private water

user.[95]Some of the important elements of the Act briefly analysed by Mustafa are:

Scope: The Act applies uniformly, without particular regard to geographical variations. It legally provides for water sufficiency for only 64 per cent cropping area thereby making the management objective to be the extensive rather than the intensive development of agriculture. It establishes a fixed rotational timeframe for the irrigation distribution system, which is often to the detriment of tailenders, thus making them vulnerable.

Definition: The Act however does not define the 'public purpose' which the government can invoke for the use and control over all the water in the territories covered by the Act. It further requires that a notification be issued by the provincial government when it deems that water supply is to be used for public purposes. It also states that the consent of the water user who might be affected by the notification is not necessary.

State Power: According to Section 6 of the Act, at any time after the notification, any canal officer, acting under the orders of the provincial government or on its behalf, may enter any land and remove any obstructions *and may close any channels*, and do any other thing necessary for such application or use of the said water.

Local participation, though envisaged by the Act is heavily inclined towards assisting the government in policing the local population. The Act further allows the provincial government to co-opt a few cultivators for assisting the authorities in investigating the transgressions of their fellow cultivators which makes the scope of participation extremely limited and asymmetrical.

As is evident from the above analysis, the Act is state-centric, and allows the users no leverage. It gives enormous power to the state, thus marginalising the the people at large. When the state leadership

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[95] Danish Mustafa, "Theory *versus* Practice: The Bureaucratic ethos of water resource management and administration in Pakistan", *Contemporary South Asia*,11 (1), 2002, pp. 39-56.

is not responsible to the people there can be a great deal of misuse of power. Not only does it lack accountability but also provides scope for water politics instead of water security.

The post independence, water policy in Pakistan is largely contained in the following documents:

Pakistan's Water Vision

Vision 2025 is a comprehensive integrated water resource and hydropower development mega-plan, launched by WAPDA. According to the this, Pakistan aims to build various storage sites (big, medium and small dams) with a total capacity of 65 MAF (80.2 BCM) and develop hydropower capacity (viable) of 40,983 MW.[96] The present generation and storage capacity of Pakistan is 5039 MW and 15 MAF respectively. The programme is proposed to be implemented in three stages. The estimated investment till 2025 is pitched at $50 billion. While, the 'water vision' of Pakistan is quite ambitious it should be emphasised that the vision was developed by a group of engineers working in senior positions in the planning commission, who neither had the mandate to work in this area, nor the political clout to translate the vision into a workable model.

National Water Policy

The National Water Policy (draft) in Pakistan of 2004, envisaged the following elements for water reform[97].

Institutional: Strengthen institutions and agencies responsible for development planning and design water resources and service delivery structures across the water sector. It also aims to improve the ability of water agencies to carry out their functions, including environmental protection, effectively and efficiently.

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[96] *Pakistan Water Sector Strategy, National Water Sector Profile*, Ministry of Water and Power, Office of Chief Engineering Advisor, 5, October 2002, at http://cms.waterinfo.net.pk/pdf/vol5.pdf, accessed March 12, 2011.

[97] Ibid.

Public-Private partnerships: It aims to provide opportunities and encourage private sector participation and community involvement at all feasible levels in the water sector. Also it aims at reducing public spending on irrigation through cost sharing and irrigation, management transfer.

Promote public education programmes, equity of use and water management: The policy aims to improve public understanding of water issues and promote and adopt principles of Integrated Water Resources Management (IWRM). It also aims to improve levels of equity in relation to irrigation water and urban and rural domestic water.

Promote run of the river projects in PoK and ensure regular dredging: The policy aims to promote the development of hydropower, with special focus on the northern run-of-river schemes and reduce water logging, soil and water salinity and saline agricultural drainage.

Devolution Plan

On August 14, 2001 Pakistan started the implementation of the Devolution Plan. The plan envisages elected local governments at various tiers. In the absence of a consolidated water policy a number of policy decisions have been implemented. These include:

1. Exploitation of groundwater in fresh groundwater areas is to be done entirely by the private sector. However, this can be a seemingly dangerous proposal, given that ground water has reached the limits of exploitation. Further, participation by the private sector can exacerbate the situation particularly because it is driven by profit. This could also result in an increase in tariffs, thus limiting accessibility and its outreach to the poor.
2. Encouraging beneficiary participation in the operation and management of irrigation and drainage systems at the tertiary canal level and for rural water supply and sanitation schemes.
3. Improvement of cost recovery both in irrigation and drainage and in rural and urban water and sanitation schemes.

4. Replacement of Salinity Control and Reclamation Project (SCARP) tube wells in fresh groundwater areas with privately owned and operated community tube wells.
5. Institutional reforms in the irrigation and drainage sector, specifically the establishment of the Provincial Irrigation and Drainage Authorities, Pilot Area Water Boards and farmer organisations.
6. Adoption of a hydel policy to encourage private sector participation in hydropower generation.
7. Enactment of the Environment Protection Act.
8. Adoption of a National Conservation strategy

National Drainage Programme

The National Drainage Programme (NDP) began in 1998 and proposed a drainage accord between the provinces in order to reduce the drainage surplus[98]. However, in 2006, an independent investigation by the World Bank inspection panel found that the design of the projects was faulty and that the World Bank had violated key rules when building the canals. As a result, many lives and livelihoods were lost and large-scale destruction of wetlands followed. According to some reports these breaches led to the flooding of fields and wetlands destroying both flora and fauna[99].

In sum the legal water framework is constituted of three key elements. Archaic laws, excessive focus on hydel projects—i.e engineering solution to water management seem to prevail over local management practices and public private partnerships. Water rights and water user friendly laws are loosely defined and in most

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[98] Drainage surplus indicates that 'the aim of the project is to address waterlogging and salinity in the Indus Basin especially for people from Southern Sindh.

[99] International Rivers Network, National Drainage Programme, at http://www.internationalrivers.org/campaigns/national-drainage-program; Also See, The Inspection Panel, "Pakistan National Drainage Programme Project," Investigation Report, July 6, 2006, at http://www.internationalrivers.org/files/attached-files/pkfinalinvestigationreport.pdf, accessed April 9, 2011.

cases non-existent. Ownership of land in many cases remains a proxy for water rights.[100] Stakeholder implications and ownership are also clearly absent from the legal framework.

Institutional Framework

Federal and provincial bodies are responsible for the water sector in Pakistan. At the apex of all the line agencies is the WAPDA, the first parastatal organisation created in Pakistan, which was given the mandate of planning and building irrigation infrastructure, along with the supporting human and financial resources.[101] The Authority is also responsible for generation, transmission and distribution of power in the country, except for Karachi where the Karachi Electric Supply Company (KESC) operates. Both WAPDA and KESC are federal institutions under the control of ministry of water and power. WAPDA has recently decentralised power distribution by creating subsidiary companies, which undertake power distribution and collect revenues. Initially, irrigation and drainage up to the field canal intake was managed by the provincial irrigation departments. However, in 1997 new Acts were passed and various line institutions were created. The first is the Provincial Irrigation and Drainage Authority (PIDA), the second is the Area Water Board[102] (AWB), the third is the Farmers Organisations (FOs)[103] and the fourth is Water Course Associations[104].

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[100] Simi Kamal, "Use of Water for Agriculture in Pakistan: Experiences and Challenges, May 3-May 5, 2009, at research.unl.edu/events/futureofwater/ppt/SKNebraska.pdf, accessed March 20, 2011.

[101] Simi Kamal, "Pakistan's Water Challenges: Entitlement, Access, Efficiency, and Equity, in Kugelman and Hathaway (eds.), *Running on Empty: Pakistan's Water Crises*, Washington: Woodrow Wilson International Centre for Scholars, 2009, p. 17.

[102] AWB is primarily responsible for the canal command and branch canals. It also operates and maintains drainage tubewells drains with capacity larger than 15 cusecs. It carries out flood protection and maintains infrastructure within its command areas. It also promotes formation, development and growth of farmer organisations.

[103] The farmer organisations are constituted along the distributary system. It ensures equitable distribution of water to small and tail end farmers. It also supplies non-agricultural users, guarantees minimum drinking water, carries out flood protection and maintains infrastructure within its command area.

[104] Below the farmer organisations are Water Course Associations. The majority of farmers along the water course form the WCA, and are registered with the field officer.

Administratively the provinces were previously divided into divisions and districts. In August 2001, after the local government ordinances were promulgated governance was decentralised power was devolved to the lower levels. This new system established elected local governments at the union council, tehsil, town, district and city district levels. All the service delivery related government departments were placed under the control of the respective district coordination officers. However, the provincial irrigation departments and PIDAs are not affected by the devolution and decentralisation.

PIDA is the successor of the Provincial Irrigation Department (PID) and is an autonomous body responsible for independent revenue collection. Its main functions relate to maintaining barrage outlets, including the operation and maintenance of spinal drains and link drains and river flood protection and maintenance of the infrastructure.[105] As far as the farmers organisations are concerned, with the exception of the formation of a few FOs in Sindh and NWFP, there has been little activity. This is mainly due to institutional loopholes as well as procedural delays in preparation and formulation of rules and regulations relating to the formation and functioning of FOs.

A landmark development relating to the devolution of power was the 18th amendment which became an Act on April 2011. The amendment abolished the concurrent list, transferring additional functions to the provinces. While the amendment emphasises the need for inter-provincial coordination, it also mandates environmental pollution and ecology as the legislative domains of provincial assemblies. As per the reforms introduced, the federal ministries of environment and food and agriculture have been dissolved. Further a new ministry of climate change has been created. A National Climate Change Policy was also approved on March 2012[106].

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[105] Simi Kamal , no. 100.

[106] Ministry of Environment, "*National Climate Change Policy (*Draft)," Government of Pakistan, April 2011.

The 18th amendment also strengthens the Council for Common Interest-which is a joint federal provincial forum. Though according to the Amendment, the composition of the Council (Article 153) remains more or less unchanged - the prime minister and his three nominees would represent the centre and the four chief ministers would represent the provinces - the changes proposed in Article 154 are noteworthy. It has been stipulated that, the council shall be constituted within 30 days of the prime minister's swearing-in and that it will have its own permanent secretariat (and not merely a desk in the cabinet division). The amendment also mandates the council to meet at least once in 90 days. Further, an amendment to Article 157 has been introduced, which obliges the federal government to consult the provincial government concerned before taking a decision to build or sanction a hydro-electric power station in any province.[107]

One can conclude therefore, that, Pakistan is on the path of reforming its institutions. However, much would depend on how these reforms would work at the grass root level. The existing political culture in Pakistan would play a key role in either facilitating or impeding these reforms.

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[107] I.A. Rahman, "What the Provinces Gain," *Dawn*, April 15, 2010, at http://archives.dawn.com/archives/19226, accessed April 18, 201.

Chapter Four

The Politics of Water Resources

Pakistan is largely dependent on agriculture. The area available for farming is 20 million hectares, out of which irrigated agriculture accounts for 16 million hectares. The remaining four million hectares is dependent on rainfall, also known as *barani* farming. Land irrigated through canals is 14.23 million hectares, land irrigated through tube wells is 3.75 million hectares and land irrigated by other sources is 0.2 million hectares.[108] According to province wise distribution, surface river flow in Pakistan is highly variable. Punjab is estimated to have 34 MAF, Sindh—3.5 MAF, Khyber-Pakhtunkhwa—2 MAF and in Balochistan—0.5 MAF. Overall in Punjab province, fresh water availability is 79 per cent of the total area, and in Sindh province fresh water availability is 28 per cent of the total area.[109]

Given this huge variability in surface water availability, engineering solutions to water distribution have largely shaped water policies. These policies have often led to inter-provincial faultlines but also intra-provincial politics. While the Indus Water Treaty signed between India and Pakistan in 1960 aggravated the riparian tensions between Sindh and Punjab, it also in many ways deprived South Punjab of the eastern Rivers, thus paving the way for the south Punjab-north Punjab divide. Therefore the Indus Water Treaty is often questioned because of the impact it had on Pakistan. Many in Pakistan, especially the lower riparians, consider the allocation of eastern rivers to India as being a big historical mistake, stating that it adversely impacted the agricultural sector in Sindh. Given

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[108] Ansar Hayat, *Irrigation sector development in Punjab (Pakistan): Case Study of District Sargodha*, Masters Thesis, Department of water and environmental Studies, Linkopings Universites, Linkopings, Sweden, Linkoping 2007, at *liu.diva-portal.org/smash/get/diva2:16896/FULLTEXT01*, p. 4.

[109] Ibid.

the impact of climate change and new instruments pertaining to carbon trading, the institutions established by the Indus Water Treaty have come under great pressure.

One of the primary reasons for theallocation of eastern rivers to India, was the belief in Pakistan that engineering solution would be able to manage the spatial spread of rivers. For instance Bambanwala-Ravi-Bedian-Dipalpur (BRBD) link canal was an exemplary precedent for the diversion of river waters when the Indus Basin Project was undertaken. The relevance of BRBD canal was that it underlined the feasibility of diverting the flow of Chenab and Ravi to make up for the loss of Sutlej-Beas waters.[110] Diversion of river water through provincial link canals, thus became a common practice, as shown in chapter one and after 60 years of its implementation, diversion projects have become one of the main reasons for inter-provincial fault lines. This chapter aims to explore how politics interferes with water management and distribution practices in Pakistan.

While spatial spread of the rivers in Pakistan is one of the key drivers of the asymmetrical relationship between different provinces, the history of canal irrigation and the colonial legacy initiated by the British also played an important role in the politics of the water sector. The colonial legacy in contemporary Pakistan can be seen in the inequitable land distribution pattern rampant in Sindh and Punjab. This overarching feudal setup has continued undisturbed post 1947, with many of the water practices remaining hostage to colonial laws and policy formulation. The colonial legacy was important as it defined the status of water rights in Pakistan, which according to the national law are non-existent as land rights are often taken as a proxy for water rights. With both geography and history playing an important role in dictating the cycle of the demand-supply of water resources, politics in the water sector is further complicated by increasing demographic pressures and economic demands. Besides, these key drivers, some other factors

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[110] Haris Gazdar, "Baglihar and Politics of Water: A historical Perspective from Pakistan," *Economic and Political Weekly,* February 26, 2005,p. 814

which complicate the distribution of water resources in Pakistan are: ineffective institutions, which fail to monitor water practices on ground, social factors which are broadly governed by a feudal environment, certain informal/traditional practices which have now become customary and an embedded societal practice; and bureaucratisation and corruption in the water sector. The role of the army and the nexus between politicians, powerful landlords and water bureaucracy also shapes water politics in Pakistan to a great extent.

While inter provincial politics also forms an important component in Pakistan's water sector, it is however dealt in detail the next chapter. The status of water resources in the four provinces; the historical legacy of the canal colonies and the current water discourse in Pakistan is influenced by the following factors:

Geography

Proximity to rivers has played an important role in the rise and fall of great civilisations. While Punjab, an upper riparian province is the most blessed province in Pakistan in terms of water infrastructure and offers a conducive terrain for gravity dams; Sindh on the other hand is solely dependent on the Indus river. Moreover its flat terrain often makes it prone to frequent floods. The salience of water resources for the different provinces of Pakistan arises from their overt dependence on the agriculture sector, which is also a source of livelihood for many. The limited water availability and its predominant use by the agricultural sector is thus one of the main factors for the inter and intra provincial contention over water resources.

Punjab

Punjab is Pakistan's largest province in terms of economy and population. It is the most fertile province in Pakistan due to the various rivers which flow north to south. Cholistan and the Thar desert (which extend further to Sindh) are on the border with Rajasthan. Punjab, being the second in the terms of size, has of 25.8 per cent of the land area in the country with 56.5 per cent of the total population. The population density of Punjab is 353

persons per square kilometre –being the highest, as compared to the national figure of 164.[111] The province plays a lead role in agricultural production and contributes about 68 per cent of the annual food grain production in the country. Some of the major crops grown in Punjab are rice, wheat, maize and cotton. Sugar cane is the grown throughout the year.

Water scarcity increases sharply as one moves to south Punjab.[112] Further, more than 50 per cent of the population of Punjab lives in the rural areas, where water is in short supply. South Punjab which is home to the Seraiki movement, has often raised its voice against north Punjab and Sindh on two grounds: (a) The Seraiki region was the mainstay of country's farm economy but it faced discrimination in terms of water distribution. It is often alleged that most of canals in upper Punjab and Sindh are perennial while the canals in the Seraiki belt are non-perennial.[113] The release of water from Chashma Barrage has also brought the differences between Sindh and north and south Punjab into the open.

Sindh

Sindh which became a part of British India in 1843 is bordered on the north by the Bahawalpur state of Punjab province; on the west and north west by Balochistan; on the east by Rajasthan, India, and on the south by Arabian Sea. Sindh is the second largest province of Pakistan in terms of the population. The two principal harvests of Sindh are: Rabi, which is sown in autumn and harvested in spring: and Kharif that is sown in summer and is reaped in

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[111] Punjab Gateway, Government of the Punjab, Pakistan, at: http://pportal.punjab.gov.pk/portal/portal/media-type/html/user/anon/page/default.psml/js_panename/ContentViewAdmin/portal/306/nav/right/punjabcms/servlet/PunjabCMSServlet?CMDCMS=V_D_BROWSER&CMDDOCTYPE=1&txtDocID=7394&txtVersionID=1, accessed August 1, 2011.

[112] Bahawalnagar, Bahawalpur, Bhakkar, Dera Ghazi Khan, Jhang, Khanewal, Layyah, Lodhran, Multan, Muzaffargarh, Rahimyar Khan, Rajanpur and Vehari.

[113] South Punjab to Bear the Brunt of Water Shortage, *Dawn*, January 23, 2010,at: http://www.dawn.com/wps/wcm/connect/dawn-content-library/dawn/the-newspaper/national/13+s-punjab-to-bear-brunt-of-water-shortage-310-za-01, accessed August 8, 2011.

winter. Millet and cotton are mainly grown through Barani (rain-fed) irrigation. Sindh's contribution to Pakistan's agriculture GDP is 23 per cent with its contribution of major products as follows[114]:

Table IV

Wheat	15 per cent
Cotton	23 per cent
Livestock	28 per cent
Sugarcane	31 per cent
Rice	42 per cent
Marine Fish	70 per cent

Source: Pakistan: Sindh Water Resource Management: Issues and Options, Occasional Paper Series, No. 15, FAO, Investment Centre, December 2003

The main source of water supply in Sindh is the Indus river and wheat, cotton, rice and sugarcane constitute 68 per cent of the total cropped area. Mango, banana, chillies are the major horticultural crops grown in Sindh.

The city of Karachi is home to nearly 40 per cent of the population of Sindh and is the economic hub of the entire country. The rural area is predominantly agricultural. According to the planning and development department, Government of Sindh (GoS), about 50 per cent of the province's population lives in the rural areas and the province contributes about 30 per cent of the national GDP.[115] The bulk of the rural population is said to be living below the poverty line and is dependent on agriculture, on animal rearing, and in the coastal belt, on fishing. Rural poverty in Sindh has also been associated with inequity in land distribution as 33 per cent of the farms are officially classified as small, i.e. their size is less than 8 ha.[116]

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[114] Sindh (Pakistan) Water Resource Management: Issues and Options, Occasional Paper Series, No. 15, FAO, Investment Centre, December 2003, at http://ftp.fao.org/docrep/fao/008/af105e/af105e00.pdf., p 6, accessed August 13, 2011.

[115] *The Nation*, December 14, 2008, at http://www.nation.com.pk/pakistan-news-newspaper-daily-english-online/Regional/Karachi/14-Dec-2008/Poverty-double-in-rural-Sindh-than-urban-areas/, accessed August 1, 2011.

[116] Frank van Steenbergen, Water charging in Sindh, Pakistan-financing large canal systems, Metameta Research, at http://www.metameta.nl/governance/docs/pdf/MetaMeta_Watercharging_Sindh.pdf, accessed June 8, 2011.

Shortage of water often aggravates intra-provincial faultlines in Sindh. For instance, districts like Thatta, Mirpurkhas, Sanghar, Khairpur, Dadu and Badin, mostly in southern Sindh are said to be affected by water shortages. Contaminated water is also a major problem. According to one report, millions of people living in southern Sindh get contaminated water through the irrigation left bank canal system of Kotri Barrage, including Phulelli Canal, Pinyari and Akram Wah. According to a survey nearly 20 to 25 tons of solid waste, from almost 60 per cent of Hyderabad city and its surroundings, is dumped into these canals daily.[117] It is also often observed that in Southern Sindh, sea intrusion is causing the permanent or seasonal submergence of irrigated cultivable lands. Drainage problems are also widespread in Sindh and are attributed to over irrigation. Moreover, as the topography is flat, water courses often change locations. Also the siltation of the distributaries in Sindh too leads to a change in their direction. As the tail end province it faces constant water shortages. These have often manifested in inter provincial water disputes between Punjab and Sindh, wherein Punjab is often criticised for stealing the water that is meant for Sindh. Farmer and fishermen collectives, often accuse the upper riparians, Punjab (Pakistan) and India for the mounting water shortages.

Khyber-Pakhtunkhwa

Khyber-Pakhtunkhwa (KP) is located on the Iranian plateau and the Eurasian land plate, which makes it prone to seismic activity. It covers an area of 74,521 sq km, with the density of population standing at 187 per square km. Geographically, the province is divided into two zones: the northern zoneextending from the Hindu Kush range to the borders of Peshawar basin; and the southern zone which extends from Peshawar to the Derajat basin. The northern zone is cold and snowy in the winter with heavy rainfall and pleasant summers -with the exception of the Peshawar

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[117] Four Million Threatened by Contaminated Water, *Dawn*, February 26, 2009, at: http://www.dawn.com/wps/wcm/connect/dawn-content-library/dawn/news/pakistan/sindh/four-million-people-threatened-by-contaminated-water—za, accessed June 8, 2011.

basin, which is hot in the summer and cold in winter. The southern zone is arid with hot summers and relatively cold winters and scanty rainfall. Its climate varies from very cold (Chitral in the north) to very hot in places like Dera Ismail Khan. Peshawar is the capital and the largest city in KP.

The major rivers of the province are the Kabul, Swat, Chitral, Panjgora, Bara, Karam, Gomal and the Zob. Thus Khyber Pakhtunkhwa is a water rich province. The Kabul is the western tributary of Indus. It enters Pakistan above Warsak in KP, and joins the Indus above Attock bridge in Punjab. The Swat joins the Kabul from the north above the town of Mardan. The Kurram and Gomal and the Zam, are the two other tributaries of Indus, and join it from the west below Kalabagh. The Kurram - though its rises in Afghanistan- flows mostly through Pakistan. The total length of the western tributaries of the Indus is. 965.6 km. The main crop of the region is sugarcane. Fruits such as apples, apricots and dry-fruits are also grown. However due to climatic reasons limited agriculture is practiced.

One of the pressing problems of KP is the illegal logging of trees by the timber mafia. The logging is estimated to be to the tune of billions of rupees each year, and often happens with the silent consent of local and federal politicians.[118] Apart from depleting the resources of the common people, illegal logging has led to siltation of rivers and soil erosion. Trees help prevent soil erosion, and help regulate supply of water to reservoirs by preventing floods. Also the composition of foliage helps in humus formation, which maintains the fertility of soil, which is the bedrock for sustaining fuel supplies to the local inhabitants.[119] However, as far as inter-provincial issues are concerned, KP has been a strong opponent of the building of the Kalabagh dam on the Indus river.

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[118] Kamila Shamsie, "Not Just a Natural Disaster," *China Daily*, August 18, 2010, at http://www.chinadialogue.net/article/show/single/en/3780, accessed August 19, 2010.

[119] Iqbal Mehmood, "Deforestration in NWFP", *NIPA*, September 2003, http://www.khyber.org/publications/026-030/deforestation.shtml, accessed June 9, 2011.

Opposition to the dam primarily stems from human displacement, water logging, salinity and submergence of fertile cultivable land.

Balochistan

Balochistan, though the least populated with about five per cent of the total population, is also the largest province and constitutes approximately 48 per cent of the total area of Pakistan. It has Iran on its west, Afghanistan and the Khyber-Pakhtunkhwa province in the north, and Punjab and Sindh provinces on the east. The Baloch, Pashtuns and Sindhis are the main ethnic group in Balochistan. The province is rich in mineral resources; it is the second major supplier - after Sindh,- of natural gas. Large parts of the province are dry and arid and face a chronic shortage of water. The elevation of the province ranges from very low (almost sea level) in the extreme south (the Arabian Sea) to the lofty Kirthar, Sulaiman and Zarghoon ranges in the north, with heights ranging from 1,000 to 2,500 metres. The province has a coastline that extends for more than 750 kms. Ecologically, the province can be divided into three regions, the northern highland region, the south-western desert region and the coastal zone. Rainfall in this region is scanty and varies from 400 mm in the northern highland region to a mere 100 mm in the desert regions to the west.

The Baloch economy depends almost exclusively on agriculture and livestock rearing for survival. Agriculture, comprising field crops, horticultural and vegetable produce, accounts for 42 per cent of the GDP of the province. Agriculture and livestock rearing together support nearly 75 per cent of the population and provide direct and indirect employment to nearly two-thirds of its people. An additional 10 per cent is contributed by livestock activities. Nearly 90 per cent of the land in Balochistan is rangeland, and supports the large livestock population of the region. The livestock and the crop production sectors are well integrated and depend critically on rainfall. In Balochistan irrigation in three out of 26 districts is by the canal system. In two districts (Naseerabad and Jaffarabad) the canal irrigation system is a part of Indus water basin. Agriculture, in 23 districts of total 26, depends on the control of flood-water, rain, karezes, springs and tube wells. The area above the altitiude of 1000 metres altitude is classified as highland.

As mentioned earlier, Balochistan draws water from two barrages, Sukkur and Guddu. While there are no problems in the diversion of water from the Guddu Barrage to Balochistan, the dispute arises from the Sukkur Barrage. Balochistan draws water from the Sukkur Barrage through the North West Canal. Disputes between Sindh and Balochistan often arise in end June and early July when rice transplantation is in full swing. It is Balochistan's contention that the Hub Dam was designed to receive rainfall runoff from the catchment area out of which 72 percent is located in Balochistan and 28 per cent in Sindh but the distribution of stored water is inequitable as 63 per cent is reserved for Sindh and 37 per cent for Balochistan. The Right Bank Outfall III drain project, which is being implemented by WAPDA in Sindh is also contested by Balochistan, as it contends that such federal projects should not just be restricted to one province.[120]

Balochistan argues that Punjab and Sindh are constructing dams and planning irrigation schemes, which greatly impact the total water flow of Indus. It also objects to the sinking of tubewells in Punjab, arguing that it adversely impacts the Indus river. Balochistan has proposed that the water extracted by tubewells should be brought into a common distribution pool. Balochistan has also been pushing the case for the construction of a separate barrage exclusively for the benefit of Balochistan.[121]

The above discussion shows all four provinces of Pakistan face different problems. However the inter-provincial distribution of water resources is a bone of contention between all of them. As water use in one province impacts the consumption pattern of the other, the supply-demand chain of water is greatly impacted. The IRSA has been unable to address the growing water demands in all these provinces. Water distribution and water consumption patterns are also greatly impacted by social structures, which is the legacy of the British colonial policy.

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[120] "Inter provincial Water Issues in Pakistan", PILDAT Background Paper, no. 25.

[121] Ibid, p. 26.

History

As mentioned in the first chapter, Pakistan is well known for its canal colonies. However a structural constraint of these were the iniquitous land ownership patterns. Punjab, for one has a historical legacy of agricultural colonisation. During the 1857-58 war many Punjab is sided with the British and emerged as important allies of the British and were given land rewards in return. With this trend continuing further into the British rule, military service became an important source of livelihood for the Punjabis, so much so that the British fondly termed the Punjabis as the martial race of India.

Meanwhile the British on their part had ulterior and administrative motives for distributing land amongst the Punjabis. While the British were keen on opening an agrarian frontier in west Punjab, as a defensive measure to deter Russians who were marching towards Central Asia, they also envisioned that Punjab would provide raw material for the industries in Great Britain. From the 1860s they began to plan irrigation channels between the Ravi, Beas, Sutlej and Jhelum and Chenab rivers. The 9 colonies developed in Punjab between 1886-1926, are given in Annexure Three.

The canal network which the British built took off from the rivers, with branches and distributaries spread over the plains of western Punjab. The irrigation infrastructure not only promoted immigration into this area from 1885 till 1947, but the canal irrigated area in the Punjab (excluding the princely states) increased from 3,000,000 to 14,000,000 acres.[122] The role of the state thus got strengthened, and the process of the creation of canal colonies, led to the emergence of a landholding in the canal colonies. Land grants were also made for breeding horses, camels and other animals for the army and these land awards made the army service an attractive profession which enabled the peasants to improve their socio-economic status.[123] Thus apart from the landlords, farmers

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[122] Imran Ali, no. 8.

[123] Hasan Askari Rizvi, *Military, State and Society in Pakistan*, Macmillan Press, London, p 39.

of two categories emerged- (a) occupancy tenants- who had a statutory right to occupy the land, and (b) simple tenants- who occupied land on the basis of a contract with their landlord.[124] These developments thus led to the formation of a hydraulic society in Punjab and the army in due time developed a vested interests in the land and the agricultural sector of Punjab. Thus many influential landlords emerged and perpetuated iniquitous land distribution patterns, an issue which till date has had a significant impact on agricultural practices and water consumption patterns.

Sindh also has feudal establishment and almost half of the tenant farmers in Pakistan are in Sindh. According to one estimate about 50 per cent of the farms, representing about 59 per cent of the total farm area are tilled by the owners, while 42 per cent (representing 12 per cent of the total farm area) are farmed by tenant/share croppers. Tenant farmers typically give almost 50 percent of what they produce to landlords. The feudal structure of land holdings in Sindh can be traced to Mughal times and peasant and tillers in Sindh are the most affected group.

Land in Sindh was divided into four administrative categories- Khalsa, Jagirat, Inaami (honorary/rewarded) and Zamindari (agrarian land). While the Khalsa was considered the sole property of the king or the ruler, the Jagirdari (land ownership) was first introduced by the Ummayyads, when the Khalifas gifted enormous lands to their relatives. The Sufi movements that emerged in Sindh in the 16th century arose in response to unequal ownership of land. An important movement which made a mark in its time was the Mehdavi movement initially led by Miran Syed Mohammad Jodhpuri in the 15th century and later by Shah Inayat in the 17th century. Believing in collective consumption, the movement attacked the social feudal order of the times underlining the need for equitable distribution of land. However the movement

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[124] The Punjab Tenancy Act of 1887 governs the legal relationship between the landlords who own and the tenant farmers who occupy rural land in the Punjab. See, "Soiled Hands: The Pakistan Army's Repression of the Punjab Farmers' Movement", *Human Rights Watch,* July 20, 2004, at http://www.hrw.org/en/node/11997/section/7, accessed March 9 2011.

dissipated and was crushed by conspiracy. With the fall of the Mughal empire, British gained the administrative control of colonial India. Introducing the land revenue system instead of collecting chauth, the zamindars got empowered and under the patronage of the British, changed the share of the tillers (Haris). Later a new system- the Makota (contract system) was introduced in order to manage agriculture. This proved disastrous, as contractors often extracted land revenue from the tillers along with the profit share on the produce.[125]

Land to the tiller and total abolition of the landlord system have always been the basic slogans of the poor Hari community of the Sindh and the tillers have mobilised through Sindh Hari committee, which demanded that the Kotri Barrage lands should be granted to the landless peasants. However, this demand has not been met and as observed from the developments in the 1960s much of the land around Guddu and Kotri barrage were earmarked for various categories of people from other parts of the country. These included active and retired personnel of the army, navy and air force, civil servants, most of whom were from the Punjab and displaced persons from the Mangla Dam, the Khyber-Pakhtunkhwa, tribal areas, and the flood affected people from eastern Pakistan. Also no quota was fixed for the landless farmers of Sindh. According to one estimate around 1.6 million acres of government land in Kotri Barrage and 1.1 million acres in Guddu Barrage was allotted to non-Sindhis. Also the best perennial land on the land channel of the Kotri Barrage was allotted to the armed forces. A small part of land in areas near Karachi and Sukkur was sold by open auction. The motive was to sell land to the urban people from Karachi and Sukkur, Punjabi businessmen and industrialists. The largest landholding local chiefs of Sindh could not purchase land in these auctions because of the restrictions due toland reforms, while small landholders and landless farmers did not have the means to do so.[126]

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[125] Ahmed Salim, *"Peasant Land Right Movement in Pakistan"*, Islamabad, Sustainable Development Policy Institute, July 2008, p. 10.

[126] Ibid, p. 32.

As in other provinces, the peasantry of KP was also betrayed by the landlords. Khan Abdul Jabbar Khan, formed the Kisan jirga, to voice the collective grievances of the peasants which included: the illegal eviction of peasants, reduction of economic rents in the ryotwari settlement areas, abolition of permanent settlements etc. Instances of forced eviction in fertile areas of KP are mostly documented in context of Charsadda, Peshawar, where an alliance between the Awami National Party and Jamaat-e-Islami was formed. As most landlords were members of the political party, a peasant eviction policy was put in place. Collective resistance towards land alienation is very weak in KP as no organised movement has taken root. For instance in the 1951 provincial election, the lower house had majority of landlords from NWFP (now Khyber-Pakhtunkhwa). The domination of landlords in the lower house was also recorded in other provinces (Balochistan, Punjab and Sindh) as well.[127] In 1968, the peasant movement was revived and the Mazdoor Kisan Party was formed under the Afzal Bangash. At present there are two parties that are active in KP, the Mazdoor Kisan Party and the Communist Mazdoor Kissan Party was formed following a merger between the Communist Party of Pakistan (CPP) and a faction which split from MKP (Major Ishaque faction in the 1990s.[128] However these are largely marginal and ineffective in mainstream Pakistani politics. These aspects of land ownership patterns, often resonate in the operational aspects of water distribution and management, an issue which will be dealt in detail in the next chapter.

Post-independence, the land reforms implemented by the respective governments, reflected the entrenched interests of the land bureaucracy. For instance during the military regime of Ayub Khan, an attempt was made to fix the ceiling of the private ownership of land at 500 acres of irrigated and 1,000 acres of un-

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[127] Talukder Maniruzzaman, "Group Interests in PakistanPolitics 1947-58", *Pacific Affairs*, Summer 1966.

[128] Ammar Aziz, "Pakistan: Hashtnagar: A Land Forgotten", *Marxist Leninist*, June 6, 2010, at http://marxistleninist.wordpress.com/2010/06/06/pakistan-hashtnagar-a-land-forgotten, accessed April 1, 2011.

irrigated land. In 1972, the ceiling was lowered—150 acres for irrigated and 300 acres for unirrigated land. However, both the 1959 and 1972 land reforms failed to reduce the power of landlords. Though both the reforms prohibited the eviction of tenants and limited the right of the landlords to the crops grown by tenants to no more than 40 per cent, but with the advent of modernisation and agricultural technologies, many tenants have either have been evicted or are being transformed to sharecroppers. Notwithstanding all these developments, the issue of surplus land acquisition was challenged in the federal Shariat Court on the grounds that it was contrary to Islamic law. Political developments in the 1970s-80s indicated that landlords had emerged as a strong lobby in the government. The political history of the Bhutto years reveals that a new alliance of landlords, the petty bourgeoisie and young radicals constituted the political base of Pakistan People's Party (PPP).[129]

Overall the course of Pakistan's economic development can be divided into three distinct phases: the consolidationphase, in the first decade after independence during which the landlord class primarily consolidated their own power. In the second decade there was rapid industrial growth which led to the rise of the industrial class, and an interest group of highly politicised army officers and civil servants. This can be termed the consensus phase as the politicians, landlords and the army came together, after having agreed on land reforms. This is because the governments in the 1980s and early 1990s avoided taking any significant land reform measures, perhaps because they drew much of their support from landowners in the countryside. In the third phase, particularly during the Musharraf years saw a devolution of power, in which decentralisation was encouraged. However, though power devolved to the local levels, the military became an important stakeholder in local affairs. This phase can be termed the 'deconcentration' phase.

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[129] Jamil Rashid, "Economic Causes of Political Crisis In Pakistan: The Landlords vs. The Industrialist," *The Developing Economies*,16(2), June 1, 1978, at http://jamilrashid.org/Articles/Japanese_1978.pdf , accessed November 30, 2010.

When Musharraf assumed power in 2000, Pakistan's Defence Ministry unilaterally imposed a cash payment contract system on the tenants on the 17,000-acre Okara military darms. This cash contract system was intended to replace the harvest share system, known as the *battai* system (sharecropping), in accordance with the Tenancy Act of 1887.[130] The tenants while refusing to pay rents, also staged a number of protests, which later turned out violent. The Okara farm dispute, according to one observer, has become into a symbol of the people's resentment against the Army's monopolisation of power and resources.[131]

Apart from the above mentioned power centres in the water politics of Pakistan, the bureaucratisation of irrigation departments has been increasingly responsible for the ineffective water distribution and management policies. According to Danish Mustafa water efficiency in Pakistan merely implies the conveyance of water from the head of the water course to the tail end of it. This, he writes, means that there is therefore no scope for the effective management of water resources in Pakistan. Citing interviews with PIDA officials he notes that, "downstream on a village watercourse, water distribution and conveyance efficiency is a social problem over which the PIDA officials have little control." On the basis on his field visits he points out that the extent to which the political class has influenced water distribution policies was revealed when a superintending engineer told him that though equity is an important element of efficiency, it is often marred by political influence and intervention.[132]

Social practices also find expression in water thefts. Water theft in Pakistan has become a serious issue, affecting canal operations and equitable distribution of water. Often thefts by influential people at the canal head leads to water shortages, thus depriving poor

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130 no. 24.

131 John Lancaster, Fighting an Army Empire, *Washington Post,* June 29, 2003, p. A19.

132 Danish Mustafa, "Theory versus Practice: The Bureaucratic ethos of water resource management and administration in Pakistan", *Contemporary South Asia*, 11 (1), 2002, p.45.

farmers at the tail end of these channels.[133] According to a report in *Dawn*, the fourth corps of the Pakistani army has a firing range near the tail of a link canal in the Bahawalpur Region. The army has leased out the land to civilians who are characterised as army contractors,who have laid illegal pipelines which lift water from pumps thus giving rise to unauthorized outlets, to divert water. In 2008, army formations laid 44 pipes on nine different channels of the Upper Chenab Canal in Sheikhpura division. It is the same story in the Badin district of Sindh, adjacent to the Indian border. Due to its geo-strategic location Badin has always been a sensitive area, and the presence of rangers, a much needed necessity, for defending national interests. However according to reports, the rangers have not only been fishing for personal consumption but for commercial purposes and the rangers have taken over 20 reservoirs in Badin district alone. The armed forces in Sindh as some scholars note run a "business empire" consisting of 30 businesses in their own right.[134]

The lack of commitment towards maintaining and sustaining the water infrastructure also compounds intra-provincial water problems in Pakistan. The World Bank report reveals that the build/neglect/rebuild philosophy, means that much of the water infrastructure in Pakistan is crumbling.[135] While the de-centralising of water practices has not helped much the earlier chapter, the undertones of water politics often find expression in water management practices, which fail to meet the 'vision' for the equitable distribution of water.

The Actors in Water Politics[136]

While the issues embedded in the geography and history of Pakistan are important, players in contemporary Pakistan also play

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[133] "Army Rangers accused of stealing water", *Dawn*, April 7, 2010, at http://archives.dawn.com/archives/42692, accessed November 20, 2010.

[134] Mehtab Ali Shah, Ferment in Sindh: Mistreatment of Fishermen in Badin, Pakistan, and its Implications, 40 (10), *March* 5-11, 2005, p 931.

[135] World Bank, no.40, p. xi

[136] Some of the issues on political actors in Pakistan are elaborated in Medha Bisht, "The politics of water discourse in Pakistan", New Delhi, August 2011 http://www.icrier.org/pdf/Policy_Series_No_4.pdf, accessed September 2, 2011.

an important role. Linking Kashmir to water suits the interests of political parties, in as much, as it helps divert the debate away from inequitable land holdings, water scarcity, poor water policies and provincial conflicts on water rights. In 2010, Yusuf Raza Gilani, Pakistan's prime minister, put water on par with Kashmir, stating that, "we want the world to concentrate so that with India we resolve all our core issues including Jammu and Kashmir and water."[137] Such concerns have also been articulated by various political parties. In Pakistan. Arvind Gupta provides a sampling of some linkages.[138]

- *Dawn* quoted the former Foreign Minister Sardar Asif Ali as saying that "if India continues to deny Pakistan its due share, it can lead to a war between the two countries." (*Dawn*,18 January 2010)
- PML(Q) Chief Chaudhary Sujat Hussain said that the water crisis between Pakistan and India could become more serious than terrorism and can result in a war (*Dawn*, 18 January 2010).
- Majid Nizami, chief editor of Nawi Waqt group of newspapers, said that "Pakistan can become a desert within the next 10 to 15 years. We should show upright posture or otherwise prepare for a *nuclear war*." (*Dawn*, 18 January 2010).
- Members of the Punjab Assembly passed a resolution denying India trade transit facilities until the resolution of the Kashmir dispute and issues related to water distribution (*Dawn*, 27 January 2010).
- Member of the Punjab Assembly Warris Khalo said that India would "remain an enemy" until the Kashmir dispute and water issues are resolved. (*Dawn* 27 January 2010).

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137 Delhi Water Terror Floods and Parched Land, *Dawn News,* April 1, 2010,at: http://thedawn.com.pk/2010/03/29/delhis-water-terror-floods-and-parched-land/, accessed November 8, 2010.

138 Arvind Gupta, "Vicious anti-India propaganda in Pakistan on Water issues,"*IDSA Web Comment*, March 29, 2010, at http://www.idsa.in/idsacomments/Viciousanti-IndiapropagandainPakistanonWaterissues_agupta_290310, accessed November 8, 2010.

- Palwasha Khan, member of National Assembly, accused India of perpetrating "water terrorism" against Pakistan and said that "experts foresee war over the water issue in the future and any war in this region would be no less than a nuclear war." (*Daily Times* 17 February 2010).
- In a recent debate in Pakistan's National Assembly, several members urged the government to impress on New Delhi "not to use" Pakistan's share of water (*Daily Times*, 25 February 2010).
- Dr. Manzur Ejaz, a commentator, writing in *Daily Times* (3 March 2010) warned that "unless Pakistan was assured on the supply of water, it will never abandon the proxies that can keep India on its toes by destabilizing Kashmir." He further added: "for Pakistan the territory of Kashmir may not be as important as the water issue."

These comments somewhere indicate that Kashmir and water are issues elevated to the same platform. It is only a matter of time when the issue of water will explode. Water can become an issue of "great emotional power" to mobilise the Pakistani people and can have a cascading effect on India-Pakistan bilateral relations.[139] Linked with nuclear threats it can set a bad negotiating precedent, thus attracting the attention of external powers to the South Asian region.

Jihadists or religious Islamist and hardline groups are another set of actors responsible for framing the water issue in the Indian context. "Only jihad can help get water released to Pakistan, so people should rise up." This statement by Hafiz Sayeed of Jammat ud Dawa is an indicator of efforts to ignite passions. Some hardliner groups also include farmer organisations, who have tried to equate water with conflict/wars. The Punjab Water Council, a collective of farmers in Punjab, for instance has stressed the necessity of "talking" water with India. They argue that talks could

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[139] Ramaswamy Iyer, "India-Pakistan Water: An Overview, "*South Asia Journal*, 29, 2010, pp. 121.

assuage Pakistani fears that Indian hydroelectric stations could run Pakistan's rivers dry. These collectives have further stated that: "If water diversions like the Kishanganga project are not settled the way they should be, then we have serious apprehensions that diversions from other rivers would also be made and precedents would be set."[140]

The Pakistan Muttahida Kisan Mahaz is a farmers' collective, which has urged the Pakistani government to approach the World Bank regarding the construction of dams by India on the western rivers.[141] Led by Muhammad Ayub Mayo, the collective has been mobilising farmers in partnership with other organisations and has released a joint communiqué stating that, 80 per cent farmers had been affected because India has been stealing the waters of the Jhelum, Chenab and Indus rivers by building dams. It has also alleged that Pakistan's agriculture would suffer losses of billions of rupees besides facing the threat of famine due to shortfall in river water supply.[142] The Mahaz, which emerged as the lobby group for farmers in Pakistan, has also been aggressively advocating for dam construction in Pakistan, in order to generate more electricity even suggesting going to war to arouse public opinion.[143] The linkage between water and terrorism is thus becoming an

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[140] "Water Row Key to India-Pak Rivalry," *Daily Times,* July 16, 2010, at http://www.dailytimes.com.pk/default.asp?page=2010\07\16\story_16-7-2010_pg1_9, accessed November 9, 2010.

[141] "Rally against Indian water aggression," *The Nation,* May 31, 2010, at http://www.nation.com.pk/pakistan-news-newspaper-daily-english-online/Regional/Lahore/31-May-2010/Rally-against-Indian-water-aggression, accessed November 10, 2010.

[142] "Movement against water suspension by India," *The Dawn,* December 14, 2009, at http://news.dawn.com/wps/wcm/connect/dawn-content-library/dawn/the-newspaper/national/movement-against-water-suspension-by-india-429, accessed November 10, 2010.

[143] Rally Against India Water Aggression, *The Nation*, May 31, 2010, at http://www.nation.com.pk/pakistan-news-newspaper-daily-english-online/Regional/Lahore/31-May-2010/Rally-against-Indian-water-aggression and Govt should take serious notice of water closure in Chenab by India: Ayub Mayo, *One Pakistan*, January 27, 2010, at http://www.onepakistan.com/news/national/28985-Govt-should-take-serious-notice-water-closure-Chenab-India-Ayub-Mayo.html, accessed November 8, 2010.

important issue in other circles. For instance Riaz Haq[144] writes that, there is an increasing fear rising social discontent, terrorism and instability arising from the potential ravages of water scarcity in the form of crop failures and poverty.[145]

Another group which has been attributing the water crisis in Pakistan to the dam building activities of India is the Engineers Study Forum, a panel of water experts. According to a report released by the panel, India is stealing 15-20 per cent of water from western rivers costing $ 12 billion loss to the agriculture of Pakistan. It further adds, that the total water availability of the western rivers is 125.6 MAF, of which India steals a large amount imposing huge economic cost in term of agricultural loss to Pakistan.[146]

While both issues and actors rely heavily on political overtones, the functional aspects of water governance and management need to be explored in view of the gravity of the water discourse.

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[144] Riaz Haq is Founder and President of Pak Alumni Worldwide, a global social network for Pakistanis, South Asians. He possesses a MS degree in Electrical engineering from the New Jersey Institute of Technology.

[145] "World Water Day: Water Scarcity Hurting Pakistan", *South Asia Investor Review,* March 22, 20119, at: http://southasiainvestor.blogspot.com/2009/03/world-water-day-water-scarcity-hurting.html, accessed November 16, 2010.

[146] "India stealing water causing $ 12 bln loss to Pakistan", *Pakistan Daily*, February 8, 2010, http://www.daily.pk/india-stealing-water-causing-12-bln-loss-to-pakistan-15770/, accessed November 10, 2010.

Chapter Five

Water Management in Pakistan
In-between Distribution and Allocation Challenges

In a letter addressed to the Government of Pakistan, the former chairman of the Indus River System Authority stated[147] :

> Pakistan is dangerously exposed to devastating floods and crippling load shedding at any time in the future, for no new dams have been built for the last 47 years. The existing reservoirs have silted by 6.5 MAF due to salting. There is lack of water management and the planners of storage dams have ignored their capacity inflow ratio. Saline lands have been put under ill-conceived salinity control and reclamation projects and national drainage programmes, which have later failed and subsequently abandoned. The irrigation system lacks proper drainage, and there is no way to evacuate injurious salts.

This statement explicitly reveals the status of water management practices in Pakistan. In this chapter, practices related to water management in Pakistan have been studied at two levels- surface water management and ground water management. However, it is observed that most of the practices have political undertones and therefore do not deliver optimum results. As is evident from the previous discussion, Pakistan's water management is overtly influenced by technocratic solutions, i.e. the construction of dams/ canals/link canals and barrages, which were initially built to improve the spatial spread of water resources. However its long term impact has led to water logging and soil salinity. While,

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147 Zeeshan Shah, "The Rising Tide": An Emerging Water Crises—the next big threat to Pakistan," *Express Tribune*, April 9, 2012, at http://tribune.com.pk/story/361646/the-rising-tide-an-emerging-water-crisis-the-next-big-threat-to-pakistan-business/, accessed July 3, 2012.

institutional structures have been established to streamline allocation of water resources amongst and between provinces, formal and informal (traditional) methods have also been adopted for the distribution of water resources. Thus before analysing the management of surface and groundwater resources, it is important to provide a brief overview of distribution and allocation practices in the water sector.

Allocation of Water

The major reservoirs (Tarbela,Mangla and Chashma) under the control of WAPDA are operated on provincial demands as approved by the IRSA.

Within the canal system, allocations are made on the basis of land ownership and tenants have no specific water rights. Thus there are no propriety rights for the canal water. As a result trading of water is not allowed under the Canal and Drainage Act, 1879. The groundwater use is also generally unregulated. Private tubewell owners often sell water to neighbouring landowners. Water allocations among the provinces are made on a five day basis as per the provisions of the Water Accord. The provinces are authorised to modify system-wise and period-wise uses within the provincial allocations.

The IRSA which came into being in 1991 oversees the implementation of the Water Apportionment Accord. It has five members- one from the federal government and one each from the provinces. The chairman is chosen for a period of one year from among the five members in alphabetical order. The term of office for members is three years. The chairman of WAPDA and the chief engineering advisor to the governmnt of Pakistan or their nominees are ex-officio members of IRSA, and have no voting rights. Decisions are taken by a majority vote with the chairman having the casting vote.[148] The IRSA first, ensures the existing usage of canal water in each province and second apportions the excess

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[148] "Inter provincial Water Issues in Pakistan", PILDAT Background Paper, no. 25, p. 9

river water , including flood surpluses and future storages amongst the provinces.[149] If a province is not satisfied with the decision of IRSA it can appeal to the Council of Common Interest, an institution created under the constitution of 1973 for resolving provincial disputes. According to Article 155 (1): If the interests of a province, the federal capital or the Federally Administered Tribal Areas, or any of the inhabitants thereof, in water from any natural source of supply have been or are likely to be affected prejudicially by–(a) any executive act or legislation taken or passed or proposed to be taken or passed, or(b) the failure of any authority to exercise any of its powers with respect to the use and distribution or control of water from that source, the federal government or the Provincial Government concerned may make a complaint in writing to the Council.

Paragraph two of the same article states that, upon receiving such complaint, the Council shall, after having considered the matter, either give its decision or request the President to appoint a commission consisting of such persons having special knowledge and experience in irrigation, engineering, administration, finance or law as he may think fit, hereinafter referred to as the Commission.

Any proposed development in the water sector has to be reviewed by IRSA to ensure its conformity to the Water Accord. The Water Apportionment Accord was signed by the four provinces in March 1991 and ratified by the CCI on March 21, 1991. Ten daily allocations were made part of the accord by the CCI on September 16, 1991.[150] There are 14 clauses in the Accord. As per Clause 2, the water distribution principle areallocated for both the Rabi and Kharif season. See Table V.

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[149] "The Water Accord - 1991", at http://www.pakissan.com/english/watercrisis/the.water.accord.shtml, accessed August 13, 2011.

[150] "Inter provincial Water Issues in Pakistan", PILDAT Background Paper, no. 25.

Table V

Province	Kharif	Rabi	Total
Punjab	37.07	18.87	55.94
Sindh*	33.94	14.82	48.76
Khyber Pakhtunkhwa (a)	3.48	2.30	5.78
(b) Civil Canals**	1.80	1.02	3.00
Baluchistan	2.85	1.02	3.87

* Including already sanctioned Urban and Industrial uses for Metropolitan Karachi.

** Engaged Civil Canals above the rim stations.

Clause 4 lays down the principle for the division of the balance of river supplies (including flood supplies and future storages. The balance river supplies for Punjab, Sindh, Baluchistan and KP are 37, 37, 12 and 14 MAF respectively. Clause 6 states that the need to construct storage sites, wherever feasible on the Indus and the other rivers is admitted. It also emphasises that storage works need to be undertaken for future agricultural development. Clause 7, while recognising that further studies need to be undertaken to establish minimum escapage needs downstream Kotri, it is also emphasised that 10 MAF below Kotri to check sea intrusion should be allowed. Clause 14, stipulates the overarching framework of the Accord. It notes that: (a) System wise allocation will be worked out separately, on the ten daily basis, (b) the record of actual average system usage for the period 1977-82, would form the basis for any future regulation pattern. These ten daily uses would be adjusted pro rata to correspond to the indicated seasonal allocations of the different canal systems and would form the basis for the sharing of shortages and surpluses on an all Pakistan basis, (c) the existing reservoirs would be operated with priority being given to the irrigation uses of the provinces, (d) the provinces will have the freedom within their allocations to modify system wise and period wise use, and (e) all efforts would be made to avoid wastage. Any

surpluses may be used by another province, but this would not establish its right to such use.[151]

IRSA has faced rough weather over implementation issues. The primary reason for this is the difference of opinion between Sindh and Punjab. While Sindh argues that distribution should be as per the ten day wise water share given to the provinces, and in case of shortages, each province should get that much less, Punjab asserts that all clauses of the accord need to be read and implemented in conjunction with each other and no clause can be read and implemented in isolation. This argument is based on the claim that Punjab makes over the Kalabagh dam, as it argues that while signing the Accord, a verbal agreement had been made that the Accord will only be implemented once the Kalabagh dam is constructed.[152] The Kalabagh Dam was proposed to be built in the 1980s downstream of the existing Tarbela dam on the Indus river. Being a multi-purpose dam, the dam was meant to deliver the following benefits[153]:

- To generate large amounts of low cost hydro-electric power near major load centres, for meeting the growing power demand of the agricultural, industrial and domestic sectors.
- To provide additional storage and regulation on the Indus and thus enhance the quantity of water available for irrigation and provide better system control and management for supplying water for the crops.
- To increase the energy and power output of the existing Tarbela scheme by the conjunctive operation of Tarbela and Kalabagh reservoirs.

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151 Water Apportionment Accord, Apportionment of the Waters of Indus River System between the Provinces, Karachi, 1991.

152 "Inter provincial Water Issues in Pakistan", PILDAT Background Paper, no. 25.

153 S. Ahmed, Water Resources Of Indus: Case Study Of Kalabagh Dam, Thesis, Higher Education Commission Pakistan, 2004, p, 5, at http://eprints.hec.gov.pk/2040/1/1959.htm, accessed August 2, 2011.

- To compensate for the storage lost due to the silting of existing reservoirs.
- To regulate and control the extreme flood peaks of the Indus to alleviate flood damage downstream.

Though the idea of the dam was conceived way back in the 1950s, it was only in the 80s that the controversy over Kalabagh dam developed, with riparians Sindh, KP, and Balochistan opposing the dam. While KP objected to the dam on account of the displacement costs it would impose specially on Nowshera and the Peshawar valley with additional impact on its drainage system, Sindh opposed the dam on environmental grounds, stating that it would harm the downstream flow of the Indus, thus adversely affecting its land, coast and forests. Meanwhile Balochistan has objected to the dam on the grounds that its plans to expand agriculture would come to a naught if the Kalabagh is built.[154] These riparian fears and competing claims, which have only become stronger over time have impeded the efforts to formulate an effective national policy on the water resources of Pakistan while also impacting the allocation of waters by IRSA to a great extent. Meanwhile, the recent spate of controversies around the Chashma-Jhelum link canal and Taunsa-Panjnad link canal have also aggravated the dispute between Sindh and Punjab. The problems arise from the fixed allocation of water under the Water Apportionment Accord 1991. No operating rules for the two canals have been laid down so far. The operating rules of the two canals are based on the understanding that if water is short in the tributary rivers (Jhelum and Chenab) and surplus in the Indus river, it can be transferred from Indus to the tributary zone through the link canals. However if there is shortage in the Indus river, the reverse should follow. Punjab's contention is that as its share has been established by the IRSA, it can use it as it likes as per Clause 14 (e) of the Accord. Sindh on the other hand argues that Punjab cannot transfer more water from the Indus river, even if it has a share on

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[154] S. Ahmed, Water Resources Of Indus: Case Study Of Kalabagh Dam, Thesis, Higher Education Commission Pakistan, 2004, p, 5, at: http://eprints.hec.gov.pk/2040/1/1959.htm, accessed August 5, 2011.

the Indus, as long as there are is a water shortage in Sindh. Both the Chashma-Jhelum and Taunsa Panjnad link canals provide water to southern Punjab. The dispute thus not only has inter-provincial implications but couldalso develop potential intra-provincial spill overs.

The intra-provincial undertones are further magnified by canal allocations, which are based on the land ownership patterns. *Warabandi* is adhered to in the watercourse commands. There is thus inequity in the canal systems as generally upper users manage to get more water at the cost of users at the end of the systems. Big and influential landlords sometimes tamper with the outlets and divert more than their share. Water theft and transmission losses through leakages are also a common problem that needs to be dealt with. The establishment of FOs and their involvement in O&M at the distributary minor canals were meant to rectify the existing inequity.[155]

Distribution of Water

As mentioned above, in the majority of canal systems water is supplied under a rotational method known as *warabandi* where water is allocated to each user for a fixed time based on the size of their holdings. The distribution system is supply based and distributes the water irrespective of the demand. *Warabandi* is thus a rotational method for equitable allocation of the available water in an irrigation system as fixed according to a roster, or a predetermined schedule, specifying the day, time, and duration of the supply to each irrigator in proportion to the size of his or her landholding in the outlet command.[156] There is a problem of inequity of water distribution within the canal systems, primarily because of the feudal set-up. The downstream users often get reduced supplies, in some cases due to the reduced carrying capacity of the upper reaches due to silting and other reasons. Excessive

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[155] World Bank, no. 40, p. 38.

[156] D.J. Bandaragoda and Saeed Ur Rehman, "Warabando in Pakistan's Canal Irrigation System: Widening Gap Between Theory and Practice", International Irrigation Management Institute, Country Paper, 7, Colombo, 1995, p. 2.

unauthorised withdrawals by users in the upper reaches are primarily responsible for the water scarcity experienced by tail enders. The tail enders also receive 20 per cent less water than those in the middle, who in turn get about 20 per cent less than those at the head end. Agricultural water pricing is done on flat-fee basis irrespective of the actual water usage, and the common method is to flood the field.[157]

Water related disputes are traditionally referred to the concerned irrigation departments. Area water boards and farmers organisations function in selected canal commands, and are responsible for ensuring equitable distribution of water among the users. However, progress on reforms has been slow because of controversy over irrigation reforms among the implementing agencies and because the vast majority of irrigation schemes are still operated and maintained by the government according to the Canal and Drainage Act, 1871.

Water rights on the hill torrents[158] are based on riparian rights with the first right of the upper riparian. The rainfall harvesting potential through hill torrents is 17 MAF.[159] The government has no role in allocation of water rights in these areas. Disputes on water rights in these areas are referred to the civil courts.

The unregulated exploitation of groundwater has resulted in water mining in all the provinces but more so particularly in Balochistan. Over-pumping in certain areas has led to water salinity and consequent deterioration of water quality. Balochistan has

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[157] Feisal Khan, p. 93.

[158] Hill torrent is a type of rainwater harvesting in which water is harvested from the mountains and directed to agricultural fields by locally made earthen division weirs across the torrent with large channels. Hill torrents encompass 65 % of the total agricultural area of Pakistan and almost the entire Balochistan province. See, Nawaz and Han, Hill Torrents Management for Increasing Agricultural activity in Pakistan, at http://www.iwahq.org/Mainwebsite/Resources/Document/P19.pdf, accessed December 22, 2011.

[159] "Inter provincial Water Issues in Pakistan", PILDAT Background Paper, no. 25, p. 21.

promulgated an ordinance for restricting the unlawful exploitation of ground water. Apart from private tube-wells, Balochistan has a few thousand minor sources of water used for irrigation, such as springs, streams and *karezes* (underground canals), where government has no role in water allocation. The water allocation of minor sources of irrigation is settled among the users as it has been for generations. About 20,000 new tube-wells have been sunk. This has resulted in the drying of *karezes* and infiltration galleries due to the lowering of the water tables in aquifers. Many users of these sources have also installed deep tube-wells for irrigation. The water table is declining by 1.5 to metres annually in almost all tube-well irrigated areas. New, deep tube-wells are being sunk every year and at an accelerating rate during the past few drought years. The Balochistan Ground Water Rights Administration Ordinance of 1978 had provisions for the regulation of ground water extraction but it has proved ineffective. In November 2000 the government issued an ordinance for the installation of water metres on all private tube-wells in Quetta valley. Electricity for tube-wells is charged at a subsidised flat rate, which also results in excessive pumping.[160] Laws relating to ground water use in other provinces, like Punjab have been prepared under the Private Sector Groundwater Development Project.

Research shows that over a period of time institutions have been unable to cope with rising and competing water demands.[161] While efforts have been made to reform policies, politics and practices on ground remain unchanged. The reason is the friction between traditional water practices,[162] political contacts within a feudal set

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[160] World Bank, no. 40, p.36

[161] Nakashima Masahiro, "Water User's Organization for Institutional Reform in Pakistan's Irrigation Sector", Hiroshima City University, at http://www.intl.hiroshima-cu.ac.jp/ ~ nakashim/Nakashima/Pak.IDJ.pdf, accessed August 3, 2011.

[162] Warabandi system, (which outlines the fixed allocation of water in a defined time period) and Canal and Drainage Act of 1873 (which outlines the blueprint for water management in Pakistan and allocated disproportionate amount of power to the state in water management), are considered as two practices which impede effective functioning of institutions, Danish Mustafa, "Theory versus Practice: The bureaucratic ethos of water resource management and administration in Pakistan", *Contemporary South Asia*, 11 (1), 2002, p.43.

up which often impede the effective functioning of the institutions, and archaic laws which are a colonial legacy of British. Though cases of effective monitoring by the collectives have also been reported, their scope and role remain confined to specific provinces. Farmers organisations (FOs), a collective which has been highly successful in reducing instances of water theft in Punjab is often cited as best case example of monitoring water management.[163]

Water Management Policies and Practices in Pakistan: Limitations and Faultlines

Ninety-two per cent of Pakistan's land area is arid or semi-arid and cannot be productive without irrigation.[164] Given the water requirements of the country, there is an overt dependence on artificial structures such as dams, barrages and link canals.The existing storage capacity of Pakistan 15 MAF which amounts to 30 days of water supply. It has a power generating capacity of 6444 MW.[165] Reports claim that given the high silt load of Himalayan rivers, storage dams like the Mangla and Tarbela have lost their water capacity due to sedimentation and siltation. A World Bank report states that:

> Implementation of water projects is characterised by inefficiencies, completion delays and time and cost over-runs. Factors that affect implementation include: weak planning and management, litigation related to land acquisition, non-compliance with agreed resettlement and rehabilitation programmes, lack of attention to environmental issues, delays in procurement, delays in preparation of accounts and carrying out audits, and lack of preparation of accounts and carrying out audits and the lack of preparation for transition from construction to operations.[166]

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[163] A hmed *et al*, "Water Resources and Conservation Strategy of Pakistan", Pakistan Institute for Development Economics, 2008, at http://www.pide.org.pk/psde23/pdf/Ayaz%20Ahmed.pdf, accessed August 13, 2011.

[164] Simi Kamal, no. 101, p. 30.

[165] WAPDA 2010, at http://www.wapda.gov.pk/pdf/BrchreHydrpwerPotJuly2010.pdf,accessed August 13, 2011.

[166] World Bank, no. 40, p. xii

Another factor which hampers effective water management is the unaccounted water losses at canal heads, leakages in water infrastructure, and thefts. Overall therefore the operation, maintenance and repair costs for water structure are high and often ignored. As users pay almost no operation and maintenance costs, the financial viability of water sector is weak. A major reason for the weak financial problem is the gap between investment and revenue generation. Since most of the money is directed towards the salaries of "heavily staffed bureaucracies", most of the infrastructure is in poor repair, which discourages the users to assume responsibility towards "poor and unaccountable services." Thus pricing and water distribution is an important challenge for Pakistan as irrigation users pay minimal charges for water. Simi Kamal writes that persistent inequalities in water distribution to head, middle and tail areas of water channels are primarily responsible for this, as only 45 per cent of cultivable land area is under cultivation at any given point of time.[167]

As mentioned before, while surface water irrigation infrastructure on the one hand has given some boost to the economy in Pakistan, it also resulted in the problem of water logging leading to salinity leaching much of the salts down, due to water pumping from tube-wells. As billions of cubic metres of water was stored in Punjab alone due to the construction of link canals, water logging became inevitable. This combined with inadequate drainage added to the problems. The initial signs of the twin menace of irrigation infrastructure were noticed in the 1960s when the disturbed water balance made tracts of lands non-productive. According to the World Bank report around 20 million tons of salt are accumulating in the Indus Basin every year.[168] According to another estimate 38 per cent of Paksitan's irrigated land is waterlogged and 14 per cent is saline. The drying up of the Indus delta has led to immense losses in the coastal system and sea intrusion is up to 225 km.[169]

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[167] Simi Kamal, no. 69, p. 32.

[168] World Bank, no. 40, p. 10

[169] Simi Kamal, no. 101, p. 29.

In order to cope with this problem, the Salinity Control And Reclamation Project (SCARP) was undertaken as a management measure to prevent water logging. SCARP emphasized groundwater pumping thus focussing on controlling salinity. Initiated at the request of Ayub Khan in 1961, and funded by the Word Bank at the urging of the United States, SCARP was financed for almost forty years, with a total estimated cost of one billion dollars. The project was to provide public tube wells to (a) lower the water table and (b) provide water for irrigation. Tube wells thus became an effective alternative to canal supplies, which were governed overtly by *warabandi*. Tushar Shah writes that "self-provision of water is the best indicator of the failure of the public water supply system."[170] However, this huge rise in the number of private tube wells in Pakistan as a preferred source of water usage gave rise to intensive aquifer mining, so much so that experts claim that the mining of groundwater will mean that the aquifers would be lost in 5-10 years.[171] The rise of water table though initially proved beneficial to Sindh, (as it absorbed much of the salts that it naturally gets due to its proximity with the delta), but in the long term proved unproductive. Also over a period of time due to evaporation, tube well usage proved costly leading to a deterioration of soil quality. Some claim that over 50 per cent of the land in canal command areas is affected by salinity.[172] Ineffective drainage plans is one of the main reasons which exacerbated water salinity in Sindh.

Given the problems of ineffective drainage, Pakistan in collaboration with the World Bank focussed on overall drainage management throughout the Indus basin. The Left Bank Outfall Drain (LBOD) was built to meet the challenges being faced by Sindh Though the project was directed at draining out saline and polluted water of the other three provinces into the sea through Sindh, the project however failed to show optimal results and had

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[170] World Bank, no. 40, p.4.

[171] Simi Kamal, no. 69, p. 34.

[172] Ibid, p.55.

an adverse impact thus damaging thousands of acres of fertile land in upper and lower Sindh.[173] Similarly a Right Bank Outfall Drain Project (RBOD 1) was also undertaken to meet the same challenge, stemming from upper Sindh and Balochistan. RBOD-1 was directed towards channelling saline water near Manchar lake in Sindh, but due to opposition from Sindh the programme fizzled out. This problem posed by the drainage projects is being addressed by RBOD-2. RBOD-2. Thus it aims at extending RBOD 1 from near Manchar to Arabian Sea, to remove saline water along the entire right bank of the Indus. The project has a capacity of 4000 cusecs and was started in 2002 at a total cost of Rs 10 billion. The project is funded by the government of Pakistan and is being executed by the Sindh government. While in 1961, 30 per cent of the land was affected by salinity, in 2008 salinity is reported to be confined to about 11 per cent of irrigated land of which 30 per cent lies in Punjab and the balance in Sindh.[174] The August 2010 floods in Pakistan have had an adverse impact on the irrigation system in Pakistan, particularly Sindh, so much so that most of the canals and dykes in Sindh are damaged.[175]

As far as institutional structures for flood management are concerned, the process involves different government organisations. The Federal Flood Commission plays a major role in remodelling the flood mitigation policy in Pakistan and is responsible for implementing the Flood Protection Sector Project I and II. FFC is the coordinating body at the federal level. Established in 1978, the FFC implements a comprehensive risk management strategy—the National Flood Protection Plan. The Flood Forecasting Division of Pakistan Meteorological Department (PMD) also plays a pivotal role. The new strategy involves greater

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[173] "Drainage Projects Damage Farmland", *Dawn*, March 1, 2010, at http://news.dawn.com/wps/wcm/connect/dawn-content-library/dawn/in-paper-magazine/economic-and-business/drainage-projects-damage-farmland-130

[174] Shahid Ahmed Chowdhry, "Pakistan: Indus Basin Water Strategy-Past, Present and Future", *The Lahore Journal of Economics*, September 2010, p.190.

[175] "PA joins chorus of complaint over slow dyke repairs", *Dawn*, February 24, 2011, at http://www.dawn.com/2011/02/24/pa-joins-chorus-of-complaint-over-slow-dyke-repairs.html, accessed March 3, 2011.

resources for reservoir operations, procedures, inspections and training, schedules for bund maintenance and reinforcement and bund breaching plans, expansion and modernisation of data collection techniques, including satellite monitoring, flood forecasting as well as implementation of flood warning system.[176]

In order to augment water supplies, a renewed thrust has been given to storage projects. These are the Mangla dam, the Greater Thal project, the Kacchi canal project and the Rainee canal project. The Mangla Dam Raising Project (2003-2010) aims at raising the Mangla dam by 30 feet, thus adding 2.9 MAF to its existing capacity of 6 MAF. The Greater Thal project (2002-2010) aims at creating a new command area of 1.5 million acres. The Kachhi canal project for Balochisan, covering Dera Bugti, Naseerabad and Jhal Magsi (2002-2012) aims at creating a command area of .71 million acres. The Rainee canal project (2002-2012) for Sindh covering Ghotki, Khairpur and Sukkur aims at creating a command area of .41 million acres.[177] The Diamer Bhasha Dam Project that is expected to be completed by 2018-19 is proposed to be built on the Indus River and with an estimated installed power generation capacity of 4500 MW with a live storage capacity of more than 6.4 MAF.[178] Simi Kamal writes that due to downstream delivery systems being ineffective, unusually a large amount of water is lost in delivery systems. She proposes that a large amount of water can be saved through better repair and maintenance.[179] Canal lining particularly n Sindh (Rohri, Dadu and Rice) is also being planned as it is estimated that it would bring an additional 492 000 acres of land under irrigation.[180]

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[176] Mustafa and Wrathall, "The Indus Basin Floods of 2010: The Cost of Agricultural Development On the Water Front," 2011, at http://www.siwi.org/documents/Resources/Best/2010/2011_OTWF_Daanish_Mustafa.pdf, accessed February 12, 2012.

[177] Ibid, p. 191.

[178] Hydro-Potential in Pakistan, Pakistan Water and Power Development Authority, May 2010, at http://www.wapda.gov.pk/pdf/BrchreHydrpwerPot July2010.pdf ,p. 15.

[179] Simi Kamal, no. 69, p. 33.

[180] Shahid Ahmed Chowdhry, "Pakistan: Indus Basin Water Strategy-Past, present and Future", *The Lahore Journal of Economics*, September 2010, p.204.

Management of ground water resources is another challenge in Pakistan. Given the extensive groundwater extraction, tube-well withdrawals need to be synchronised with aquifer recharging. While in Punjab, groundwater extraction has reached its limits, regulatory controls in Balochistan are often not adhered to. The groundwater potential is 56 MAF and around 48 MAF is pumped annually.[181] Some of the reasons for depletion of ground water resources, along with its mismanagement are[182]:

1. Political interference
2. Failure of permit systems in the 1980s.
3. Weak regulatory frameworks due to lack of political interests.
4. Failure to enforce the PIDA Act of 1999-2000 due to administrative and political complications.

Some of the methods by which management of groundwater resources can be expedited include: improving surface supplies by focussing on reducing system losses. This is so because much of the groundwater recharge in the Indus Basin is from canal seepage. Thus an integrated approach is required for conjunctive conservation of surface and ground water.[183] Managing the supply-demand chain could be another way of controlling excessive dependence on tubewells. A shift from supply management to demand management has also been proposed. However, traditional practice of *warabandi,* should be monitored closely so that tail-enders can receive their entitled share. Change in cropping patterns and water saving technologies can also be encouraged.[184]

Streamlining operation and management costs of the existing water projects is another management challenge faced by Pakistan. All

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181 PILDAT, op cit, p. 21.WAPDA, op cit, p. 8.

182 A.S. Qureshi, *Ground Water Management in Pakistan,* GOP/IWMI workshop on Climate Change, Food and Water Security, February 2003. at: http://www.slideshare.net/globalwaterpartnership/20-a-qureshi-gwp-iwmi-ws

183 Simi Kamal, no. 69. p. 35.

184 Kaiser Bengali, "Water Management Under Constraints" in Kugelman and Hathaway (eds.), Running on Empty: Pakistan's Water Crises, Woodrow Wilson International Center for Scholars, Washington 2009, p. 61.

costs of the water projects are supposed to be borne by the provincial governments. Between 1973 and 1990 O&M expenditures grew at an average rate of 4.9 per cent and accounted for 0.45 per cent of the GDP. Since the 1990s, O& M has remained stagnant and accounts for 0.16 per cent of the GDP. Kaisar Bengal attributes the declining O&M expenditure to the growing constraints on provincial finances. Such constraints, he argues have been imposed by the shifting of the burden of federal fiscal budget containment to the provinces. This as Bengali puts it has had an "attendant effect on the performance of the agricultural sector."[185] Commenting on the financial implications of O&M, Feisal Khan writes that in Punjab province alone, irrigation infrastructure is valued at an estimated $20 billion, which would require an annual replacement and maintenance budget of $ 0.6 billion. Executing these maintenance expenditures, would also necessitate cost recovery practices. which he states should be one per cent of the value of the infrastructure stock, which in Punjab works out to Rs 1,800/ per hectare. The actual *abiana* (water rate) collected in 2005 was Rs 150/hectare.[186] The minimal attention given to such issues has adversely impacted the quality of canal irrigation, which operates at approximately 30-40 per cent of the rated capacity.[187]

Thus, as can be gauged from the above discussion, water management practices are shaped largely by techno-centric solutions. Also the existing policies and prevailing practices have a feudal bias, within which the agricultural and irrigation sector operates. One of the primary reasons for ineffective water management is the weak institutional structure, inaccessible bureaucracy and archaic laws, where the political leadership is not accountable to the people at large. Thus, while institutions need to be restructured, they also need to be made more accountable, transparent and efficient in terms of service delivery. Also a clear

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185 Ibid, p. 58.

186 Feisal Khan, "Water Governance and Corruption in Pakistan", in Kugelman and Hathaway (eds.), Running on Empty: Pakistan's Water Crises, Washington: Woodrow Wilson International Centre for Scholars, 2009, p.88.

187 Ibid.

articulation of water rights and water accountability need to be emphasised and worked upon.

Alternative, approaches to Integrated Water Resource Management in Pakistan can also provide a panacea for the existing water management issues. This is important, as Pakistan has the largest integrated irrigation network in the world — a sectoral approach would therefore only be harmful in the long term. Integrated water resource management is essentially the practice of making decisions and taking actions while considering multiple view points on water management. These decisions and actions relate to situations such as river basin planning, organisation of task forces, planning of new facilities, controlling reservoir releases, regulating flood plains and putting in place new laws and regulations. In Pakistan future water needs would be substantially greater than the total potential supply, and therefore there is a need to reduce the water losses from the water supply systems, to improve the overall irrigation efficiency, to construct water reservoirs on potential sites along with the adoption of artificial ground water recharge techniques to integrate the rain and excess flood water to supplement the depleting water aquifers[188].

Some of the areas, which the National Policy on Climate Change identifies as critical for the integrated water management in the water sector are[189]:

1. To ensure that, while making water allocations to various sectors in the medium- to long-term, due consideration is given to changes in sectoral demands caused by climate change;
2. To protect groundwater through management and technical measures like regulatory frameworks, water licencing, slow

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[188] Hussain Sufi, Tariq Sultan, "Integrated Water Resource Management in Pakistan," Paper No. 286, Water Resources Planning and Organisation, Lahore, at: http://pecongress.org.pk/images/upload/books/4-Intergrated%20Water%20Resource%20Management%20in%20Pakistan%20(4).pdf, p. 13, accessed on July 9, 2012.

[189] Ministry of Environment, "National Climate Change Policy (Draft)," Government of Pakistan, April 2011.

action dams, artificial recharge especially for threatened aquifers, and to adopt integrated water resources management concepts.

3. To ensure rational ground water exploitation by avoiding excessive pumping
4. To ensure recycling of wastewater through proper treatment and reuse it in agriculture, artificial wetlands and groundwater recharge etc;
5. To protect and preserve water 'catchment' areas, and reservoirs against degradation, silting and irrigation system contamination;
6. To encourage active participation of farmers in water management along with line departments by accelerating implementation of participatory irrigation management reforms
7. To ensure water distribution among provinces - as far as possible according to crop sowing timings;
8. To address sea water intrusion into Indus Deltaic Region by allocating required water flow downstream Kotri
9. To take appropriate measures to preserve the ecology of dry river reaches of eastern rivers
10. To develop contingency plans for short term measures in order to adapt to water shortages that could help to mitigate drought
11. To explore the possibility of joint watershed management of trans-boundary catchment areas with neighbouring countries
12. To safeguard Pakistan's rights on trans-boundary water inflows according to international norms and conventions
13. To explore the possibility of entering into water treaty with Afghanistan;
14. To promote integrated watershed management including ecological conservation practices in uphill watersheds.

As these recommendations reveal, the need for a fresh approach to integrated water management is being felt in Pakistan, and this could become the precursor of positive change if followed sincerely. However, such approaches need to be complemented by multiple reforms, not only at the institutional level, but also at the societal level, where a change in attitude, behaviour and mind-set is a precondition for successful management and distribution practices of the water sector in Pakistan.

Chapter Six

The External Factor

Climate Change and Environmental Degradation in Pakistan: Assessing 'Security' Challenges

While the previous chapters have examined the internal dimensions of the water sector—relating to governance, political and institutional management, and the bureaucracy, this chapter throws light on the unintended consequences of climate change on traditional and non-traditional dimensions of security. However, before an impact assessment is undertaken, it would be appropriate to study the projected impact of climate change on the water sector in Pakistan.

Climate Change and the Water Sector

The limited availability of fresh water resources is increasingly becoming apparent in Pakistan. According to the government estimates, over a period of time, Pakistan has become a water-stressed country with the overall per capita water availability going below 1500 cubic metres per year. Projections are made that the per capita availability might be less than 1000 cubic metres per year by 2035 and might even go so low as 800 cubic metres per year by 2026. Only a few decades ago, Pakistan was considered to have an abundance of water. This shift from abundance to scarcity resulted largely from the increased demand for water by an expanding irrigation infrastructure, population growth, less than optimal water use practices, and economic development. Given the already scant water resources in Pakistan, it has been argued that, the near and long term effects of climate change on Pakistan's water resources will further challenge the country's water security, resources and aggravate inter and intra-regional ethnic tensions[190].

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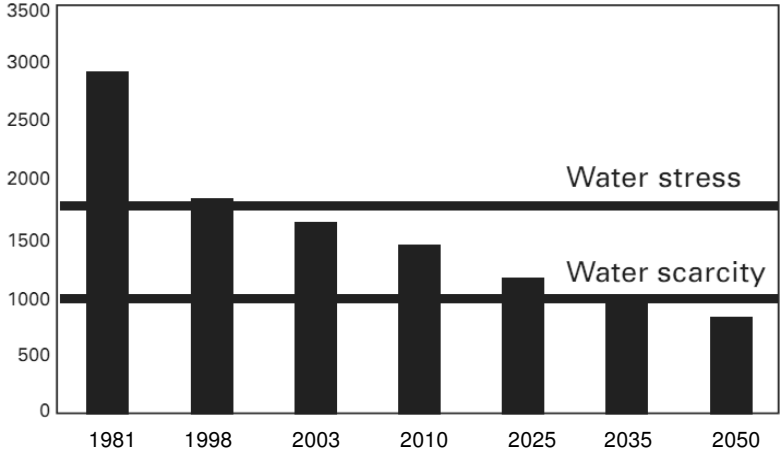
[190] Bruce Vaughn, Nicole T. Carter, Pervaze A. Sheikh, Renée Johnson, "Security and Environment in Pakistan," Congressional Research Service, Washington DC, August 3, 2010, at: http://www.fas.org/sgp/crs/row/R41358.pdf, accessed on October 13, 2011.

Declining Per Capita Water Availability in Pakistan



Source: World Bank 2005 data (adapted by) Vaughn, Carter, Sheikh, Johnson, Security and Environment in Pakistan, Congressional Research Service, 2010

The figure below reflects the declining per capita water availability in Pakistan.

An important source of water in Pakistan is rainfall as about 50 million acre-feet (MAF), comes from the monsoon and westerly winds and river inflows. Meanwhile, about 141 MAF in the Indus River System is largely glacier and snow melt fed from the Hindukush-Karakoram-Himalayas (HKH) mountain ranges. The share of the main contributing rivers to Indus-Pakistan in Pakistan is-Indus: 44 per cent, Chenab- 19 per cent, Jhelum- 16 per cent, Kabul- 16 per cent and others-5 per cent.[191] Climate change can influence the quantity of water available, thus impacting the existing food, water and energy security in the long term.

Additionally, the impact of climate change combined with mismanagement of water resources and fossilised institutional practices, will further strain water supply options in Pakistan. These

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[191] Planning Commission, "Task Force on Climate Change," Government of Pakistan, February 2010, at http://www.pc.gov.pk/usefull%20links/Taskforces/TFCC%20Final%20Report.pdf, p. 13, accessed on July 9, 2012.

in the long term can have national and regional implications. According to one study, inefficient water consumption as well as changing land use patterns, such as deforestation and soil degradation will reduce the supply of water that could otherwise be available. Poor infrastructure in cities, with leakage rates between 30-40 per cent, will also diminish supplies, as will evaporation from man-made reservoirs. Other contributing factors include inadequate knowledge of ground and surface water, budgets, which reflect unsatisfactory representation of the value of water in economic models, and the lack of a general agreement on water rights. These factors would further increase the difficulty of managing water effectively within states and hinder forging of effective water sharing agreements between states.[192] Most of these factors have the potential of becoming increasingly relevant in the context of Pakistan.

Apart from adaptation and mitigation challenges that climate change could pose to Pakistan, there are certain traditional and non-traditional challenges that need to be dealt with. Due to climate change, glacial melting can lead to significant changes in the Indus flow. A 2010 study states that melt water from the Himalayas accounts for 60 per cent of the flow of the Indus River. The study also says that projected temperatures can lead to an 8.4 per cent decrease in upstream water flow into the Indus by 2050, which would threaten the food security of those dependent on the river for irrigation.[193]

According to some well accepted studies on the impact of climate change in Pakistan, there has been a rise of 0.6-1.0°C in mean temperature in arid coastal areas, arid mountains and hyper arid plains. This has been accompanied by a 10-15 per cent decrease in both winter and summer rainfall in the coastal belt and hyper arid plains. Meanwhile, there has been 18-32 per cent increase in rainfall in the monsoon zone especially in the sub-humid and humid areas

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[192] Intelligence Community Assessment, "Global Water Security", Office of the Directorate of National Intelligence, United States of America, February 2012.

[193] Bruce Vaughn, *et.al.*, no. 190.

and a five per cent decrease in relative humidity in Balochistan. The southern half of the country on the other hand has witnessed a 0.5 to 0.7 per cent increase in solar radiation.[194] The Task Force on Climate Change identified certain effects climate change[195]. These are:

- Increased variability of monsoon.
- Rapid recession of HKH glaciers threatening water inflows into the Indus River System; reduction in capacity of natural reservoirs due to glacial melt and rise in snow line.
- Increased risk of floods and droughts.
- Increased siltation of major dams resulting in greater loss of reservoir capacity
- Severe water-stressed and heat-stressed conditions in arid and semi-arid regions, leading to reduced agricultural productivity and power generation.
- Increased upstream intrusion of saline water in the Indus delta, adversely affecting coastal agriculture, mangroves and breeding grounds of fish; and
- Threat to coastal areas including the city of Karachi due to sea level rise and increased cyclonic activity due to higher sea surface temperatures.

While most of these predictions cover a 25-30 years' timeline, there are certain underlying factors, which make Pakistan uniquely susceptible to climate change. While most of them have been mentioned to some degree, some perhaps need reiteration. As already mentioned before, Pakistan is primarily an arid and semi-arid country, where about 60 per cent of the area receives less than 250 mm of rainfall per year and 24 per cent receives between 250-500 mm. Not only does climate change endanger energy security, but also threatens food security as Pakistan's economy is largely agrarian and therefore climate sensitive. There are also potential risks to coastal areas, particularly Karachi, which is Pakistan's largest

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194 no. 189.

195 Planning Commission, "Task Force on Climate Change," no. 191, p. 1.

city and the hub of industrial activity and international trade. Also vulnerable is the Indus deltaic region due to sea level rise and potential cyclonic activity. While the mountainous regions are vulnerable to glacial lake outburst floods and landslides, the country's scant forests (only 5 per cent of the land area being forested) are vulnerable to forest fires as well as reduced regeneration. Meanwhile, issues pertaining to human health –heat strokes, diarrhoea, cholera, and vector borne diseases amongst others and dangers to human settlements from cyclones and floods also need to be addressed in the near future.[196]

Security Issues and Climate Change

Water shortages, poor water quality, and floods by themselves are unlikely to make Pakistan a failed state. However, water problems, when combined with poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions; contribute to growing disruptions that can result in state failure.[197]

Security implications of climate change can be two fold—non-traditional and traditional. While the non-traditional impact could be food, energy, water and health—primarily issues relating to human security; the traditional impact could be felt on the overall stability of the Pakistani state.

Traditional Security and Consequences of Climate Change

It is generally believed that, environmental factors such as water scarcity, soil depletion, and natural disasters can intensify conflict or stress within a country thus potentially threatening the security of a particular country. In other words, the effects of climate change might threaten the national security of a country which is already weakened by poor governance, poverty, and armed insurgents.

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[196] Ibid.

[197] Intelligence Community Assessment, "Global Water Security," Office of the Directorate of National Intelligence, United States of America, February 2012.

Thus, it is argued that while environmental stress alone might not become a geo-political concern, but when added to the existing political and socio-economic stress, it has the potential to become of geo-political importance due to the instability that it could create.[198] The literature on water and conflict, is generally traced back to the 7th century BC.[199] According to various scholars the causes of conflict lie either in the river basin or the nation state. Thus, while the first perspective takes the river basin as the unit of analysis, the second identifies states as the basic unit of analysis. These debates can provide an important perspective in the case of Pakistan.

The Debates

River Basin-Unit of Analysis

Aaron Wolf, Yoffe and Giordano[200] are the main proponents of this view. Also known as the Oregon School, Wolf et. al. consider external factors as being most important for perpetuating conflict. The basic argument proposed by Wolf and others is that, as the institutional capacity of the river basin weakens because of rapid external changes conflicts become inevitable. The external indicators for triggering conflict in a particular region are: (a) emergence of a new management structure in a newly created international basin, and, (b) physical changes which are a product of policies directed at building storage sites, which are generally taken in the absence of a cooperative regime. According to this view there is no direct correlation between conflict and climate change, economic growth, population density and government type. The supporters of this view argue that these factors can influence conflict but are not causally related to it, because the adaptive capacity of institutions in a cooperative regime can help mitigate conflict.

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198 Bruce Vaughn, *et.al.* no. 190.

199 In the 7th century B.C. Ashurbanipal of Assyria seized control of water wells as part of his strategy For Desert Warfare in Arabia. See, Peter H. Gleick, "Water and Conflict," *International Security,* 18 (1), Summer 1993, p. 85.

200 Aaron T. Wolf, Shira B. Yoffe and Mark Giordano, "International Waters: Identifying Basins at Risk, *Water Policy*, 5 2003.

Offering another perspective, Homer Dixon,[201] traces the causality between environmental scarcity and violent conflict. Dixon argues that decreasing supplies of physically controllable water resources, such as clean water and good agricultural land would provoke interstate "simple scarcity" conflict or resource wars. He considers population growth and the unequal social distribution of resources as being the main factors for perpetuating environmental scarcity. Dixon's main argument is that a reduction in the quantity and quality of a resource shrinks the resource pie, while population growth leads to smaller slices for each individual. Meanwhile unequal resource distribution means that some groups would get disproportionately bigger slices, thus creating social discontent and conflict. This supply and demand model givesleads to two patterns of interaction-(a) resource capture and (b) ecological marginalisation. While Dixon unlike Wolf considers resource scarcity to be the primary factor in triggering conflict, he broadly endorses the view, that the capacity of the state and institutions can generate adaptive strategies!!

State-Unit of Analysis

Peter Gleick[202] is the main proponent of this perspective and primarily focuses on the potential imbalance between the demand and supply side of water. In view of the historical precedent of water induced conflicts, Gleick argues that if resource is the defining factor for determining the power (political and economic) of a nation, water can become a potential tool for military action. The behaviour of the state is the primary thrust in Gleick's analysis and he identifies four specific indicators for determining the causal relationship between water and conflict. These are: (a) annual water withdrawals with respect to annual water availability (b) annual per capita water availability (c) dependence on exogenous water (water supply originating from outside the borders of the country) and (d) high dependence on hydel power as a fraction of total electricity supply. Highlighting a number of traditional and non-traditional threats which could become alive at the level of the

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[201] Thomas F. Homer Dixon, "Environmental Scarcities and Violent Conflicts: Evidence from Cases," *International Security,* 19 (1), Summer, 1994.

[202] Peter H. Gleick, "Water and Conflict," *International Security,* 18 (1), Summer 1993.

state, Gleick proposes that access and control over headwaters can be the primary factors for perpetuating conflicts. While Gleick's analysis is very similar to that of Homer Dixon, his main focus is on the preferences and interests of the states that are vulnerable because of dependence on water from outside their territorial boundaries and the growing water demand from within the territorial boundaries.

Kent Hughes Butt[203] on a similar note as that of Gleick, emphasises the need to re-evaluate the concept of strategic resources in the 21st century. Given the rise in population, change in climate conditions and the imbalance in water resource supply and demand, Butt argues that water would continue to be a source of tensions thereby becoming a key variable in future international conflicts. He argues that while conflict generally has multiple causes, water will serve as the catalyst to ignite the existing flammable mixture of ethnic, religious or historical enmities. He cautions that from a strategic perspective, competition over scarce water resources could assume increased importance due to proliferation of weapons of mass destruction. Thus any competition over regional water resources could scale up quickly from being noteworthy to significant.

Pakistan for instance, as an applied case study can be significantly understood within the parameters of the aforementioned arguments. It not only suffers from demand induced scarcity and structural scarcity[204] but also institutional incapacity. While demand –induced scarcity stems from Pakistan's growing population and per capita use of resources; structural capacity stems from the inequitable distribution and use of natural resources in Pakistan, stemming from social inequality. Institutional incapacity stems from poor governance, bureaucratic method of functioning and weak institutions. These factors, as can be argued could have a debilitating effect on the impact of environmental degradation and climate change, and thus make Pakistan an ideal case for potential water conflict.

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[203] Kent Hughes Butts, "The Strategic Importance of Water," *Parameters*, Spring 1997.

[204] Bruce Vaughn, *et.al.* no. 190.

Michael Kugelman in a short article published in *Foreign Policy* in May 2012 argues that environmental issues threaten Pakistan's fragile stability in three specific ways. First, the use of water issue as a tool by the fundamentalist groups to further political goals. Territorial aspirations –linked to the liberation of Jammu and Kashmir, could not only stir up hostilities with India but water scarcity in Pakistan can fuel the political discourse that Indiais responsible for Pakistan's water woes. Second, environmental stress could exacerbate urban violence in Pakistan. The case in point, as Kugelman points, out is the city of Karachi, which being located in a coastal zone is vulnerable to flooding and cyclones. An environmental disaster could wipe out vast swathes of the city's heavily contested real estate, which means that land would become even even more precious, thereby raising the stakes for the city's fighting factions and this would lead to an increase in violence. Third, environmental insecurity in Pakistan also threatens the nuclear security of the region. Kugelman writes that the fear is not that of militants seizing nuclear weapons, but rather the nation experiencing a disaster of the type that befell Japan's Fukushima nuclear plant in 2011. He quotes a study published by the journal Nature, according to which more than 8 million people live within a 30 kms radius of the Karachi Nuclear Power Plant (KANUPP), the largest number for any nuclear facility in the world.[205]

Non-Traditional Security and Consequences of Climate Change

The most significant and manifest impact of climate change would be on human security-primarily health, food and energy. It is predicted that the rise in temperatures in the northern areas, could create a new health hazard for Pakistan in terms of aggravation of malaria. At present the mosquito season is currently limited by low temperatures in winter. Also higher air and water temperatures are favourable for the reproduction of many types of flies and other vectors of disease and thus lead to a rise in infectious disease,

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[205] Michael Kugelman, "Pakistan's Climate Change Challenge," *Foreign Policy*, May 9, 2012, at http://afpak.foreignpolicy.com/posts/2012/05/09/pakistans_climate_change_challenge, accessed on July 13, 2012.

particularly in the northern part of Pakistan. Another climate change related impact is the winter smog, which has been seen over the entire Punjab in the winter months of January and December for the last several years. Climate change will thus not only affect human health, but the overall social development of Pakistan could be affected by the outbreak of heat related and vector borne diseases, coupled with malnutrition[206].

Food security is an important component of water security in Pakistan as agriculture and livestock sector is the mainstay of the national economy. Agriculture accounts for 22 per cent of the GDP, and as stated earlier 60 per cent of the country's exports. The total cultivable land area in Pakistan is about 22.2 million hectare (mha) of which, 66 per cent is irrigated by canal water, 22 per cent by water from tube wells and wells and the rest simply relies on rainfall. Farmers with only five hectares or less of land account for 86 per cent of the farms and 44 per cent of the farmed area of Pakistan. These small scale farmers are the most vulnerable to impact of climate change because they lack the financial resources and access to information needed for adaptation. Also about 38 per cent of the cultivable land in Pakistan has already suffered environmental damage (17 per cent due to water erosion, 8 per cent due to wind erosion, 5 per cent due to water logging, and 8 per cent due to salinity and sodicity.[207] It is predicted that climate change would further exacerbate such environmental degradation, thus affecting the food production potential of Pakistan.

Climate change, would affect the different provinces differently because climate in Pakistan varies from sub-zero temperatures in the north to above 50 degrees centigrade in the south. Simulation models have been used to assess the impact of climate change on the wheat crop in the four agro-ecological zones in Pakistan—the northern mountainous region; the northern sub-mountainous region; the southern semi-arid plains; and the southern arid plains) as well as on the Basmati rice crop in the semi-arid plains of Punjab (Sheikhpura district). According to the findings, the wheat growing season would become shorter with the rise in average temperature

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[206] Planning Commission, "Task Force on Climate Change," no. 191, pp.29-30.

[207] Ibid, p. 19.

in all the agro-ecological zones of Pakistan. Like wheat, the season for Basmati rice cultivation in the semi-arid plains of Punjab will also become shorter with rise in temperature. These findings have serious implications for the future of food security in Pakistan. Also an increase in the frequency and intensity of precipitation events over short periods of time is also expected under the influence of climate change. This would result in damage to crops and the top soil resulting in productivity losses.[208]

Energy security would be a major issue in Pakistan in the years to come. This is already evident from the power riots across the cities in Pakistan in the last few months. As hydro power accounts for 30 per cent of the total electricity generation mix, climate change would impact energy security significantly. According to a recent study published by the Asian Development Bank in July 2012, on *Climate Change and Adaptation in the Electric Power Sector*, it has been argued that, electric power production and distribution infrastructure can be highly vulnerable to the impact of climate change because[209]:

- Increase in water temperature is likely to reduce generation efficiency, especially where water availability is also affected.
- Increase in air temperature will reduce generation efficiency and output as well as increase customers' cooling demands, stressing the capacity of generation and grid networks.
- Changes in precipitation patterns and surface water discharges, as well as an increasing frequency and/or intensity of droughts, might adversely impact hydropower generation and reduce water availability for cooling purposes to thermal and nuclear power plants.
- Extreme weather events, such as stronger and more frequent storms, can reduce the supply and potentially the quality of fuel (coal, oil, gas), reduce the input of energy (e.g., water,

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208 Ibid, pp 19-21.

209 "Climate Risk and Adaptation in the Electric Power Sector", Asian Development Bank, July 2012, at http://www.iadb.org/intal/intalcdi/PE/2012/12152.pdf, accessed July 20, 2012.

wind, sun, biomass), damage generation and grid infrastructure, reduce output, and affect security of supply.

- Rapid changes in cloud cover or wind speed (which may occur even in the absence of climate change) can affect the stability of those grids with a sizeable input of renewable energy, and longer term changes in these and precipitation patterns can affect the viability of a range of renewable energy systems.
- Sea level rise can affect energy infrastructure in general and limit areas appropriate for the location of power plants and grids.

Some of the indirect impacts, which have been identified, are[210]:

- Reduction in river flow rates with consequent reduction of hydropower generation, which will necessitate an increase in fossil fuel capacity and a commensurate increase in water cooling needs.
- Higher temperature will result in increased demand for energy for pumping ground water to meet higher irrigation requirements due to increased evapo-transpiration, and to compensate for water losses due to evaporation.
- Higher temperatures will increase electricity demand for space cooling, thereby increasing the peak demand hence requiring additional generation capacity.

Energy security thus will inevitably impact the economic growth of the country too. It has been projected by the Planning Commission of Pakistan that the demand for energy between 2005-2030 will increase at about 7.5-8.0 per cent per annum on the basis of a 7-8 per cent sustained annual growth in GDP[211]. The current consumption trends, coupled with the impact of climate change, could result in foreseeable energy shortages in the near future.

It would be therefore be appropriate to conclude that climate change can have serious security implications for Pakistan. The next chapter offers some conclusions along with future trends, which might become manifest in the coming years.

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[210] Planning Commission, "Task Force on Climate Change," no. 191, p. 25.

[211] Ibid, p. 23.

Part III

Looking Ahead: Some Scenarios

Chapter Seven

Conclusion
A Futuristic Assessment

Pakistan's water sector has played an important sectoral role in contributing to the development of the nation. Given the increasing demands primarily stemming from rising demographic pressures and urbanisation, environmental and water quality along with water quantity are the issues which will inform the overall water policy in Pakistan.

Domestic water management is one of the key areas that Pakistan needs to focus on. The management issues will need to be dealt at three levels – institutional, intra- provincial and inter-provincial. While the institutions need to evolve keeping the contemporary demands in minds, efficiency needs to supplement the equity in water distribution pattern. Water bureaucracy needs to be made accountable and more transparent, and political and agricultural lobbies need to better oversight. Also, at the inter-provincial level transparency in water distribution and allocation should be encouraged. Mistrust between provinces, as the PILDAT report states should be transformed into trust. This will only be possible when all parties are satisfied that all are complying with the agreements in letter and spirit. Addressing intra-provincial disputes, particularly in Sindh and Punjab is another challenge which should be met by the federal government. This is important as south Punjab and Karachi are increasingly being grippedby militancy.

Pakistan as stated in this monograph is an arid country, highly dependent on surface and ground water. However, the over exploitation of groundwater, lack of maintenance of the irrigation system and the embedded corruption in the water sector have made reforms most urgent. Given the domestic, industrial and agricultural usage and the dependence of Pakistan on agricultural exports for its foreign exchange earnings, has made the issue of water security critical for the policy makers. While the decision makers do realise the dangers stemming from water scarcity, water

distribution methods need to be looked at. Also the acts, by which all the laws are tilted in favour of the state and do not factor in the peoples' needs should be reviewed.

Pakistan's water management challenge is thus a mounting concern and the United States has allotted significant sums to both Afghanistan and Pakistan for the purpose. A major chunk of the $46.8 million aid goes to Pakistan. A multi-year arrangement has established a *water working group* within the U.S-Pakistan strategic dialogue. The first phase of the programme focuses on building a high efficiency irrigation system, water storage dams, municipal water and service delivery, and dams for irrigation.[212]

Food and energy security are issues directly related with water management and development challenges. While the lobby for developing storage projects for food and energy security is quite strong, opposition from the lower riparians primarily Sindh, Balochistan and KP, complicate any decisions on water projects. Also the vision of federal agencies such as WAPDA is very ambitious and does not relate to the ground realities of Pakistan as the rich and powerful landlords, and people with political influence are game changers. Institutional reforms envisaged in late nineties are yet to engage the people as real stakeholders. However, there are some positive changes at the policy level, but they are yet to show results the ground level.

Based on this assessment, it would be interesting to see how the water sector could influence the behaviour of the Pakistani state. Three alternative scenarios have been crafted based on the current situation. While two scenarios reflect the structural (political, social and environmental) factors prevailing in Pakistan, the third scenario is based on the interventions and new policies, being introduced at various levels.

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[212] "Avoiding Water Wars: Water Scarcity and Central Asia's Growing Importance for Stability in Afghanistan and Pakistan", Committee on Foreign Relations, United States Senate, February 22, 2011, p. 13.

Scenarios

Domestically, the political discourse on water could take root in Pakistan and this in fact could be seen as a strategic tool by the policy makers to unite and mobilise certain voices of dissent. While the discourse on water in Pakistan is still in an incipient stage, as the water crisis gets aggravated due to a combination of external (climate change) and internal (fossilised institutions, ineffective and archaic policies and bureaucratic mode of functioning) factors, certain groups mentioned in this monograph, could get activated and find their voices strengthened over a period of time. Some of these could be those consisting of retired engineers, farmer organisations, fundamentalists, army personnel who have a vested interest in land, and political parties. The focus on reforming domestic institutional and management practices, would be replaced by a political narrative which is externally targeted against India. Territorial aspirations could gather momentum, where water security could be linked to the Kashmir Valley. Water, is an emotive subject and has the power to mobilise people and this could have a cascading effect not only on Pakistan's domestic politics but also on India-Pakistan bilateral relations. The trend of the internal water discourse (once it gains critical mass in Pakistan) can thus not only freeze Pakistan's negotiating posture in Indo-Pakistan bilateral talks but can also strengthen the voices of the advocates of large dams, thus further promoting techno centric solutions of water management. Also, the jihadist advocacy of water wars can be strategically used to attract media attention. These linkages could also suppress the domestic voices of dissent against the inequitable land distribution patterns and ineffective water laws in Pakistan. As it has been mentioned, land reforms in Pakistan have been a protracted process, marked by a conspicuous absence of political will. If this scenario plays out, then the process of reform would get derailed.

The second scenario particularly relates to a fragmented polity, where various stakeholders raise their voices against the state (Pakistan). While intra and inter-provincial faultlines become sharper, these are enabling conditions for water conflicts to play out. Street riots and vandalism spread across the cities of Pakistan,

could become a common feature. It has been argued by one author that environmental stress could intensify Pakistan's urban violence. For instance, much of the conflict in Karachi stems from land. The stakes could be further raised for the fighting factions if cyclones, floods and other climate related phenomenon wipe out swathes of the city's real estate .[213] Meanwhile, in the wake of water shortage, provinces might get more assertive of their water rights. This would lead to a stalemate in decision making. As water is a politically sensitive issue, compromises on water sharing agreements are less likely to happen amongst parties involved in a power struggle. Though at the policy level, there could be emphasis on integrating water management approaches, operationalising them at the grass root level, would be difficult, due to an intersection of vested interests and the centralised approach, of the state. Lack of institutional capacity, weak policies and ineffective monitoring would further aggravate matters. Intra-provincial fault lines, coupled with ethnic estrangement could also become more visible. The Seraiki belt movement could for instance strengthen, thus straining relations between north and south Punjab. Also, fissiparous tendencies between north and south Sindh could intensify. This could be coupled with the divergence of views, between the key political parties in Sindh viz. - Muttahida Qaumi Movement, Pakistan Peoples' Party and Awami National Party. While the fundamentalists would appropriately use water as a mobilisation strategy, right wing elements in due course might get strengthened in the domestic politics of Pakistan.

Alternatively, given the pressures of street power, which seem to be gaining ground in Pakistan, and the formulation of new policies in the water sector, in the third scenario, institutional reforms might be taken up seriously by the policy establishment. As institutional reforms shape up, and power is devolved to the lowest denomination, due importance would be given to farmer organisations and people participation in water management

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[213] Michael Kugelman, "Pakistan's Climate Change Challenge," *Foreign Policy*, May 9, 2012, at: http://afpak.foreignpolicy.com/posts/2012/05/09/pakistans_climate_change_challenge, accessed on July 13, 2012.

practices. Also, integrated water management techniques might be adopted and incorporated. All these initiatives would be perceived as imperative to avoid water stress in Pakistan. Domestic water management would therefore be perceived as a key tool to avoid situations of water stress and water conflict. As domestic management of water issues becomes a key focus, fresh proposals could also be made to India for effective water management of the Indus water basin.

Given the existing trends, where efforts are being made to facilitate power trade and according each other the MFN status, ties with Pakistan could slowly improve. Over a period of time it could even reach a point of irreversible change as constituencies for peace and engagement are created and sustained on either side. Integrated water management could thus give a new lease of life to Indus Basin. Perhaps, the situation might even become conducive for an Indus Water Treaty II. The key components of an Indus Water Treaty could be improved water governance and and the addition of new variables introduced by climate change. Thus, the focus of the Indus Water Treaty II would be on initiating reforms both at the domestic and the bilateral level.

Given the three scenarios, it is clear that external solutions and focus on increasing the sheer quantity of water, are a recipe for disaster—both at the domestic level and at the bilateral level. The external environment is fast changing. It is therefore important to incorporate policies which neutralise adverse impact of climate change. While integrated water management techniques need to be incorporated, domestic institutional reforms, would be the best way for initiating positive change.

Annexure One

Canals in Punjab

Canals	PercentageArea Perennial
Upper Chenab	60
M.R Link	0
C.B.D.C	100
Depalpur (Upper)	0
Depalpur (Lower)	0
B.R.B.D	0
Lower Chenab (East)	0
Lower Chenab (West)	95
Upper Jhelum	95
Lower Jhelum	69
Thal	86
L.B.D.C	100
Haveli	97
Mailsi	36
Pakpattan (Upper and Lower)	60
Fordwah	15
East Sadiqia	98
Abbasia	48
Bahawal	47
Qaim	0
Panjnad	33
D.G. Khan	0
Muzaffargarh	0
Rangpur	0

Source: Imran Ali: The Punjab under Imperialism 1885-1947, Princeton: Princeton University Press, 2003

Annexure Two

Canal Commands in Sindh

Barrage	Canal	Number of Distributaries
Sukkur	Dadu	120
	Rice	90
	NW	127
	Khairpur Feeder East	55
	Rohri	283
	Nara	163
	Kharpur FeederWest	68
	Total	**906**
Kotri	Akram Wah	49
	Fulleli	74
	Kalri Baghar Feeder	110
	Piyari Feeder	113
	Total	**346**
Guddu	Bagari Sindh	85
	Desert Pat	45
	Ghotki Feeder	64
	Total	**194**

Source: Frank van Steenbergen, Water charging in Sindh, Pakistan – Financing Large Canal Systems , at: http://www.metameta.nl/wordpress/wp-content/uploads/2012/02/MetaMeta_Watercharging_Sindh.pdf

Annexure Three

Canal Colonies in Punjab

Name of Colony	Period of Colonisation	Doab	District	Name of the Canal Work
Sidhnai	1886-1888	Bari	Multan	Sidhnai
Sohag Para	1886-1888	Bari	Montgomery	Lower Sohag Para
Chunian	1896-1898 1904-1906	Bari	Lahore	Upper Bari Doab
Chenab	1892-1905	Rechna	Gujranwala Jhang Lyllapur Lahore Sheikhpura	Lower Chenab
Jhelum	1902-1906	Jech	Shahpur Jhang	Lower Jhelum
Lower Bari Doab	1914-1924	Bari	Montgomery Multan	Lower Bari Doab
Upper Chenab	1915-1919	Rechna	Gujranwala Sialkot Sheikhpura	Upper Chenab
Upper Jhelum	1916-1921	Jech	Gujrat	Upper Jhelum
Nili Bar	1926-	Bari	Montgomery Multan	Sutlej Valley Project

Source: Administrative Report of the Punjab Public Works Department, 1945-46.Cited in Imran Ali, The Punjab Under Imperialism 1885-1947.

This monograph undertakes a descriptive analysis of the water sector in Pakistan and underlines issues related to Pakistan's water policies, politics and management practices. While the thematic focus is on developing linkages between the British colonial legacy - the creation of canal colonies in west Punjab, the impact of partition on the Indus Water Treaty and Pakistan's water sector, the study explains why Pakistan followed a technocratic paradigm to manage its water resources. As societal norms play an influential role in water distribution and allocation, the monograph highlights the interface between policy and politics. It argues that domestic water management is perhaps one of the key areas which requires urgent attention in Pakistan.

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