Re-Imagining the Indus

October 2011

Observer Research Foundation
&
Lahore University of Management Sciences

ACKNOWLEDGEMENT

The project team wishes to record its gratitude towards DFID for initiating, funding and supporting the project and also for its enduring tolerance in accommodating unforeseen delays in executing the project.

The project team also wishes to record its gratitude to Ms. Aarya Venugopal at the Observer Research Foundation for proof reading the entire report.

CONTRIBUTERS

RAFAY ALAM
Lahore University of Management Sciences, Pakistan

MUHAMMAD AZEEM ALI SHAH
Lahore University of Management Sciences, Pakistan

MAAZ GARDEZI
Lahore University of Management Sciences, Pakistan

SHAH BAKHT SOHAIL
Lahore University of Management Sciences, Pakistan

ROHAN D'SOUZA
Jawaharlal Nehru University, India

INDERJEET SINGH
Punjab University, India

A K JAIN
Punjab Agricultural University, India

SAMIR SARAN
Observer Research Foundation, India

HANS RASMUSSEN THETING
Observer Research Foundation, India (2010)

SONALI MITTRA
Observer Research Foundation, India

LYDIA POWELL
Observer Research Foundation, India

AKHILESH SATI
Observer Research Foundation, India

TRIDIVESH SINGH MAINI
Observer Research Foundation, India

DISCLAIMER

Due care has been taken to ensure that the contents of this report are based on credible sources as listed in the footnotes. Observer Research Foundation or Lahore University of Management Sciences may not be held responsible for any omissions or inaccurate information. The views expressed in this report may not be attributed to any individual contributor unless explicitly cited.

PRIMARY CONTACT:

Mr. Akhilesh Sati

Observer Research Foundation

20, Rouse Avenue, New Delhi-110 002
Phone: +91-11-43520020 (Extn. 2102) Fax: +91-11-43520003
Email: akhileshs@orfonline.org
www.orfonline.org

TABLE OF CONTENTS

1 Outline of the Report

1.1 Introduction

The word 'rival' derived from the Latin word *'rivalis'*-meaning *'one using the same river'*-aptly conveys how the use of a water body by one party necessarily affects its use by other parties leading to problems of collective action.[1] If water resources are shared across territorial borders, the collective action problem takes an international dimension and often becomes a medium for articulating deeper territorial, political and social conflicts.

Most of the world's populations live in shared river basins. 145 countries accounting for over 90 percent of the world population are in shared river basins; over 260 of these basins are shared between more than two countries constituting the hydrological interdependence of millions of people.[2] Two in every five people in the world live in international water basins which account for 60 percent of global river flows.[3] Given the scale of shared river basins, there has been a steady stream of predictions of *'water wars'* between nations. A field of study labelled 'hydro-politics' understood as the *'study of conflict and cooperation between States over water resources that transcend international borders'* has also emerged in the last three decades.[4]

The *'water wars'* thesis has generated world-wide interest, particularly from the security community, but historical records fail to endorse its core idea. Records going back 50 years conclude that there have been only 37 cases of reported violence between States over water; over the same period, more than 200 treaties on water were negotiated between countries.[5] The Permanent Indus Water Commission which oversees a treaty on

1. Human Development Report 2006, p. 214
2. Ibid.
3. Ibid.
4. Schmeier, S. 2010. 'Governing International Watercourses – Perspectives from Different Disciplines: A Comprehensive Literature Review', Berlin Graduate School for Transnational Studies & the Hertie School of Governance
5. Oregon State University Database: http://www.transboundarywaters.orst.edu/database/interwatereventdata.html

sharing of the Indus river basin between India and Pakistan survived and functioned during two major wars between the two countries and so is held up as an example for the durability of water governance institutions.

Yet today, a combination of objective and subjective factors appear to be contributing to an increase in the probability of a 'water conflict' in the Indus basin. Will Pakistan and India eventually demonstrate that the past is not a good guide to the future when it comes to water?[6]

The project 'Re-Imagining the Indus' carried out jointly by the Observer Research Foundation, India and the Lahore University of Management Sciences, Pakistan is an inquiry into this issue. The objective of the joint study was not to merely document the differences but to go beyond the shrill and clichéd stances that restrict innovative thought processes and provide fresh approaches for dealing with the real challenge that India and Pakistan face with regard to their shared water resources.

Towards this end, effort was made to understand the gap between the *rhetoric* and *reality* in sharing and using water resources in the Indus basin. The *rhetoric* of the looming water crisis in India and Pakistan as portrayed in the English on-line media in Pakistan and India was studied using standard media content analysis techniques; the *reality* of the 'water-crisis' in the Indus basin was studied by a team of experts drawn from fields of agricultural economics, soil and water management, political history, sociology and water governance. Exclusive papers by the experts traced agricultural practices from pre-colonial to the post partition period. The questions that underpinned the papers were: (i) What factors drove change in water-use practices in the Indus basin in each period and (ii) Are current practices sustainable under increasing external stressors such as economic growth, population pressure and climate change.

This report is a compilation of observations, lessons and insights that emerged from the both segments of the study. Section 1 of the report is a brief description of the broad contours of the project including key milestones and achievements followed by Section 2 which is an executive summary of key observations and conclusions from the study. Section 3 is a brief analysis on 'Drivers of Conflict' in the region that draws from the subsequent sections of the report that include a Media Content Analysis (Section 4) and a brief summary of papers on Water Use Practices in the Indus basin starting from the pre-colonial to the current period (Section 5). The report concludes with annexures in

6. Postel, L. & Wolf, A.T. 2001. 'Dehydrating Conflict', Foreign Policy, No 126 (Sep-Oct), pp. 60-67

Section 6 which includes, the basis of the Media Content Analysis and the specially commissioned academic papers that formed the basis of the study.

2 Key Message & Recommendations

2.1 Key Message

The water resource management discourse on the Indus is being 'securitised'; as national security concerns are being linked to the management of the Indus basin. With securitization low political issues such as water resource management are linked with the high political issues of national survival. Securitisation of the Indus discourse is contributing to retarding institutional development and is undermining the extent to which uncontested hydrological data can be generated and shared between the two countries. This is setting off a spiral of discontent and mistrust. Securitisation is a zero-sum game where both Pakistan and India stand to lose if they do not carefully manage the water that they share.

The following conditions necessary for the success of the 'securitization process' have become enablers of the securitization process:[7]

- Demand for rhetoric that follows the grammar of security
- A society that accepts claims of the 'securitizing actor' (military establishment in Pakistan and hawkish analysts in India)
- Presence of certain 'objects of reference' which are generally held to be threatening:
    - o Decline in availability of surface water
    - o Growth of hydro power projects of India on the Western rivers

The rhetoric of an 'existential threat' posed by India with regard to water is perpetually repeated in academic as well as popular media circles in Pakistan quoting the political, military and bureaucratic elites to convince the public that the threat is real, thus legitimizing the use of exceptional measures to combat or prevent this threat.[8]

7. Conditions identified by the Copenhagen School which originally developed the securitization theory during the 1990s in order to construct a 'neo-conventional security analysis which sticks to the traditional core of the concept of security (existential threats, survival)
8. Coskun, B.B. 2009. 'Cooperation over Water Resources as a Tool for De-securitisation: the Israeli – Palestinian Environmental NGOs as De-securitising Actor,' European Journal of Economic Studies, EJEPS 2 (2) 2009

The Indus Water Treaty (IWT) which is a static technical arrangement that treats the Indus as a mute volume of water is flawed both as a concept and water management practice.[9] The Treaty as it is being interpreted now is fundamentally incapable of handling 'variability' arising from uncertain weather patterns, changing climate conditions, economic growth and the consequent pressure on demand for water. The 'variability' of water flow in the Indus has become a source of disagreement rather than as an opportunity for renewed understanding. Climate change and its impacts require that the IWT is reviewed from an ecological and social perspective rather than from the rigid technical perspective that has dominated the discourse (see paper by Rohan D'Souza in Section 6 for a detailed and eloquent elaboration of this idea).

2.2 Recommendations

REMOVE THE RIPARIAN IRON CURTAIN

It was understandable that the IWT took the shape of a 'riparian iron curtain' as it was part of the 'divorce settlement' between India and Pakistan in 1947. Maximising the 'use' of water to enable India and Pakistan to build their nations was the driving theme while ecological and social consequences were overlooked. Cooperation was mentioned in Section VII of the Treaty but it was merely an afterthought as it provided no firm guidelines. It is time to remove the riparian iron curtain in the context of the Indus Water Treaty and incorporate sophisticated joint water management frameworks that involve active participation from all stake holders from both sides of the border and take into account ecological and social sustainability, climate impacts, water and environmental quality.

DE-SECURITISE THE DISCOURSE

If mutual self interest is the key driver of cooperation, then de-securitisation is the key to the establishment of positive peace. For this the core problem must be framed as one of relative water scarcity which can be addressed by recourse to a wide range of coping strategies such as the extensive use of water management techniques, diversification of crop patterns, shift away from water intensive crops etc rather than as a problem of absolute scarcity and thus a limitation to economic growth. As a first step the de-securitisation process would involve extensive and sustained interaction between stakeholders such as farmers, policy makers and media personnel in which the real nature of the water crisis in the basin is brought out. Interactions must be facilitated between

9. D'Souza, R. 2011. Hydro-Politics, the Indus Water Treaty and Climate Change: Writing a New Script for the Indus Rivers

journalists from both countries, especially those from the non-English media to produce counter-narratives centred on water management to take on the security centred narratives. To bring counter narratives emerging from non governmental organisations from the margins to the main-stream official endorsement and support is required.

DEMOCRATISE PEACE MAKING

Peace making need not be the prerogative of the Federal Government. Key de-securitising actors such as farmers, academics, non governmental organisations and common people can contribute tremendously to peace initiatives. Such initiatives have demonstrated concrete positive results in the Jordan River basin and also in the Cauvery river basin in South India. In the Cauvery river basin, farmers from Karnataka and Tamil Nadu who had historically engaged in an acrimonious dispute over water empathised with each other's problems when they were brought together and contributed to diffusing the tension as they realised that were part of the Cauvery river family. A similar approach can be adopted between farmers from India and Pakistan to create a sense of joint ownership and management with a longer term vision to create an 'Indus family' approach.

Closer collaboration between Punjab Agricultural University, Ludhiana and Faisalabad University will foster enduring partnerships in generating uncontested knowledge. Agricultural scientists from both sides could meet periodically to share findings which can be mutually beneficial for both sides. A first step would be to design and implement a sustained interaction with the Punjab Water Council, a forum of farmers in Pakistan that has emphasised the need to talk to India on the issue of water.

AVOID THE 'WATER SECURITY' TRAP

When the world is becoming more globalised and integrated, attaching the word 'security' to every thing from energy to water and food does not make sense. The idea of 'water security' leads to the idea of 'water nationalism' which essentially means that India and Pakistan must control water resources no matter what the cost.[10] Under this paradigm, both countries will fight over water and continue to grow water-hungry grain and sugar-cane in the water scarce Indus basin towards their quest for 'food security'. 'Water nationalism' will not only increase water insecurity for both countries but also contribute to broader insecurity in the South Asian region.[11]

10. Turton, A.R, Ashton, P & Cloete, E (eds). 2003 Transboundary Rivers, Sovereignty and Development: Hydropolitical Drivers in the Okavango River Basin, African Water Issues Research Unit (AWIRU) and Green Cross International (GCI)
11. Rajan, R. 2010. 'The Resource Security Trap', The Mint, 9 August 2010.

Import of food grain, though highly controversial in relatively poor countries like Pakistan and India, is a viable back-up strategy which could enable both countries to adapt to water stress over the short term during periods of drought. When Pakistan (or India) imports one tonne of grain it also imports 1000 cubic meters of water because it takes that much water to produce a tonne of grain.[12] By importing food staples, India and Pakistan can allocate more of their scarce water to industries and cities which generate far more economic value per litre than agriculture does. This necessarily means that both countries are economically strong with sufficient foreign exchange to buy food grain from the global market. In the eventuality of food imports, a safety net is absolutely essential for the poor in both countries as the entry of large countries such as India into the global grain market can send grain prices spiralling upwards thus consigning a greater number to hunger and starvation.

In the mean time, efficient water use must be explored. Efforts must be in place to increase the productivity of water use in both Pakistan and Indian without compromising on ecological sustainability. Measures such as drip irrigation and shifts in cropping patterns must be introduced. This requires investment and investment is unlikely to materialise if the Indus discourse continues to be framed as an existential threat in Pakistan.

RE-IMAGINE THE BORDERS

The conventional view of national territorial boundaries as strong and durable fences, safeguarding the country from hostile external forces is an outdated notion. In the words of Shyam Saran,[13] India's former Foregin Secretary Advisor, borders must serve as 'connectors' or 'transmission belts', which bring us closer to our neighbours in a mutually beneficial embrace rather than as impenetrable walls behind which we insulate ourselves. Border-states become important platforms for mutual interaction as the can serve as bridges linking India with its neighbours.

In this light, interactions at the governmental and people level, between the two Punjabs with close historical and cultural ties could become the catalyst for adoption of better water management practices and economic development in Punjab on both sides of the border thus turning the 'border' into a 'bridge'. In Shayan Saran's words 'it is time we re-imagined our country's borders and made our border regions full stakeholders in India's development'. There cannot be a better place than the Indus Basin to begin 're-imagining' our borders.

12. Postel, L. & Wolf, A.T. 'Dehydrating Conflict' Foreign Policy, No 126 (Sep-Oct 2001), pp. 60-67
13. Saran, S. 2011. 'Re-Imagining India's Borders'. Business Standard, 24 June 2011

3 Drivers of Conflict in the Indus Basin

3.1 Introduction

There is a complex interaction between water issues and political relations as far as Pakistan and India are concerned. It is not always the case of conflicts over water resources leading to worsening of political relations; it is more often the case of a difficult political relationship rendering the water issue more intractable.[14] The issue has layered complexity as three of the rivers that flow into Pakistan through the Indian portion of J & K, the territory over which the two countries have waged multiple wars.

The current position of Pakistan and India with regard to the Indus Basin reflects path dependence; their respective positions are derived from their respective positions at the time of signing the Indus Water Treaty. These positions were in turn derived from their respective positions at the time of partition in 1947. At the time of partition, both countries started with a nationalistic approach to using the waters of the Indus with a strong emphasis on 'water independence' which continues in more muted forms today. India's position, traditionally based on the theory of exclusive appropriation of water by one riparian state, commonly known as the 'Harmon doctrine' and that of Pakistan based on the idea of 'historic use' persist in current debates. The contest between these positions is the context for the analysis that follows.

3.2 Theoretical Framework

The guiding questions for the analysis are:

- Is the water based conflict in the Indus basin becoming more controversial, acrimonious and intractable?

14. Iyer, R.R. 1999, 'Conflict-Resolution: The Three River Treaties,' Economic & Political Weekly, Vol 34 Jun 12-18, 1999, pp. 1509-1518

- If so, what factors are driving this shift?
- How large is the gap between the *rhetoric* and *reality*?
- What are the measures that will facilitate the narrowing of the gap between rhetoric and reality?

To answer the questions, first a distinction was made between the *primary* and *secondary* drivers of the water related conflict in the Indus basin.[15] *Primary drivers* are at the core of the conflict involving competing identities such as statehood, religious affinity, racial tension and competing interests such as security and control over territory along with the value trade-offs and problems stemming from the ranking of these interests. At the primary level, solutions to the 'water conflict' are only possible when 'high political' issues such as statehood, security and territory between the parties are solved.[16] *Secondary drivers* such as Geographic Riparian Location, Asymmetry in Economic Influence, Basin Dependence, Media Framing, Adversarial Institutional Structure and Processes and Distrust are not necessarily at the core of this conflict but are more visible and therefore more controllable.[17] This synthesis report focuses exclusively on these *secondary drivers* of conflict. Many of the drivers are well known but are rarely discussed in the context of the Indus basin conflict.

3.3 Hegemony of Riparian Geography

The Indus Water Treaty sets out the legal framework for the sharing of the waters of six rivers: the Indus River and its five tributaries. All six rivers-Indus, Chenab, Jhelum, Sutlej, Beas, and Ravi-flow through Northern India and into Pakistan. Under the pact, the waters of three rivers-the Indus, the Chenab and the Jhelum, which pass through Jammu & Kashmir-are to be used by Pakistan, while India has rights to the waters of the Sutlej, the Beas and the Ravi before these three enter Pakistani territory.[18]

Rivers for use by Pakistan:

- The Indus: Originates in Tibet and flows through Jammu & Kashmir
- The Chenab: Originates in India's Himachal Pradesh state, travels through Jammu & Kashmir

15. Adapted from the framework in Nie, Martin. 2003. 'Drivers of Natural Resource-based Political Conflict', Political Sciences, Vol 36, Dec 2003, pp. 304-341
16. Lowi, M. & Rothman, J. 1993. 'Arabs and Israelis: The Jordan River', Faure, G. & Rubin, J. (eds.): 'Culture and Negotiations: The Resolution of Water Disputes', Newbury Park, pp. 156-175
17. Kehl, J.R. 2011. 'Hydro-Political Complexes and Asymmetric Power: Conflict, Cooperation, and Governance of International River Systems', American Sociological Association, Volume XVII, Number 1, pp. 218-235
18. Indus Water Treaty 1960

- The Jhelum: Rises in Jammu & Kashmir and flows into Pakistan and finally joins the Chenab

Rivers for use by India:

- The Sutlej: Originates in Tibet, flows through Himachal Pradesh and Punjab before joining the Chenab
- The Beas and the Ravi: Originate in Himachal Pradesh state and flow into Pakistan and finally empty into the Chenab

The Chenab which combines the waters of four rivers, the Jhelum, the Sutlej, the Beas and the Ravi to form a single water system which then joins the Indus in Pakistan is seen as a critical lifeline of Pakistan.[19] Control of headwaters of the Indus in general and the Chenab in particular by India and the fact that all three of the Western rivers assigned to Pakistan originate or flow through Jammu & Kashmir is the most intuitive type of driver in the conflict between the two nations and it is the most static.[20] When Pakistan and India became independent countries in 1947, the boundary was drawn right across the Indus basin making Pakistan, the lower riparian state. Two vital irrigation head-works, Madhopur on Ravi and Ferozepur on Sutlej - on which the irrigation canals of Pakistan's Punjab had been dependent, were in Indian territory; the headwaters of Chenab and Jhelum were also in India specifically in the disputed region of Jammu & Kashmir.

This perceived 'riparian hegemony' of India, an accident of history that overlooked the significance of geography, was and continues to be a source of great insecurity for Pakistan. The Indus Water Treaty (IWT) was meant to settle this fear but Pakistan remains threatened that India will ultimately exercise its 'hydro-hegemony' and use it as a tool in its political bargain with Pakistan.[21] The construction of hydro-electric power stations by India on the Western tributaries of the Indus, especially in the last two decades has re-ignited this simmering suspicion.[22] While studies show that no single hydro power project along the Indus waters controlled by the Indus Water Treaty will affect Pakistan's access to water, some argue that the cumulative effect of many projects could store enough water and potentially limit the supply to Pakistan which could be

19. Haq, N & Khan, M.N (ed.) 2009. 'Pakistan's Water Concerns', Fact File, Islamabad Policy Research Institute Bertram, S. 2000. 'Motivating Water Diplomacy: Finding the Situational Incentives to Negotiate', International Negotiations 5, pp. 223-236
20. Sinha, R. 2006. 'Two Neighbours and Treaty: Baglihar Project in Hot Waters', Economic & Political Weekly, February 18, 2006
21. Chandrasekharan, S. 2010. 'The Indus Water Treaty- Its Dynamics and Reverberations'
22. 'South Asia Analysis Group, Paper no. 3676, February 19,http://www.southasiaanalysis.org/\papers37\paper3676.html

detrimental to its agricultural sector, specially if it coincided with critical moments in its growing season.[23]

One of Pakistan's key concerns over India's hydro power projects on the Western Rivers including the Baglihar project is whether the project is a run of the river (RoR) project as India claims or a storage dam project as claimed by Pakistan. The underlying fear is that a storage project will curtail water flows into Pakistan. Noted Indian expert on water issues Ramaswamy Iyer points out that the term RoR was one of the 'most leading terms in the water engineer's vocabulary' and that 'it is the most crucial issue in the differences between India and Pakistan in the case of most Indian projects on the Western rivers in the Indus system'.[24] India claims that all the projects that it is building on the Western rivers of the Indus are RoR projects with only pondage and not storage while Pakistan says that India is building storages.

Two incidents, separated by 60 years are commonly cited to illustrate and justify Pakistan's fear of India's control over the headwaters of the Western rivers. The first was an incident that preceded the IWT by at least ten years and the second materialized almost fifty years after the signing of the treaty. Both are used to frame India as the hydro-hegemon. On 1 April 1948, India stopped water flows in Pakistan's canals exactly eight months after independence and the morning after the Arbitral Tribunal, the body convened to adjudicate on partition disputes closed.[25] Going by recorded facts, it is hard to discern whether the incident was the result of a lack of foresight on the part of State level administrators in Pakistan and India rather than a wilful act by India to demonstrate its hydro-hegemony and a defiant act by Pakistan to establish its rights to historic use of the Indus water.

The 'standstill' arrangement to maintain flows from the Indian head works to Pakistan till 1 April 1948 had been negotiated between East (Indian Punjab) and West Punjab (Pakistani Punjab) but West Punjab had apparently failed to respond to East Punjab's requests to renew the agreement despite numerous reminders from East Punjab, presumably because West Punjab sought to establish its right over water on the basis of the concept of 'historical use'.[26] The East Punjab government cut off canal supplies

23. Briscoe, J. 2011. 'Avoiding Water Wars: Water Scarcity and Central Asia's Growing Importance for Stability in Afghanistan and Pakistan', Committee on Foreign Relations, US Senate, Washington

24. Personal communication with Mr Iyer. According to Mr Iyer, RoR involves big dams (sometimes very big). It is said to involve 'pondage' and not 'storage' but one doesn't know quite whether in a given case there is pondage or storage. Even if there is only pondage, and even if all the waters diverted to the turbines return to the river, there will still be a dry patch between the point of diversion and the point of return to the river, and if there is a cascade of RoR projects, there will be a series of dry patches - what will that do to the river, Mr Iyer asks

25. Albenia, A. 2008. 'Empires of the Indus: The story of a River', John Murray, UK

26. Verghese, B.G. 2011. 'Water Security in South Asia', Speech at the Observer Research Foundation on 9 February 2011

without reference to Delhi and Pakistan plunged into a temporary water crisis.[27] Though the Indian Prime Minister Nehru openly rebuked East Punjab for acting unilaterally, Pakistan continues to harbour suspicion over India's true intentions. It was the start of the sowing season and a whole harvest in Pakistan depended on this water. The moment could not have been worse for Pakistan and it is *'seared into Pakistani consciousness as evidence of India's desire to undermine the fragile new country Pakistan'* as Daanish Mustafa puts it.[28]

The incident was noticed across the world and especially by the United States which had emerged as a superpower after the Second World War and where coincidentally the new World Bank was based. In 1951, David Lilienthal former head of the Atomic Commission toured India and Pakistan and identified the Indus water controversy as one of the most serious issues facing independent countries.[29] It was he who contentiously linked it to the nascent Kashmir issue but his primary argument for the Treaty was a purely technical and scientific one. He observed that the copious amounts of river water that flowed out to sea simply had to be diverted and distributed properly between the two new nations. On 20 August 1951, Eugene R Black, President of the World Bank wrote to the Prime Minister of Pakistan and India enclosing a copy of Lilienthal's article and offered the bank support for the development of Indus infrastructure along the lines suggested by Lilienthal.[30]

Historians quote a confidential British Foreign Office memo written on 1 November 1951 that showed that Lilienthal had become a partner in Lazards, an international financial advisory and asset management firm to illustrate that his primary interest in the Indus Treaty was financial.[31] Despite this, the British supported the idea from the Bank a plan was made for the division of the Indus basin in the form of the Indus Water Treaty (IWT).

The second incident that reverberates repeatedly in the Indus discourse today is that of India choosing to fill the Baglihar dam by blocking a flow of 23,000 cusecs of water of the Chenab River in August 2008 which ironically also happened to be the height of the planting season in Pakistan.[32] The debate is still on in the media and seminar circuits in Pakistan and India over whether India was in breach of the Indus Water Treaty in

27. Ibid.
28. Quoted in Mustafa, D. 2010. 'Hydro-Politics in Pakistan's Indus Basin', Special Report, United States Institute of Peace.
29. Albenia, A. 2008. 'Empires of the Indus: The story of a River', John Murray, UK
30. Ibid.
31. Ibid.
32. Briscoe, J. 2010. 'War or Peace on the Indus', The News, 05 April 2010 & Briscoe, J. 2010. 'Troubled Waters: Can a Bridge be built over the Indus?' Economic & Political Weekly, Vol XLV No 50. December 11, 2010.

choosing to fill Baglihar at the time it did, despite the fact that the matter is officially closed by the Indus Commissioners.[33] World Bank expert John Briscoe has persuasively argued Pakistan's case in a number of recent writings and used the incident to illustrate the point that there is a real and present danger to Pakistan originating in India's control over substantial cumulative live storage of water. According to him, this 'live storage' is worth one month of low season flow on the Chenab.[34] Ramaswamy Iyer has responded to this observation with the explanation that filling of the Baglihar was well within the provisions of the IWT and that the provisions of the IWT required the filling to be done between 21 June and 31 August on condition that a minimum flow of 55,000 cusecs is maintained and that there was no deliberate attempt to restrict water flows.[35] As per Pakistan's observations the stoppage extended into September which is disputed by India.

Pakistan has consistently expressed concerns over specific hydro power projects on the Indus by India, citing technical violations of provisions in the IWT. Objections raised on the Salal Hydroelectric Project on river Chenab in the state of Jammu and Kashmir (J&K) in the late 1970s were resolved after lengthy consultations by the Indus Water Commissioners of the two Governments.[36] Other projects over which Pakistan has raised technical objections include but not limited to the Wullar Barrage project, the Baglihar hydroelectric project, the Swalakote hydroelectric project, the Dul Hasti hydroelectric project as well as the Kishanganga hydroelectric project on the Kishanganga river in J & K.[37]

The conflicts over both the Wallar and Baglihar projects failed to be resolved by the permanent Indus Committee set up on the basis of provisions in the Indus Water Treaty (IWT) and so invoked the provision to approach the World Bank which had a role in mediating the IWT.[38] Claiming that it was not the arbitrator of the IWT, the World Bank appointed a neutral expert to resolve the conflict. The neutral expert classified Pakistan's objections as 'differences' and not serious 'disputes' which could have paved the way for the issue to be taken to a Court of Arbitration as envisaged in the treaty-a position that Pakistan would have preferred.[39] The neutral expert did require India to make technical changes but Pakistan was not satisfied with his verdict as it saw it as being in favour of

33. Iyer, R.R. 2011. 'Pakistan: Water on the Boil Again', The Hindu, 26 June 2011
34. Briscoe, J. 2010. 'War or Peace on the Indus', The News, 05 April 2010 & Briscoe, J. 2010. 'Troubled Waters: Can a Bridge be built over the Indus?' Economic & Political Weekly, Vol XLV No 50. December 11, 2010.
35. Iyer, R.R. 2011. 'Briscoe on the Indus Treaty: A Response', Economic & Political Weekly, Vol XLVI No 15, January 15, 2011.
36. Iyer, R.R. 1999. 'Conflict-Resolution: The Three River Treaties', Economic & Political Weekly, Vol 34 Jun 12-18, 1999, pp. 1509-1518
37. Verghese, B.G. 2011. 'Water Security in South Asia', Speech at the Observer Research Foundation on 9 February 2011
38. Sinha, R. 2006. 'Two Neighbors and Treaty: Baglihar Project in Hot Waters', Economic & Political Weekly, February 18, 2006
39. Ahmed, T. 2009. 'Water Disputes between India and Pakistan- a Potential cases Belli'

India.[40] Pakistan Government's inability to pin down India on the Baglihar and Wullar projects was criticized by the farming community and political parties. This sense of having been betrayed by the Government continues to cloud judgment on the issue.[41] India's view on the verdict was that Pakistan's objections were based on apprehensions rather than technical reality. In fact India's former Foreign Secretary Shyam Saran observed that the Indus Water Treaty under which the reference was made *'could not deal with suspicions'*.[42]

The Kishenganga project to be built on the Kishenganga, a tributary of Jhelum has taken the conflict to newer heights. The 330 MW project of India upstream is seen as threatening the potential capacity of the 969 MW Neelam-Jhelum project planned by Pakistan downstream. The key issue here is the planned diversion of one tributary of Jhelum to another.[43] According to Iyer, this diversion could be contentious within the context of the IWT as there is 'existing agricultural use' of water in Pakistan ruled Kashmir.[44] The project has moved to the International Court of Arbitration as desired by Pakistan and it is likely that Pakistan will invest heavily in this case as it touches upon the issue of prior use of water which has been one of its traditional positions.[45]

Kashmir is used by both sides to make their case on the issue of using the Indus waters but ironically to Kashmiris in Jammu and Kashmir (J & K), the Baglihar project is both a bonanza-as it meets their demand for electricity-and an instrument for political bargain-as it has supposedly compromised on its agricultural potential. The Kashmiris are said to believe that Pakistan intended to deny J & K the right to use its own rivers, based on the situation in Pakistan controlled Kashmir where they believe people have no right to use Mangala and Jhelum which meet the power and water needs of Punjab and other parts of Pakistan.[46] On the other hand J & K remains unsatisfied with the Indus Water Treaty (IWT) and its assembly has passed a resolution asking the Government of India to review the IWT. J & K has argued that but for the treaty, the State could have increased area under irrigation by another 40,000 hectares over and above 33,000 hectares which was under irrigation before 1960.[47] J & K's ambivalence towards the IWT lends itself for exploitation by those pursuing a strategy of 'securitizing' the Indus water discourse. During the Pakistan-United States strategic dialogue in 2010, General Kayani is quoted

40. Verghese, B.G. 2011. 'Water Security in South Asia', Speech at the Observer Research Foundation on 9 February 2011
41. Ibid.
42. Ibid.
43. Iyer, R. R.2010. 'India-Pakistan Water: An Overview'. South Asia Journal, Vol 29
44. Iyer, R.R. 2010. 'Arbitration & Kishenganga Project', The Hindu, June 25, 2010
45. Pakistan to move arbitration court on Kishenganga project, Dawn 3 May 2010
46. Verghese, B.G. 2011. 'Water Security in South Asia', Speech at the Observer Research Foundation on 9 February 2011
47. Sinha, R. 2006. 'Two Neighbors and Treaty: Baglihar Project in Hot Waters', Economic & Political Weekly, February 18, 2006

to have said that the Pakistan army is an India centric institution and that this reality would not change until the Kashmir issue and water disputes are resolved.[48]

Given that India's hydro power projects on the western rivers have become 'objects of threat' for Pakistan, it requires closer examination. India's renewed interest in hydro-electric projects in the Himalayan Rivers since the late 1990s is primarily a response to the growing gap between supply and demand for electricity in India and also a result of the wave of globalization and deregulation that swept the electricity sectors of the developing world around the same time. That was also a period when India began liberalizing its economy in general and its electricity sector in particular. The Electricity Act enacted in 2003 opened up the power generation segment to the private sector.

The hydro power segment proved to be particularly attractive to the private players as projects involved relatively less cumbersome bureaucracy and red-tape associated with securing land, coal or natural gas in the case of thermal power projects. Between 1970 and 2000, the proportion of hydroelectric capacity in the Indian power sector had dropped significantly-from about 46 percent in 1970 to 40 percent in 1980, 29 percent in 1990 and around 25 percent now.[49] Given that the total hydroelectric potential in India is estimated to be in the order of 150 GW, the Government of India is keen on increasing the share of hydro power in India's total power generation capacity, especially in the light of carbon mitigation regimes which favour hydro power.

India has only managed to construct 37 GW of hydro power projects in the entire country in the last 100 years and there appears to be a sense of urgency in making up for lost time. The hydro power sector is also an attractive revenue earner for the Himalayan states in India which have lagged behind in industrialization compared to other states. Water is primarily a State subject (requiring Federal Government consent) and electricity is a Concurrent (State and Federal Government) subject under the Indian Constitution. In matters of hydro power development, State power prevails in routine decisions over allocation of hydro power projects to interested bidders. State Governments tend to prioritize short term financial gains over long term ecological sustainability and this often results in over-allocation of projects on a single river. The large number of projects that India is seen to be planning on the Indus river system has made some in Pakistan to presume that India has *'un-pious dream of turning Pakistan into a desert'*[50] but in reality it is no

48. General Kayani's quiet coup,' The Hindu, August 3, 2010
49. ORF Centre of Resources Management Database
50. Haq, N & Khan, M.N (ed.). 2009. 'Pakistan's Water Concerns, Fact File', Islamabad Policy Research Institute Quoting Roznama Jang, June 2009

more than a combination of an expression of India's rather irrational fascination with 'quantitative and supply centred' approach to energy security rather than an emphasis on its qualitative aspects along with commercial aggressiveness of the industry players.

Over 40 percent of the Indian population lack access to electricity and the stated objective of the Government of India is to close that gap by 2012 primarily by augmenting electricity supply. All means of generating electricity are being pushed including hydro power and many concerns over environmental and social sustainability are being brushed aside as 'anti-development' views. Whether or not the additional electricity will go to light up the lives of those without electricity or just meet the growing demand of those who are already quite well supplied with electricity is unclear now but the idea that power generation projects must be pursued to provide electricity to the poor in India is seen as an unquestionable fact.

Despite the urgency and the growing involvement of the private sector in power generation, the development of hydro projects is unlikely to progress at the pace that is being presumed by some in Pakistan because environmental and social groups within India are raising concerns that are not very different from the concerns raised by Pakistan such as the claim that Run of the River (RoR) projects impact the life and flow of river systems and that these projects radically alter the flow of the river especially in cases where States have allowed a cluster of projects to be constructed along the same river.[51] Democratic accountability which assigns equal rights to all stakeholders over deciding the fate of a river is definitely a strong limiting factor within India and it is likely to control the unbridled growth of commercially driven hydro power projects.[52]

Table 3.1: The Indus Water Treaty as seen by Pakistan & India

PAKISTAN'S CONCERNS OVER IWT	INDIAN VIEW ON IWT
Construction of dams on Western Rivers violation of the spirit of the Treaty and can cause up to 30 percent water loss	Elaborate restriction on water use on Western rivers. Restriction onRoR dams will impact energy development in Kashmir and elsewhere
Construction of dams will give India the ability to affect Pakistan's water resource (assistance to Afghanistan in construction of water-storage dams also alluded to)	Fear that Pakistan is trying to nullify permissible uses clause in the IWT
FILLING OF BAGLIHAR RESERVOIR CITED AS PROOF OF INTENTIONS (THOUGH OFFICIALLY BAGLIHAR ISSUE IS RESOLVED)	INDIA WILL NOT CUT-OFF ECONOMIC NOSE TO SPITE PAKISTAN
Water issues have been inextricable linked to Indo-Pak issues	Poor water usage and water infrastructure in Pakistan

Source: Presentation by Rafay Alam at the Conference "Blue Revolution: Charting South Asia's Water Future' in New Delhi on 11 April 2011

51. Jhunjhunwala, B, 2010. Presentation on the 'Environmental Impact of Hydro Power Projects', at a seminar held jointly by the Rosa Luxembourg Foundation and the Observer Research Foundation on 8 September 2010.
52. Lukes, S. 1997. 'Power: A Radical View', Palgrave Macmillan

What is driving the perception of conflict in the region is not merely the number of hydro power projects that are being executed and planned by India but also the manner in which it defends its action. India maintains that it is well within its rights to construct hydro power projects on the Western tributaries of the Indus, a position that is confirmed by the Minister for Water and Power of Pakistan, Raja Parvez Ashraf [53] and also officially endorsed by the Indus Water Commissioners in India and Pakistan. This much repeated argument may be a fact but it is not a message that has facilitated understanding and cooperation between the two nations in popular media discourses. In the context of India's riparian relationship with much smaller neighbours such as Nepal and Bangladesh, Iyer in one of his earlier articles points out that the *'twin dangers of big country insensivity or arrogance and small country pathology can wreck even a good relationship'*.[54] Though Iyer excludes Pakistan from the typology of small countries, economic and diplomatic gains made by India in the international context are probably contributing to Pakistan feeling less like a *'big country'*. Iyer rightly argues that while *'everybody recognizes the first danger (big country arrogance) few perceive or understand the second (small country pathology)'*.

Indian politicians, bureaucrats and engineers may be correct in asserting that India is within its rights in building hydro projects, but on occasions *'they can also be unimaginative, patronizing and insensitive in their negotiations with smaller neighbors'* as Iyer notes. The following positions which Iyer describes as manifestations of small country pathology seem to be describing Pakistan's positions rather than that of a 'small' nation:[55]

- A tough stand during negotiations for fear of being considered weak
- Complaining at a later stage that the negotiations were between unequal partners
- A tendency to seek explanations in terms of deviousness or machinations or malevolence on the part of Indians instead of exploring solutions
- The tendency not to recognize that differences can arise which can be resolved through mutual negotiations but instead framing it as non implementation or violation of the treaty

The Indian position that emphasizes technical correctness is probably accurate and necessary in official platforms but in a public discourse it could be seen to reflect a sense of riparian superiority and technical 'arrogance' that assumes certainty over the response of nature (such as the flow of water) to man made technological constraints (such as dams or pondages). The spatial and temporal certainty of river flows can no longer be

53. Iyer, R.R. 1999, 'Conflict-Resolution: The Three River Treaties', Economic & Political Weekly, Vol 34 Jun 12-18, 1999, pp. 1509-1518
54. Ibid.
55. Ibid.

assumed to be static or rigid as the IWT does, especially in the light of changes in the climate and in the seasons. If certainty can be presumed in any thing, it is only in that there is almost nothing certain in the outcome of interactions between man and nature as the climate problem clearly testifies.

Given India's presumed and real fears as the lower riparian to China in the Gangetic basin, India can now probably empathise with Pakistan's lower riparian concerns. The Task Force Report 'Water Security for India: The External Dimension', argues that *'China's aggressive south-to-north water diversion projects on the rivers that originate from the Tibet region, is opening up a new front of uncertainty in Sino-Indian relations as well as the overall hydrological dynamics in South Asia'*.[56] If India were to follow the recommendations of the report, it *'must create global awareness about the water resources in Tibet and build regional pressure'* to take on China because as the report puts it *'Tibet's water is for humanity, not for China alone'*. Ironically what India is recommended to do to take on China is exactly what Pakistan is currently doing to take on India.

3.4 Asymmetric Military & Economic Power

India's asymmetry in 'hard power' and what has been described as 'sticky' economic power is commonly assumed to be obvious and overwhelming in South Asia given her territorial dominance, the size and influence of her population, her economic resources and military capacities compared to her neighbours.[57] India is thus portrayed as a regional power by default but a closer look reveals a modified picture. There were periods when India had the idea as well as the political will and the capability to be a regional hegemon. India's pure 'hard power' strategies of the 1970s and 1980s that fostered this image created a deep seated mistrust towards India's intentions among its smaller neighbours.[58] This perception softened only when the doctrine of Prime Minister Gujral was adopted in the 1990s as it emphasized non-reciprocity and assigned greater responsibility on the part of India towards its smaller neighbours. The shift in favour of 'soft-power' contributed to portraying India as a benign hegemon rather than a regional bully.[59] The softening of India's stand may or may not have had purely altruistic objectives but it transformed the image of South Asia from one of chronic instability to one which is sought after by foreign investors and foreign policy makers.

56. IDSA Task Force Report. 2010. 'Water Security For India: The External Dynamics'
57. Mead, W.L. 2004. 'America's Sticky Power,' Foreign Policy, March 1, 2004. He described economic policies and institutions act as 'sticky power,' that attracts other countries and then traps them to it.
58. Wagner, C. 2005. 'From Hard Power to Soft Power? Ideas, Interactions, Institutions and Images in India', Heidelberg Papers in South Asian and Comparative Politics, South Asia Institute, Department of Political Science, University of Heidelberg
59. Ibid.

India greatly benefited from this shift and became one of the economic powers of the region but unfortunately Pakistan did not. India is no longer the poor, unwieldy, slow and lumbering economy that it used to be; it sits on the Security Council of the United Nations and is invited to the High Table of global economic powers. While Pakistan continues to rely on aid and overseas assistance, India is an *'aid-giver and has America eager to be its friend'* as The Economist puts it.[60] Industrialized nations see India as the answer to the growing power of China as its stable democracy gives it moral power.

Figure 3.1:Economic Growth Rates of India and Pakistan: 1991-2001

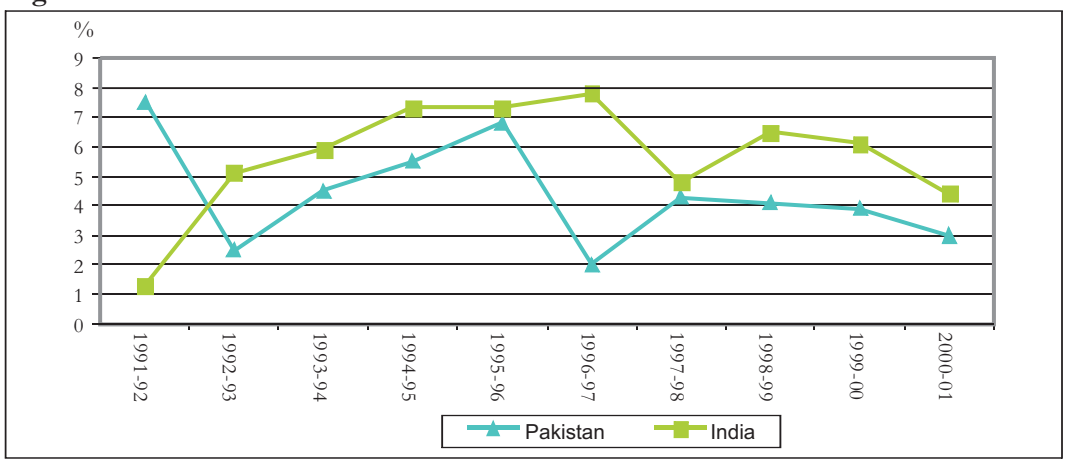
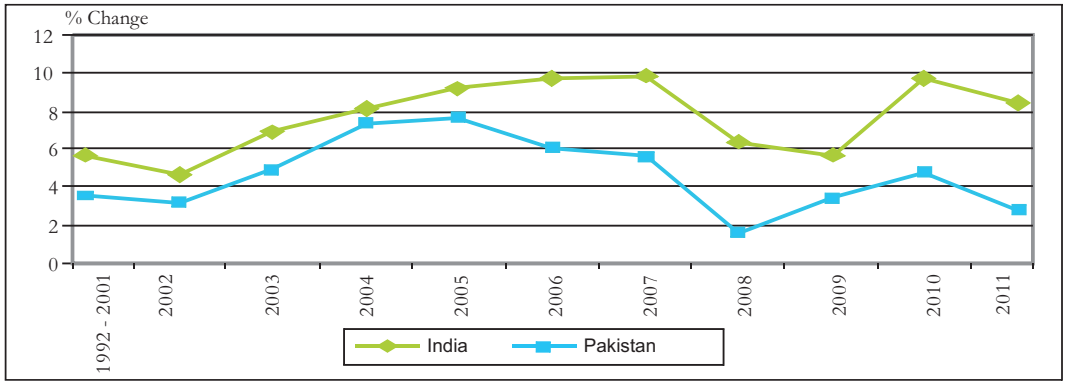


Figure 3.2: Economic Growth Rates of India & Pakistan: 2001-2011



At the time of partition Pakistan inherited a significant advantage in terms of water resources. Pakistan with only 18 per cent of the population of undivided India got half of the canal system carrying 400,000 cusecs of water, and half of 24 million acres of land irrigated by state owned canals.[61] Pakistan also got a prosperous belt of small-scale industries as well as a share of natural resources which helped it achieve growth rates of about 6 per cent on average for about two decades following independence.[62] Until the 1990s, Pakistan followed a more open economic policy compared to India, which helped it to achieve higher growth rates. The GDP per capita of Pakistan until as recently as the

60. The Economist May 21, 2011, pp. 39
61. First Five Year (1951-55) Plan Document of India
62. ORF database on Pakistan

early 2000s was about 20 per cent higher than that of India.[63] Pakistan's average annual economic growth rate between 1965 and 1980 was 5.8 percent compared to India's 3 percent.[64] As Aatish Taseer, the son of the slain Governor of Pakistan's Punjab eloquently points out, in this period Pakistan could look down on India: *'with all its democracy and pluralism, it was an economic disaster; Pakistan had better roads, better cars; Pakistani businesses were thriving; its citizens could take foreign currency abroad. Compared with starving, socialist India, Pakistan was on much surer ground. So what if India had democracy? It had brought nothing but drought and famine.'*[65]

However Pakistan squandered the head start through a reversal of liberal policies in the 1970s and the short-term objective of getting foreign assistance in the 1980s.[66] In the past two decades, Pakistan's growth rates have consistently fallen short of that of India and India has not only managed to catch up in terms of per capita GDP but has also moved past Pakistan. The ratio of exports to GDP for Pakistan in 1990 was 15.5 per cent against India's 7.1 percent. By 2005, the trade ratio had not changed much in Pakistan but it nearly tripled in India.[67]

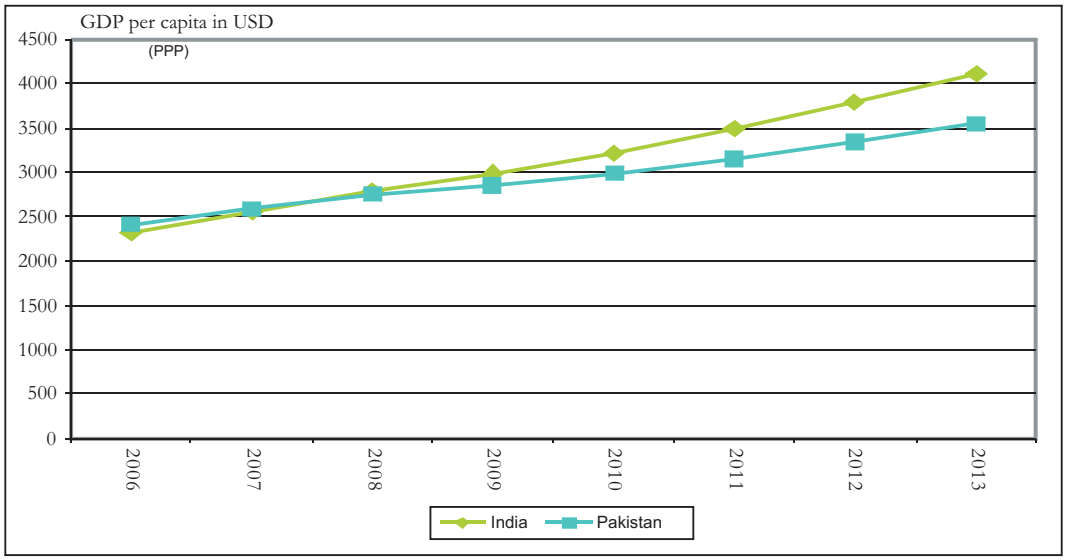
Pakistan's economic stagnation relative to India can be traced to its political uncertainty. Nine different governments including interim governments, elected governments and military regimes ruled Pakistan from 1988-2000, a period which saw heightened political instability.[68] Despite far-reaching reforms introduced in 1991, economic indicators fell sharply in contrast with the 1980s for several reasons that were not limited to political instability.[69] The GDP growth rate decelerated to 4 percent and the persistence of fiscal and external deficits led to the accumulation of large levels of domestic and external debt throughout the decade. Development expenditures took a major hit and GDP dropped to 3 percent from 8 percent in the first half of the 1980s.[70]

India's growth momentum started to pick up exactly when Pakistan started to stagnate. India's GDP growth rates began exceeding what was labeled the 'Hindu rate of growth' of 2-3 percent in the in the 1980s and accelerated to over 7 percent in the 1990s and 2000s following radical economic reforms. If India sustains this momentum in the next

63. The Economist, 28 August 1998
64. Baru, S. 2011. 'The Geo-economics of 1991,' The Business Standard 27 June 2011
65. Taseer, A. 2011. 'Why My Father Hated India,' Wall Street Journal, 16 July 2011
66. Isharat Husain, 1999. 'Pakistan-The Economy of an Elitist State,' Oxford University Press, Karachi
67. Baru, S. 2011. 'The Geo-economics of 1991,' The Business Standard 27 June 2011
68. Husain, I. 2009. 'Pakistan & Afghanistan: Domestic Pressures and Regional Threats: The Role of Politics in Pakistan's Economy,' Journal of International Affairs, Vol. 63, No. 1, Fall/Winter 2009, pp. 1-18
69. Zaidi, A.1999. 'Issues in Pakistan's Economy,' Oxford University Press, Karachi
70. United Nations Development Programme, Human Development Report 1990, Oxford University Press, New York

two decades, it will move from a USD 1.4 trillion economy to a USD 6 trillion dollar economy in 15 years which would be larger than China's economy today and one third of the American economy today.[71] With that India will go from being the 11th largest economy to the 3rd or 4th largest economy in the world.[72] India is now eight times the size of Pakistan in terms of economy, close to seven times in population and four times in territorial size. As a proportion of GDP Pakistan spends roughly twice as much as India on its military but in absolute terms India's military budget is almost seven times that of Pakistan.[73]

Figure 3.3: GDP per capita in Pakistan & India: 2006-2013



Primary Sources: IMF, IISI, And National Statistics

Table 3.2: Pakistan & India: Hard Military and Sticky Economic Power 2011

	INDIA	PAKISTAN
GDP in USD Billion	1,430	178
GDP, 2011, percentincrease on previous year, forecast	8.2	2.8
Population, m	1,200	180
Defence budget, $ bn	38.4	5.2
Army, active troops, m	1.1	0.55

Source: The Economist May 21, 2011, pp. 39,

Despite this colossal asymmetry, Pakistan and India continue to be engaged in what may be called an 'enduring' conflict, in defiance of received wisdom that 'enduring' conflicts are necessarily between relatively equal powers. Until recently, equality with India, at least as far as hard military power is concerned was thought to have been achieved by Pakistan through strategy, tactics, acquisition of qualitatively superior weapons and nuclear arms. Economic stagnation in Pakistan has eroded this precarious balance and this explains

71. Panagaria, A. 2011. 'India and the Global Economy', speech at the Observer Research Foundation on 14 January 2011
72. Subject to the growth or stagnation of Japan
73. Rajagopalan, R. 2007. 'India-Pakistan Security Discourse,' in Matto, A., Kak, K, Jacob, H. (ed) India & 'Pakistan Pathways Ahead,' Centre for Strategic and Regional Studies, University of Jammu, KW Publishers, New Delhi, pp. 117-128

why for the first time in the last 50 years of the bilateral relationship between Pakistan and India, the IWT is being used in the manner in which it is being used now so as to convey violation of the IWT with intent to control head waters of the Indus by India.

Till the 1990s when Pakistan's economy was ahead of that of India, the water discourse in the country was inwardly focused on domestic governance concerns.[74] The aggressive anti-India rhetoric over water started when Pakistan's economy started to decline relative to that of the Indian economy and the Baglihar dam construction in 2004 gave it a convenient peg to hang its case.

Theory suggests that the party which presumes weakness in a sustained conflict, generally widens the scope of the conflict by portraying the stronger party as an aggressor, with the intention of changing the balance of power. By projecting India as being assertive of its geographic advantage and in addition a violator of the provisions of the IWT, conflict perceptions are being escalated and external interest is being invited. The intention is to change the 'balance of power'.[75] If theory is accurate, external interest must necessarily promote cooperation rather than conflict in riparian disputes; yet in the case of Pakistan and India, external influence, currently being conveyed through the larger Western discourse appears to be facilitating conflict. Most of the academic and popular media discourses emerging from the West project 'alarmist' views based on perceptions of India's riparian hegemony and call for measures to stop an impending 'water-war' in the region.[76]

3.5 Basin Dependence

The level of dependence on the Indus basin is a factor that has historically influenced the threat perspective among the riparian nations. In terms of degree of dependence, Pakistan is clearly more vulnerable than India on the basis of parameters such as 'water scarcity' and 'dependence on a single river system' which are generally used to justify its insecurity. The Indus accounts for over 77 per cent of surface water flow in Pakistan while the Indus tributaries within India's borders account for only about 7 per cent of utilizable surface water flow.[77]

74. Gazdar, H. 2005. 'Baglihar and the Politics of Water: A Historical perspective from Pakistan,' Economic & Political Weekly, Vol. 40, No. 9 (Feb. 26 - Mar. 4, 2005), pp. 813-817

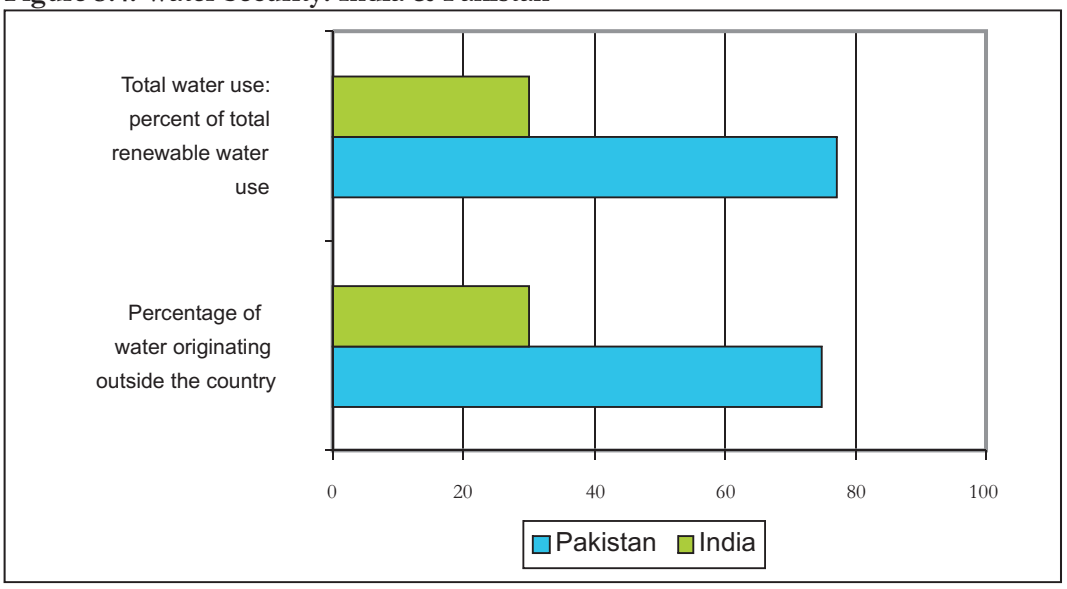
75. Kehl, J.R. 2011. 'Hydropolitical Complexes and Asymmetric Power: Conflict, Cooperation, and Governance of International River Systems, ' American Sociological Association, Volume XVII, Number 1, pp. 218-235

76. Committee on Foreign Relations. 2011. 'Avoiding Water Wars: Water Scarcity and Central Asia's Growing Importance for Stability in Afganistan and Pakistan', US Senate, Washington and Hellinger, D.J. Maj, USAF, 2010. 'Waters Without Borders: Scarcity and the Future of State Interactions over Shared Water Resources', Air Command and Staff College, Air University. The latter is an academic thesis which contains a disclaimer on views expressed being only personal.

77. Garg, N.K & Hassan, Q. 2007. 'Alarming Water Scarcity in India', Current Scienec Vol 93, No 7 10 October 2007

Pakistan uses more than 75 per cent of its total renewable water (also known as the exploitation index) while India uses on average about 30 per cent of its renewable water resources, subject to basin-wise and regional variations.[78] An exploitation index between 20 and 40 per cent is labelled as 'stressed' and exploitation indices above 40 per cent are labelled 'severally water stressed'. Pakistan with an exploitation index of 75 per cent is relatively more vulnerable than India as it has little leeway in terms of increasing its water availability.

Figure 3.4: Water Security: India & Pakistan



Source: United Nations Economic and Social Council for Asia and the Pacific

What must be emphasized here is that at the global level India's water challenge is far more critical for the rest of the world than that of Pakistan while in the context of the Indus, Pakistan's water crisis is more critical. The total water resource base for India estimated at 2518 billion cubic meters (including surface and ground water) is substantial but highly variable in space and time.[79] 50 percent of the annual precipitation falls in just one month and 90 percent of river flows occur in only 4 months of the year. As a result, accessible, reliable supply of water is only 30 percent of the available freshwater resources. The water storage capacity per person in India is smaller by a factor of 10 compared to China and by a factor of 30 compared to the United States indicating the scale of investments needed for water storage infrastructure.[80]

Crop irrigation currently accounts for nearly 80 percent of overall water consumption in India and this share is projected to remain the same even by 2030. At 1195 billion cubic meters, India's demand for water for agriculture by 2030 will be the largest in the world

78. United Nations Economic and Social Council for Asia and the Pacific.
79. Most of the figures sited in this paragraph are from Charting our Water Future, 2009 by the 2030 Water Resources Group
80. Ibid.

followed by sub-Saharan Africa at 820 billion cubic meters and China at 420 billion cubic meters. Current availability of water in India, estimated at 740 million cubic meters will be short of demand by over 50 percent by 2030. Most of India's river basins are expected to face severe deficit by 2030 unless consorted effort is taken to transform its most populous basins–the Ganga, the Krishna and the Indian portion of the Indus.

The agriculture sector is important for both the countries as a large share of the population in each country (two fifths in Pakistan and three fifths in India) is dependent on agriculture. Partly because of the increasing scarcity of surface water (from the Indus river canal system) and partly because of the uncertainty in availability of surface water at the required time, ground water irrigation has shown an exponential growth in the last 50 years in both countries. Recent data suggests that over 1.2 million tube-wells are installed in Pakistan out of which over one million are said to be in Punjab alone.[81] 71 percent of irrigated area of Pakistani Punjab receives either exclusive tube-well water or both surface and ground water while in the rest of the provinces, the share of tube-well irrigation is almost insignificant.[82]

The dependence on ground water is even greater in India. India is in fact the largest groundwater user in the world accounting for more than a quarter of the global total. With more than 60 percent of irrigated agriculture and 85 percent of drinking water supplies dependent on it, groundwater is a vital resource for rural areas in India.[83] The number of tube wells in India is estimated at over 19 million with Punjab alone accounting for over 1.2 million.[84] In both countries the degree of dependence on ground water either equals or exceeds dependence on surface water.

In terms of the percentage of surface water originating outside the country, Pakistan is again far more vulnerable than India as more than 75 percent of Pakistan's water flows originate outside the country compared to India's 30 percent.[85]

Table 3.3: The Flow of the Indus River Basin (in an average year)

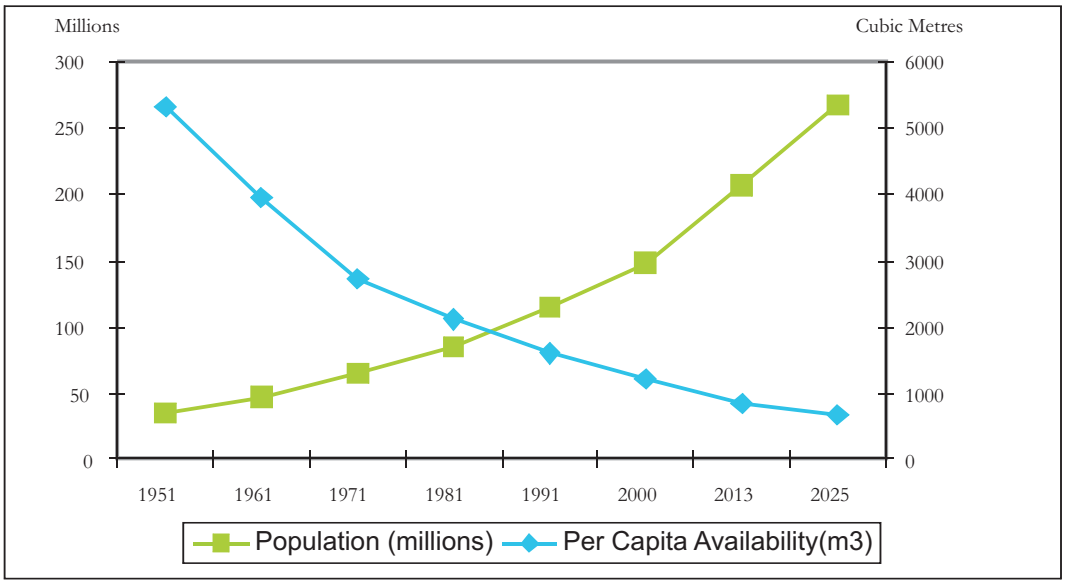
RIVER	WATER FLOW IN BCM	PERCENT OF TOTAL
Indus	111.0	53.5
Jhelum	28.3	13.6
Chenab	28.3	13.6
Sutlej	16.6	8.0
Beas	15.6	7.5
Ravi	8.2	3.8

Source: Gulati, N.D. 1973. 'Indus Water Treaty: An Exercise in International Mediation', Bombay: Allied Publishers pp.30

81. Shafique, M.S. 2010. 'Nature of Water Crisis in Pakistan & A Potential Way Out', International Hydropolitics
82. Ibid.
83. World Bank. 2010. 'Deep Wells and Prudence: Towards Pragmatic Action for Addressing Groundwater Overexploitation in India'
84. Director, Agriculture, Punjab as cited in Statistical Abstract 2007 and 2009 of Punjab
85. United Nations Economic and Social Council for Asia and the Pacific

In terms of per capita water availability, a rather crude but widely used measure of water scarcity, Pakistan is yet again in a relatively more precarious state than India. Basins are defined as 'water stressed' if they have per capita water availability below 1700 cubic meters (based on long-term average run off) or facing water scarcity when supplies drop below 1000 cubic meters.[86] Pakistan's per capita availability of water is said to have declined from 5600 cubic metres in 1947 to 1200 cubic metres in 2005, fast approaching the threshold level of 1000 cubic metres by 2007.[87] The use of per capita volume as an indicator of stress can be misleading as the requirement for irrigation which predominates in Pakistan and India is far greater per capita than for domestic and industrial use typical of developing countries. Moreover, the per capita water availability parameter does not account for efficiency of water use.

Figure 3.4: Change in Population and Per Capita Water Availability in Pakistan



Source: Draft State of the Environment Report

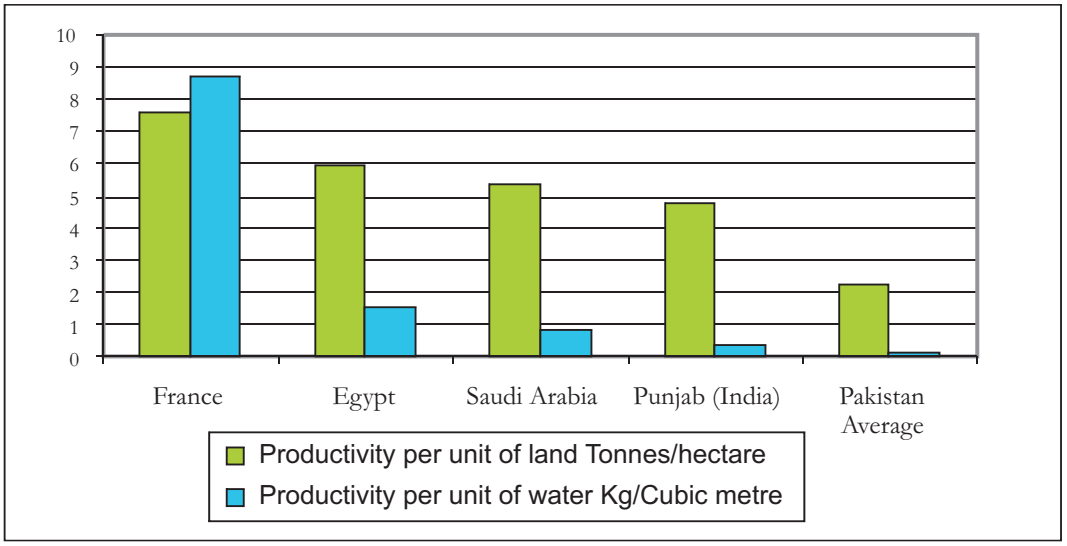
About 97 percent of Pakistan's freshwater resources are expended in irrigation and agriculture, yet Pakistan has one of the lowest productivities per unit of water and unit of land in the world.[88] This is despite the fact that large parts of Pakistan are known to have conditions that favour agriculture such as good soils, abundant sunshine and excellent farmers. Yet crop yields, both per hectare and per cubic meter of water, are much lower than international benchmarks and lower than that in India. Waste is incurred at several stages: Canal heads, water courses and farms themselves all are the sites of considerable leakage. Furthermore, with Pakistan's major hydroelectric dams losing storage capacity, there is little reserve during times of famine. Pakistan is in fact in dire need of major hydroelectric projects to increase power generation, protect against

86. UNDP, UNEP, World Bank and World Resources Institute
87. World Bank. 2007. 'Pakistan, Strategic Country Environment Assessment'
88. Ibid.

seasonal flooding, and to have greater control over the water supply.[89] Pesticide poisoning, among other problems also stem from the endemic misuse of water in Pakistan.

Pakistan's lower agricultural yield compared to India is explained in terms of the difference in quality of water service. Yields in India which are said to be more dependent on predictable and self controlled groundwater are in some cases twice those of Pakistan where agriculture depends on unreliable and inflexible canal supplies. There is no lesson in this for Pakistan as there is a dark ecological externality connected to the extensive use of ground water in India. The use of ground water in India in general and Punjab in particular is partly driven by the provision of free electricity to farmers which means that the marginal cost of pumping water is zero. The consequence is an irreversible depletion of ground water in the region. A NASA satellite study found that groundwater levels in the Indus basin on the Indian side have been declining by an average of one meter every three years. More than 109 cubic km of groundwater disappeared between 2002 and 2008 which is double the capacity of India's largest surface water reservoir, the Upper Wainganga, and triple that of Lake Mead, the largest man-made reservoir in the United States.[90]

Figure 3.5: Agricultural Productivity in Select Countries



Source: Kamal, S. 2009. Use of Water for Agriculture in Pakistan, Conference on the Future of Water & Food, May 2009, University of Nebraska

Pakistan had 9.2 million hectares irrigated land in 1950-53 which went up to 18.02 million hectares by 2003, an increase of almost 100 percent over a period of 50 years. Though there has been an increase in water diversions to canals at different stages, it was

89. Warraich, H. 2011. 'Pakistan's bubbling water crisis', Foreign Policy, June 13, 2011
90. http://www.nasa.gov/topics/earth/features/india_water.html

not in the same proportion as horizontal expansion in irrigated land.[91] In a World Bank paper on Pakistan's water economy, Briscoe & Qamar list a set of 'sobering facts' to capture Pakistan's water vulnerability: it is water stressed, it has little scope for injecting more water into the system, it is dependent on a single river, it has allowed large scale degradation of the river system, its groundwater is already over-exploited, its flood and drainage problems are getting worse, its future water flows are uncertain on account of climate impacts such as glacial melt, change in snow fall and monsoon rain, it has an inadequate knowledge base, its water infrastructure is in poor shape, its project implementation practices are far below global benchmarks, its water system is financially unsustainable, it has to invest in large and contentious dams, its water governance and water productivity are poor.[92] Ironically most of these 'sobering facts' that characterise Pakistan's water status arise from domestic mismanagement of water resources (largely true even for India) and have little to do with the fact that much of its water originate in India.

What is surprising is that the discourse on Pakistan's water crisis which should have been rationally framed around the above listed 'sobering facts', is instead being framed as a 'security problem' originating in the fact that Pakistan shares the Indus waters with India even by John Brisco who originally drew attention to the 'sobering facts' that characterise Pakistan's water economy. In Pakistan, John Briscoe's much cited article originally published in 'The Nation' in Pakistan in 2010 and later as an expanded version in the Economic & Political Weekly in India has become the basis for framing India as the source of Pakistan's water woes.[93]

The framing of Pakistan's water crisis as a 'water security' crisis is gaining global importance. As revealed by wikileaks, US Ambassador to New Delhi David Mulford is said to have conveyed that *'even if India and Pakistan could resolve the Baglihar and Kishanganga projects, there were several more hydroelectric dams planned for Indian Kashmir that might be questioned under the IWT'*.[94] The then US ambassador to Pakistan, Anne W. Patterson is said to have pointed out that Pakistan was *'facing a 34 per cent water shortage in 2008 because of a reduction in water flows in the Chenab, translating into 'lower crop yields for winter'*. She is also said to have communicated that though *'officially, India dispelled Pakistani claims but unofficially, it admitted*

91. Piracha, A & Majeed, Z. 2011. 'Water use in Pakistan's Agriculture Sector: Water Conservation under the Changed Climatic Conditions', International Journal of Water Resources & Arid Environments 1(13): 170-179, ISSN 2079-7079
92. Briscoe J & Qamar, U. 2005. 'Pakistan's Water Economy: Running Dry', World Bank
93. Cited and displayed on overhead projections by many of the speakers at the Yong Global Leaders Conference on Indo-Pak Cooperation in Lahore on 7-8 July 2011.
94. Cable dated 25 February 2005 available on a wide variety of websites

that 'structural constraints of Baglihar Dam and weather constraints' have resulted in a reduction of Pakistan's share of water."[95]

While one can understand why the 'securitisation' of the water discourse makes sense for 'high-politics' of Pakistan's military dominated leadership, it is difficult to see why the international community is endorsing the view. External influence is in general proved to be statistically significant positive factor in trans-border river basin conflicts. Settlements negotiated with third party assistance have also proved to be enduring as the Indus Water Treaty has demonstrated. If 'external influence' intends to play a positive role in resolving the resurgent water conflict in the Indus basin, it needs to begin with the re-framing of the issue as a challenge of water use practices that can be addressed through the systematic application of knowledge and technology rather than an issue of absolute scarcity or as an issue of national security.

3.6 Media Framing

The media particularly the vernacular media in both countries predominantly frame water scarcity in the Indus Basin as a consequence of the problems that are external to them. The structure of the IWT which each party presumes to have a built in favour of the other is often cited as a reason for the shortage. The overall focus is on the 'game of politics'. Drama, conflict and polarisation continue to be seen as pre-requisites for news worthiness by the media in both Pakistan and India.

Conclusions from the Media Content Analysis (MCA) using online English language publications carried out jointly by the Observer Research Foundation, India and the Lahore University of Management Sciences, Pakistan revealed certain basic patterns that led to key themes in the water debate in both the countries over the two seasons.[96]

The components of these key themes characterize the way Pakistan and India portray the water issue in the English on-line media. It is fairly evident that agriculture, Indian transgression, internal disputes, IWT and environment constitute the imagination of water by the Pakistani online English media. On the other hand, governance, groundwater situation, domestic consumption, agriculture and domestic water sharing constitute the Indian English on-line media's reportage on water. Needs, local political

95. Cable dated November 3, 2008 available on a wide variety of websites
96. Refer to the separate detailed report 'Re-Imagining the Indus: Media Content Analysis' by the Observer Research Foundation and the Lahore University of Management Sciences.

economies, lifestyles and aspirations would need to be reconciled, understood and managed in the media discourse. The challenge for the two countries is clearly to focus on issues of governance without deflecting blame on the politics; water should be de-securitized and de-politicized so that it remains an organic discourse about people and resources and managing needs with capabilities.

The reportage on Indus Waters Treaty (IWT), another perceived area of friction and dispute, has been relatively moderate and sober in the English on-line media and there seems to be little debate or substantive disagreement on the treaty in the media space. While we can safely infer that the provisions of the IWT are not described as unfair by the reportage, Indian action and perceived transgression is clearly a major narrative in media reports in Pakistan. This reportage suggests a level of sophistication where there seems to be a distinction between the two and this needs to be preserved. On the other hand, a more robust engagement mechanism around the treaty may not only strengthen it but also improve the implementation of the provisions in letter and spirit.

The paradox of the water discourse is that while it covers all the micro-narratives that are important the level of debate or the sophistication of reporting on these is lacking. The level of debate can be termed as low but unambiguous. It is low as it skims over issues such as agriculture practices, environment, awareness and capacity building but unambiguous as there is a deterministic pronouncement on issues that they do agitate in their reportage. This is established by the fact that in the findings the issues that are 'not mentioned' is statistically the largest, implying that expert opinions and concerns are yet to find space in the media discourse.

On a positive note the MCA shows that the level of hostility towards India remains relatively low and reduces significantly over the two seasons (in the online English language media). The periodic hostility between the two countries might have led us to expect a more aggressive discourse than what the MCA demonstrates. It is also apparent that the debate has not yet been subverted by either terror groups or by the political right in the two countries at least as far as the English on-line media is concerned. While this is an aspect that should cause concern to both governments, dialogue and real time cooperation on managing the river may be the only way to prevent this from happening (See Section 4 for a more detailed account of the Media Content Analysis).

3.7 Adversarial Institutional Structures and Processes

Who owns water is the fundamental question behind water conflict irrespective of whether it is at the local, regional, national or transnational levels. Historically water was treated as an open access resource in undivided India with free access for all with no notions of property rights over it.[97] The Indian Easements Act 1882 recognised 'riparian rights' arising out of ownership of land and the main principle it endorsed was that a riparian owner had natural right to use the water of the stream which flows past his land equally with other riparian owners and also has the right to have the water come to him undiminished in flow quantity or quality and go beyond his land without obstruction but was subject to Government regulation.[98]

There were water disputes among and between provinces and princely states in undivided colonial India.[99] In 1866, the British decided that irrigation projects should be constructed by the Union Government and financed by public loans and that the waters should be utilised optimally irrespective of political boundaries of British India and the princely states. The Srihind canal completed in 1882 was one of the result of this policy.[100] With the introduction of the Montagu-Chemsford Act in 1921, irrigation became a provincial subject but the ultimate control of major irrigation projects remained with the central government, but the Government of India Act passed in 1935 put irrigation wholly under provincial control.[101]

This historic precedent is reflected in the current Indian constitution which distributes the jurisdiction over water and what is described as *'water power'* between the State and the Union Government. Though the power of the State Governments is clearly qualified in terms of the power of the Union Government, the States have prevailed over the power of the Union even in issues concerning inter-state rivers over which the constitution clearly allocates power in favour of the Union Government:

- Entry 56 of List 1 (Union List)
    a. Regulation and development of inter-state river valleys to the extent to which such regulation and development under the control of the Union are declared by Parliament to be expedient in the public interest

97. Upadhyay, V. 2009. 'The Ownership of Water in Indian Laws', in Iyer, R.R. (ed.) 2009. 'Water and the Laws in India', Sage, New Delhi
98. Ibid.
99. Verghese, B.G. 1997, 'Water Conflicts in South Asia', Studies in Conflict and Terrorism, 20 (2), 185-1944
100. Singh, N. 2002. 'Inter-State Water Sharing in India: From Conflict to Cooperation,' Man & Development, December 2008
101. Shah, R.B. 1994. 'Inter-State Water Disputes: Historical Overview,' International Journal of Water Resources, 10 (2), 175-189

- Entry 17 in the List II (State list)
    a. Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power are subject to the provision of entry 56 of List I. This is qualified by Article 262.
- Article 262.
    a. Parliament may by law provide for the adjudication of any dispute or complaint with respect to the use, distribution or control of the waters of, or in, any inter-State river or river valley.
    b. Notwithstanding anything in this Constitution, Parliament may by law provide that neither the Supreme Court nor any other court shall exercise jurisdiction in respect of any such dispute or complaint as is referred to in clause (a).

As per Entry 17, the States have the power to legislate in respect of water supplies, irrigation and canals, drainage and embankments, water storage and waterpower subject to the provisions of Entry 56 in the Union list which enables the Union to deal with inter-State rivers if the Parliament considers it 'expedient in the public interest' that the regulation of the inter-state river waters should have been taken over by the Union; and the State cannot pass legislation with respect to or affecting any aspect of water beyond its territory. As far as intra-state rivers are concerned, States have the exclusive legislative jurisdiction. With regard to adjudication of disputes relating to waters of inter-state rivers and river valleys, the Parliament is empowered to make law in this behalf under Article 262 of the Constitution.[102]

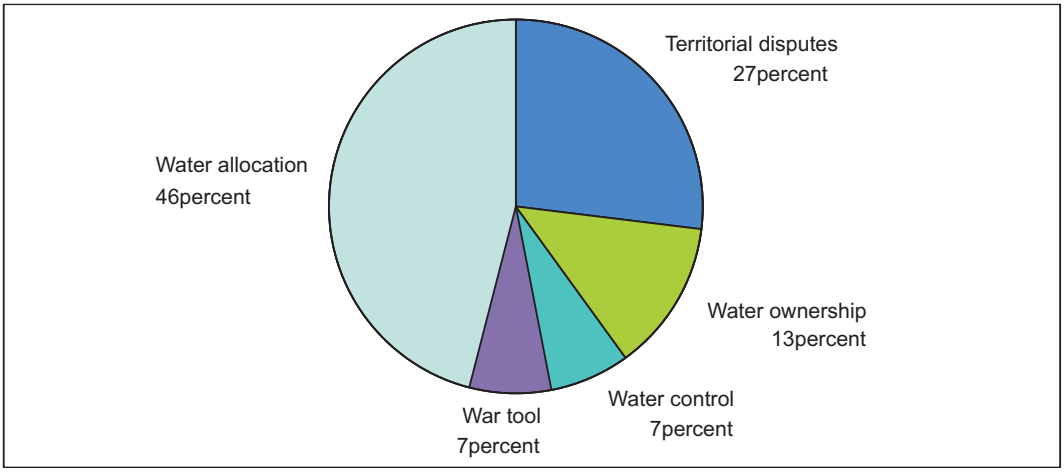
The spirit behind the Constitutional provisions in India is that the States would exercise their powers in a manner that would not prejudice the interest of other States. Yet competitive politics between the states, centre-state political conflicts, weakening of the Union by coalition politics along with the pressures of population growth and the growing demand for resources have all contributed to states looking inward to their own self-interest at the expense of other riparian states and the nation as a whole.[103] Indian States have invariably chosen a hostile stand on the matter of sharing inter-state rivers and even gone to the extent of refusing to comply with the rulings of the Supreme Court thus initiating a 'constitutional crisis'.[104] In the conflict between Haryana and Punjab over the construction of the Sutlej-Yamuna canal, the Indian Supreme Court ruled in favour of the Union Government that the canal should be constructed. The ruling was not

102. Iyer, R. 2011. 'Should Water be Moved to the Concurrent List', The Hindu 18 June 2011
103. Gupta, S. 1996. Environmental Policy and Federalism in India', National Institute of Public Finance and Policy, New Delhi
104. Ramana, M.V.V. 1992. 'Inter-State River Water Disputes in India,' Madras: Orient Longman.

based on the Constitutional power assigned to the Union Government but rather on the vague notion of Punjab's 'obligation' towards the country.[105]

State level decision making power over water issues becomes important in the context of trans-border rivers because the allocation of hydro power projects on the Western rivers of the Indus that are the 'objects of threat' for Pakistan is within the purview of State Governments in India. States base their allocation decisions on the prevailing 'economic-development' paradigm that promotes commercial and industrial aspects over social and environmental aspects. Though there are approvals required at the Federal level, potential private or public sector operators of hydro power projects treat constraints arising from the Indus Water Treaty as mere foot notes in their detailed project reports.[106]

Figure 3.6: Nature of Water Related Conflicts in the Indus Basin



Source: Allouche, J. 2005. Water Nationalism: An Explanation of the Past & Present Conflicts in central Asia, The Middle East and the Indian Subcontinent. PhD Thesis, University of Geneva

Given that out of all water conflicts in the Indus basin between Pakistan and India since partition, 46 percent was about water allocation rather than about territory (27 percent), water ownership (13 percent), water control (7 percent), and war tool (7 percent), it is important that allocation of water that is likely to be affected by hydro power projects receives the attention that it deserves.[107] It is not enough if justice is done in terms of allocation, it must also be seen to have been done which means that a more sensitive and positive message must be framed for public consumption with regard to water flows that will be affected by hydro power projects in India.

105. Singh, G. ed., 2002. 'Punjab Waters: SYL canal', Institute of Sikh Studies, Chandigarh
106. Based on personal experience of one of the contributors who was part of team bidding for hydro power projects on the Chenab offered by the Government of Himachal Pradesh in 2007-08.
107. Allouche, J. 2005. 'Water Nationalism: An Explanation of the Past & Present Conflicts in central Asia, The Middle East and the Indian Subcontinent',. PhD Thesis, University of Geneva

India's 'hydraulic mission' in the Himalayan rivers which is seen to be a major factor that will interfere with the allocation of waters must be seen in the context of its foreign policy consequences. The mission to mobilize water resources for energy generation relegates decision making, both at the Federal and State levels, to the domain of specialists most of whom are engineers by training. Yet the focus of their actions in the context of the Western rivers of the Indus falls within the domain of foreign policy and international relations.[108] Actions of these engineers which may be perfectly rational within the engineering context cascades into lower parts of the basin as 'insecurity of supply of water' for Pakistan and becomes associated with the threat perceptions in a national security context, potentially placing them in the domain of high politics. This link is rarely appreciated and given due importance.

In the particular context of agency decision making, such as that of hydraulic engineers making decisions on behalf of India, there exists an uncontroversial, yet modest, definition of public interest that is analytically distinct from the merits of the decision itself. Hydraulic engineers act in public interest when they implement statutory directives and exercise their discretion in the service of Government intent; they violate public interest when their decisions are motivated by the demands of a small group such as the hydro power generators or the desires of State level officials who have narrower interests. To the extent that economic and engineering interests of India's hydraulic mission casts a shadow on India's global stature, the path to peace and uncontested outcomes between Pakistan and India lies in an integrated, multidisciplinary approach in decision making over hydro power projects rather than an engineer and technology centred approach that currently dominates decision making.

3.8 Distrust

Mutual distrust between stakeholders on either side of the border originates from long standing issues between Pakistan and India such as sovereignty over Kashmir. The leadership on both sides, including the current Prime Ministers of Pakistan and India do not refrain from confessing that the problems which exist on both sides are merely a symptom of a larger malaise.[109] To begin with, the heinous partition of 1947 resulted in unprecedented bloodshed and migration on sides, increased rancour and animosity between two nation-states and to a large degree between religious communities in north

108. Henwood , R & Funke, N. 2002, 'Managing Shared Watercourse Systems in Southern Africa: International Relations or Foreign Policy?' In Turton, A R & Henwood, R (eds.), 'Hydro-politics in the Developing World: A Sothern African Perspective, Pretoria: African Water Issues Research Unit (AWIRU)

109. See, The Hindu ' Gilani for ending India-Pakistan 'distrust', May 24, 2010

India. While the fact that India adopted a secular constitution blunted the religious fissures, the bitterness between the nation-states grew with time. The 1965 war followed soon after and interaction between both countries was disrupted. Visa regimes which did not exist until 1952 facilitated free movement between countries but have since become quite stringent.

The introduction of a restrictive visa regime in 1965 created an impermeable wall, which only few on both sides could cross. While numerous proposals have been mooted from time to time to liberalise the visa regime, the agreement of 1974 did precious little to facilitate greater communication between ordinary Indians and Pakistanis.[110] Apart from restricted travel, till date Pakistanis cannot receive Indian newspapers and TV channels and vice-versa. In the absence of any interaction it is easy for the print and electronic media to spread misconceptions about the other side and to up the ante during times of tension such as the aftermath of the Mumbai attack or the more recent Operation Geronimo.

The 1971 war and the creation of Bangladesh added a new dimension. Pakistan army's anti-India feelings intensified after defeat at the hands of the Indian army. Support to Bangladesh bruised national pride and was seen as Indian interference in Pakistan's internal affairs. Since the 1980's and 1990's, India has been accusing Pakistan of fomenting trouble in India, in the province of Kashmir and for a decade in Punjab while Pakistan feels that India is not doing anything to address the core issue of Kashmir. In the post 9-11 scenario, the Indo-Pak rivalry has also extended to Afghanistan, where India has quite a significant presence and is making sizeable economic investments.

The 2008 Mumbai attacks have worsened tensions and more and more sections of society in India are beginning to support tough measures against Pakistan. Dialogue which began in 2003 and carried on till 2008 was disturbed after these attacks and only resumed in April 2011, but there is only limited appetite for peace in Delhi. While Indian Prime Minister, Dr Manmohan Singh has been steadfast in his commitment to continued engagement with Pakistan, Operation Geronimo has weakened his position to a large degree. The hawks both within and outside the Indian establishment, are of the opinion that India needs to adopt a harder posture vis-à-vis Pakistan, and that the Indian Prime Minister has been unnecessarily treating Pakistan with kid gloves.[111]

110. It was next to impossible to obtain Visas for faculty of the Lahore University of Management Sciences to visit India and for the faculty of the Observer research Foundation to visit Pakistan for the project 'Re-Imagining the Indus'
111. Yardley, J. 2011. 'India sees new reason to distrust Pakistan', The New York Times May 3, 2011

As other emotive issues are beginning to lose their appeal to moderate sections of society, hardliners find it easy to accuse India of stealing Pakistan's water. President Zardari who began with an agenda for peace with India could not refrain from stating that 'the water crisis in Pakistan is directly linked to relations with India. Resolution of the water issue could prevent an environmental catastrophe in South Asia, but failure to do so could fuel the fires of discontent that lead to extremism and terrorism.'[112]

3.9 Conclusions

The Indus Water Treaty created two hydrologic systems where there was one. More importantly, the Treaty which was born out of a combination of geo-politics, science, technology and finance overlooked its ecological and social consequences. Though the IWT regime did aim to institutionalise conflict management through measures such as developing mutually agreed rules and procedures, sanctioning the enforcement of these rules and procedures and generating uncontested data, the treaty is showing fault lines that can eventually fracture the precarious water relationship between Pakistan and India.[113]

The sustainability of the IWT regime requires both a hard side and soft side or as Homer-Dixon puts it both 'technical' and 'social' ingenuity.[114] Technical ingenuity is data intensive and is needed to solve practical problems such as water management while social ingenuity, which is the less tangible social capital needed to negotiate and maintain the institutions of the Indus. Social ingenuity is seen as a pre-requisite for technical ingenuity and it is in social ingenuity that there is a deficit in the context of the IWT.

If India and Pakistan can accommodate some degree of uncertainty and openness in their respective positions, it will facilitate the building of deep-listening and build common ground across differences and thus create the much needed social capital; it will also develop a respect for diversity of approaches and standpoints regarding the problem of water scarcity and call for an attempt to learn from the context where change is likely.[115]

112. Bucombe, A & Waraich, O. 2009. ' India is stealing water of life, says Pakistan', The Independent, March 26, 2009
113. Turton, A. 2003. 'The Hydro-political dynamics of cooperation in Southern Africa: A Strategic Perspective on Institutional Development in International River Basins', in Turton, A.R, Ashton, P & Cloete, E (eds). 2003 'Transboundary Rivers, Sovereignty and Development: Hydropolitical Drivers in the Okavango River Basin,' African Water Issues Research Unit (AWIRU) and Green Cross International (GCI)
114. Homer-Dixon, T. 2000. 'The Ingenuity Gap', London, Jonathan Cape
115. Shah, M. 2010. 'The Power of Uncertainty: Reflections on the Nature Transformational Initiatives', Malcolm Adisehiah Centenary Lecture, 10 April 2010

Table 3.4: Drivers of Conflict

CATEGORY	DRIVER	STRONGER RIPARIAN (GENERAL FINDING)	WEAKER RIPARIAN (GENERAL FINDING)	INDIA (INDICATIVE TENDENCY)	PAKISTAN (INDICATIVE TENDENCY)
Hard power (military)	Level of military mobilisation	Qualified negotiation	Qualified negotiation	Qualified negotiation	Conflict
Geographic riparian hegemony	Control of headwaters	Conflict	Conflict	Conflict	Conflict
Economic Power	Economic disparity in terms of GDP per capita	Qualified negotiation	Qualified negotiation	Qualified negotiation	Qualified negotiation
Soft power	Political accountability	Negotiation	Negotiation	Qualified negotiation	Qualified negotiation
Adversarial Institutional and Structures and Processes	Distribution of decision making power over water and rivers	Qualified negotiation	Qualified negotiation	Qualified negotiation	Qualified negotiation
Basin dependence	Percentage of water use from the basin	Conflict	Conflict	Qualified negotiation	Conflict
External influence	Involvement of third party	Negotiation	Negotiation	Conflict	Conflict
Media Framing English	-	-	-	Qualified negotiation	Qualified negotiation
Media Framing Vernacular	-	-	-	Conflict	Conflict
Distrust	-	-	-	Conflict	Conflict

Based on Kehl, J.R. 2011. Hydro-Political Complexes and Asymmetric Power: Conflict, Cooperation, and Governance of International River Systems, American Sociological Association, Volume XVII, Number 1, Page 218-235

The table which captures a set of possible outcomes between Pakistan and India in the context of the Indus dispute shows India precariously balanced between conflict and cooperation and Pakistan skewed in favour of conflict. The 'absence of an open conflict' in the Indus basin is thus not an indication of the 'presence of cooperation' but rather a situation that has been described as 'negative peace'.[116] The decisions of both governments are made against a background of imperfect knowledge about the intentions and capabilities of the other.[117]

Under current conditions of inherent national insecurity or 'negative peace', decision makers in both countries are adopting the precautionary principle and are assuming the 'worst case' scenario for strategy formulation. This in turn is perceived by the other as a potential threat to its national security and so it is forced to adopt an even more stringent precautionary approach in its own decision making. This is escalating into a spiral of insecurity like the cold war era with hydraulic infrastructure replacing nuclear weapons.[118]

116. Turton, A. 2003. 'The Hydro-political dynamics of cooperation in Southern Africa: A Strategic Perspective on Institutional Development in International River Basins', in Turton, A.R, Ashton, P & Cloete, E (eds). 2003 'Transboundary Rivers, Sovereignty and Development: Hydropolitical Drivers in the Okavango River Basin,' African Water Issues Research Unit (AWIRU) and Green Cross International (GCI)
117. Le Marguand, D.G. 1977. 'International Rivers: The Politics of Cooperation', Vancouver, University of British Colombia
118. Turton, A. 2003. 'The Hydro-political dynamics of cooperation in Southern Africa: A Strategic Perspective on Institutional Development in International River Basins', in Turton, A.R, Ashton, P & Cloete, E (eds). 2003 'Transboundary Rivers, Sovereignty and Development: Hydropolitical Drivers in the Okavango River Basin,' African Water Issues Research Unit (AWIRU) and Green Cross International (GCI)

Ironically, the expansion of the concept of security to the environment is attributed to the fact that the cold war was won by accelerating the arms race rather than the actual use of those arms.[119] The hydraulic arms race may limit the prospect of a full blown war but it will facilitate the indefinite extension of negative peace which in economic and social terms will be extremely expensive for both Pakistan and India.

Table 3.5: Institutional Dynamics of Water Discourse

	NAGATIVE PEACE SECURITISATION OF WATER DISCOURSE	POSITIVE PEACE DE-SECURITISATION OF WATER DISCOURSE
Security of supply	Attempts to improve security of supply by India cascade into Pakistan as insecurity of supply	A basin-wide development plan will improve the security of supply for both countries in a coordinated and non-competitive manner
National security	Insecurity in the Indus basin heightens the sense of national security threat by both countries	Greater regional security translates into improved security for both countries, water resource management becomes less of a national security threat as range of unilateral actions available for either country are reduced
Threat perception	Both countries compete for scarce water resources with a zero-sum outcome	Competition for scare water resources is reduced increasing the probability of plus sum outcomes

Source: Turton, A. 2003. 'The Hydro-political dynamics of cooperation in Southern Africa: A Strategic Perspective on Institutional Development in International River Basins', in Turton, A.R, Ashton, P & Cloete, E (eds). 2003 'Transboundary Rivers, Sovereignty and Development: Hydropolitical Drivers in the Okavango River Basin,' African Water Issues Research Unit (AWIRU) and Green Cross International (GCI)

There will be some unintended consequences, one of which is the undermining of investor confidence. No investor would consider semi-arid areas of the Indus if it is believed that it faces an existential threat. Given that only technologies such as crop diversification and drip irrigation have the capacity to address the real challenge of water management in the Indus basin, domestic and foreign investment are critical to alleviating water tension. In this light, a shift from the existing paradigm of 'negative peace' to a more enduring and complex 'positive peace' is necessary to facilitate economic growth and efficient water management.

The optimal long range objective must be to move away from phrasing environmental challenges such as the water challenge as 'national security' threats but rather as a challenge of managing global public goods.[120] The fluvial regime of the Indus is a complex geomorphic, chemical and biological process in motion which cannot be subjugated by science and technology towards meeting State objectives.[121] In the words of Rohan D'Souza, 'we need to think like a river instead of thinking like a State; the Indus Water Treaty must be reviewed form delta upwards and for this 'new dialogue' among river communities we need to organise 'new constituencies' in which the technical expert no longer occupies the centre stage.'[122] If we fail to understand the significance of this observation, 'we will allow a 50 years old Treaty to come in the way of a 5000 year old Indus civilisation' as Rafay Alam poignantly observes.[123]

119. Allan, J.A. 2001. 'The Middle East Water Question: Hydropolitics and the Global Economy', London.I.B. Tauris
120. Waever, O. 1995. 'Securitisation and Desecuritisation' in Lipschutz, R.D. (Ed.) On Security. New York: Colombia University Press.
121. D'Souza, R. 2011. 'Cusec Deadlock: The Indus & Hydropolitucs in a Fault Zone, Presentation at the Conference "Blue Revolution: Charting South Asia's Water Future' in New Delhi on 11 April 2011
122. Ibid.
123. Rafay Alam at the Conference "Blue Revolution: Charting South Asia's Water Future' in New Delhi on 11 April 2011

4 Media Content Analysis

4.1 Key Findings

- Agricultural concerns and interprovincial disputes dominate media reportage in Pakistan.
- Indian media lays greater emphasis on urban-centric water concerns and interventions including those around groundwater and domestic consumption.
- There is a seasonal lag between when Indian and Pakistani media is sensitive to the actions and criticisms of each other.
- India figures high in Pakistani press reports in the winter months while Pakistan only appear in Indian reports in the spring months.
- Level of hostility towards India remains relatively low and reduces significantly over the two seasons in the media reportage in Pakistan.
- The criticism of the Indus Waters Treaty (IWT) has been relatively moderate and sober in the media space.
- Lack of sensitivity to changing climate, environmental degradation and agriculture practices is apparent in both Indian and Pakistani media.
- There is equal emphasis in both the countries on the aspects of water governance and infrastructure.
- Media reports in both the countries, Pakistan more than India, recognizes the need for the two countries to co-operate on water issues.

4.2 Introduction

Water will arguably be one of the most critical themes in South Asian political debates in the years to come. Although the water debate, especially between India and her neighbouring countries has been one of the key issues in the region since independence,

several recent developments indicate that the emerging scarcity accompanied by a growing demand for water will place this resource at the centre of regional politics. While this is not necessarily a worrisome development and any heightened awareness of managing and sharing this precious resource is beneficial, there is a fear, that in the emergent political narrative, the importance and relevance of some core aspects may be neglected. Some of these include the interrelationships between: changing weather patterns and water availability; agriculture, irrigation and electricity; electricity, energy policy and water; and most significantly the relationship between communities, water bodies, development policies and lifestyles. The discussions around the politics of water must be able to accommodate some of these crucial micro-narratives if they are to benefit the constituencies the discourse professes to serve.

The engagement on water between India and Pakistan was naturally undefined at Partition but was subsequently formalized by the Indus Waters Treaty, 1960. The Treaty has managed to survive political tensions and conflicts between the two countries but, as the per capita water availability continues to decline, the debate is likely to intensify and the Treaty is expected to face intense pressures in the days ahead. The per capita water availability in India has fallen from 1800 cubic meters (cu m) in 2005 to 1731 cu m in 2010. In Pakistan the per capita water availability fell from 1200 cubic metres per annum in 2005 to 1038 cubic metres per annum in 2010.[124] These numbers are already around a third of what was available at the time of partition. The decline in water availability has and will lead the countries into further water stresses in the near future. There is a reason to argue that the declining water availability itself may serve as the basis for new security apprehensions on both sides and the current framework of managing the resource may have its limitations.

The scarcity of such a critical resource can lead people and policy makers to choose irrational responses that may lead to deepening of contests and conflicts. Water is a flammable issue that can easily be used by rogue organizations, terror groups and state actors as well for purposes of political positioning, to fuel hatred and conflict, phenomena witnessed around the world and in the region. The objective of this paper is to contribute an articulate, sensitive and cooperative framework to the present and future debates over water and to add a unique perspective to the growing narratives around water in general.

124. People's Daily online, Population growth will reduce water availability in Pakistan, June 28, 2010; Available at: http://english.peopledaily.com.cn/90001/90777/90851/7042509.html

In an attempt to map the debate on water within and between Pakistan and India, this paper has chosen to analyze the news reports in the two countries during the spring and winter months of 2010 by deploying Media Content Analysis (MCA). Mapping and measuring the intensity and characteristics of the debate will hopefully help politicians, policymakers and scholars to identify the pressure points in the debate, and potentially help focus their response as well. Another objective of the research is to relocate the water debate from the arena of myths and perceptions, into a conversation based on existing facts. What is actually driving the debate on water? How is the discussion on water framed in the media and, which of the causes and consequences of water scarcity receive the most attention and in what time periods? Media is a vital component of public opinion formation and studying media coverage on this vital issue will be beneficial in understanding how we imagine 'water' and its nuances as people, policy-makers and nations.

4.3 Background

Public opinion on issues of significance is often a product of debate in the public sphere. While there are contrary view points on the strength of the relationship between media discourse and public opinion and on the sequencing within this relationship there is an acceptance that they do closely follow each other. The conversations around water should and do cover three key elements even at a cursory level. The first and the most dominant is the political nuance and it seemingly continues to dominate media and research space. The second element that is gaining importance is water governance with associated discussions on infrastructure, administration and management. The third and the most recent narrative globally places water firmly within the discourse of climate. This section will briefly discuss each of these in relation to India and Pakistan.

The Political Discourse

The Indus water debate has taken different shapes and forms, with a broad division into conflict, cooperation and conciliation. Within each of these aspects lie subsets of discourses which have taken different directions over space and time. The debate has evolved from its beginning in 1952 when the discussion was characterized by the presence of external actors with an intended depoliticized focus. David Lilienthal, former Chairman of Tennessee Valley Authority and one who is widely recognized as having begun the mediation process, and former World Bank President Eugene R. Black argued that the issue (of water sharing between India and Pakistan) was to be treated as a

functional or engineering problem rather than a political one.[125] N.D Gulhati who led the Indian delegation in the Indus Water Treaty negotiations supports this position obliquely when he describes the mood during the negotiations in the 1950's - "there was no mass audience to address nor rhetoric or inflammatory debating tactics"[126]- reaffirming the technical nature of the endeavour at that time.

Contesting this view and the proposition that the Indus Water treaty of 1960 was devoid of political contestations, the head of Pakistan's Indus Water Commission Jamaat Ali Shah stated that *"In 1960, Pakistan did not want to give its 3 rivers to India"*. He further argued that India has breached water agreements and that this will jeopardize the water treaty. He noted that the countries should look beyond the treaty in further negotiations.[127] Not surprisingly, Shah's Indian counterpart G.Ranganathan maintained that both sides were committed to the treaty and that 'all hydropower projects being built by India conform to the provisions of the IWT'.[128] This in a sense highlights how the stakeholders have comprehended the treaty differently and from their unique vantage points.

The water debates were to soon transform to risk discourses and IWT was viewed from the lens of security. John Briscoe, former senior Adviser to the World Bank on water issues with specific experience on Indo-Pakistan relations, wrote *'This (downstream) vulnerability was driven home when India chose to fill Baglihar exactly at the time when it would impose maximum harm on farmers in downstream Pakistan."* Adding *"once it has constructed all of the planned hydropower plants on the Chenab, India will have an ability to effect major damage on Pakistan."* His assertions were a reflection of a belief that the IWT offered *"a very uneven playing field. The regional hegemony is the upper riparian and has all the cards in its hands. This asymmetry means that it is India that is driving the train, and that change must start in India"*. In an interview with Pakistani Newspaper, The Dawn, Briscoe added the narrative of terror to the security discussion and asserted that *"If you want to give Lashkar-e-Taiba and other Pakistani militants an issue that really rallies people, give them water"*.[130] This imagination of the water-sharing framework is undoubtedly an extreme political understanding of the issue that may yet find resonance in some quarters.

The fear of 'water wars' on conflicts between India and Pakistan has been a commonly agitated scenario, something that Briscoe alludes to as well. Undala Z Alam differs from

125. Kalpakian, Jack "Identity, conflict and cooperation in international river systems" Ashgate Publishing Ltd. 2004, p. 160
126. Gulhati, Niranjan D. "Indus Water Treaty: An exercise in international mediation" Bombay, Allied Publishers, 1973
127. Shamsi, Amber Rahim "We will have to look beyond the Indus Water Treaty" The Dawn, March 3, 2010
128. "India says design of Nimo-Bazgo hydropower project is within limits" March 29, 2010, Available online at- http://www.dnaindia.com/world/report_india-says-design-of-nimo-bazgo-hydropower-project-is-within-limits_1364960, Accessed on November 20, 2010.
129. Briscoe, John "War and Peace on the Indus?" The News International, April 5, 2010
130. The Dawn "Water Dispute fuels India-Pakistan tensions" April 30, 2010

this line of thought though and avers *"the issues of water scarcity, competitive use and a wider conflict do not necessarily lead to war ,since war cannot guarantee a country's water supply in the long run…..that India and Pakistan did not wage war over the Indus Waters despite prime candidacy for a water war, leads to the questioning of the water wars rationale…"* she further adds that the rationale is based upon three principal building blocks; water scarcity, a wider conflict and bellicose public statements, each of which have been found wanting in their primacy to a conflict situation.[131]

On the other hand, in a rare statement widely perceived by the Indian side as vindicating its stand, former Pakistani Foreign Minister Qureshi admitted that Pakistani authorities had a tendency to *"pass the buck"* and exaggerate differences with India over the sharing of river waters. According to Qureshi, mismanagement within the country itself resulted in the loss of 34 million-acre feet of water,[132] a fact that accentuates importance of governance and management of the resource and shifts the emphasis from the political. Ramaswamy Iyer, former Secretary of the Water Resources Ministry of India has continually emphasized on the need to define the 'water issue' conceptually. He has argued that the 'issue' of 'water sharing' has been resolved by the IWT" and now the two countries must look for constructive cooperation in implementing the treaty in its letter and spirit and to manage this resource even while dealing with emerging challenges such as climate change.[133]

Governance

Water management has emerged as one of the most critical factors in the debate as a result of plummeting per capita water availability in both the countries with India doing only marginally better at this point. However the issue is seen to be more critical for Pakistan given its single river system and predominantly agricultural economy.

In a study done in 2009,[134] Michael Kugelman[135] establishes the centrality of water management to the debate in Pakistan. The report describes how intensive irrigation and poor drainage practices have caused water logging and soil salinity throughout the Pakistan. The recommendations place considerable emphasis on development of an ecologically sustainable water infrastructure models, balance of centralized and

131. Alam, Undala Z. "Questioning the Water Wars Rationale: A case study of the Indus Water Treaty" The Geographical Journal 164(4): 341-353, December 2002
132. The Indian Express "Pakistan mismanaging Indus water- Qureshi" May 1, 2010
133. Iyer, R "Pakistan's Questionable Move on Water" Economic and Political Weekly, 45(13): 10-12, March 27, 2010
134. Kugelman, Michael & Hathaway, Robert M. (Ed.) "Running on Empty: Pakistan's Water Crisis" Woodrow Wilson International Center for Scholars, Asia Program, Washington D.C, 2009
135. Michael Kugleman 2009, Pakistan's Water Crisis; Woodrow Wilson International Centre for Scholars in Washington, DC.

decentralized water management and involvement of the private sector. A considerable section of the report focuses on the inter-provincial rivalry especially between Sindh and Punjab with allegations of Punjab drawing more than its share of the water, as allocated by the 1991 Indus Water Sharing accord. The report quotes Kaiser Bengali, a Pakistan based economist, who asserts that *"Pakistan cannot address its water crisis without a paradigm shift in the way Pakistan thinks about water management"*. Bengali argues for a 'socio-centric' approach' which relies on physical and human resource management for a more resource efficient and ecologically conducive method as opposed to the existing 'techno-centric' approach which focuses on engineering solutions and storage.

According to Wilson John, Pakistan's per capita storage capacity is only 150 cubic metres compared to 5000 cubic metres in the US and Australia and 2200 in China. The holding capacity of the existing reservoirs and dams in Pakistan is 30 days while it is between 120 to 220 days in India, 500 days in South Africa and 900 days in the US.[136] In the Pakistan Vision 2030 report published by the Planning Commission of Pakistan it is stated that mismanagement has caused stagnation and degradation of water sources. The Planning Commission also refers to the lack of storage facilities as a major challenge.[137]

Water management in India has also been the cause of considerable concern. The mid-term appraisal of The Eleventh Plan, brought forth by the Planning Commission in 2010 recognizes this challenge. The plan also expects the challenge to intensify over time due to rising population, and growth in both agricultural and industrial demand. Along with the traditional issues of pollution and inadequate efficiency on surface water irrigation, it highlights the groundwater situation as critical and cites a NASA Gravity Recovery and Climate Experiment (GRACE) satellite study indicating an alarming decrease in the level of the ground water table.[138] The situation is particularly critical in urban centres. It is estimated that the water loss due to theft, aging pipelines and infrastructure in Mumbai is as high as 40 to 50 per cent,[139] a reality experienced by each metro in India, which places considerable stress on the resource as a whole.

The report further cites that net irrigated area through canals has actually undergone a decline, rather than achieving an accelerated growth. From an average contribution to

136. John, Wilson, "Water Security in South Asia: Issues and Policy Recommendations" ORF Issue Brief, Issue Brief #26, February 2011, p. 4
137. "Pakistan in the 21st Century: Vision 2030" Executive Summary, Planning Commission, Government of Pakistan, available online at http://www.planningcommission.gov.pk/vision2030/Pak21stcentury/Chapterpercent20Wise/07-Executivepercent20Summary.pdf, Accessed on November 20, 2010
138. Anderson, Gretchen Cook "NASA Satellites Unlock Secret to Northern India's Vanishing Water" Available online at http://www.nasa.gov/topics/earth/features/india_water.html, August 12, 2009 (Downloaded on November 20, 2010)
139. John, Wilson, "Water Security in South Asia: Issues and Policy Recommendations" ORF Issue Brief, Issue Brief #26, February 2011, pp. 3-4.

national irrigated area (NIA) of around 17.5 million ha in the mid-1990s, area irrigated by canals has come down to less than 15 million ha in the first decade of the 21st century. A major problem affecting irrigation systems in the states is due to severe erosion of the financial health of water utilities as a result of low water charges and poor recovery mechanisms. Not only does this encourage inefficient water use and a tendency for head-end canal users to shift to water intensive crops, it also creates an environment in which irrigation charges does not even cover operating cost leading to progressive neglect of maintenance and reduced efficiency. Planning commission Deputy Chairman Montek Singh Ahluwalia recently stated that the *"water crisis was more serious than the energy crisis in India and said that better pricing of water was going to become imperative."*[140] Pricing and water use indeed places people, practises and sustainability firmly within the water debate.

4.3.1 People, Practice and Environment

The danger of treating water management as an engineering solution (as was the approach in the 1950s and 60s) is that we neglect the organic nature of water and its symbiotic relationship with people, life and livelihood. In our neglect of this reality not only do we lose the ability to share this resource equitably, we are also prone to its careless preservation. The most significant threat to water reserves in India and Pakistan is pollution and salinity of water sources. According to John *"In India, regular groundwater quality monitoring carried out by the Ministry of Water Resources has shown high incidence of arsenic, fluoride and iron in certain inland and coastal areas. The problem of salinity has been increasingly noticed in the coastal areas of Tamil Nadu, Gujarat, Orissa and Pondicherry. The inland presence of salinity has been detected consistently in Maharashtra, Punjab, Rajasthan, Haryana, Gujarat, Karnataka, Uttar Pradesh, Delhi, Orissa and Bihar. The high levels of salinity are caused by excessive exploitation of ground water and surface water."*[141] The problem increases in complexity as close to 90 percent of the rural population of India uses ground water for drinking and household purposes.[142]

The problem of groundwater pollution is also prevalent in Pakistan. In the state of Punjab, drinking water supplied to 11 cities with over a population of 2 million was found to be laced with excess arsenic and fluoride concentrations. In addition to this, it is estimated that 36 per cent of the population of Sindh and Punjab was exposed to high (five times the safe limit) arsenic levels in the water. Drinking water in several urban areas

140. The Financial Express "Montek plans to put a price tag on water to minimise wastage" November 15, 2010
141. John, Wilson, "Water Security in South Asia: Issues and Policy Recommendations" ORF Issue Brief, Issue Brief #26, February 2011, p. 5
142. Ibid.

of Pakistan has also been shown to be laced with biological and chemical pollutants mainly because 99 per cent of industrial effluent and 92 per cent of urban wastewater are discharged into rivers without treatment.

The changing climate is also an ever-present reality for the region. A World Bank report confirms that given the high seasonal concentration and high variability in rainfall, risks associated with climate variability were likely to worsen in the entire South Asian region. It specifically cites both India and Pakistan as being affected by water scarcity evidenced by growing shortages. Even while conceding that precise consequences of the changes were hard to predict, the report indicates that the region was highly sensitive to climate change and the receding glaciers in the Hindu Kush could initially increase annual runoff in the glacial fed rivers followed by a steep decrease in annual flows.[143]

The report highlights that agricultural productivity in the region has slowed down and one of the most pertinent threats to the agricultural sector was the precarious water situation. It prescribes adaptation practices such as planting resilient crop varieties, changing planting dates and adopting farming practices with shorter growing season. It also suggests considerable investment in research and advanced technology development and dissemination.

The report "India's Initial National Communication to United Nations Framework Convention on Climate Change" pointed out that *"the hydrological cycle, a fundamental component of climate, is likely to be altered due to climate change and that preliminary assessments have revealed that the severity of droughts and intensity of floods in various parts of India is likely to increase"*. The report pointed out that rise in sea levels and melting of glaciers *"will adversely affect the water balance in different parts of India and quality of ground water along the coastal plains."*[144] Pakistan has and risks facing further threats of climate change. According to John *"It is believed that Pakistan could suffer serious food crisis caused by flooding of its fertile areas in Punjab and other places as it happened in 2010. Dramatic changes in monsoon patterns are likely to render large areas less productive because of scanty rainfall in the years to come."*[145]

These discussions are the point of departure for this study and the three specific themes examined herein help us define the scope of the MCA and to frame the main Research Question and its sub-themes while deploying MCA

143. World Bank "Shared Views on Development and Climate Change" International Bank for Reconstruction and Development/World Bank, Washington D.C ,2009.
144. John, Wilson: "Water Security in South Asia: Issues and Policy Recommendations" ORF Issue Brief, Issue Brief #26, February 2011, p. 6
145. Ibid.

4.4 Research Question & Methodology

The broad Research Question for this paper is "What is the general discourse on water scarcity and crisis in the Indian and Pakistani Media?

The paper shall deploy MCA and shall interrogate the media coverage on three specific themes discussed in the previous section to arrive at a comprehensive understanding of the discourse:

- The Political discourse
- Water Governance
- People, Practice and Environment

The research shall seek to describe media narrations on each of these core issues in the Indian and Pakistani press during the spring and winter months of 2010.

4.4.1 Rationale for the method used

This study employs Media Content Analysis (MCA) as the method to evaluate and understand the portrayal of the issue of water shortage and crisis within and between Pakistan and India, in the respective countries media(s). This method will assist in bringing forth the key themes in the water debate, repetitive patterns and meaningful absences in the media coverage. The adoption of MCA lends this research two distinct advantages over any other research methodology.

The distinct ability of the MCA to analyse a large body of text in the first place would be crucial in managing the expected abundance of coverage on water issues in the mainstream media of Pakistan and India, especially if a meaningful time frame of research and a wide cross-section of the media are to be included in order to make the analysis more representative. This ability is widely recognised by a number of scholars and is emphasised by the assertions of Gerbner, that this method is the appropriate tool to *"delineate trends, patterns and absences"* across a large sample size.[146] Secondly, if structured purposefully, this method has the inherent capability to draw valid inferences from this large sample size by *"systematically and objectively"* seeking out patterns and characteristics

146. Deacon, D., Pickering, M., Golding, P., & Murdock, G. "A Practical Guide to Methods in Media and Cultural Analysis". London: Arnold. 1999, p. 117

within a text.[147] This ability of the MCA to conduct dispassionate research is also reaffirmed by Weber[148] and Krippendorff,[149] two experts who saw great potential in this approach to media research.

Another important characteristic of this approach is its usefulness in gauging the dynamics that may surround any quantitative findings. Max Weber saw this method as a means of monitoring the *'cultural temperature'* of society.[150] The study of the media coverage on water issues in both countries is important because the media sets the agenda for the public debate to a large extent. Increasing water shortage in both countries is likely to induce constraints in several areas. The potential calamity caused by the deepening water shortage will be reflected by the media. In this light, the media coverage can be seen as an indicator of the general sentiments and views on the causes and consequences of water shortage. Editorial biases notwithstanding, the reporter, who is also a citizen, represents the smallest political unit in any country. The reporter's expressions in the media may offer an interesting insight into the thoughts of the countries populace on the issues under consideration and by deploying this methodology we may be able to draw some insight on the prevailing sentiments surrounding water.

Since the discourse on water is widely seen as being political the media is certainly used by governments and other interested parties as a means of stating positions, promoting perceptions and communicating with its citizenry and stakeholders. MCA is a means to decipher key messages within large narrations it is described as *"the primary message-centred methodology"* by Neuendorf.[151] A reason why "in the field of mass communication research, content analysis has found considerable favour and has been the fastest growing technique over the past 20 years or so."[152]

However there is debate on the extent of the abilities of MCA. Some scholars firmly categorize media content analysis as a purely quantitative research tool and espouse *"objectivity, inter-subjectivity, a priori design, reliability, validity, generalisability, replicability, and hypothesis testing"* for its successful application.[153] Qualitative analysis clearly lies outside

147. Stone, P. J., Dunphy, D. C., Smith, M. S., & Ogilvie, D. M. "The General Inquirer: A computer approach to content analysis". Cambridge: MIT Press, 1966. p. 5
148. Weber, R.P. "Basic Content Analysis". London: Sage Publications, 1990, p. 5
149. Krippendorff, K. "Content Analysis: An Introduction to its Methodology" London: Sage Publications. 2004, p. 18
150. Hansen, A., Cottle, S., Negrine, R. & Newbold, C. "Mass communication research methods". London: Macmillan. 1998, p. 92
151. Neuendorf, K. "The Content Analysis Guidebook". Thousand Oaks, CA: Sage Publications, 2002, p. 9
152. World Bank "Shared Views on Development and Climate Change" International Bank for Reconstruction and Development/World Bank, Washington D.C ,2009; p. 1
153. Ibid.

the range of this method. This inability to employ MCA for qualitative analysis is also recognized by Graber[154] who argues that, *"By looking at aggregated meaning-making across texts, the method tends to skate over complex and varied processes of meaning-making within texts."* Qualitative analysis is more appropriate through other methods including discourse analysis, semiotic analysis, interpretative analysis or critical analysis[155] although *"with only minor adjustment, many are appropriate for use in content analysis as well."*[156]

Shoemaker and Reese[157] do not support the hypothesis that limits content analysis for the purpose of quantitative research alone. Shoemaker and Reese develop two distinct approaches to MCA, the behaviourist approach and the humanist approach. While the behaviourist approach concerns itself with the effects that the content produces, the humanist approach looks backwards from media content to try to identify what it says about society and the culture producing it. Humanist approach seeks to discover 'truths' about a society by deciphering the "the media's symbolic environment."[158] This humanist approach to MCA lends significantly to the current research and it is through this ability of MCA that we seek to uncover the 'truths' in the public debate on water in both countries.

Despite, the strong endorsement of MCA for use in qualitative research, our research remains careful not to predict the motivation of the producers or the interpretation of the audiences based on MCA alone and we agree that for this purpose a combination of methodologies would be needed. The MCA alone remains unable to engage with the deep rooted, historic, religious and cultural biases that may be agitated within individuals on sensitive issues such as water in the Indian and Pakistani media. In our research, whenever inferences have been made from the interrogation of the texts, they are usually discussed in context or from a perspective that is transparent.

The key aspect that determines the effectiveness of the MCA is its Inter Coder Reliability (ICR). ICR is the extent of agreement between different coders (scholars) on the inferences arrived at from the interrogation of the texts. *"If content analysts cannot demonstrate strong reliability for their findings, then people who want to apply these findings should be wary of developing implementations."*[159] Findings arrived at by different coders have the

154. Deacon, D., Pickering, M., Golding, P., & Murdock, G. "A Practical Guide to Methods in Media and Cultural Analysis". London: Arnold. 1999, p. 117
155. Neuendorf, K: Neuendorf, K. "The Content Analysis Guidebook". Thousand Oaks, CA: Sage Publications, 2002, pp. 5-7
156. Ibid. p.41
157. Shoemaker, P. & Reese, S. "Mediating the Message: Theories of influences on mass media content". White Plains, NY: Longman. 1996,
158. World Bank "Shared Views on Development and Climate Change" International Bank for Reconstruction and Development/World Bank, Washington D.C ,2009, pp. 31-32
159. Potter, W. & Levine-Donnerstein, D. "Rethinking validity and reliability in content analysis". Journal of Applied Communication Research, 27, 1999, pp. 258-284.

potential to be biased by the values, beliefs and specific social and political leanings of the coder.[160] In fact the susceptibility to coder bias is the foremost disadvantage of MCA.[161]

Though some see this susceptibility as a virtue of the method and argue if analysts *"were not allowed to read texts in ways different from the ways other readers do, content analysis would be pointless."*[162] In the current research, the inter-coder reliability test will be tested by two coders with different educational, social and cultural backgrounds; European and Indian. The advantage of this combination is that we will be able to combine contextual knowledge with objectivity. In this study, Inter Coder Reliability (ICR) of over 80percent was achieved; where ICR = Agreement / (Agreement + Disagreement).

4.4.2 Time Frame

The first variable for the MCA was the time frame for which the Pakistani and Indian online media articles were analyzed. Since the purpose was to capture the general debate on water issues in both countries, the research steered clear of the period where Pakistan was shocked by the late summer/fall flood months of 2010. Though this period is interesting in relation to how the media coverage responds to extreme crisis, but it would not create an image of the general public debate. In order to do this, the paper analysed media coverage on this issue in two different periods, the winter months (January-February-March) and the summer months (April-May-June). The two periods were selected in an attempt to draw distinct results, with winter months being the months of water deficiency due to reduced glacial flows and the summer months being normal flow periods.

4.4.3 Search Terms

The overall sample data was collected from the mainstream English language Indian and Pakistani online media sources. The samples were collected using the search term "water shortage crisis" alongside "Pakistan" and "India" for the individual countries. Additionally, the archives of each source were examined where available, for water crisis related texts. The search was limited to the *Time Frame*. It must be mentioned here that the availability of data from the online news media was largely dependent on the quality and accessibility of the respective archives. This is a potential bias within the MCA and could

160. Deacon et all, 1999, "A Practical Guide to Methods in Media and Cultural Analysis". London: Arnold. 1999, p. 122
161. Smith, Ronald D. "Strategic planning for public relations" Routledge, 2004, p. 296
162. Krippendorff, K, "Content Analysis: An Introduction to its Methodology" London: Sage Publications. 2004, p. 23

distort representation on the basis of online presence. On the other hand, it could be argued that better archives may reflect size and significance and hence their representation must be commensurate. Since the study is intended to provide insight into the general discourse on water, a sample set based on the most significant online newspapers was deemed appropriate.

Another potential problem is the lack of representation of the Urdu media in Pakistan and the vernacular press in India. This is primarily due to the limits of the scope of this particular research both in time and resources. In the course of examining media organisations it was discovered that most mainstream Urdu papers and Hindi papers have corresponding English versions as well. The main themes in the Urdu and/or vernacular media would mostly be covered in their English publications although with certain time lead or lag. However, we acknowledge that some themes and content might have been lost due to the absence of Urdu and vernacular media that do not have corresponding English publications. This should be addressed by a longer and more comprehensive analysis of this debate.

At this stage it must also be mentioned that there was a discussion on including some of the more radical press in Pakistan, with smaller reach and niche constituencies. The decision to not consider these was based on two factors. First, to seek the contours of the water debate in the radical press would amount to seeking the obvious. The debate would be rhetorical and would colour the attempt to discover the centrist and articulate press coverage on the subject. Secondly, if we seek to assist in the strengthening of the more sensitive narrative on water (as is the intention of the study), it is the main stream media that is read by the policy makers and large sections of society that needs analysis. There could be other views and this will remain one of the key structural decisions of this paper.

Datasets (Texts) from two seasons of media coverage in the main online English language newspapers in India, and Pakistan were examined. The newspapers from which the samples were collected were based on readership. In each of the two time periods, 100 articles were identified for both countries (total data size of 400 articles) and thereafter these were reduced to 50 in each period for both countries randomly with a total data size of 200. The randomization was done by using the software available online at www.randomizer.org.

4.4.4 Coding Frame

The coding frame was structured based on the key investigations already identified and discussed in the previous section. The process of finalising the coding frame involved an iterative and interactive engagement between the co-coders and the sample texts. This was accomplished initially by testing the suitability of the queries against the sample texts themselves. Thereafter, a framework of interrogation was designed to make it uniformly applicable across the texts in the sample data. The purpose of the structure was to create an interrogative framework that could subsequently be utilized by the coders and by other scholars and which would hold true for different time periods and sample sets.

4.4.5 Interrogation of Texts

The sample data was now divided into four subsets of data. Two sets for the winter months, and two sets for the summer months from the Pakistani and Indian media each. The interrogative frameworks of a total of 19 questions were presented to each article in both datasets. The questions posed to the Indian media and the questions posed to the Pakistani media differed in a few key areas in order to keep the questions contextually relevant.

4.5 Findings

Through the MCA we were able to identify the dominant themes in the media reportage of the two countries. We were also able to capture some significant absences from the debate in both countries. In the following sections we discuss the key findings from Pakistan and India separately and based on the research framework and its themes; The Political Discourse, Governance and People, Practise and Environment. When presenting the findings, the output is represented in percentage of articles that had debated the respective question. Thus, we add up the percentage and show the distribution of arguments. By only presenting the percentage of articles that agitate a certain theme gives the impression that the rest were either ambiguous or rejected the argument. This is not the case. This approach would leave out the "not mentioned" (some times which also equates to "not applicable" or "not pertinent"), and create an inaccurate picture of the distribution.

4.5.1 Pakistan

The Political Discourse

As per to the MCA, IWT is not yet dominating the reportage in Pakistan. While this may not be an endorsement of the IWT, it could indicate a low level of discontentment or critique. While 18 percent of the total articles debated the IWT in relation to water shortage, only 56 percent[163] of these articles presented the IWT as the cause of water shortage. The remaining 44 percent had an ambiguous approach to the argument. For the summer months this figure reduced significantly and only 4 percent of the total articles debated the IWT. Although the figure is small and shows a reduced interest in this topic, all of the articles argued that the IWT was unfair and a cause of water shortage. There was no ambiguity in the results for the summer months.

Table 4.1: Pakistani MCA – The Political discourse

Pakistani MCA Winter-Spring The Political Discourse		Winter (percent)				Spring (percent)			
		Yes	No	A*	N**	Yes	No	A*	N**
CAUSES	IWT	10	0	8	82	4	0	0	96
	Indian action and/or transgression	36	2	14	48	22	0	2	76
	Inter-provincial water distribution/ unfair implementation of domestic water sharing accord	26	0	6	68	24	0	2	72
IMPLICATIONS	Conflict between stakeholders (People, Institutions, Political Parties)	20	0	10	70	20	0	10	70
	Negative sentiments towards / between India	20	0	12	68	12	0	0	88
SOLUTION	Political pressure against India	18	4	16	62	10	0	10	80
	Increased cooperation between Pakistan and India	22	2	22	54	8	0	22	70
	Implementation of domestic water sharing arrangement in letter and spirit is a solution	30	0	0	70	6	0	0	94

A* = Ambiguous; N** = Not mentioned

The MCA show that the inter-country dispute on water sharing between Pakistan and India received a lot of attention during the winter months. 76 percent of the articles in the MCA debated India's role in relation to water shortage. Out of these articles roughly 58 percent argued that Indian actions were the reason for water shortage. 2 percent of these articles argued that Indian actions were not responsible for water shortage in Pakistan, and the remaining 16 percent chose an ambiguous or neutral approach to the question. In the summer months, the focus on India's role in water shortage in Pakistan plummeted to 24 percent. However, out of all the articles that mention India in the water

163. The value corresponds to the percentage of the articles within the smaller subset of the number of articles that actually mention the IWT while the value in table (10 percent) corresponds to the share of articles that assign blame on the IWT in the total set of articles reviewed. This pattern of presenting shares is used consistently throughout the report.

debate, over 90 percent argue that India is the cause of the problem. The remaining 10 percent were ambiguous. This temporal difference in reportage may indicate a certain constituency that continues to apportion residual blame on external factors without debating other contributory factors.

From the analysis it is evident that the inter-provincial disputes in Pakistan received significant attention, and is comparable to the attention given to the bilateral dispute between India and Pakistan. In the winter months, 26 percent of the articles in the sample referred to inter-provincial distribution issues as the main cause of water shortage. Out of all the articles that covered this aspect, 80 percent reported it to be the cause of the problem. The figures remain stable over the seasons, only dropping 2 percentage points from the previous placing inter-provincial water distribution at the heart of the problem. Out of all the articles that mentioned inter-provincial distribution in the water debate in the summer season, 90 percent see it as the reason for water shortage.

Another aspect that emerged from the MCA was the prevalence of conflict between stakeholders in the water debate. These "conflicts" need further clarification. In these cases we are dealing with intra-provincial, sectoral and users versus utility conflicts. During the winter months 30 percent of the articles positioned conflict between stakeholders within the water shortage narrative. 66 percent of which argued that water shortage is the reason for conflict among stakeholders. The figures for the summer months were similar to the winter months.

The MCA shows that a significant negative sentiment in the reportage towards India during the winter months. An explanatory note should be included for this question. When looking for negative sentiments towards India in the MCA for the Pakistani media, the coders looked for cases where the intentions and morals of the Indian government and people was argued to be "ill conceived" or "intentionally damaging" to Pakistan. Out of the 32 percent that were identified with these characteristics, 63 percent of these articles contained a negative sentiment towards India. The remaining 37 percent were more difficult to label entirely negative, but showed signs of hostility towards India and Indians. Thus they were labelled ambiguous. As expected, the percentage of articles that either argued or reported negative sentiment towards India in connection with blaming India for the water shortage went down to 12 percent in the summer months. There was no ambiguity in these results.

Following the argument that India is the cause of the water problems in Pakistan, a large part of the media coverage on the solutions to water shortage revolved around whether political pressure against India was needed in order to solve the problem. During the winter months 38 percent of the media coverage debated political pressure. 18percent argued or reported that there was a need to pressure India. 16percent remained ambiguous, and 4 percent argued that there was no need for political responses or rhetoric. During the summer months the percentage of articles that discussed this idea fell to 20 percent. Out of these articles 50 percent agreed that political pressure was needed and 50 percent remained ambiguous.

The discussion on cooperation between India and Pakistan to resolve issues related to water shortage received noteworthy attention during the winter months. 46 percent of the articles covered this issue in winters. 48 percent of which argued that India and Pakistan should expand cooperation to solve issues. 48 percent of the articles remained ambiguous towards cooperation, and the remaining 4 percent conveyed lack of support. During the summer months the percentage of articles that covered this aspect fell to 30 percent. In this period only 26 percent were positive and the rest remained ambiguous.

Reflecting inter-provincial distribution of water as a cause of water shortage, 30 percent of the total articles during the winter months presented improved implementation of water sharing arrangements between provinces was presented as a solution. The reduction of this percentage during the summer months is interesting. Down from 30 percent in the winter months, the percentage of articles that focused on improved implementation of domestic water sharing arrangements as a solution dropped to 6 percent in the summer months. There was no ambiguity in the results for winter months or the spring months.

Governance

The variable that received the most attention in the Pakistani MCA as a cause of water shortage was administrative lapses and management deficiencies. In the winter season 44 percent of the articles focused on administrative lapses with relation to water shortage. 86 percent argued that administrative lapses were at the core of the problem. The remaining 14 percent were ambiguous to the question. In the summer months, the figures remained relatively stable at 42 percent. In this time period, 90 percent of the articles argued that water shortage was due to administrative lapses. The remaining 10 percent were ambiguous.

Table 4.2: Pakistani MCA –Governance

Pakistan MCA –Governance		Winter (percent)				Spring (percent)			
		Yes	No	A*	N**	Yes	No	A*	N**
CAUSES	Administrative lapses or challenges at the local, regional or national level	38	0	6	56	38	0	4	58
	Insufficient water provision and storage infrastructure	20	0	0	80	14	0	0	86
SOLUTION	Improvement in Public water management	22	0	8	70	34	0	4	62
	Investment/attention/technology solutions to water provision and storage infrastructure	18	0	0	82	28	0	0	72

A* = Ambiguous; N** = Not mentioned

Another argument that found mention among the sample texts in the Pakistani media was the causal relationship of water shortage and lack of physical infrastructure such as functioning storage facilities and pipelines. 20 percent of the articles in the winter months alluded to poor infrastructure as the cause of water shortage. All the articles that focused on water infrastructure argued that the state of the provision system was affecting water availability. For the summer months this number dropped to 14 percent with no ambiguity or rejection of this claim.

Consequently, coverage focussing on the need to improve governance received attention in the articles under analysis. During the winter months 30 percent of the total articles reviewed, debated the significance of governance in relation to water shortage. 73 percent of which argued that there was a need for improvement, while 27 percent remained ambiguous. During the summer months the total percentage of articles that debated governance in relation to water shortage rose to 38 percent. Out of these only 10 percent remained ambiguous and 90 percent believed water shortage would be reduced with improved water governance.

As well as identifying the problem with physical water provision infrastructure, many articles also subscribed to the solution involving investments in water related infrastructure. In the winter period 18 percent of the total articles reviewed alluded to the need for investment in infrastructure. Interestingly this number rose to 28 percent of the total articles during the summer months. There was no ambiguity or rejection of the idea in either season. Perhaps this is representative of the fact that as the debate moves to the summer and tension between provinces and countries simmer down, more time and space is available for substantive and technical aspects of water management.

People, Practice and Environment

As expected, a substantial percentage of the articles reviewed in the winter months focused on climatic variations, mostly seasonal, as the explanation for water shortage. In the winter months 32 percent of the articles placed this explanation at the centre of the debate, of which 94 percent argued it to be the primary cause and only 6 percent were ambiguous. This percentage plummeted to 12 percent during the summer months, with no ambiguity. This change in the overall attention may be attributed to higher volume of rainfall during the summer months.

Table 4.3: Pakistani MCA –People, Practice and Environment

Pakistan MCA -People, Practise and Environment		Winter (percent)				Spring (percent)			
		Yes	No	A*	N**	Yes	No	A*	N**
CONSEQUENCES OF WATER SHORTAGE	Changing climate/rainfall conditions	30	0	2	68	12	0	0	88
	Environmental degradation	4	0	0	96	6	0	2	92
	Underground water affected	6	0	0	94	6	0	0	94
	Agricultural/agro dependent rural sector suffered	58	0	0	42	56	0	2	42
	Domestic consumption affected	24	0	2	74	32	0	0	68
SOLUTION	Crop diversification or changing cropping patterns	2	0	0	98	4	0	0	96
	Training/awareness to improve water efficiency	10	0	0	90	4	0	0	96

A* = Ambiguous; N** = Not mentioned

There was little media space offered to the interrelationship between water and the environment. Only 4 percent of the articles focused on this relationship in the winter period and each did draw a positive correlation. During the summer months 8 percent of the total sample discussed this aspect, of which 75 percent posited a positive correlation and 25 percent were ambiguous.

The limited focus on groundwater resources in the Pakistani media was surprising. Water shortage and its effect on groundwater sources has been a concern among experts, however this is not reflected in the public debate. During the winter months, only 6 percent of the articles focused on the effect on groundwater sources. This percentage did not change during the summer months, which reflects a low level of debate on this aspect in the main media discourse.

The concern on the consequences of water shortage is evident from the analysis. During the winter months 58 percent of the articles focussed on the effect of water shortage on the agricultural sector. All of which argue that the sector would suffer from the water shortage. The percentage focusing on this relationship remained stable at 58 percent during the summer months, however with a small change in the percentage that affirmed that it led to the agricultural sector suffering. 97 percent were positive and only 3 percent remained ambiguous. Not surprisingly, out of all the articles that mentioned water shortage and its effect on the agricultural sector, almost all contained dire predictions for the future of the Pakistani agricultural sector.

The link between water shortage and reduced household consumption was mild during both seasons of analysis. During the winter months 26 percent of the articles covered the effect of water shortage on household consumption. 92percent of these articles established that reduced water availability has in fact lead to reduced household consumption/availability, while only 8 percent remained ambiguous. The percentage of articles focusing on the effect on household consumption rose to 32 percent during the summer months with no ambiguity. This is quite surprising as we would normally expect a reduced reportage as water is generally more abundant during the summer months.

Scant attention was given to crop diversification or agricultural innovation as a solution to water shortage. Only 2 percent of the articles mentioned this during the winter months, and 4percent during the summer months. Although there was no ambiguity and all the articles covering crop diversification was unison in its positive effect on water efficiency, the coverage of this much discussed and well endorsed idea remains non-existent.

Educating farmers to use water more efficiently received some attention during the winter months. 10 percent of the articles argued that this could solve water shortage. However, during the summer months this plummeted to 4 percent. These results paint a somewhat similar picture as with the earlier question. Although there was no ambiguity or rejection of the idea, the focus is still very limited in the media in comparison to its importance in 'policy making and academic circles'.

4.5.2 India

The Political discourse

Expectedly, the results from the MCA for the Indian Media differ in many respects from the Pakistani MCA. However, similarities are also in abundance and these normally reflect the state of water governance, water provision and storage infrastructure. We also see important absences and differences in the debate that will be discussed in the next section.

Table 4.4: Indian MCA –The Political Discourse

Indian MCA -The Political Discourse		Winter (percent)				Spring (percent)			
		Yes	No	A*	N**	Yes	No	A*	N**
CAUSES	Unfair/or flawed IWT provisions	0	0	4	96	2	0	0	98
	Uneven inter-provincial water distribution/usage	8	0	0	92	14	0	0	86
	India not abiding by the water agreements (Pakistan's assertion)	8	0	8	84	26	0	2	72
IMPLICATIONS	Conflict between stakeholders (People, Institutions, Political Parties)	14	0	2	84	6	0	2	92
	Pakistan accuses India of breaching water agreements	10	0	4	86	26	2	10	62
	Water is employed as a socio-political tool by extremist elements	10	0	0	90	8	0	0	92
SOLUTION	Pakistan and India should intensify cooperation to resolve water issues	10	0	0	90	12	0	12	76

A* = Ambiguous; N** = Not mentioned

On the question of whether the provision of the IWT had at any time caused water shortage in India, there was little, if any, interest in the Indian MCA. In the winter months only 4 percent of the articles focused on the IWT with relation to water shortage. Important to note, all of these articles remained ambiguous to the question. During the summer months only 2 percent placed the IWT within the debate. There was no ambiguity in the results during the summer months. Interestingly it was not a very prominent discussion in the Pakistani Media either at this time.

Despite the low attention given to the IWT in the Indian media, the response to Pakistan's allegations of India not abiding by the water provisions was comparatively higher over the two seasons. In the winters, 16 percent of the articles responded to the allegations. 8 percent labelled the assertions as unreasonable, equivalent to the number

that remained ambiguous. However, during the summer months this percentage rose to 26percent with only 2 percent remaining cryptic. Out of these articles 93 percent[164] labelled the allegations from Pakistan as unreasonable. The remaining 7 percent were ambiguous to the question.

Like Pakistan, India also suffers from inter-provincial disputes on water sharing. During the winter months 8 percent of the total articles reviewed labelled these disputes as a central cause of water shortage. This number rose to 14 percent during the summer months. The results were unambiguous in both seasons and there was no rejection of the idea.

The interrogative framework for India media reports also contained its responses to the Pakistani views of India with relation to water issues. During the winter months 14percent of the articles focused on Pakistani accusations against India on water issues. 71percent of these articles reported that water shortage had lead to accusations from Pakistan that India was breaching the IWT. 29 percent remained ambiguous. Interestingly the focus on Pakistani accusations against India rose to 38 percent during the summer months. Out of these articles 68 percent showed that Pakistan had accused India of breaching water agreements, 26 percent were ambiguous and roughly 6 percent rejected the assertion.

The conflict between the different stakeholders created by water shortage was reflected in the Indian media. During the winter months the number of articles covering tension between people, institutions and political parties was a significant 16 percent. Out of these articles over 87 percent reported a direct connection between water shortage and conflict. 13 percent remained ambiguous. As was expected, with increased availability of water during the summer months this percentage reduced to 8 percent.

In addition to this, in the winter months 10 percent of the articles in the MCA reported that extremists groups in Pakistan had employed water shortage as a socio-political tool. This reduced slightly to 8 percent during the summer months. There was neither ambiguity nor rejection of this idea in the results.

During the winter months 10 percent of the articles unambiguously argued or reported that India and Pakistan should intensify cooperation in order to solve water disputes between the two countries. This percentage is at the expected level for the Indian media.

164. The value corresponds to the percentage of the articles within the smaller subset of the number of articles that actually mention the IWT while the value in table (10 percent) corresponds to the share of articles that assign blame on the IWT in the total set of articles reviewed. This pattern of presenting shares is used consistently throughout the report.

India's water problems are not argued to be caused by Pakistan, and thus the articles that focused on cooperation with Pakistan, do so, in a broader geopolitical context. During the summer months the issue of cooperation with Pakistan was debated more frequently. 24 percent of the articles mentioned this solution. Out of these articles 50 percent supported the idea of cooperation with Pakistan, while the other 50 percent remained ambiguous.

Governance

The emphasis on governance is even more prevalent in the Indian media. 38 percent of the total articles included this aspect in the water debate during the winter months. Out of these articles around 68 percent argued that administrative lapses were the cause of water shortage. The remaining 32 percent were ambiguous. This percentage increased significantly during the summer months. 52 percent of the articles conveyed a direct linkage between administrative lapses and water shortage. Out of these articles 92 percent portrayed a direct causal connection and only 8 percent remained ambiguous.

Table 4.5: Indian MCA –Governance

Indian MCA –Governance		Winter (percent)				Spring (percent)			
		Yes	No	A*	N**	Yes	No	A*	N**
CAUSES	Administrative lapses or challenges at the local, regional or national level	26	0	12	62	48	0	4	48
	Insufficient water/supply provision and storage infrastructure	24	0	10	66	26	0	2	72
SOLUTION	Improvement in public water management/Regulation	24	0	12	64	32	0	2	66
	Investment in water provision/ technology provision and storage infrastructure	32	0	8	60	28	0	4	68
	Public-private partnership/ better water pricing partnership	2	0	0	98	4	0	0	96

A* = Ambiguous; N** = Not mentioned

The focus on insufficient physical water provision and storage infrastructure was higher in India. During the winter months 34 percent of the media reports from India included this argument in the water debate. Out of these articles 70 percent argued or reported that there was a direct connection, while 30 percent remained ambiguous. The overall attention given to the linkage between insufficient infrastructure and water shortage dropped slightly to 28 percent during the summer months. However out of these articles

the percentage that portrayed a direct connection rose to 93 percent, while only 7 percent remained ambiguous.

Like in Pakistan, improving water management/regulation was an important issue. During the winter months 36 percent of the articles debated water management with relation to water shortage. Out of these articles 67 percent argued or reported that improving water management would help resolve water shortages. 33 percent of the articles remained ambiguous. During the summer months the overall percentage of articles debating improving water management fell slightly to 34 percent. However, the percentage of articles that argued or reported in the affirmative increased to 94 percent, with only 6 percent of the articles remaining ambiguous.

Improving the physical infrastructure of water provision and storage was the primary solution put forward in the Indian MCA. During the winter months 40 percent of the articles took up the need for improved and enhanced water infrastructure. Out of these articles 80 percent argued or reported that investment in infrastructure would solve water shortage. The remaining 20 percent were ambiguous. During the summer months the percentage of articles debating the need for additional water infrastructure fell to 32 percent. 88 percent of the articles reported or argued that investment in infrastructure would resolve water shortage, while only 12 percent remained ambiguous.

The Indian MCA demonstrates some degree of attention to the idea of public-private partnership. During the winter months only 2 percent of the articles reported or argued that this solution would help water shortage. In the summer period the number of articles presenting this solution rose to 4 percent

People, Practice and Environment

As in the analysis of the media in Pakistan, changing and variable climate did figure in the discourse on water and water scarcity. 28 percent of the articles in the winter months introduced this inter-linkage between climate and water. 93 percent[165] of the reportage presented a direct linkage of climate to water shortage and only 7 percent remained ambiguous. As expected, this percentage dropped to 16 percent during the summer months. In these articles there was no ambiguity.

165. The value has been calculated out of the total number of articles that mentioned the respective topic (removing the 'not mentioned' values), dissecting them into positive and negative response to the questions proposed.

Table 4.6: Indian MCA –People, Practice and Environment

Indian MCA -People, Practice and Environment		Winter (percent)				Spring (percent)			
		Yes	No	A*	N**	Yes	No	A*	N**
CAUSES	Changing climate/rainfall conditions	26	0	2	72	16	0	0	84
IMPLICATIONS	Environmental degradation/ issues	10	0	2	88	6	0	0	94
	Underground water affected	34	0	0	66	36	0	0	64
	Agricultural/agro-dependent rural sector suffered	22	0	10	68	16	0	6	78
	Domestic consumption affected	20	0	16	64	20	0	4	76

The value has been calculated out of the total number of articles that mentioned the respective topic (removing the 'not mentioned' values), dissecting them into positive and negative response to the questions proposed.

The inter-relationship of water and the environment was covered by 12 percent of the articles in the winter months. 83 percent of which argued or reported a correlation between water shortage and environmental degradation. The overall percentage dropped to 6 percent during the summer months. There was no ambiguity in this result, all of which argued or reported environmental considerations.

The issue of groundwater resources was an aspect which was reported very differently in the media texts of the two countries. In India, 34 percent of all the articles in the winter months covering water argued or reported that groundwater resources were depleting due to water shortage and/or increased water consumption. This percentage rose to 36 percent during the summer months. There was no ambiguity in the articles under analysis in either season and all portrayed a causal effect between water shortage and depleting groundwater sources.

Although both countries media focused on water shortage and its effect on the agricultural sector, there was a significant difference in the scale of coverage. While Pakistan had percentages over 50 in each period, India remained around 30 percent or lower. During the winter months, 32 percent of the Indian media attention on water shortage focused on its effect on the sector. Out of these articles below 70 percent argued or reported that the agricultural sector had suffered due to water shortage, while the remaining 30 percent was ambiguous. The number of articles reduced to 22 percent in the summer months, out of which 72 percent argued or reported that the agricultural sector had indeed suffered due to water shortage, while the remaining 28 percent was ambiguous.

Along with groundwater, it seems like domestic/ household consumption has taken the "missing share" from the lower reporting on agriculture (as against the Pakistani Media articles analysed) in the Indian media. 36 percent of the articles in the winter months included the effect of water shortage on domestic/ household consumption. 55percent of the articles argued or reported a direct link between water shortage and consumption, the remaining 45 percent stayed ambiguous. During the summer months the total number dropped to 24 percent with 83 percent conveying a direct effect on consumption. This could be reflective of the fact that the National Media in India caters more to the urban realities as against the rural needs.

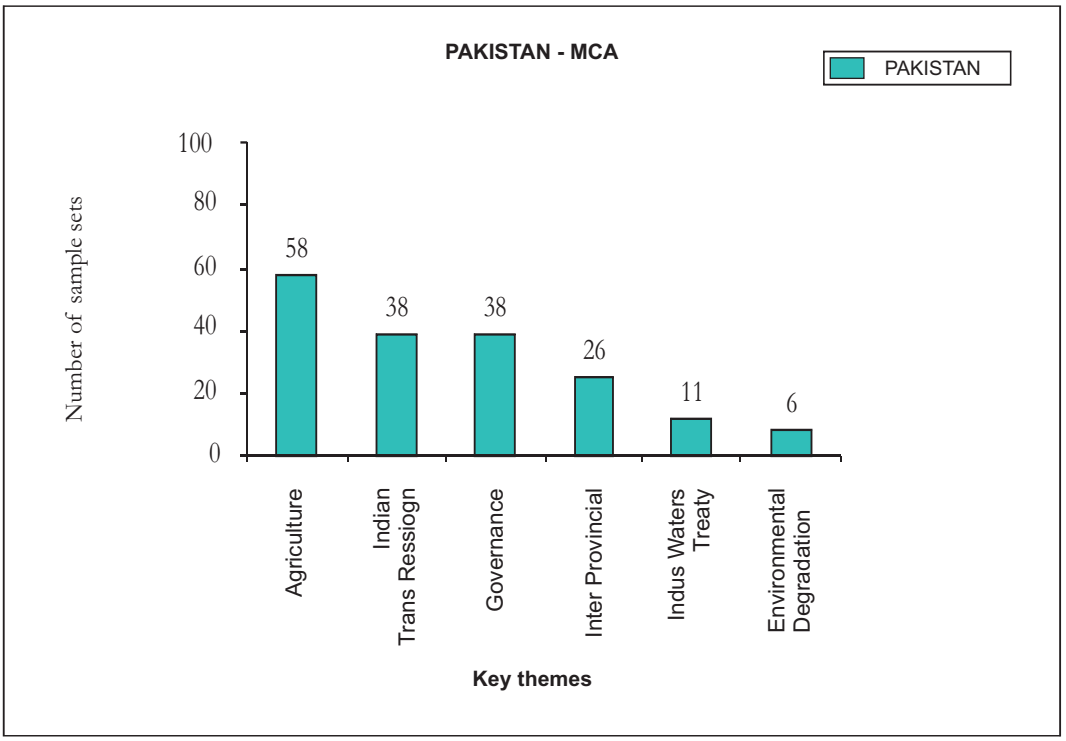
During the winter months no article in the MCA mentioned crop diversification as a solution to water shortage. In the summer months however, crop diversification received some attention. 6 percent of the articles in the MCA mentioned crop diversification with relation to solutions to water shortage. 66 percent reported or argued that crop diversification could be a solution, while 33 percent remained ambiguous. .

A secondary set of solutions that were mentioned were pertaining to 'awareness', education and crop diversification. Some articles in the MCA brought up the idea of spreading awareness about personal water utilization as a solution to water shortage. Another aspect of this was training farmers to use water saving techniques etc. During the winter months 8 percent of the articles debated this solution. 50 percent argued or reported that it would solve water shortage, while 50 percent remained ambiguous. During the summer months the percentage of articles that debated this solution rose to 10 percent. There was no ambiguity in the articles from this time period, all argued or reported that awareness spreading would solve water shortage.

4.6 Analysis and Conclusions

As already discussed, MCA is not an appropriate tool to determine the causes or motivation of how issues are reported and framed and how they are received and understood by the reader or audience. To determine these we would need to augment the finding of the MCA with surveys and interviews at the production and reception end of the media chain. However, the results from the MCA do provide us with an overview of the current discourse on water in Pakistan and India. The findings help us acquire an insight into the distribution of focus in the debate and thus give an indication of the areas that are frequently agitated, aspects that might be absent and the balance amongst the narratives.

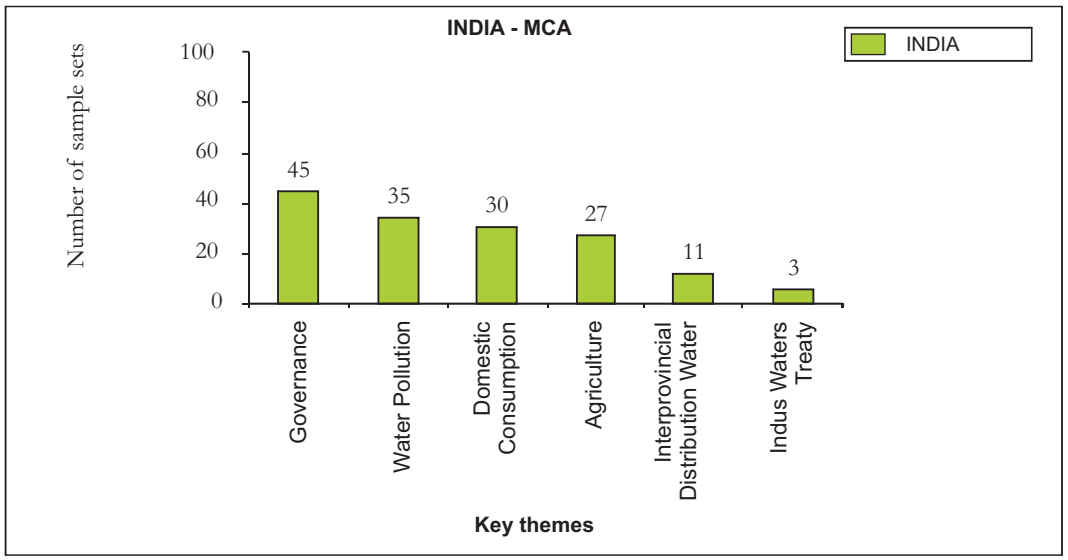
Figure 4.1: Pakistan – Imagining the Indus[166]



The MCA revealed certain basic statistics which helped in identifying the key themes in the water debate in both the countries over the two seasons. The components constituting these themes do characterize the way India and Pakistan look at the waters of the 'Indus'. It is fairly evident that agriculture, India, internal disputes, IWT and environment constitute the imagination of water by the Pakistani Media. On the other hand, governance, groundwater situation, domestic consumption, agriculture and domestic water sharing constitute the Indian media's reportage on water. Surprisingly, there is lack of significant presence of the IWT in the samples examined. The paradox of the water discourse is that while it covers all the micro-narratives that are important the level of debate or the sophistication of reporting on these is lacking. The level of debate can be termed as low but unambiguous. It is low as it skims over issues such as agriculture practices, environment, awareness and capacity building but unambiguous as there is a deterministic pronouncement on issues that they do agitate in their reportage. This is established by the fact that in the findings the "Not Mentioned" column is the winner, implying that expert opinions and concerns are yet to find space in the media discourse.

166. The values presented in the graph is the total number of articles mentioning the respective topic over the two seasons, out of a total of 100 sample sets analyzed.

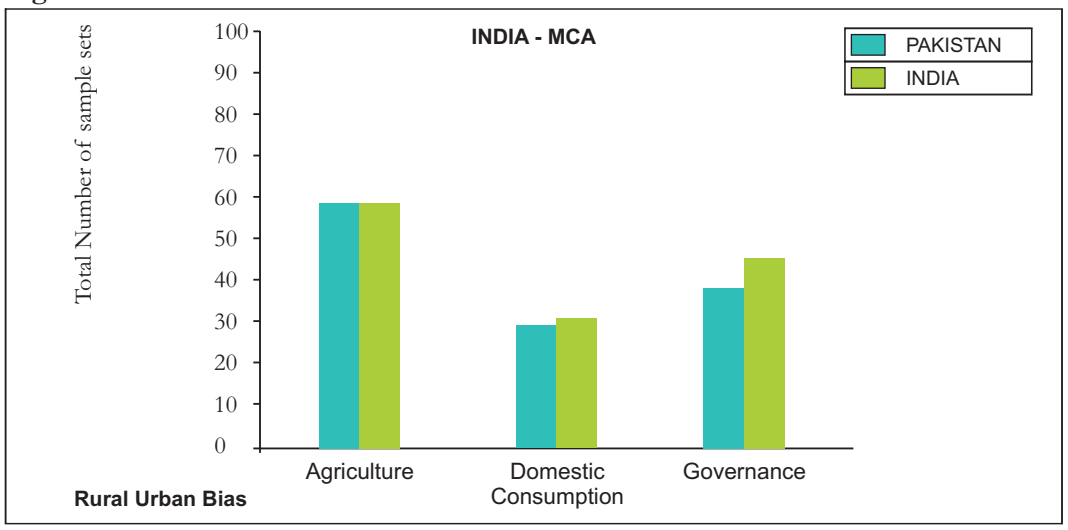
Figure 4.2: India – Imagining the Indus[167]



The above findings also show certain critical difference in the media debates of the two countries on water. While for Pakistan, Indus is synonymous with its rural needs and its relationship with India to a large extent, both these elements are subdued in the Indian debates where water is now more of an urban theme with increased focus on issues of consumption, infrastructure and governance. This difference in our very comprehension of the waters of the shared river may lend its own dynamics to the debate. Let us briefly examine some of these distinct trends which may otherwise be overlooked when discussing the larger water narrative with its political implications.

Rural- Urban Imagination of Water[168]

Figure 4.3: Rural – Urban Bias in India and Pakistan

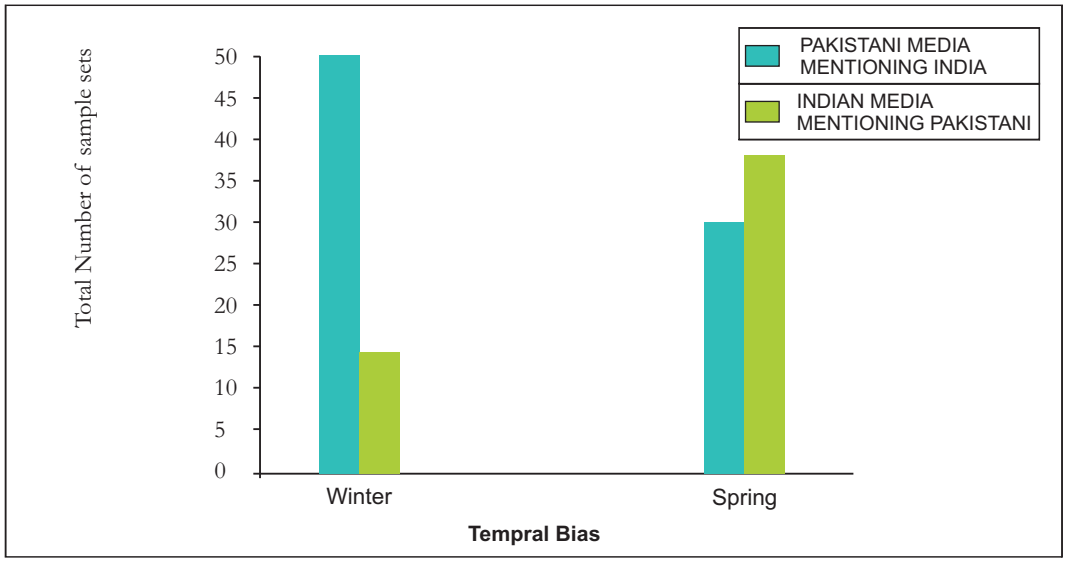


167. Ibid.
168. Ibid.

The water oriented discussions in India have a strong element of urban concerns and urban centric apprehensions and interventions. These are apparent when you see the emphasis on domestic consumption issues, urban groundwater issues (See fig 1.5) and on matters of governance. It is the middle–class and elite in urban centres that is far more sensitive to matters of water management, infrastructure and governance in general. In both these aspects the coverage is more slightly more pronounced across seasons in India. On the other hand, the Pakistani media treats the rural issues with greater sensitivity, which could be attributed to its political economy that still ensures greater say of the agriculture sector in its policy-making mechanisms. These scalar dichotomies between the countries may form the basis of their unique approach, policies and practices around water. This difference presents the debate on water sharing a nuance that would entail creating a common vocabulary to achieve efficiency in a cooperative arrangement. Needs, local political economies, lifestyles and aspirations would need to be reconciled, understood and managed.

Temporal Bias

Figure 4.4: Temporal bias in Indian and Pakistani media reportage on water issues[169]



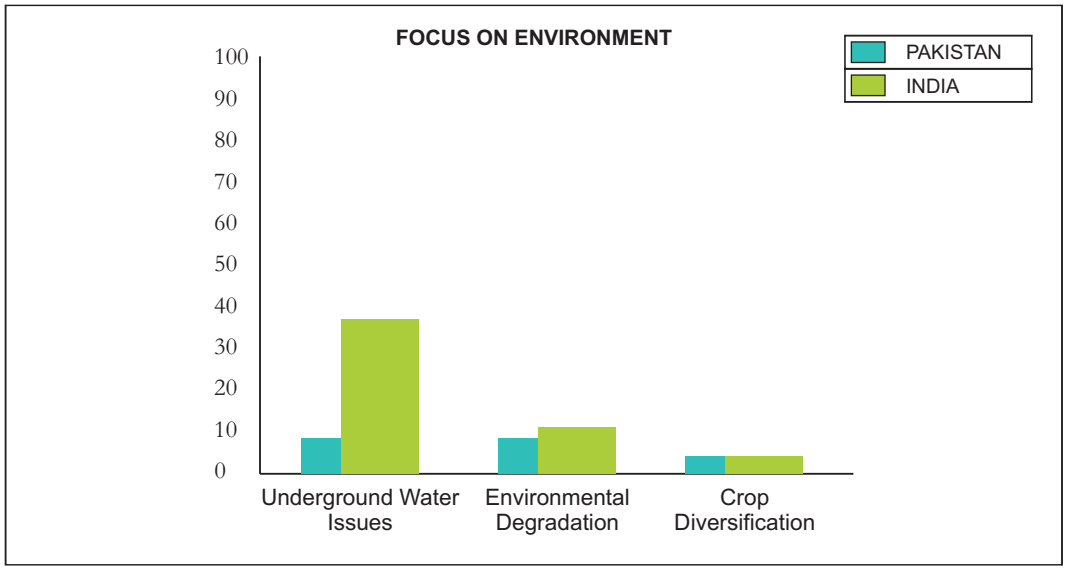
In Pakistan during winters when the availability of water is low, India and Indian action come under scrutiny and the intensity of negativity towards India reduces considerably as the water flow improves in the summer months. While the reasons for this could be many, it would be naïve to assume that political opportunism (by a section) and an attempt to deflect attention from poor governance and infrastructure do not play a

169. The values presented in the graph have been calculated based on the number of articles mentioning the respective topic in the two seasons, out of a total of 50 sample sets analyzed for each.

significant role in the variability. Similarly in India, while the hyphenation of Pakistan and Water is muted in the winter months, the awareness of the criticism from Pakistan increases in the summer month. There is a seasonal phase lag on when each of the country is sensitive to the actions and criticisms of the other. Is this witnessed due to the increased demand of electricity in the industries and homes in India that necessitates Hydro Power generation? Do our specific water requirements shape the media discourse on issues of sectoral and geographic contests? Are expediency and politics shaping the narratives in the two countries? The challenge for the two countries is clearly to focus on issues of governance without deflecting blame on the politics; water should be de-securitised and de-politicised so that it remains an organic discourse about people and resources and managing needs with capabilities.

Focus on environment

Figure 4.5: Focus on environment in India and Pakistan[170]



The third distinct trend is the apparent lack of sensitivity to changing climate, environmental degradation and agriculture practices. While in India, it may appear there is a fair degree of concern on ground water availability, the debate is still restricted to one on resource scarcity rather than on the ecological impact of unsustainable withdrawal.

The findings show that these are the three areas which receive little attention in the reportage, even though they are vital to the life, livelihood and socio-economic development of the community and region. The neglect of more efficient agricultural

170. The values presented in the graph have been calculated based on the number of articles mentioning the respective topic over the two seasons, out of a total of 100 sample sets analyzed.

practices like crop diversification and training and capacity building for the same is a symptom of the low level of debate on substantive issues. With their huge populations still growing and global warming affecting water availability and quality, India and Pakistan should begin to revisit their individual and collective discourse on this subject and this may aid in shaping a more considered collective action.

The absence of these key themes in the debate while disappointing also do present opportunities for cooperation between the two countries. Joint Data Centres on water and Regional Environment Monitoring Station may be the appropriate next steps. Sharing of individual experiences with technologies and policies may also be possible by instituting a Joint Working Group on this resource.

On a positive note the MCA shows that the level of hostility towards India remains relatively low and reduces significantly over the two seasons. The periodic hostility between the two countries might have led us to expect a more aggressive discourse than what the MCA demonstrates. It is also apparent that the debate has not yet been subverted by either terror groups or by the political right in the two countries. While this is an aspect that should cause concern to both governments, dialogue and real time cooperation on managing the river may be the only way to prevent this from happening.

Lastly, the reportage on Indus Waters Treaty (IWT), another perceived area of friction and dispute, has been relatively moderate and sober and there seems to be little debate or substantive disagreement on the treaty in the media space. While we can safely infer that the provisions of the IWT are not described as unfair by the reportage, Indian action and perceived transgression is clearly a major narrative in media reports in Pakistan.

This reportage suggests a level of sophistication where there seems to be a distinction between the two and this needs to be preserved. Poor implementation of the treaty by the two sides must not undermine the strength of the scheme. On the other hand, a more robust engagement mechanism around the treaty may not only strengthen it but also improve the implementation of the provisions in letter and spirit.

The challenge is to raise the level of the debate without raising the pitch. The water narrative needs to be more informed and sensitive to some of the micro-issues that are vital. Issues of climate, crop patterns, agriculture practices, water infrastructure and use, water policy must all figure increasingly in water reportage. At the same time to create

such awareness we must not generate hysteria and paranoia over climate, pollution or scarcity lest these are subverted by vested interests and the narrative redeployed for political purposes.

5 Executive Summary: Mapping Water Use Practices in the Indus Basin

5.1 Introduction

The river Indus rises on the Tibetan Plateau and in its passage through Pakistan and India it drains through the highest mountain ranges of the world. The basin is sometimes referred to as the 'Third Pole' as it contains the greatest area of perennial ice outside the Polar Regions.[171] The Himalayan glaciers and snow sustain water flow in the Indus and rich mineral sediments from the mountains contribute to the fertility of the alluvial plains.[172] A combined annual average volume of about 175 billion cubic metres (175 cubic kilometres or about 140 million acre feet) including all major tributaries is discharged into the Indus plains.[173] The basin extends over 1 million square kilo-meters with roughly 59 percent in Pakistan, 28 percent in India and the rest in Afghanistan, Tibet and China.[174]

The Indus basin is known to be one of the oldest areas of agricultural production. Though there is a lack of continuous record on agricultural practices in the Indus Basin in the pre-colonial era, available records show that the annual floods of the Indus and its tributaries shaped the development of agriculture in the region and water availability and reliability were determining constraints of agriculture in the basin.[175] This section of the

171. Archer, D. R, Forsythe, N, Fowler, H. J, Shah, S. M, 2010. 'Sustainability of Water Resources Management in the Indus Basin under changing Climatic and Socio-economic conditions,' Hydrol, Earth Syst. Sci., 14, 1669–1680, 2010, www.hydrol-earth-syst-sci.net/14/1669/2010/ doi:10.5194/hess-14-1669-2010
172. Ibid.
173. Ibid.
174. IUCN, 2010. 'Beyond the Indus Water Treaty: Ground Water & Environmental Management – Policy Issues & Options', IUCN Pakistan, Karachi, p. 10
175. Gilmartin, D, 1994. 'Scientific Empire and Imperial Science: Colonialism and Irrigation Technology in the Indus Basin', The Journal of Asian Studies, Vol 53, No 4 (Nov 1994), pp. 1127-1149

report is a summary of papers that were commissioned as part of the study 'Re-Imagining the Indus' to map water use practices in the Indus basin in three distinct periods: the pre-colonial, the colonial and post independence periods with exclusive focus on the Punjab region which is now a part of both Pakistan and India (detailed papers are available in Section 6 of this report)

The objective of the summary that follows is to give a chronologically ordered coherent account of the developments and identify circumstances (economic, social, political, etc) that facilitated certain water use practices in the respective period and record its impact and consequences based on the set of set of papers provided in Section 6. Some material has been incorporated into the summary to give the narrative some degree of continuity but there remain critical gaps in capturing the water use practices of Pakistan and India in the post colonial era.

The key questions that underpin the summary narrative are:

- What are the key features of agricultural water use practices in the Indus basin in the pre-colonial, colonial, post independence eras?
- What were the factors that led to certain water use practices in the four distinct periods?
- Were these practices sustainable economically and ecologically? If so what were the institutions and incentives that facilitated such practices?

5.2 Pre-Colonial Era: 6th – 17th Century

The Indus River is the sixth largest river in the world whose agrarian civilization belongs to the fifth millennium B.C. The origin of ploughed pastures can be traced back to 2400BC as depicted by the Kalibangan excavations in western Rajasthan. It shows grids formed by channels running from north-south, and east-west in a pattern very identical to the one still practiced today. Similarly, ingenious hydraulic systems were found in the bath houses of Mohenjo-Daro that intrigued modern engineers to explore the evolution of system designs. As these civilizations were inextricably tied to the Indus they died out with the eastward shift of the Indus River (see full paper on pre-colonial and colonial era agriculture in the Indus Basin by Maaz Gardezi in Section 6).

Though the area around the Indus River has always been rich and superior to other parts of India, the arid land could not be cultivated on rain water alone and some form of

artificial method of irrigation had to be developed as the population swelled.[176] In fact, one of the reasons for the decline of Indus civilization has been attributed to the *'…character of culture that had stagnated, probably as a result of complacency impeding further effort…This led to inadequate maintenance of irrigation channels and bunds that resulted in total system collapse.'*[177]

Lands adjacent to the rivers had alluvial soil that was ideal for different crops. The vastness of land and relative abundance of rainfall had made life simple and yet prosperous in the basin. Most of this region required some form of irrigation to sustain crop growth year after year and the extent of irrigation was dependent on rainfall in a particular region.

Canal building started in the 8th century when a number of inundation canals were built by emperors and minor rulers to facilitate agriculture.[178] Records suggest that cycles of inundation canal construction strongly influenced localized patterns of agriculture opening areas away from the direct action of the river floods to regular irrigation when rivers filled canals in the hot spring and summer months.[179] When canal irrigation began to make a difference in agricultural production, Arab conquerors of the Sindh region began to differentiate between irrigated and non-irrigated lands to levy taxes.[180]

Emperors, minor rulers and conquerors of the region introduced new irrigation methods as there was a dire need to expand their empire and then provide adequate food supply to the growing population. During the pre-Mughal era, the Sultans dealt with water management as an existential issue for the prosperity of the region. There is evidence of 'Kolab' (water reservoirs) in Sialkot and 'Haud' (lake) in Palwal which were necessary in arid and hot regions of the Indus basin.[181] The first lake constructed by Sultan Iltumish in the 12th Century was a multi-purpose lake that supplied clean drinking water to the city's population as well as for growing seasonal fruits along its boundary. Soon afterwards, Sultan Alauddin Khalji is credited with having taken interest in developing lakes, tanks and cisterns for the progress of agricultural produce.

176. Much of the content for the post colonial and colonial periods is from the paper 'A Historical perspective on the Indus Basin' by Maaz Gardezi (see Section VII Annex 1))
177. Ul-Haq, A, 1998. 'Case Study of the Punjab Irrigation Department,' Consultancy Report, Pakistan National Programme,' International Irrigation Management Institute, Lahore
178. Ibid.
179. Gilmartin, D, 1994. 'Scientific Empire and Imperial Science: Colonialism and Irrigation Technology in the Indus Basin', The Journal of Asian Studies, Vol 53, No 4 (Nov 1994), pp. 1127-1149
180. Ul-Haq, A,1998. 'Case Study of the Punjab Irrigation Department,' Consultancy Report, Pakistan National Programme,' International Irrigation Management Institute, Lahore
181. Siddiqui, I. 1986. 'Water Works and Irrigation System in India during Pre-Mughal Times', Journal of the Economic and Social History of the Orient, Vol. 29, No. 1, pp. 52-77

The most important development in irrigation in the 13th century was the construction of large artificial canals. During Khalji's regime, a system of inundated canals that provided water only when rivers were flooded was developed. These canals were linked to large rivers and therefore unpredictable in operation and routinely subject to frequent breaches. The construction of large canals in the region between Sutlej and Delhi was pioneered by Sultan Firoz Shah Tughluq (1351-1388). The Emperor also directed public department to build a canal from Sutlej to Jhajjar (a distance of 48 cos or 144 Km).[182] This was also the period of development of bridges, aqua-ducts and dams that were used to store water throughout the year.

Canals were constructed to provide water to acutely dry areas in the basin and an important consequence was that these canals provided the opportunity to grow two crops a year. Farmers could now harvest both the Kharif (summer) and Rabi (winter) crop in a single year. These canals provided an added benefit to the farmers because they could dig relatively shallow wells which were sufficient to obtain ground. On the whole, the canals turned out to be a catalyst for fast growing agricultural production, migration and employment in the region.

Another important development of this period was the introduction of the Persian Wheel.[183] In the 14th century, this was a luxury that only the rich and prosperous farmers could afford. Set up on the wells and the newly constructed water storages, it was adopted seamlessly with the contemporary infrastructure. The wells also had social benefits, as the income from sale of its water was provided to the poor.[184] Later metallic buckets were introduced on the Persian wheel. This replaced the existing pottery vessels and by the early 16th century, the wheel was adopted in almost all sugar-cane and rice growing parts of Punjab. From the early 16th century onwards, ground water was extensively used for irrigating the lands. Dug wells and Karez (underground water channels) were constructed and lifting devices such as Charas, Shaduf, Rati and Persian wheel assisted in extracting ground water. In an area of generally sparse and unreliable rainfall, technical innovations that increased water availability were critical for growth.

The Punjab during the Mughal period comprised of five main Doabs.[185] The Bai Jallandhar Doab formed the area between Sutlej and Beas, covering an area of 50 cos

182. 1 cos equals 3 km

183. The Persian Wheel operates in deep wells. It comprises of three wheels and a beam horizontally attached to a toothed wheel outside the well. To the outer end of the beam a pair of bulls or buffalos is yoked. The animals move in a circular path, pulling the beam and thus making the wheels revolve. As the machine is turned, the buckets hanging in a chain dip, one by one, into the water. Again, they reach the top and then empty into a trough. The water flows through a drain to the fields, orchards,etc.

184. Gopal, L. 1980. 'Aspects of History of Agriculture In Ancient India,' Varanasi, pp. 116-120

185. A Doab is a term used for a tract of land lying between two confluent rivers

(150 Km). The second was the Bari Doab lying between the Beas and the Ravi stretched over a distance of 17cos (51 Km). The third was the Rechna Doab which was the area between Ravi and the Chenab which stretched over an area of 30 cos (90 Km) and was the most fertile and rich among the Doabs.[186] The fourth was the Chaj Doab, which engulfed the Chenab and the Jhelum River, and the last, the Sind Sagar Doab which lay between the Indus River and Jhelum River. The Sind Sagar Doab was the most desolate tract of land that spread over a large area.

Emperor Babur, the founder of the Mughal empire gave a detailed description of the prevalent modes of irrigation practices[187] in India in his treatise 'Babarnamah.'[188] The volume talked about the perennial canals that were built during this period which had permanent head-works. These head-works did not extend across the entire stream and allowed the floods to pass over their crests and facilitated perennial irrigation.[189] There is also recorded evidence of perennial irrigation in the early 17th century when a 80 km long canal was constructed by Emperor Jahangir (1605-27) to bring water from the right bank of the Ravi to the pleasure gardens of Sheikhupura near Lahore. Some of the important canals constructed by the Mughal emperors included the Western Jamna Canal, Hasli Canal, Shah Nehr and a series of other inundation canals. Canals built by the Mughal rulers were not limited to irrigation as they were also used to provide water to the parks and gardens of the Mughal royalty.[190]

Understanding historical patterns of canal construction in the pre-British era has important linkages with the political imperatives of British rule. The expansion of inundation canals, which required relatively little in terms of permanent head-works, depict that such construction was not always a matter of technical innovation.[191] The regional Indus States that sought to consolidate their local power when the Mughal empire started to decline turned widely to inundation canal construction in the late 18th and early 19th centuries to provide an agricultural base for their control of local and regional elites.[192] Historically, the prosperity of the cultivator relied solely on the benevolence of the King but the Mughals did away with this system by developing an

186. Akbar, M. 1985. 'Punjab under the Mughal Raj', Vanguard
187. Khan, S, Tariq, R & Yuanlai, C. 2006. 'Can Irrigation be Sustainable?' Agricultural Water Management
188. Fahlbusch, H, Schultz, B & Thatte, C D. 2004. 'History of Irrigation, Drainage and Flood Management'
189. Ahmad, S. 2000. 'Indigenous Water Harvesting Systems in Pakistan', Water Resources Research Institute
190. Ul-Haq, A., 1998. 'Case Study of the Punjab Irrigation Department,' Consultancy Report, Pakistan National Programme, International Irrigation Management Institute, Lahore.
191. Gilmartin, D, 1994. 'Scientific Empire and Imperial Science: Colonialism and Irrigation Technology in the Indus Basin', The Journal of Asian Studies, Vol 53, No 4 (Nov 1994), pp. 1127-1149
192. Ibid.

irrigation system that farmers could depend on and ensured that revenue collection and its assessment was unbiased.

The construction of canals depended usually on the ability of the ruler to mobilize local elites and their followers in canal digging. Creating new communities of sharers in canal water and in their yearly obligations of canal silt clearance and maintenance kept the canal flowing during summer months.[193] This allowed not only the localised production of valuable commercial crops such as Indigo but also facilitated the definition of a structure of power linking the ruler and local elites together.[194] Though the ruler usually helped to organise canal silt clearance, canal sharers bore the primary responsibility for annually clearing the canals of silt. This was a service provided by irrigators using unpaid canal labourers known as *chhers* was in return for rights to take water. Increasing control of the environment particularly water resources proved critical to policy, but it was achieved less by direct control than by ruling regimes' ability to define and manipulate 'communities' of canal sharers, frequently dominated by privileged elites in order to mobilize the investment and labour necessary for expanding cultivation.[195]

5.3 Colonial Era: 17th – 19th Century

The early historical accounts of the basin including those of the British reflect military and strategic interests rather than concern for water resources.[196] One of the earliest interest of the British was recorded in the 15th century when Sir Thomas Roe, the first ambassador from England to the Mughal Court alerted the East India company to commercial prospects on the commodious river 'Syndhu' in his first letter dated 24 November 1615.[197] Over the next five years Roe frequently mentioned the *'famous and very requisite'* Indus in his communication describing its navigational potential and the rich traditions of its inhabitants.[198]

A message highlighting the region's agricultural prospects was also conveyed by merchant and sailor Alexander Hamilton in his three volume account of the East Indies which described his thirty five year experience (1688-1723) of the people and seasons of

193. Gilmartin, D, 1994. 'Scientific Empire and Imperial Science: Colonialism and Irrigation Technology in the Indus Basin', The Journal of Asian Studies, Vol 53, No 4 (Nov 1994), pp. 1127-1149
194. Ibid.
195. Ibid.
196. Weascoat, J. 1999. 'The Historical geography of the Indus Basin Management: A long-term Perspective 1500-2000,' in Meadows, A & Meadows, P.S (eds.) 'The Indus River: Biodiversity, Resources and Humankind', Oxford, Oxford University Press. pp. 416-28
197. Albenia, A. 2008. 'Empires of the Indus: The story of a River', John Murray, UK
198. Ibid.

the Indus region.[199] He observed that the region abounded richly in wheat, rice and legume and that the people never knew the misery of famine as the Indus overflowed all the low grounds in the months of April, May and June and when the floods receded, left a *'fat slime'* on the banks which was tilled easily before it dried up and brought forth *'plentiful crop'*.

Almost a century later, Alaxander Burnes, an officer serving in India for the East India Company revived interest in the economic prospects of the Indus and sought the opening of the Indus for trade and navigation based on his extensive survey of the Indus which he chronicled in his travelogue 'Travels into Bokhara' published in 1834.[200] The navigational proposition generated interest but was not pursued as investigations such as comparison of maps of the Indus made in 1817 and 1837 showed the river system to be *'highly unstable'*, subject to *'frequent flooding'* and *'change of course'*, especially at the mouth.[201] During the crop failures in the Indus basin in 1824-5 and 1832-3, the British who were already established in India did not offer any relief as their focus was on navigation on the Indus.

In 1844, Charles Napier a British General who had set out to conquer the Indus revived the plan for a steam boat firm on the Indus.[202] A company 'Indus Flotilla' was established in 1859 for steamers and barges to run cargo through the Indus tributaries but it eventually failed-partly because of the unpredictable nature of the Indus and partly because of competition from railway lines.[203] Ultimately it was canal based irrigation that came to the rescue and saved the East India Company from bankruptcy and ruin in its trade and navigational ventures on the Indus.

British interest in canal building and irrigated agriculture in the Indus basin began when the East India Company annexed Punjab in 1849. Until the 1857 revolt in Punjab, the British did not really interfere with local rules and customs with regard to irrigation in the Indus unless it interfered with their policies.[204] However after 1857, they began a focused effort to push irrigation systems to fertilise the land in the *'doabs'*[205] between Punjab's

199. Alexander Hamilton, 1727. 'New Account of the East Indies', available at http://www.archive.org/details/anewaccounteast01hamigoog
200. Burnes proposed to undertake a journey of exploration through the valley of the Indus in 1829 but he could not carry out his exploration project owing to political apprehensions. In 1831 Burnes was sent on a journey through the Indus to Lahore with a pretext of a present of horses from King William IV to Maharaja Ranjit Singh which supposedly could not withstand the treacherous journey over land: Source: Encyclopedia Britannica.
201. Albenia, A. 2008. 'Empires of the Indus: The story of a River,' John Murray, UK
202. Keith, A B, (ed.) 1922. 'Speeches & Documents on India Policy', 1750-1921, Volume I, London, Humphrey Milford, Oxford University Press, 1922, pp. 274-284
203. Gazetteer of the province of Sind by E.H.Aitken, 1907
204. Cullet, P & Gupta, J 2009. 'India: Evolution of Water Law and Policy', in Dellapenna, W J & Gupta, J (eds), 2009, 'The Evolution of the Law and Politics of Water', Dordrecht: Springer Academic Publishers.
205. The plains of Punjab form a system of interfluvial tracts, known locally as doabs or the land between two rivers.

rivers outside the action of river floods.[206] They became aware that the opulence of their State was contingent on the affluence of the cultivators. The first major canal project was the Upper Bari Doab Canal (UBDC) which was conceived as an expansion of an old Mughal canal but the work was expedited as it became necessary to provide employment for the disbanded Sikh soldiers who would otherwise have little encouragement to turn to agriculture.[207] The incentive towards agrarian development reduced the threat of an uprising in the newly annexed state.[208] This was centred around the old Sikh majority areas of Amritsar, Lahore and Gurdaspur. The 'canal colonies' formed by the British provided momentum for a growth that lasted for more than a century. These colonies underscored the linkages between canal building, agricultural settlement and political control.[209] It has been observed by some historians that the creation of canal colonies and a modern irrigation system was one of the primary reasons for water disputes in the Indus. In the absence of artificial systems for irrigation, the value of water would have been in ecological and social terms rather than commercial terms.[210]

During the famine of 1877, the British Government realized that there were no real back up provision for mitigating the impact of such a disaster. Traditionally safety nets in the event of such disasters were provided by the villagers in the shape of common knowledge shared in the community. With the replacement of traditional methods with the price mechanism (with price controls and taxes) and changes in crop production, there was no safety net when famine struck. Modernity that had replaced ancient common knowledge failed to be an effective mechanism in addressing the challenge. However the policy push after the famine was again directed towards building more canals as it was seen not only as a means for protection against famine but also as a means for sustaining State revenues.[211]

The irrigation network that materialized in this period was based on perennial canals that led off from head-works. It is estimated that between 1885 and 1947, there was an increase from 3,000,000 to 14,000,000 acres of land in Punjab (excluding princely states) that were irrigated by these canals. The British also wanted to assert their authority and

206. James, H, 1849. 'Canals of the Mooltan District', November 29, 1849, Selections from the Records of the Punjab Administration, Old Series No 1, India Office Records, London quoted in Gilmartin, D, 1994. 'Scientific Empire and Imperial Science: Colonialism and Irrigation Technology in the Indus Basin', The Journal of Asian Studies, Vol 53, No 4 (Nov 1994), pp. 1127-1149

207. Frost, H.F.B. 1904. 'Note by Superintending Engineer,' Bari Doab Circle on the History of Bari Doab Canal, Punjab PWD, Irrigation file no 355 of 1904, PWD Secretariat, Lahore quoted in Gilmartin, D, 1994. 'Scientific Empire and Imperial Science: Colonialism and Irrigation Technology in the Indus Basin', The Journal of Asian Studies, Vol 53, No 4 (Nov 1994), pp. 1127-1149

208. Mustafa, D. 2001. 'Colonial law, Contemporary Water issues in Pakistan', Political Geography 20 (2001), 817D

209. Nijjar, B S. 1968. 'Punjab under the Great Mughals,' 1526-1707 AD', Thacker

210. Aloys, M.A. 1967. 'The Indus Rivers: A Study of the Effects of Partition,' New Haven: Yale University Press

211. Stone, I 1984. 'Canal Irrigation in British India: Perspectives in Technological Change in a Peasant Economy', Cambridge, Cambridge University Press.

stabilize 'frontier regions'. For example, in the Upper Sindh frontier, development of canals was a catalyst to guide the hostile tribes towards peaceful agricultural occupations. British policy also fostered investment in canal development by larger land lords and pastoral chiefs, as a potential measure of stability and peace in the region.

The colonial canal building era essentially consisted of two stages: in the first stage existing canals were renovated while in the second phase inundation canals were gradually converted into perennial canals. Between 1876 and 1885, thirteen other canals were constructed that drew water from the Sutlej River. From Ravi River, Sidhani canal was reconstructed, which irrigated lands around Multan District. The inundation canals in Punjab were Khanwah, Katora and Grey canals on Sutlej River. In Sindh, Mitharao was the first canal built along the eastern Nara channel of the Indus River. The weir on the Jamrao canal (perennial) across the Nara River, irrigated the Tharparkar district. Ghar canal was another important canal, which originated 50 km downstream of Sukkur and followed a natural offshoot of the Indus River. The Sukker canal branched off from the right bank of the Indus and followed an old channel. Generally, the Sindh inundation canals were built at a lower level than the river and they received water only when the river was flooded.

The Lower Chenab canal was the first canal constructed by the British to bring irrigation water to wastelands occupied by the pastoral nomads.[212] The arrangement to turn the Sandal bar area (now Sheikhupura, Toba Tek Singh and Faisalabad) in the Rechna Doab into a large organized colony tested engineering skill and dexterity of the British. A weir was erected across the Chenab at Khanki village in Gujranwala district to control the water supply to the main canal. With a release of 311 cusecs it was one of the major irrigation projects in 1892. A related project was sanctioned in 1897, which irrigated the area between the Chenab and the Jhelum (Chaj Doab) from a weir at Rasul on the Jhelum River. The Lower Jhelum Canal opened in 1901, caused profits from agricultural land to increase by 20 percent by 1920.

By 1901 four of the five rivers of Punjab were canalized or dammed which not only accelerated grain production but also dramatically increased tax revenues that could be sent to London.[213] Punjab became a model province for the British in terms of productivity and peace but the region of Sindh in the Indus basin remained a challenge. As the report of the Indian Irrigation Commission stated regretfully in 1903, 60 percent of surface water ran out as 'waste' into the sea through the Sindh region.

212. Arthur, A. 1967. 'The Indus Rivers: A Study of the effects of Partition'
213. Albenia, A. 2008. 'Empires of the Indus: The story of a River', John Murray, UK

The Sindh gazette noted that the idiosyncrasies of the delta's cultivation methods and the fact that rice (and only rice) grew abundantly. With its frequently flooded paddies shifting settlements and semi nomadic farmers the unhealthy delta did not fit into the picture of a viable or desirable agricultural model. For the British who wished to transport grain quickly into northern India it made better economic sense to develop Punjab and upper Sindh than to defend the strange agrarian culture of the mangroves.

The Triple Canal Project was endorsed in 1905, and became the first project to move water from one river to another. This project curtailed the transfer of available water in the Jhelum River across two Doabs. The need for this project arose when the water from Ravi River was insufficient to inundate lower areas of the Bari doab. The project consisted of a feeder canal[214] from the Jhelum River at Mangla to the Chenab River above Khanki (Upper Jhelum Canal), a feeder canal from Marala on the Chenab River to the Ravi River at Balloki, to divert the transferred water into the new Lower Bari Doab Canal (LBDC).

By the 1920s, the British were eager to supply Lancashire's cotton mills with more raw material and so began to examine how to irrigate Sindh's rainless deserts.[215] Irrigation projects under way upstream in the Punjab and those planned for Sindh alarmed the Sindhis for if the level of water went down, navigation would be harmed and the impact on fishing and agriculture would be devastating. But the British officials dismissed these concerns believing that there was enough water to go around. A site was chosen for Sindh's first barrage at Sukkur in the North of the province and after some delay work began.[216] The Sukkur Barrage completed in 1932 was the first barrage constructed on the Indus River. The Sukkur barrage changed Sindhi society for ever as the huge expanse of wasteland was transformed into fertile agricultural regions almost overnight.[217] Grain and cotton exports in turn helped Karachi to become a world class port. Landowners and administrators lavished praise upon this development which was said to be the biggest irrigation project in the world.[218]

During 1921, the Sutlej Valley Project was sanctioned for the development of the Punjab, Bikaner (now in India) and Bhawalpur state areas. The project consisted of four weirs on the Sutlej River at Ferozepur, Sulemanki, Islam and Panjnad while eleven more canals were completed by 1933. The Trimmu Barrage, was the last barrage completed

214. A canal serving to conduct water to a larger canal.
215. Albenia, A. 2008 Empires of the Indus: The story of a River, John Murray, UK
216. Ibid.
217. Ibid.
218. Ibid.

prior to the Second World War. This was located below the junction of the Jhelum and the Chenab Rivers and was to be completed in 1937.

Revenue generation from agriculture which was an integral part of the British administration in India in general and Punjab in particular was quite successful. At the turn of the 20th century, about one sixth of the total revenue of Punjab was from agriculture.[219] The British considered it a prerogative for the State to gain a share of the annual produce of each unit of land. This was in contrast to the system under the Mughal regime, during which the precise share of the State varied according to local conditions: weather conditions, variability in soil fertility, average price variations in cropping patterns and sources of irrigation. Furthermore, the method of assessment and revenue collection was undertaken and enjoyed by different ranks of employees and dependents of the State. This extremely flexible method was remarkable and the British embraced only some aspects of this system.[220]

The British also had a strong intention to develop a market from a capitalist viewpoint. This was a drastic break with the past, which manifested from the introduction of new intermediaries between the State and the taxpaying masses. These people were usually induced to abandon traditional restraints, and hence to discard the old recipe that helped mediate the burden on the typical village peasant. Collection of taxes in cash and not in kind, and miniscule efforts by these intermediaries for the diversion of taxes towards the maintenance of capital, greatly affected the knowledge systems and traditions that had helped build and preserve water-management techniques in the region. However, this system failed to create the capitalist landowner class that had been desired. Furthermore, transfer of power from 'Zamindars' to these new agricultural intermediaries led to the demotion of peasant's occupational rights and the customary rights to fixed revenue rates.[221]

In the Mughal era, the tax burden for the irrigation system was based on a land-water combination. The move to colonial revenue generation and its claim to tax land only led to many revelations regarding the efficiency and domination of the State. One significant outcome of such a transfer of power was the decline of the traditional irrigation system in colonial India. After the introduction of new revenue generation mechanisms by the British, the impact on the roles and responsibilities of tenants and

219. Habib, Z. 2005. 'Pakistan: Indus Basin and Water Issues,' South Asia Journal
220. Banerjee, A. 2005. 'History, Institutions, and Economic Performance: the Legacy of Colonial Land Tenure Systems in India', The American Economic Review
221. Baden, B H . 1907. 'A short Account of the Land Revenue and its Administration in British India: with a sketch of the land tenures'

landlords was ambiguous.[222] The move from taxing variable agricultural production to fixed yields and the subsequent move to cash from in-kind tax collection, 'upset the rhythm of procedures' between the agrarian stakeholders. The allocation of roles to service and maintenance of tanks and channels were greatly perturbed due to duties being obscurely defined by the administration. The attempt to create a mechanism that highly valued profits and revenue and the commercialization of produce and dissembling community control over the water and land resources led to the subservience of the native population but it served the purpose of the British which was to control the operations of the irrigation system.

The British were however, not oblivious to the fact that traditions in Punjab played a pivotal role in agricultural practices. In 1891, the Revenue Secretary of the Punjab Government explaining this phenomenon wrote to the centre:[223] *'it seemed essential to preserve the tradition of Punjab as a country of peasants' farmers. No other general frame of society is at present either possible or desirable in the Province. Capitalist farming in general is not a system suitable to Punjab. But a moderate infusion of the capitalist element is not out of advantages. It supplies natural leaders for the new society; it gives opportunity to the Government to reward its well deserving servants, and to encourage the more enterprising of the Provincial gentry; it attracts strong men who are able to command the services of considerable bodies of tenants; it furnishes a basis from which agricultural improvements may be hereafter extended, and lastly, it enables Government to obtain a better price than might be otherwise possible for the ownership as distinct from the users of land.'*[224]

The British considered perennial canal construction as a product of ingenuity in engineering and technology. Technicians, urban mercantilist and most intermediaries believed that science had provided excellent support for achieving a rise in yield and increase in land area. However, there was another side to this rabid belief. Perennial canals increased water-logging and salinisation. With irrigation systems, much like most other large-scale technological development, a complete picture of the pros and cons is evident only with the passage of time.

Perennial canals did not require annual, large-scale recruitment of labour for silt clearance as was necessary for inundation canals. Unpaid *chher* labour[225] provided by the irrigators during the winter clearance season were considered by the British as a form of coercive slavery that undermined the guarantees of private property. However, this form of labour was a symbol of customary and community cohesion that had been practiced

222. D'Souza, R. 2006. 'Water in British India: The Making of a 'Colonial Hydrology', Jawaharlal Nehru University, New Delhi
223. Habib, Z. 2005. 'Pakistan: Indus Basin and Water Issues,' South Asia Journal
224. Ali, I. 1988. 'The Punjab under Imperialisation 1885-1947', Princeton: Princeton University Press
225. Whitcombe, E. 1860. 'Agrarian Conditions in Northern India: The United Provinces Under British Rule 1860-1900

since many generations. J. B. Lyall, later Punjab Lieutenant-Governor, was one of the few Englishmen who supported the system of *chher* labor. He stated: *"…not only on grounds of economy of management, but also on the ground that it tends to preserve and promote self-government. The system is solidly founded on custom, and suits the habits and circumstances of the people concerned"*.[226] However the Chher labour practice was eventually abolished during colonial times and the problem of silt management was addressed through science and technology. Silt management was based on a mathematical formula which controlled the slope of the canal and water velocity devised by R G Kennedy, the Chief Engineer of Punjab.[227]

Warabandi, a rotational method for distribution of irrigation water, with fixed time allocations based on the size of landholdings of individual water users within a watercourse command area was an institutionalized system in the Indus basin originating in the pre-colonial times.[228] The primary objective of the method was to distribute scarce water in an equitable manner over a large command area. For *warabandi* to achieve this objective, the system was designed with minimum control to allow a 'free flow' of water into the outlets, so that each water turn receives its proportional share.[229] When the British started to build the canal irrigation network, *warabandi* was adopted from an existing practice as a water distribution method at the watercourse level. This changed with social and economic conditions and the original farmer-managed *kachcha* (unofficial) *warabandi* tradition shifted to the more rigid *pucca* (official) *warabandi* schedules.[230] The Canal and Irrigation Act of 1873 limited the number of outlets and fixed the area to be irrigated from each channel in the name of efficiency and this contributed to the watering down of the *warabandi*. Though still in operation it is neither equitable nor as efficient as it was in the pre-colonial era.

The British emphasised water use efficiency, which loosely translated meant 'using as much water as was possible through technically integrated irrigation networks including but not limited to old inundation canals.' Technical irrigation expertise was treated as a mathematical discourse shared with engineers across the world. The hydraulics of irrigation canals and dam construction had little to do with local knowledge.[231] The pre-

226. Lyall, J B. 1882. 'Memorandum by Financial Commissioner', Punjab, August 2, 1882. Punjab Revenue and Agriculture, Irrigation, London
227. Sharma, K R. 1948. 'Irrigation Engineering,' Jullundur: India Printers
228. Bandaragoda, D.J & Rehman, S. 1995. Warabandi in Pakistan's Canal Irrigation Systems: Widening Gap between Theory & Practice. International Irrigation Management Institute
229. Ibid.
230. Ibid.
231. Gilmartin, D, 1994. 'Scientific Empire and Imperial Science: Colonialism and Irrigation Technology in the Indus Basin', in the Journal of Asian Studies, Vol 53, No 4 (Nov 1994), pp. 1127-1149

eminence of engineering, science and technology initiated during the Colonial period slowly eroded the traditional community based water distribution and management practices.

The land use patterns in the Indus basin which traditionally emphasized the physiographic patterns of the region changed into 'rectangulation' during the colonial era.[232] Creating irrigated fields out of waste land had many social advantages from the British perspective. It increased agricultural production to meet the needs of the growing population and it evicted those whom the British referred to as 'un-taxable' nomads who were thought to be using the desert for low intensity grazing or as a refuge from law.[233]

The ecological consequences of this rigid scientific approach were significant. By enabling the storage of huge amounts of river water and viewing each drop that went to the sea as 'waste' what the engineers ignored was the need for plenty of fresh water downstream in the Delta in order to maintain a healthy balance with the salt water from the sea and thus safeguard the unique ecosystem of the mangroves, shrimp bed, fish and farmers.

The British are credited with the development of an integrated irrigation system but some historians argue that it was not the result of an integrated plan. While it is true that the British controlled all the main provinces along the Indus basin, the canal system was the combination of several unconnected ventures of canal building which were embarked upon in isolation at different times and in different provinces.[234] As the canals were not a part of an overall master plan it led to arbitrariness in constructions and increased rivalry between the provincial governments in Punjab, upstream and Sindh downstream. Fuelled partly by political needs of each province and partly by the commercial revenue needs, the competition led to dispute over water allocation.[235] Shishir Gupta argues that even without partition, the regional disparities created by the uneven development of the Indus valley would have raised inter-provincial problems.[236] He observes that the British concentrated on land that they owned, marginalising

232. Holmes, D.A. 1968. 'The Recent History of the Indus', The Geographic Journal, Vol.134. No 3 (Sept 1968) pp. 367-382.
233. James, Lt. Hugh.1849. 'Canals of the Modern District: Selections from the Records of the Punjab Administration,' Old series No 1, India Office Records quoted in Gilmartin, D, 1994. 'Scientific Empire and Imperial Science: Colonialism and Irrigation Technology in the Indus Basin', in the Journal of Asian Studies, Vol 53, No 4 (Nov 1994), pp. 1127-1149
234. Khosla, A.N. 1958. 'Development of the Indus River System: An Engineering Approach', India Quarterly, Vol XIV, No 3 (July-September), pp. 233-53.
235. Allouche, J. 2005. 'Water Nationalism: An Explanation of the Past & Present Conflicts in central Asia, The Middle East and the Indian Subcontinent', PhD Thesis, University of Geneva
236. Gupta, S. 1960. 'The Indus Water Treaty 1960', Foreign Affairs Reports, Vol 9, No 12 , pp. 153-163, December, Indian Council of World Affairs

privately owned land as well as land that belonged to the princely states which were also in need of irrigation. According to him, it is this inequality that sowed the seeds of discontent which eventually became an international quarrel when Punjab was spilt between Pakistan and India.

In 1947, the waters of the Indus system irrigated 26 million acres annually but this was far below the maximum potential of the Indus basin which was estimated to be about 65 million acres in the plains and 58 million above the rim stations.[237] One problem that remained unaddressed at this time was that there was no water storage anywhere along the basin. While irrigation could be increased by constructing new canals the water had to be taken as it flowed. Within a given canal system what was taken upstream could not be used downstream. The absence of storage meant that the huge surplus that was available in the monsoon months from June to September flowed out to the sea. There were no hydro-electric projects in the entire river system and all the canals depended on the storage provided by snows and glaziers of the Himalayan Mountains. The lack of storage is cited by some authors as a factor that contributed to the current upper versus lower riparian tensions.

5.4 Post Independence: 1947-2010

The partition in 1947 divided the Indus plains between two national jurisdictions. Pakistan and India were at odds over how to share and manage what was essentially a cohesive and unitary network of irrigation. For thirteen years after independence, the two countries maintained the system but this was a period with latent inefficiencies, continued hostility and a wider anticipation of a final settlement. The Radcliffe Award in Punjab, received condemnation from both countries. It entitled the head-works in some districts to India while the entire network of canals extending from those head-works to Pakistan. In this hostile environment, India and Pakistan began implementing unilateral plans for Nation building which included strategies to control and utilise waters of the Indus for agriculture. As Rohan D'Souza puts it *'this was a period that left unquestioned the idea of progress, insisted upon the supreme belief in development, inculcated faith in modern technology and advocated an unwavering confidence in positive science'*.[238]

237. Gulati, N.D. 1973. 'Indus Water Treaty: An Exercise in International Mediation,' Bombay, Allied Publishers
238. D'Souza, R. 'Framing India's Hydraulic Crisis: the Politics of the Modern Large Dam'.

5.4.1 Pakistan: Ground Water Use and Flood Management

Pakistan began building the Kotri barrage just north of Thatta. This dam like those that followed was supposed to solve the country's problems. While the dam is said to have facilitated the mass production of cash crops Kotri also began the trend of the next sixty years; growing debt to Western banks, experts and construction firms.[239] Following the construction of the Kotri barrage in 1958 the Delta shrank from 3500 to 250 square kilometers. Then Tarbela dam, the biggest dam of all was built. No attention was paid to the cries of the delta farmers that dams will destroy deltas. Wealth and money lay in the cotton fields of Punjab and Northern Sindh which according to many historians gave the (military) rulers all the power to control the entire country through the control of a hundred year old centralized irrigation system.[240] The Pakistani Government thus invested heavily in irrigation infrastructure as it was their primary means to control the society.

Ground Water use in Pakistan (see paper by Shah Bakht Sohail in Section 6) is not very different from that in India though it was initiated towards meeting different objectives. The focus of groundwater policy in Pakistan was on control of water logging and the stimulation of private tube well development. Government interventions were supply driven there was little concern about over exploitation of aquifers or deteriorating groundwater quality.[241]

Due to the inadequate provision of drainage facilities during the development of the canal irrigation system in the Indus Basin (Pakistan), water logging occurred throughout the Basin. Associated with water logging was the phenomenon of salinisation of the soil from capillary rise and evaporation of the mineralised groundwater. Water logging and salinity left irrigation areas unfit for irrigating. The Pakistan Government's response to this was the crash program for reclamation of land known as the Salinity Control and Reclamation Projects (SCARP), combating high water tables primarily through vertical drainage.

In 1954, the large tube well drainage scheme started and soon a second benefit of the drainage tube wells was realized: where the tube wells pumped fresh groundwater, they

239. Albenia, Alice. 2008. 'Empires of the Indus: The Story of a River,' John Murray, UK
240. Ibid. N 65
241. Groundwater Development and Management in Pakistan, p. 2

not only lowered ground water tables, but they also augmented surface irrigation supplies in Pakistan. In much of the affected areas, the programme did wonders, converting the saline land into productive land. In fresh groundwater areas, the SCARP drainage tube wells doubled as an as additional source of water. Also, the government in several ways supported private groundwater exploitation. Foremost was the provision of power-supply to tube well owners. The electric charges moreover were subsidized.

For tube well owners in Punjab (Pakistan) and Sindh they were 40 percent less than the normal rate and in Balochistan and NWFP the subsidy even amounted to 60 percent. Tube well development was further promoted through a series of government programs, which provided free pump sets and wells and tube well loans under soft conditions. However, groundwater is not a 'renewable resource' as originally assumed. It is depleting fast, and its management in Pakistan offers certain challenges. The overexploitation of the groundwater during the SCARP Programme, as well as afterwards when the government offered subsidies for the exploitation of groundwater in the form of soft loans and cheaper fuel for the purposes, has led to the reverse problem of falling water tables in Punjab in Pakistan.

Punjab (Pakistan) in this sense is a paradox: it has places where the water table is so high that it leads to water-logging. Those are the areas where the tube wells have not been installed yet. Then, there are those areas where ground water has been over exploited leading to a fall in the water table, leaving the area unfit for irrigation. Groundwater policy in Pakistan relied on public investment and subsidies rather than on regulation. Legislation was not enforced. It was not clear whether the federal government or the provincial governments in Pakistan should regulate groundwater exploitation. All policies initiated so far were formulated and implemented at federal and provincial level. The involvement of local government was minor. There was no involvement of local farmers' organisations as local governments and farmers' organisations are weak in Pakistan.

Yet another consequence of rapid agricultural development and economic growth in Pakistan is the occupation of the flood plains of the Indus by human habitations. Large scale irrigation projects in the Indus delta have turned them *'from being flood dependent agrarian regimes into flood vulnerable landscapes'* as D'Souza puts it. This has also given rise to the misplaced perception that floods are 'unnatural' and that they have to be 'controlled' (See paper by Ali Shah in Section 6).

Barrages were the most important man-made structures that the Indus torrents encountered on their way to the Arabian Sea in Pakistan. Barrages raised the water level in rivers so that irrigation canals could be fed. In making barrages, the natural course of the river was diverted. Barrages were preceded by training works, guide bunds, and marginal bunds because of the pressure the river exerted on the sides when its course was being changed. These structures were technically designed to withstand the water pressure to protect neighbouring communities. Standard operating procedure dictated that all maintenance and development works on these structures end before the flood season starts on 15th of June every year because of their critical importance. This was openly violated in the case of Jinnah Barrage located at Kalabagh. An emergency repair work, incidentally started over a year ago, on the downstream Apron of the Jinnah Barrage was still in progress when the flood hit the barrage in late July 2010. Due to this work, around 10 gates out of a total of 56 gates of the barrage were closed, leaving 46 gates to take all the pressure. This resulted in increased pressure on the barrage and its allied structures as the closed gates provided an obstruction to the flow of water. As the Irrigation Department tried to get these gates opened, a swirling action of waves resulted in a parallel flow alongside the Left Guide Bund of the barrage, which collapsed exposing the neighbouring communities to bear the brunt. This unfortunate tragedy in Pakistan stand testimony to Iyer's observation that 'flood control' is an unfortunate term. Floods are natural phenomena which occur periodically in a river and that they cannot be prevented or controlled. Efforts to control them could in fact lead to adverse consequences.[242]

5.4.2 India: Irrigation and the Green Revolution

Pakistan was not alone in assuming that large hydraulic structures were the answer to food and water shortages.[243] An important part of India's plans for agricultural and industrial development was the utilization of the country's water resources, particularly through multipurpose river valley projects. The Irrigation and Navigation Commission, a government agency set up in the post-war period to plan and promote such projects, declared that only about five percent of India's water resources are were being utilized, irrigating some 46.89 million acres, or 19 percent of the cultivated land, and producing about half a million of an estimated potential of 40 million kilowatts of electric power.[244] To harness these resources, there were in the 1950s some 46 river valley projects planned

242. Iyer, R.R. 2011. 'Wrong and Right Thinking about Rivers', lecture delivered at Jawaharlal Nehru University on 13 June 2011
243. Morgan, L. 1952. River Development in India', Far Eastern Survey, Vol 21, No 8 (May 21), pp. 82-83
244. Ibid.

or under construction, by both the central and state governments. At a cost originally estimated at over four billion rupees ($300 million), they were intended to provide irrigation for about 8.7 million acres and production of about 1.1 million kilowatts of power.[245]

The Bhakra Nangal Project of India on the Sutlej was critical to the agriculture revolution that followed in the next few decades. It was famously described by India's first Prime Minister Jawaharlal Nehru as *'something tremendous, something stupendous, something which shakes you up when you see it* and that *'Bhakra', the new temple of resurgent India, was the symbol of India's progress.'* The proposal to construct a storage reservoir on the Sutlej originated in a note dated 8 November 1908 by Sir Louis Dane but the project took more than fifty years to be completed.[246] Bhakra Nangal was designed to provide annual irrigation to some 1.46 million hectares in Punjab, Haryana and Rajastan[247] and it is widely used as a proxy for India's or more specifically Punjab and Haryana's agricultural success even though there are studies that have argued that ground water mining contributed more to the regions' success than surface (Indus) water.[248] Bhakra Nangal which was expected to irrigate over 2 million hectares was made possible by cutting off a near equivalent amount of supplies for the Sutlej Valley project in Pakistan.[249]

In the beginning of the 1960s, agricultural practices of Pakistan and India were generally described as 'traditional' and 'incredibly low in yields', 'inefficient' and one that 'routinely led to food shortages' and 'famine'.[250] An early 1960s article in the Ford Foundation's involvement in Intensive Agriculture in India described India as 'richly endowed with sunshine, vast areas and a long growing season' but 'the solar energy, soil for irrigation and water for irrigation are the most under-used in the world'.[251] Soon after this article, the Ford Foundation established itself as one of the major founders of the Green Revolution.

It is widely believed that the 1960s marked the beginning of India's green revolution. However experts have shown that a large percentage of India's rice paddies had been replaced by new varieties developed in the colonial agricultural departments in Punjab and Madras (now Chennai) and that farmers in Punjab were planting three new varieties

245. Ibid.
246. Bhakra Beas Corporation website
247. Vaidyanathan, A. 2005. 'Flawed Critique of Bhakra', Reviews, Economic & Political Weekly, Vol 40, No 49, Dec 3-9, pp. 5166-5169
248. See for example, Dharmadhikary, S, Sheshadri, S, Rehmat, 2005. 'Unravelling Bhakra: Assessing the Temple of Resurgent India', Manthan Adhyayan Kendra
249. Dharmadhikary, S, Sheshadri, S, Rehmat, 2005. 'Unravelling Bhakra: Assessing the Temple of Resurgent India', Manthan Adhyayan Kendra
250. Newman, B. 2007 'A Bitter Harvest', Institute for Food and Development Policy
251. Shiva, V. 1991. 'The Violence of the Green Revolution', Zed Books

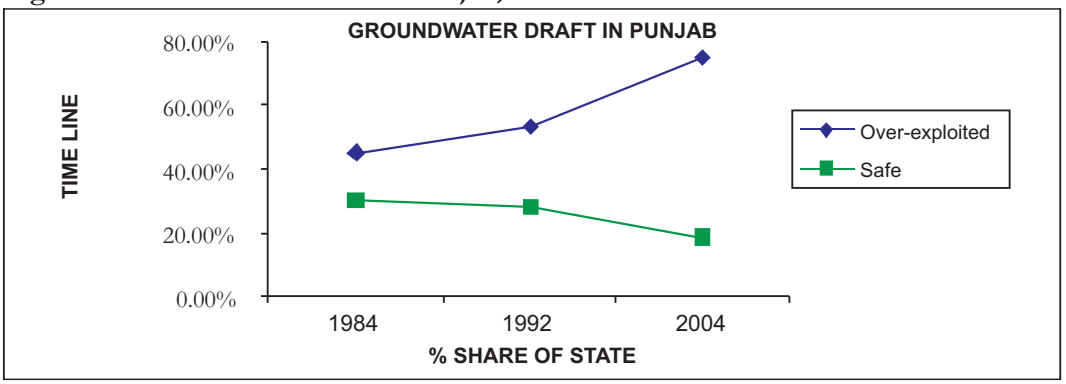
of sugar cane within a single generation aided by canal based irrigation in the late 19th century.[252] The formal 'green revolution' in India initiated in the 1960s was completely dependent on new high yield varieties of seed which in turn required new varieties of fertilizers and increased irrigation. Between 1960 and 1980 yields for wheat in Punjab increased by 124 percent and yields for rice increased by 175 percent.[253] This result was achieved partly by the 'building on the best' strategy proposed by the visiting American delegation in 1959 which meant that the target of the green revolution were the largest farmers in Punjab with large acreages irrigated by the British canal system.[254]

In the context of this report, two consequences of the green revolution and its attendant policies are worth noting: the Green Revolution seeds and technologies were dependent on much heavier irrigation than the canals, let alone what the monsoon could provide. The new seeds used three times more water than did traditional ones.[255] Most of these increased irrigation needs were met through a dramatic increase in wells and tube wells in Punjab. Between the 1960 and 70s well use for irrigation increased by 80 percent.[256] The combined power of one million tube wells in Punjab was pushing ahead grain production and thus contributing to India's 'food security' while imposing irreversible damage on its fragile ecology, specially on its under ground aquifers of which over 60 percent are overexploited and in a state of terminal decline.[257] As Iyer points out in a letter concerning a critical report on the Bhakra Nangal and the Green Revolution that 'the provision of irrigation was part of the Green Revolution strategy' and that 'part of the criticisms of the Green Revolution must apply to large irrigation projects as well.'[258]

The second is the social consequence where farmers with substantial holdings (more than fifty acres) experienced a qualitative change in their lifestyles comparable to that of the urban middle class in India while those with smaller holdings who were in fact the majority suffered absolute and often irreversible decline.[259] Even the Punjab Human Development Report (2004) points out that the shift toward larger and larger farms has meant 'duel processes of pauperisation and proletarianisation' in Punjab.[260]

252. Baker, C. 1984 in Bayliss-Smith, T and Wanmali, S. 'Understanding Green Revolutions', Cambridge, Cambridge University Press
253. Mc Guirk, A & Mundlak, Y. 1991. 'Incentives and Constraints in the Transformation of Punjab Agriculture,' Research Report 87, International Food Policy Research Institute
254. Shiva, V. 1991. 'The Violence of the Green Revolution', Zed Books
255. Ibid.
256. Agnihotri, P. 2002 'Tube wells, Drilling for Deep Trouble', The Tribune 16 February 2002
257. See Annex II
258. Iyer, R.R. 2006. Bhakra Nangal and the Green Revolution, Letters, Economic & political weekly, January 7, 2006
259. Frankel, F. 1973. 'Politics of the Green Revolution: Shifting Peasant Participation in India and Pakistan', in Food, Population, Employment: The Impact of the Green Revolution
260. See full paper by Inderjeet Singh in Annex II for more on the social consequences of heavy input based agriculture in Punjab

Figure 5.1 Groundwater Draft in Punjab, India

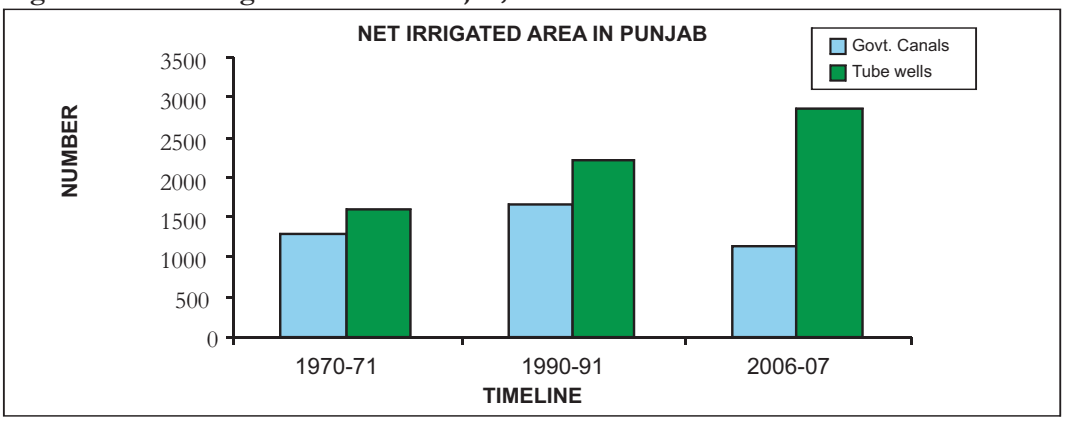


Source: Central Ground Water Board, Punjab.

In India, the structural shift to ground water use in Punjab was also driven by competitive state level electoral politics that had made a habit of giving away electricity free to farmers. The source of irrigation in Punjab (India) shifted from the canals to the tube-wells, with the availability of the free or subsidized electricity to the farmers and other governmental policies encouraging the use of electric tube-well instead of diesel pumps. As a result, the number of the tube wells went up from 0.197 million in 1971 to 1.27 million in 2009. An analysis of the net irrigated area revealed that about 28 percent of the total area is irrigated by surface water or canals and rest 72 percent of the area is irrigated by tube-wells and wells (see paper by Inderjeet Singh in Section 6).

Strong growth of the agriculture in Punjab (India) was through a chemical and water centred production system. The increased use of chemical fertilizers and pesticides, development in infrastructure, consolidation of land holdings, expansions of irrigation facilities led to an increase in the rice and wheat production in the area. With little or no augmentation of the canal system, surface water supply in Punjab has remained almost constant since the early eighties. Volumetric estimates varied between 12.34 and 13 million acre feet (15.2 and 16 billion cubic meters) during the 15 yrs preceding 1985. Further, low and decreasing water-use efficiency of surface water management has been a common concern of water systems all over India.

Figure 5.2: Net Irrigated Area in Punjab, India



Source: Statistical Abstract, Govt. of Punjab, various issues

110 blocks in Punjab (India) are over exploited as groundwater withdrawal is more than 100 percent, 3 blocks are at critical stage where groundwater withdrawal is between 90-100 percent, 2 blocks are at semi critical stage where the withdrawal is between 70-90 percent and 23 blocks are safe having groundwater withdrawal less than 70 percent. The safe blocks are located either in foot-hill region that has deep groundwater or in the region having poor quality groundwater.

The average groundwater exploitation is 166 per cent in Punjab (India). During the last decade the average fall of water table in the state was 0.55 m/year. The general direction of groundwater flow is from North-east to South-west. Water table decline has serious economic impact on the farmers as they have to install deep submersible pumps to draw water from deeper aquifers in Punjab (India) also resulting in higher energy consumption for pumping. Additionally water availability may decrease as a result of climate change. Competitions from industrial and household sectors as a consequence of demographic growth, rapid industrialization and urbanization will also reduce water availability for the agricultural sector (See paper by A K Jain in Section 6).

5.5 Conclusions

Pre-colonial agriculture and water use practices were adaptive to natural processes: tanks, inundation canals, wells water wheels etc harvested what nature provided in the form of rain, floods or underground aquifers.[261] They were sustainable but did not generate huge surpluses. Colonisation aimed to command nature when it instituted a dramatic break with the past through canal based perennial irrigation.

Table 5.1: Agricultural Practices & their Consequences

PERIOD	STRUCTURAL / SOCIAL	ECONOMIC	ECOLOGICAL
Pre-colonial	Community based, pastoral and nomadic agriculture	Subsistence level production, poor	Highly sustainable
Colonial	Technology and Science intervene and separate man and nature; separation between segments of the society who could and could not appropriate technology	Surplus production, rich	Sustainable in the short-term
Post Colonial	Intense use and abuse of technology; heavy input based monoculture production, polarisation of communities	Surplus for the minority and subsistence for the majority	Unsustainable

It brought three major influences in the Indus basin: a transformation from a resource gathering and food production economy into a commodity-oriented economy; a change in long-standing social relations and customs as local social relations became less

261. D'Souza, R. Framing India's Hydraulic Crisis: The Politics of Large Dams

important and social cohesion declined; and the development of the market and the importance given to wealth.[262] Commercial production became more important than subsistence, exploitation more important than conservation, and the individual more important than the community. While colonization in Pakistan and India was less aggressive than in Africa, it deforested large tracts to give way for access to coal and timber and to promote agriculture. The State gradually took ownership of forests and community irrigation and usufructuary schemes were dismantled. Water logging and salinity problems increased and small-scale irrigation schemes broke down leading to impoverishment of the small farmers.

If the British put irrigation and agriculture in the Indus delta on an overdose of vitamins, independent Pakistan and India put it on steroids. The Indus river delta which once carried 180 billion cubic meters of water into the ocean weaving an intricate and complex ecological landscape along its journey is now a caricature of its original self. The dams and diversions built by Independent Pakistan and India have reduced its flow at the tail end to less than a tenth of its historical level and the landscape is scarred with the wounds of input intensive agriculture. A complex web of domestic policies combined with a competitive approach to appropriating water under the Indus Water Treaty is further aggravating the already fragile basin.

Pakistan and India divert more than 90 percent of the Indus water and extensively 'mine' ground water to support a system of agriculture that has one of the lowest productivities in the world in terms of per unit of water and per unit of land. Both use the narrative of 'water-scarcity' and 'water-security' in domestic hydro-political discourses to cover poor water governance, gross negligence, inefficiency and mismanagement of water resources. The fetish for 'yields' in agricultural production continues despite its huge environmental and social costs. In July 2011, the Prime Minister of India awarded the Punjab State the 'Krishi Karmana' award for achieving the highest ever food grain production in 2010-11 without using the occasion to acknowledge that this had come at a huge environmental and social cost.[263]

In this context, the ecological failure of the Indus Water Treaty is quite notable. As pointed out by Rohan D'Souza, the ecological consequences of this over-exploitation have been little studied and little understood in terms of long term implications for both

262. Gadgil, M., & Guha, R. 1992 'The Use and Abuse of Nature', New Delhi: Oxford University Press quoted in Dellapenna, J.W. & Gupta, J. (eds), 2009, 'The Evolution of the Law and Politics of Water', Dordrecht: Springer Academic Publishers, 2009.
263. Press Information Bureau, Mumbai, 16 July 2011
264. 121. D'Souza, R. 2011. 'Cusec Deadlock: The Indus & Hydropolitucs in a Fault Zone, Presentation at the Conference "Blue Revolution: Charting South Asia's Water Future' in New Delhi on 11 April 2011

the flood plains of Pakistan and the 'upper riparian' sections of the rivers lying in India.[264] He rightly argues that a different set of institutional arrangements will be required between India and Pakistan to reverse policy away from the volumetric/quantitative and engineering notion of river control. Instead of a technical and technology based approach run with the narrow expertise of engineers and state negotiators, the new compact for river sustainability in the region would require different social constituencies and their experiences with the Indus waters. This would involve drawing upon and fostering cooperative dialogues between river communities on both sides of the border; such as fisher folk, irrigation dependent farmers, river ecologists, water historians, sociologists and aquatic specialists. These plural narratives can imbue the IWT with a much needed ecological sensitivity. By acknowledging rivers as complex ecological entities, water sharing strategies between Pakistan and India will crucially depend on how a range of otherwise ignored historical and social fluvial experiences in the region are deployed to deal with flow variability. Water politics between Pakistan and India, urgently needs an ecological dimension and must be able to think from the delta-upwards.

6 Annexures

6.1 Background Papers for Mapping Water Use Practices

6.1.1 Hydro-Politics, the Indus Water Treaty and Climate Change: Writing a New Script for the Indus Rivers

Rohan D'Souza, Asst. Professor, Department of Social Sciences, Jawaharlal Nehru University

Introduction

Discussions on the Indus Rivers have become overwhelmingly strategic. Flows are matters of political contest, vested interests and above all else, national security. Ironically enough, such strident noises over the division of waters have mostly avoided meaningful attempts to recall the region/watershed's often times troubled, histories. It is, as if, the Indus Water Treaty (IWT) of 1960 could be almost nonchalantly deployed to snip vast flowing courses into neat divisible segments and with equal ease 'rationally' allocate immense volumes between nations. That is, a mere blunt knife approach can comprehensively sever and move about a complex hydrology without so much as an afterthought about disturbing delicately poised fluvial ecologies or the implications of coarsely stirring whole river-based communities.

The IWT—with this structured 'forgetting' of the Indus basin's many pasts and varied environments—not unexpectedly, is often concluded by experts to be a 'successful' legal-technical arrangement that has suffered from frequent and exceptional political 'misperceptions'. It can, however, be more convincingly argued the other way. The IWT

was an unsteady political project to begin with and is now fatally failing as a legal-technical arrangement. But reversing the analytical vantage, requires a sharp perceptual shift as well. A type of taproot understanding of the IWT is urgently called for. By which, new facts, so to speak, must be dug up, sunned and differently seasoned in order to have us go beyond the limited simplifications of hydraulic data, official statistics, engineering opinion and statist imperative.

Between the 16th and the 18th centuries, the *Mughal* Empire held, in a single firm embrace, vast territories of what today comprises India and Pakistan. For the *Mughal* ruling elites, applying a regular squeeze over agricultural surpluses was the preferred route to wealth and privilege. Typically enough, given this essentially land based notion of power, the empire's numerous and intricate network of rivers were, at best, used either for navigation or as avenues to conduct easy trade. These inestimable flows, in other words, became natural outliers to the imperial governments' otherwise more onerous quest to extract revenues from soil. It would be unfair, however, to entirely dismiss all Mughal efforts at harnessing water. Several innovative structures, for example, helped deftly steer river currents into gardens, fountains, hunting grounds and even giant reservoirs.[1]

On balance, nevertheless, comprehensive fluvial management was rarely ventured upon. It was only in the middle of the nineteenth century, following the steady consolidation of British colonial rule in the sub continent, that big immodest engineering intervention for total hydraulic control was carried out. In particular, the vast semi-arid flood plains—sandwiched between the Indus and Gangetic river systems—became amongst the first sites, the world over, for implementing large scale modern irrigation schemes.

The Great Hydraulic Turn

For the sprawling Indus basin, coursed through by the fluvial fingers of the *Indus, Ravi, Chenab, Beas, Sutlej,* and *Jehlum* colonial hydraulic interventions were, in fact, both technically and politically unprecedented.[2] For the first time in the region, permanent structures in the form of barrages and weirs were thrown across river-beds. These durable head-works were equipped with a series of shutters to regulate flows by impounding water during lean seasons, to be then diverted in calibrated quantities across miles of canals. On the reverse, in times when the rivers were swollen or torrential, the shutters would be flipped open to hurriedly jettison discharge. In effect, by alternately impounding or quickening the discharge of flows, the river's variable or

moody regime, it was held, could be transformed from a seasonal to a perennial irrigation possibility.[3]

Beginning with the Upper Bari Doab Canal (1859) and the Sirhind system (1882), the drive climaxed with the 'most ambitious' irrigation project of the colonial period—the Triple Canal Project (1916). These perennial canal schemes, however, were assembled not merely as channels commandeering river flows but were, in the words of David Gilmartin, crucially linked to 'political imperatives of state building'.[4] The colonial dispensation, in effect, vigorously pursued perennial irrigation and agricultural settlement as means essential for stabilizing its otherwise unsteady authority in the region. At heart, canal building was the pressing attempt to yoke the then just disbanded Sikh soldiery and a large number of non cultivating 'predatory' herdsmen to 'permanent interests in landed property'.

The impacts of perennial irrigation, however, can also be historicized differently. Indu Agnihotri in a seminal essay on the canal colonies in the British Punjab argued that irrigation did not, as is widely held, simply bring water and increase agricultural productivity into hitherto desolate 'wastes'. Rather, the colonial canal colonies, of the late nineteenth and early twentieth century's, overwhelmed and overran a pre-existing vibrant pastoral economy; who, besides herding, also seasonally cultivated crops through inundation canals. This process of marginalization, if not substantial elimination, of the pastoral and their unique ways of living with the ecologies of the doabs continues to find only rare mention.[5]

The point here is that the introduction of modern irrigation in the semi-arid flood plains of the Indus system was enabled following intense struggles over the creation of landed property, the elimination of pastoral livelihoods and accompanied by relentless wide ranging environmental transformations. Raising agricultural productivity through perennial irrigation, hence, involved, by design or otherwise, a deafening silence about different pasts: the ignored but suffered consequences of waterlogging, soil salinisation, the violence of landed property, the defeat of nomadic peoples, instabilities brought on by mono-cultures and commercial agriculture, the attrition ridden assembling of colonial social hierarchies and inevitably the forced 'training' of once volatile free falling rivers into contained disciplined irrigation channels.

Profoundly intertwined with the relentless march of modern irrigation in the doabs was the life world of the colonial civil engineer. Though often less heralded, these energetic,

restless, innovative and adventurous men of empire were made steadfast with technical training in modern river management and control. Such expertise was systematically rubbed into them at the Addiscombe Military Seminary (near Croyden), Royal Indian Engineering College (Cooper Hill) or the Thomason Civil Engineering College (Roorkee). Through the lens of 'imperial science', colonial environments for these engineers were not merely to be 'catalogued, studied and observed' but actively pursued for large scale manipulation; all in the name of commerce, civilization and endless improvement. In the same stride, this resolute quest to control nature was intimately tied to the equally severe project of dominating colonized populations. For the British colonial enterprise, in other words, intensely extracting from nature and exploiting subject peoples seemed almost logically to go hand in hand.

Attempting the dramatic transformation of complex and immense river systems through engineering, however, was no simple task. In aiming to physically shuffle, transfer, move or redirect vast volumes, engineers resorted to reductionist and specialized mentalities. That is, colonial engineers planned and crafted modern river control initiatives primarily through ideologies for abstractions in the form of formulas, equations, model-making, and by repeatedly fine tuning an overwhelmingly quantitative notion of hydrology. Irrigation engineering preferred, in terms of their self image and professional training, to be defined principally by the 'mathematical sciences'.[6] Such a notion of handling water, in effect , assumed an unequivocal trust in numbers, while simultaneously aiming to wilfully ignore and shut out local-knowledges or place-specific ecological idiosyncrasies involved in harnessing flows.

If anything, therefore, the ascendance of colonial hydrology meant the consolidation of the universal, expert driven and specialized practices for river management alongside the steady marginalization of localized cultures and place-based knowledges for water management. Christopher V. Hill, in a recent article, notes that engineers from the Royal Indian Engineering College (Cooper Hill) were encouraged through their training to sustain an 'ignorance of the environmental exceptionality of their respective regions, and a deep belief that local knowledge was irrelevant'.[7] The mighty Indus basin, in effect, was disciplined with the elegance of numbers and rational hydraulic model building. The river systems, hence, that otherwise stood as messy miscible admixtures of flows, histories, cultures, localities and exceptional environments was conceptually recast as straight contained channels. A once heterogeneous collection of people and places, through imperial science, cement and quantitative hydrology could be turned into homogenous spaces.

Nation-Making with Cross Border Rivers

Following the hydraulic re-arrangements of the nineteenth century, the Indus basin witnessed, in the mid twentieth century, a second equally dramatic rupture— the division of waters for nation-making. In effect, scuffles over hydraulic access and rights that characterized the colonial period were transformed into bitter disagreements over clarifying issues of ownership and control of the Indus rivers. As the Radcliffe Line etched a hard border between Pakistan and India on 17th August 1947, flows had to be reconfigured as national rivers. From previously watering an uninterrupted contiguous political bloc, the Indus and its tributaries, in step with this logic of partition, had to be hastily inserted within new geographical scales and imagined as part of decolonized national biographies'.

Not unexpectedly, complications over the Indus erupted as intractable hydropolitics between Pakistan and India, for a start, flows had to be instantaneously sliced and diced at multiple conceptual levels, in order to acknowledge the region's changed geo-political realities. Stretches of the tributaries, hence, that fell within India were classified overnight as upper riparian waters while Pakistan, on the other hand, inherited downstream flows. Having been thus officially instituted as cross border flows, the various arms of the Indus system could now only be managed through a raft of international rules and protocols. The first involved a band-aid approach with the concluding of an immediate pact appealingly termed the Standstill Agreement, by which all existing flow arrangements were to be maintained till 31st March, 1948. Alarmingly enough, for Pakistan, the government of India "suspended" supplies the very next day in which the Agreement officially lapsed. Though flows were eventually restored after 18 long days, the shock of being denied water not only "seared" the Pakistani sense of entitlement to the rivers but the entire incident brutally made known to both sides that water could easily translate into severe problems of politics and power.[8] The subsequent Inter-Dominion Agreement, as a stop gap arrangement, actually ended up further amplifying the fact that sustaining a divided fluvial system, invariably, if not urgently, needed an enduring "final settlement".

Following a period of staggered negotiations, the IWT was finally clinched in 1960, as a trilateral deal between Pakistan, India and the World Bank. As noted by Daanish Mustafa, the IWT process substantially mirrored the political landscape of its time. A

context that was defined by extreme suspicion between the two countries, their respective location in larger geo-political strategies for the region and relationships that were repeatedly marred by political competition. Rehearsing elements or features of the IWT, however, would not be helpful here, as they have been competently done elsewhere. What, nevertheless, needs to be marked is the fact that the IWT was overwhelmingly a legal-technical document.

A notion about flows which, on the one hand, were firmly anchored in colonial legacies for water management in the region, while, on the other, water agreements were crafted as legal protocols for nation-making. That is, flows were appropriated not on the basis of their ecological properties but rather sub-divided in order to enforce hard national borders. The Indus system, in essence, was inserted into the geo-political calculations of a troubled region and made legible primarily as statistically tabulated hydraulic data. The physical constituency of the river regime was, thus, starkly framed simply as a network of water channels, with the aspired "normal" defined as a seasonally determined "average volume". Rivers as national resources, hence, became facts without stories and quantities without qualities. That is, flows were not understood as organically interconnected and interacting elements of wetland ecologies, aquifers, lakes, marshes and the combined actions of innumerable tributary streams. Rather, as mere volumes contained in channels, rivers could be abstracted, diverted or interfered with to satisfy national priorities.

Putting Ecology into Flows

The belief that rivers are merely moving masses of water crying out to be regulated and dammed, has been dramatically challenged, since the 1980s, by a fresh spirited theoretical turn amongst river ecologists. These ecologists have been convincingly able to demonstrate that fluvial regimes are complex geomorphologic, chemical and biological processes in motion. Rivers, accordingly, are made up of habitat mosaics that support a wide variety of aquatic and riparian species. And the beating heart that keeps alive the river's ecological health and viability is its natural flow regime or the flood pulse, which organizes and defines the river ecosystem itself.

It is now understood that natural variable flows create and maintain a range of productive dynamics between the channel, floodplain, wetland and the estuary. The magnitude and frequency of high and low flows consequently regulate numerous

ecological processes. While wetlands provide important nursery grounds for fish and export organic matter and organisms into the main channels, the scouring of floodplain by inundations often helps rejuvenate innumerable habitats for flora and fauna within the basin. Even periods of low flow sometimes creates contexts for certain kinds of ecological benefits, by either allowing certain biological organisms to thrive. A large body of recent evidence indicates that natural flow regimes of virtually all rivers are inherently variable, and that this variability is critical to ecosystem function and native biodiversity. In effect, rivers with highly altered or artificially regulated flows might in most cases lose the ability to support riverine ecological processes.[9]

By thus recasting, in fundamental ways, the manner in which fluvial processes are understood, river ecologists are now suggesting that a fresh paradigm is required for managing and interacting with such hydraulic endowments. Centrally, what is being argued, is that flows are embedded in ecological contexts and therefore transferring them through technological fixes can and often do have several unintended environmental consequences. Simple steel and concrete approaches aimed at water abstraction, diversion and interference, in other words, must give way to an entirely new spectrum of knowledges, which will treat flows as being determined by non-linear ecological qualities. Put differently, treating river as mere mute volumes is flawed both as a concept and as a water management practice.

Handling and harnessing variability and stochastic flow regimes, consequently, have become critical to shaping sustainable approaches towards river management. Equally as well, flows must be grasped as organic entities: rivers stitch together innumerable ecological processes to produce an intricate and interconnected fluvial system. The entire Indus basin, in effect, is a collection of relationships between streams, floodplains, the head reaches, aquifers and inevitably the chaotic delta. Small wonder then that the so called "success" of the IWT has resulted in the relative ecological devastation of the Indus delta. Historically, for the Indus basin, a rough calculation suggests before projects for siphoning flows began in the nineteenth century, up to 150 million acre-feet of fresh water probably fell into the delta, along with the deposition of close to 400 million tons of nutrient rich fertilising silt. These immense uninterrupted volumes nourished and sustained a sprawling collection of mangroves, inlets, creeks, estuaries and other wetland ecologies.

Subsequent to projects for damming and draining of the Indus and its tributaries for agriculture, hydropower, and nation building, the amount of fresh water flowing into the

delta has been steadily reduced to a lean 10 million acre feet (less than 10 percent of historical flows). The disastrous ecological consequence of starving the delta through massive fresh water transfers has only now begun to be acknowledged. Besides eroding livelihood possibilities for close to 1.2 million inhabitants in the delta and along the coasts, the fluvial impoverishment of the delta has also resulted in several tangible negative impacts on fish breeding, damage to marine food webs, destruction of unique salt water ecological habitats, and an inestimable loss in biodiversity.[10]

By suggesting that flow variability is central to fluvial health, river ecologists have put forward a definitive challenge to the cement-steel based water-control ideologies of the contemporary civil engineer; whose entire conceptual tool kit, as pointed out earlier, was mostly drawn up in the colonial setting of the long nineteenth century in the subcontinent. In a similar vein, the hitherto untroubled pre-eminence of the expertise generated by giant centralised water bureaucracies such as the Central Water Commission (India) and the Indus Water Commission. (Ministry of Water and Power, Government of Pakistan) need to, in the light of these new ecological facts, be carefully qualified and reconsidered as well. These institutions, with their training anchored in quantitative hydraulic data, have thus far been oriented primarily towards strategizing for "average flows". These are technical-bureaucratic institutions, in other words, that are committed to searching for and premised entirely upon harnessing hydraulic predictabilities.

Significantly enough, these centralized water bureaucracies also play crucial roles in shaping national water policies and informing political processes over the building of hydraulic infrastructure in Pakistan and India, respectively. But with variability and stochasticity as the new norm for engaging with river systems, so to speak, what becomes of these legal-technical institutions and their infrastructural technologies? Put differently, if climate change is about the intensification of hydraulic unpredictability in the region will the IWT as a legal-technical institution be able to respond to the new challenges.

Climate Change, Changing Contexts and Changed Constituencies

Pakistan in 2010 was witness to an unprecedented weather moment. Sometime in July a 'blocking event' occurred, which technically refers to an entire jet stream being halted. In

this particular case, the blocking event hovering over the western Himalayas then ended up colliding against the then oncoming and heavily laden summer monsoon clouds. The collision led, predictably enough, to an intense precipitation episode. Immense volumes of water hurtled down the Himalayan slopes and rapidly overwhelmed and smashed through every conceivable channel of the Indus system. Such was the intensity that four months worth of rainfall fell, by one estimate, in the span of a mere few days. Parts of Northern Pakistan, in fact, even received more than three times their annual rainfall in a matter of 36 hours.[11]

Following the downpour, the over saturated channels violently burst their banks and Pakistan's flat flood plains were, in a flash, literally roofed over with enormous sheets of seemingly unending waters. In the assessment of the geographer Kuntala Lahiri-Dutt, while a freak weather pattern and not climate change could in an immediate sense account for the Indus floods, "whether or not, however, this blocking event was a consequence of the long-term effects of climate change rather than simply an abnormal weather pattern is impossible to answer".[12]

Such has been the severity of the devastation brought on by the "great floods" of 2010 that even estimates of the overall damage continue to escape a credible count. Some rough approximations by various government agencies, international organizations and relief bodies, suggest a stunning picture, to say the least. In one careful survey of the various estimates, it is indicated that 21 million people overall were affected. Close to 1700 people or more perished and 1.8 million homes were damaged or destroyed. In its wake, the floods also rummaged through 2.3 million hectares of standing crops and brought about a loss of US$5 billion to the agriculture sector and around US$2 billion each to the physical and social infrastructure. These disturbing numbers, nevertheless, do not cover or even indicate the long term costs for recovery and reconstruction that will be involved in meaningfully rehabilitating both the social and economic infrastructure in the region.[13]

But the flood-devastated realities of Pakistan, as Daanish Mustafa and David Wrathall in a recent insightful essay argue, point to a far more striking conclusion: that the floods were aggravated and its impacts made even more ferocious because of vulnerability. Beginning with the dramatic hydraulic transformations in the colonial period, independent Pakistan persevered in creating a "a mismatch between the design assumptions of the infrastructure, such as embankments and barrages and the dynamic reality of the channels' carrying capacity."[14] That is, Pakistan's hydraulic and social

designs were geared to "ignore the river system's natural rhythms, in return for agricultural productivity and prosperity". Overcoming the potential dangers in such a trade-off, for them, therefore, would require a "better tactic", which plainly stated was to "adapt to the Indus basin's hydro-meteorological regime".

In effect, several obvious implications can be drawn from such a perceptive and out-of-the-box assessment. For one, evidences on the ground forcefully suggests that the IWT dispensation with its attendant hydraulic infrastructure and governance architecture will be unable to either cope with or over ride fluvial variability brought on by the extremes of climate change events. The IWT of 1960 pursued hydraulic infrastructural development to harness "average flows" and crafted legal mandates to manage fluvial predictabilities. The protocol for negotiations, moreover, in such an arrangement, was made dependent upon a narrow band of engineering expertise and imperatives brought on by regional geo-politics. .

Over recent years, as fluvial dynamism has begun to intensify and characterize river behaviour in the Indus basin, the IWT, many feel, has already begun to reveal its wear and tear. Concerns abound, for example, over whether the felt or perceived decline in flows from the head-reaches have been brought on by problems of natural variability or the more insidious possibility, according to some voices, of systematic infrastructural interferences in the upper riparian. If the hydraulic abnormal sharp seasonal peaks or troughs in the flow regime thereby becomes the new normal there will be obvious pressures for more agile institutional and political responses. But as we have pointed earlier, the IWT as a legal-technical arrangement is fundamentally based on the old normal of neat averages and equally determined statistical predictabilities. Hydraulic volatility, in other words, becomes a source of disruption and dangerous disagreement rather than a point for different opportunities and renewed understandings.

Climate change and its perceived impacts, in effect, push for an active reconsideration of the IWT framework. Instead of an overt emphases on technical and technology based approaches, run with the narrow expertise of engineers and state negotiators, the new compact for river management/sustainability in the region would require different social constituencies and their experiences with the Indus waters. This would involve drawing upon and fostering cooperative dialogues between riverfront communities[15] on both sides of the border; such as fisher folk, irrigation dependent farmers, river ecologists, water historians, sociologists and aquatic specialists (to name a few). These plural narratives can imbue the IWT with a much needed ecological sensitivity. By

acknowledging rivers as complex ecological entities, water sharing strategies between Pakistan and India will crucially depend on how a range of otherwise ignored historical and social fluvial experiences in the region are deployed to deal with flow variability. That is, the IWT or another compelling version has to be crafted to meaningfully grasp the Indus and its temperamental tributaries as qualities of flows rather than as blocs of disconnected volumes. The current reign of cement, steel and quantitative hydrology, in other words, must urgently give way to viable dialogues over fluvial relationships and ecological process.

Water politics between Pakistan and India, urgently needs an ecological dimension and must acknowledge the varied fluvial linkages, from the delta-upwards. This will involve, significantly enough, harnessing the full gamut of what have been termed as confidence building measures (CBMs), such as evolving soft borders, thickening track two diplomacy and actively enabling scholarly exchange. It might no longer be possible to sustain the mere division of the Indus Rivers; rather we must actively seek new political and cultural possibilities for the beneficial sharing of waters.

Endnotes:

1. Abha Singh, 'Irrigating Haryana: The Pre-Modern History of the Western Yamuna Canal' in Irfan Habib (ed.), Medieval India 1: Researches in the History of India 1200-1750, Delhi: Oxford University Press, 1992, pp.49-61. Iqtidar Husain Siddiqui, 'Water works and irrigation system in India during the pre-Mughal times' in Jos Gommans and Harriet Zurndofter, Roots and Routes of Development in China and India, Lieden, Boston, 2008. For a useful collection on pre-colonial irrigation and water management strategies in the subcontinent see Anil Agrawal, and Sunita Narain, (eds.), Dying Wisdom: Rise, Fall and Potential of India's Traditional Water Harvesting Systems New Delhi: Centre for Science and Environment, 1997; Tripta Wahi, 'Water Resources and Agricultural Landscape: Pre-Colonial Punjab' in Indu Banga (ed.), Five Punjabi Centuries: Polity, Economy, Society and Culture, c.1500-1990 (Essays for J.S. Grewal), New Delhi, Daryaganj: Manohar, 1997, pp.267-84.
2. Rohan D'Souza, 'Water in British India: The Making of a 'Colonial Hydrology'", History Compass, 4/4. May, 2006, pp.621-8.
3. Herbert M. Wilson, Irrigation in India, Delhi: Daya Publishing House (First published 1903), 1989, pp.78-81; D.G. Harris, Irrigation in India, London: H. Milford, Oxford University Press, 1923, pp. 5-7. For an introduction to the modern hydraulic moment in British India see Elizabeth Whitcombe, E., Agrarian Conditions in Northern India: The United Provinces Under British Rule, 1860–1900,vol. 1, Berkeley: California University Press, 1972; Canal Irrigation in British India: Perspectives on Technological Change in a Peasant Economy,Cambridge: Cambridge University Press, 1985: Imran Ali, The Punjab Under Imperialism, 1885–1947, New Delhi: Oxford University Press, 1987 ; Rohan D'Souza, Drowned and Dammed: Colonial Capitalism and Flood Control in Eastern India, New Delhi: Oxford University Press, 2006 and David Hardiman, 'Well Irrigation in Gujarat: Systems of Use, Hierarchies of Control', Economic and Political Weekly, 33(25), 1998, pp. 1533–44.
4. David Gilmartin,'Scientific Empire and Imperial Science: Colonialism and Irrigation Technology in the Indus Basin', The Journal of Asian Studies, 53/4 , 1994, p. 1132. Also see David Gilmartin, 'Water and Waste: Nature, Productivity and Colonialism in the Indus Basin', Economic and Political Weekly, 38(48), 2003, pp.5057-65.
5. Indu Agnihotri, 'Ecology, Land Use and Colonization: The canal Colonies of Punjab' in Mahesh Rangarajan & K. Sivaramakrishnan (ed.) India's Environmental History: Colonialism, Modernity and the Nation, Ranikhet: Permanent Black: 2012, pp. 37-63.
6. Benjamin Weil, 'The Rivers Comes: Colonial Flood Control and Knowledge Systems in the Indus Basin, 1840–1930s,' Environment and History 12(1), 2006. pp. 3–29.
7. See Christopher V. Hill 'Imperial Design: The Royal Engineering College and Public Works in India' in Deepak Kumar, Vinita Damodaran and Rohan D'Souza (ed.), The British Empire and the Natural World: Environmental Encounters in South Asia, New Delhi: Oxford University Press, 2011, p.73.
8. For an excellent discussion on the politics over the Indus rivers between India and Pakistan see Daanish Mustafa, 'Critical Hydropolitics in the Indus basin' in Terje Tvedt, Graham Chapman & Roar Hagen, Water, Geopolitics and the New World Order (A History of Water, Series II, Volume 3), London, New York: I.B. Taurus, 2011, pp. 374-94.
9. J.V. Ward and J.A. Stanford.. 'Ecological Connectivity in Alluvial River Ecosystems and its Disruption by Flow Regulation', Regulated Rivers, Research and Management 335/GR: 1995, 1–15; N. LeRoy Poff, et al.. 'The Natural Flow Regime: A Paradigm for River Conservation and Restoration' , BioScience 47/11, 1996, 769–84; Barry L. Johnson, William B. Richardson and Teresa J. Naimo, 'Past, Present and Future Concepts in Large River Ecology: How rivers function and how human activities influence river processes' BioScience 45(30, 1995, 134-41; Richard H. Norris and Martic C. Thomas, 'What is River health?, Freshwater Biology, 41, 1999, pp. 197-209.
10. See the report by the IUCN, "Indus Delta, Pakistan," Case Studies in Wetland Valuation no. 5 (May 2003). Also see Altaf A. Memon, "Devastation of the Indus River Delta", Proceedings, World Water & Environmental Resources Congress 2005, American Society of Civil Engineers, Environmental and Water Resources Institute, Anchorage, Alaska, May 14–19, 2005, pp. 1–14.
11. Kuntala Lahiri-Dutt, 'Indus floods, 2010: why did the Sindhu break its agreement?' September 1, 2010. Seehttp://asiapacific.anu.edu.au/blogs/southasiamasala/2010/09/01/indus-floods-2010-why-did-the-sindhu-break-its-agreement/
12. Ibid.
13. Daanish Mustafa, and David Wrathall, 'Indus basin floods of 2010: Souring of a Faustian bargain?' Water Alternatives 4(1), 2011, pp. 72-85
14. Ibid., p.7
15. I draw upon this useful notion of a riverfront community from Sarandha Jain's wonderfully compelling book on the Yamuna river titled In Search of Yamuna: Reflections on a River Lost , New Delhi, Vitasta publishing pvt. ltd, 2011. The riverfront community, she suggests, refer not only to people who live by and off the river but become a "bridge" between land and water, river and society and as "mediators between nature and culture".

6.1.2 A Historical Perspective of the Indus Basin

Maaz Gardezi, Research Scholar, Lahore University of Management Studies, Pakistan

Origin of the Indus Basin

The mighty Indus River, originating in Tibet in the Himalayas is the sixth largest river of the world whose agrarian civilisation belongs to the fifth millennium B.C. The origin of ploughed pastures can be traced back to 2400BC as depicted by the Kalibangan excavations in western Rajasthan. It shows grids formed by channels running from north-south, and east-west in a pattern very identical to the one still practiced today. Similarly, ingenious hydraulic systems were found in the bath houses of Mohenjo-Daro that should intrigue modern engineers to explore the evolution of system designs. The area around the Indus River has always been rich and superior to other parts of India. However, the arid land could not be cultivated on rain water alone and some form of artificial methods of irrigation had to be developed as the population swelled. In fact, one of the reasons for the decline of Indus civilisation has been attributed to the '…character of culture that had stagnated, probably as a result of complacency impeding further effort…This led to inadequate maintenance of irrigation channels and bunds that resulted in total system collapse.[1]

Agriculture and Water Management: The Sultans

Agriculture was the bastion of the people. Lands adjacent to the rivers had alluvial soil that was ideal for different crops to be harvested. The vastness of land and relative abundance of rainfall had made life simple and economical in Punjab. However, the need and requirement for irrigation varied with the climatic and physical circumstances. The

necessity for perennial irrigation was inversely related to the amount of rainfall. Hence, majority of this region required some form of irrigation to sustain crop growth year after year.

The renaissance of water management for irrigation can be traced back to the twelfth century. Historical anecdotes point to the importance given by emperors, minor rulers and conquerors of introducing new irrigation methods. There was a dire need to expand their empire and then provide adequate food supply to the burgeoning population. During the pre-Mughal era, the Sultans dealt with water management as an existential issue for the prosperity of the region. Due to the hot climate and arid soil, one can find evidence of 'Kolab' (water reservoirs) in Sialkot and 'Haud' (lake) in Palwal.[2] The first lake constructed by Sultan Iltumish in the 12th Century was a multi-purpose lake that supplied clean drinking water to the city's population as well as for growing seasonal fruits along its boundary. Soon afterwards, Sultan Alauddin Khalji is credited with having taken interest in developing lakes, tanks and cisterns for the progress of agricultural produce.

The most important development in irrigation was the construction of large artificial canals. These development dates back to the 13th century during Khalji's regime. The Sultans had developed a system of inundated canals that provided water only when rivers were flooded. These canals were linked to large rivers and therefore unpredictable in operation and routinely subject to frequent breaches. The construction of large canals in the region between Sutlej and Delhi was pioneered by Sultan Firoz Shah Tughluq (1351-1388). The Emperor also directed public department to build a canal from Sutlej to Jhajjar (a distance of 48 cos, 1 cos equals 3 km). This was also the period of development of bridges, aqueducts and dams that were used to store water throughout the year. The canals were constructed to provide water to acutely dry areas of Punjab and Haryana. Importantly, these canals provided opportunity to farmers to grow two crops a year, which was impossible earlier due to water scarcity. Farmers could now harvest both the Kharif (summer) and Rabi (winter) crop in a single year. The canals provided an added benefit to the farmers. Now, they had to dig relatively shallow wells which were sufficient to attain ground water. A few other large canals were built that provided a catalyst for fast growing agricultural production, migration and employment in the region.

Another important development of this period was the introduction of Persian Wheel.[3] In the fourteenth century, this was a luxury that only the rich and prosperous farmers could afford. Set up on the wells and the newly constructed water storages, it was

adopted seamlessly with the contemporary infrastructure. The wells also had social benefits, as the income from sale of its water was provided to the poor.[4] Furthermore, metallic buckets were introduced on the Persian wheel. This had replaced the existing pottery vessels and by the early sixteenth century, the wheel was adopted in almost all sugar-cane and rice growing parts of Punjab.

Irrigation: Mughal Empire

The Punjab during the Mughals comprised of five main Doabs.[5] The Bai Jallandhar Doab formed the area between Sutlej and Beas, covering an area of 50 cos. The second was the Bari Doab lying between the Beas and the Ravi stretched over a distance of 17cos. Thirdly, the Rechna Doab which is the area between Ravi and the Chenab stretched over an area of 30 cos and being the most fertile and rich among the Doabs.[6] Fourthly, the Chaj Doab, which is engulfed between the Chenab and the Jhelum River, and lastly, the Sind Sagar Doab lying between the Indus River and Jhelum River. The Sind Sagar Doab was the most desolate tract of land that spread over large areas.

Emperor Babur, the founder of the Mughal dynasty, wrote in his 'Babarnamah'[7] a detailed description of the prevalent modes of irrigation practices in India.[8] The Mughals constructed perennial canals that had permanent head-works. These head-works either did not extend across the entire stream or allowed the floods to pass over their crests. Perennial irrigation had a benefit of supplying water throughout the year.[9] The first evidence of Perennial irrigation dates back to early seventeenth century when an 80 km long canal was constructed by Emperor Jahangir (1605-27) to bring water from the right bank of the Ravi to the pleasure gardens of Sheikhupura near Lahore. From the early 16th century onwards, ground water was extensively used for irrigating the lands. Dug wells were installed, Karez (underground water channels) were dug and lifting devices such as Charas, Shaduf, Rati and Persian wheel assisted in extracting ground water. In an area of generally sparse and unreliable rainfall, technical innovations that increased water availability were critical for growth. For example, the introduction and diffusion of the Persian wheel between the 13th and 19th centuries depicts the harnessing of animal power to wells, and hence encouraged large-scale migration and agricultural settlement in Punjab. Similarly, cycles of inundation and construction strongly influenced localised patterns of agriculture, opening areas away from the direct action of river floods to regular irrigation when the rivers filled the canals in summer.

Understanding historical patterns of canal construction in the pre-British era has

important linkages with the political imperatives of rule. The expansion of inundation canals, which require relatively little in terms of permanent headworks, depict that such construction was not always a matter of technical innovation.[10] In fact, in the wake of the decline of the Mughal Empire, the rulers turned widely to canal construction to consolidate their local supremacy and provide an agricultural base for their control of local and regional elites. This largely depended on the competence of the rulers to rally elites and their followers in canal digging. The emphasis was on creating communities which engaged in the sharing and maintenance of the canal and its water. The Britsh were aware that the opulence of their state was contingent on the affluences of the cultivators.[11] In the past, the prosperity of the cultivator was solely relied on the benevolence of the King. The Mughals had expressed interest in bypassing any such adherences by making revenue collection and its assessment unbiased, and providing a momentum to agricultural production through the development of irrigation in the region.

British Canal Colonies

The coming of the British to power, in some form, reshaped the patterns of canal construction. The canal colonies formed by the British provided momentum for a growth that lasted for more than a century. These colonies highlight the linkages between canal building, agricultural settlement and political control. There were manifold reasons for the commencement of the canal irrigation program. The British government in India had failed to provide any relief for the crop failures in 1824-5 and 1832-3. Moreover, half a century later during the famine of 1877, no real provisions were made for mitigating such a natural disaster. These safety nets had been antecedently rendered by villagers in the shape of common knowledge shared in the community. However, due to failures in price mechanism (price controls and taxes) and crop production, the rulers failed to relieve cultivators from this catastrophe. More importantly, archaic common knowledge was overshadowed by modernity.

The irrigation network that materialised after 1885 was based on perennial canals that led off from headworks. It is estimated that between 1885 and 1947, there was an increase from 3,000,000 to 14,000,000 acres of land in Punjab (excluding princely states) that were irrigated by these canals. After the annexation of Punjab, the first major canal project was the Upper Bari Doab Canal (UBDC). This was to be made in the centre of the old Sikh majority areas of Amritsar, Lahore and Gurdaspur. The construction of this canal was a blessing in disguise. Employment to the disbanded Sikh soldiers and an

incentive to work towards agrarian development reduced the threat of an uprising in the newly annexed state.[12] The British also wanted to assert their authority and stabilise 'frontier regions'. For example, in the Upper Sindh frontier, development of canals was a catalyst to guide the hostile tribe towards peaceful agricultural occupations. British policy also fostered investment in canal development by larger land lords and pastoral chiefs, as a potential measure of stability and peace in the region.

Colonial canal building was undertaken in two stages. Firstly, the existing canals were renovated while in the second phase inundation canals were gradually converted into perennial canals. The Punjab inundation canals were Khanwah, Katora and Grey canals on Sutlej River. Between 1876 and 1885, thirteen other canals were constructed that drew water from the Sutlej River. From Ravi River, Sidhani canal was reconstructed, which irrigated lands around Multan District. In Sindh, Mitharao was the first canal built along the eastern Nara channel of the Indus River. The weir on the Jamrao canal (perennial) across the Nara River, irrigated the Tharparkar district. Ghar canal was another important canal, which originated 50km downstream Sukkur and followed a natural offshoot of the Indus River. The Sukker canal branched off from the right bank of the Indus and followed an old channel. Generally, the Sindh inundation canals were built at a lower level than the river and they received water only when the river was flooded.

Large construction projects were undertaken in the area of what is now Pakistan. The Lower Chenab canal was the first canal constructed by the British to bring irrigation water to wastelands occupied by the pastoral nomads.[13] The arrangement to turn the Sandal bar area (now Sheikhupura, Toba Tek Singh and Faisalabad) in the Rechna Doab into a large organized colony tested engineering skill and dexterity of the British. A weir was erected across the Chenab at Khanki village in Gujranwala district to control the water supply to the main canal. With a release of 311 cusecs it was one of the major irrigation projects in 1892. A related project was sanctioned in 1897, which irrigated the area between the Chenab and the Jhelum (Chaj Doab) from a weir at Rasul on the Jhelum River. The Lower Jhelum Canal opened in 1901, caused profits from agricultural to increase by 20% in 1920.

The Triple Canal Project was endorsed in 1905, and became the first project to move water from one river to another. This project curtailed the transfer of available water in the Jhelum River across two Doabs. The need for this project arose when the water from Ravi River was insufficient to inundate lower areas of the Bari doab. The project

consisted of a feeder canal[14] from the Jhelum River at Mangla to the Chenab River above Khanki (Upper Jhelum Canal), a feeder canal from Marala on the Chenab River to the Ravi River at Balloki, to divert the transferred water into the new Lower Bari Doab Canal (LBDC).

After the First World War, the Sukkur Barrage Project, the first barrage constructed on the Indus River was initiated. This was commissioned to irrigate in 1932. During 1921, the Sutlej Valley Project was sanctioned for the development of the Punjab, Bikaner (now in India) and Bhawalpur states area. The project consisted of four weirs on the Sutlej River at Ferozepur, Sulemanki, Islam and Panjnad while eleven more canals were completed by 1933.

The Trimmu Barrage, was the last barrage completed prior to the Second World War. This was located below the junction of the Jhelum and the Chenab Rivers and was to be completed in 1937. At the time of Independence, Kalabagh Barrage (Jinnah), Kotri Barrage on the Indus River and the Bhakra Dam in India on the Sutlej River were under construction.

The Supremacy of the State

The British administration held revenue generation from agriculture to be an integral part of the Indian economy. At the turn of the 20th century, about 1/6th of the total revenue of Punjab was from agriculture.[15] The British considered it a prerogative for the State to gain a share of the annual produce of each unit of land. Under the Mughal regime, the precise share of the State varied according to local conditions: weather conditions, variability in soil fertility, average price variations in cropping pattern and sources of irrigation. Furthermore, the method of assessment and revenue collection was undertaken and enjoyed by different ranks of employees and dependents of the State. This extremely flexible method was remarkable and the British embraced some aspects of this system.[16]

The British had a strong intention to develop the colonial market with a capitalist viewpoint. There was a drastic break with the past, which manifested from the introduction of new intermediaries between the State and the taxpaying masses. These men were usually induced to abandon traditional restraints, and hence to discard the old recipe that helped mediate the burden on the typical village peasant. Collection of taxes in cash and not in kind, and miniscule efforts by these intermediaries for the diversion of

taxes towards the maintenance of capital, greatly affected the knowledge systems and traditions that had helped build and preserve water-management techniques in the region. The Permanent Settlement failed to create the capitalist landowner class that had been desired. Furthermore, transfer of power from 'Zamindars' to these new agricultural capitalist intermediaries led to the demotion of peasant's occupational rights and the customary rights to fixed revenue rates.[17]

In the Mughal era, the tax burden for the irrigation system was based on a land-water combination. The move to colonial revenue generation and its claim to tax land only, led to many revelations regarding the efficiency and domination of the State. One significant outcome of such a transfer of power was a resulting decline of the traditional irrigation system in colonial India. After the introduction of new revenue generation mechanisms by the British, the impact on the roles and responsibilities of tenants and landlords was ambiguous.[18]

The move from taxing variable agricultural production to fixed yields and the subsequent move to cash from in-kind tax collection, 'upset the rhythm of procedures' between the agrarian stakeholders. The allocation of roles to service and maintenance of tanks and channels were greatly perturbed due to duties being obscurely defined by the administration. The attempt at creation of a mechanism that highly valued profits and revenue, commercialization of produce and dissembling community control over the water and land resources led to the subservience of the native population and desirable operability of the irrigation system by the British.

Tradition vs. Modernity

The British were however, not oblivious to the fact that traditions in Punjab played a pivotal role in agricultural practices. In 1891, the Revenue Secretary of the Punjab Government explaining this phenomenon wrote to the centre:[19] 'It seemed essential to preserve the tradition of Punjab as a country of peasants' farmers. No other general frame of society is at present either possible or desirable in the Province…, as already remarked, capitalist farming in general is not a system suitable to Punjab. But a moderate infusion of the capitalist element is not out of advantages. It supplies natural leaders for the new society; it gives opportunity to the Government to reward its well deserving servants, and to encourage the more enterprising of the Provincial gentry; it attracts strong men who are able to command the services of considerable bodies of tenants; it furnishes a basis from which agricultural improvements may be hereafter extended, and

lastly, it enables Government to obtain a better price than might be otherwise possible for the ownership as distinct from the users of land.'

The British considered perennial canal construction as a product of ingenuity in engineering and technology. Technicians, urban mercantilist and most intermediaries believed that science had provided excellent support for achieving a rise in yield and increase in land area. However, there was another side to this rabid belief. Perennial canals increased water-logging and salinisation. With irrigation systems, much like most other large-scale technological development, a complete picture of the pros and cons is evident only with the passage of time. Perennial canals did not require annual, large-scale recruitment of labour for silt clearance as was necessary for inundation canals. Unpaid *chher* labour[20] provided by the irrigators during the winter clearance season were considered by the British as a form of coercive slavery that undermined the guarantees of private property. However, this form of labour was a symbol of customary and community cohesion that had been practiced since many generations. J. B. Lyall (later Punjab Lieutenant-Governor) was one of the few Englishmen who supported the system of *chher* labor. He stated: "…not only on grounds of economy of management, but also on the ground that it tends to preserve and promote self-government. The system is solidly founded on custom, and suits the habits and circumstances of the people concerned".[21] On the whole, constant technical monitoring, administration and modeling had replaced the regular employment of labour. In the case of silt control, labour that was previously assembled by the community was now replaced by more complicated techniques of scientific adaptation to an evolving environment.

Water distribution: Warabandi & Chakbandi

The passage of the Canal and Drainage Act (1873) was a corollary of various efficiency concerns in water management, within the engineering community in India. The Act prescribed the number of outlets from each channel and the allocation of irrigated area based on each outlet. Such drastic centralization and control mechanism of water management was bound to have crucial effects on the role of community within the design and use of irrigation systems. The British policy makers were aware of the need to sustain the balance of power between the land and its users. They were also keen to bridge the gap between science and the existing distribution systems prevailing in India. One such system of water distribution known as warabandi was based on the notion of fixing of timed turns for water. Systematic turns based on time had always been present on the sharing of well water. The crucial difference and one which interested the British

engineers the most, was that warabandi system was not dependent on ties of kinship or genealogy. It however, treated water sharing as a single and controlled entity. For the engineers, this meant that each outlet of the channel could now be quantified as per timely use based on the farmers' need. More importantly, it meant that scientific knowledge and quantifiable data could now seamlessly integrate with an existing system that enforced local cooperation and the harmony.

Stemming from this Act, major reforms were brought forward that affected not only the new perennial canals, but also the old inundation canals. One such reform focused on the assimilation and modification of channels and on reduction in numbers of watercourses and outlets. This process was known as chakbandi. The chakbandi system was originally introduced to tackle silting of channels, but it provided the British with a subtle advantage in having greater control over the distribution of water. However, a paradox existed. The desire to bridge traditions and scientific modernity by the British was in itself a deterrent from achieving their political and economic goals. Their overemphasis on approbation of the traditional and social institutions only caused to impede their goals of expansion and creation of capitalist agriculturalist. A similar view point argues that traditional 'local knowledge' formed the foundation of the political system as well as a desired prerequisite for scientific engagement in canal construction. However, political troubles (especially within the context of colonial irrigation) arose from differences in the ideology and scientific authority of the colonial state itself. What was not a reason for conflict was the contradiction between engineering (or science) and the cultural imperatives of India's social organization.

Need for a Treaty?

After 1947, as in many other regions following the Second World War, the Indus plains were divided between two national jurisdictions. There were diverse issues, which stemmed from the partition including: population readjustment, property disagreements, reorganization of transportation networks and the demarcation and regulation of boundaries. However, the disparate feature of the lower Indus region from other regions of the world was that the single largest system of irrigation works in the world had been developed there. Reports prepared by the Indian Irrigation Commission between 1901 and 1903 regarded the Punjab projects within the context of the entire Lower Indus Basin. The outcome of these reports was to regard several Indus rivers as a single regional hydrologic system, which could transfer water across hundreds of miles from areas of opulence to those where there was an acute shortage. As the great single-

purpose system was expanded, political disputes as to the use of its water arose among the concerned states and even among districts. These were inherited by the new states of Pakistan and India in 1947, though such disagreements were far less fundamental than the simple fact that what had been developed as a central system of water control and use was coercively divided into two parts. The Indus system was planned for development as a unit by the British; that same system, adapted substantially by enormous water works intended to control it and to use its waters for certain limited ends, had become two separate units. The boundary that divides them is not a formal design on the landscape; it is a functional barrier to interaction between areas, shared by competitive nation states. It was not set keeping in mind the impacts it would have on the basin.

For thirteen years after Independence, the two countries maintained the system. This was a period with latent inefficiencies, continued hostility and a wider anticipation of a final settlement. The Radcliffe Award in Punjab, received condemnation from both countries. It entitled the head-works in some districts to India while the entire network of canals extending from those head-works to Pakistan. The issue of equitable distribution of water in the Basin was a precedent set by the British before partition. However, contrary to this, the rights of the upper and lower riparian had never been laid down by the colonizers. Hence, this period entailed complex negotiations on both sides. Finally, in 1960, the two countries signed a treaty under the auspices of the World Bank, by which Pakistan had been granted full rights to the water of the western rivers (Chenab, Jhelum and Indus) while India has been granted full rights over the eastern rivers (Ravi, Beas and Sutlej). Under this agreement, Pakistan was also given financial assistance to develop a compensatory network of canals, reservoir and barrages to mitigate the diversion of water in its eastern rivers to India. This was done by diverting water in Pakistan's western rivers to its eastern rivers via link canals. This treaty resulted in a dramatic fall in the natural flow of the eastern rivers and in turn the discharge of Indus in to the Arabian Sea. More importantly, one can state that the treaty created two hydrologic systems which has previously been one. Men, not nature, were to be the architects and engineers for these new environments, just as men earlier had joined and dealt with waters of the basin in ways which nature had never intended.

Bibliography:

A Banerjee, 'History, institutions, and economic performance: the legacy of colonial land tenure systems in India', The American economic review (2005).
Aloys Arthur, The Indus Rivers: a study of the effects of partition, (1967).
BH Baden, 'A short account of the land revenue and its administration in British India: with a sketch of the land tenures', (1907).
BS Nijjar, 'Punjab under the Great Mughals, 1526-1707 AD', Thacker (1968).
Cf. Lallanji Gopal, Aspects of History of Agriculture in Ancient India, Varanasi, pp. 116-120 (1980).
David Gilmartin, 'Scientific Empire and Imperial Science: Colonialism and Irrigation Technology in the Indus Basin' The Journal of Asian Studies, Vol. 53, No. 4 pp. 1127-1149, (1994).
D. Mustafa, "Colonial law, contemporary water issues in Pakistan", Political Geography 20 (2001), 817
E Whitcombe, Agrarian Conditions in Northern India: 'The United Provinces Under British Rule, 1860-1900, Wilson, H.M., Irrigation in India, (1989).
H. Fahlbusch, Bart Schultz and C.D. Thatte, 'History of Irrigation, Drainage and Flood Management', (2004).
I Ali, The Punjab under imperialism, 1885-1947, (1988)
Ian A Talbot, The Punjab under Colonialism: Order and Transformation in British India, (2000).
Ian Stone, Canal Irrigation in British India: Perspectives on Technological Change in a Peasant Economy. Cambridge: Cambridge University Press (1984).
Iqtidar Siddiqui, 'Water Works and Irrigation System in India during Pre-Mughal Times', Journal of the Economic and Social History of the Orient, Vol. 29, No. 1, pp. 52-77 (1986).
Israr-ul-Haq, 'Case Study of the Punjab Irrigation Department', International Irrigation Management Institute Lahore, Pakistan National Program (1998).
James B Lyall, Memorandum by Financial Commissioner, Punjab, August 2, 1882. Punjab Revenue and Agriculture, Irrigation, London. (1882).
Jurriens, P.P Mollinga, P Wester, Protective Irrigation in India and Pakistan, (1996)
M. Akbar, 'Punjab under the Mughal Raj', Vanguard, (1985).
Rohan D'Souza, Water in British India: The Making of a 'Colonial Hydrology' Jawaharlal Nehru University, New Delhi, (2006).
S Khan, R Tariq, C Yuanlai. 'Can irrigation be sustainable?' Agricultural Water Management, (2006)
Shahid Ahmad, 'Indigenous Water Harvesting Systems in Pakistan', Water Resources Research Insitute (2000).
Zaigham Habib, Pakistan: Indus Basin and Water Issues, South Asia Journal (2005).

Endnotes:

1. Asrar-ul-Haq (1998)
2. Iqtidar Hussain Siddiqui (1986)
3. The Persian Wheel operates in deep wells. It comprises of three wheels and a beam horizontally attached to a toothed wheel outside the well. To the outer end of the beam a pair of bulls or buffalos is yoked. The animals move in a circular path, pulling the beam and thus making the wheels revolve. As the machine is turned, the buckets hanging in a chain dip, one by one, into the water. Again, they reach the top and then empty into a trough. The water flows through a drain to the fields, orchards,etc.
4. Lallanji Gopal (1980)
5. A Doab is a term used for a tract of land lying between two confluent rivers.
6. M. Akbar (1985)
7. Fahlbusch, Schultz and Thatte (2004)
8. S Khan, R Tariq, C Yuanlai (2006)
9. Shahid Ahmad (2000)
10. Gilmartin (1994)
11. BS Nijjar (1968)
12. D. Mustafa (2001)
13. Alloy Arthur (1967)
14. A canal serving to conduct water to a larger canal.
15. Zaigham Habib (2005)
16. A Banerjee (2005)
17. BH Baden (1907)
18. Rohan D'Souza (2006)
19. Zaigham Habib (2005)
20. E Whitcombe (1972)
21. James B Lyall (1882)

6.1.3 Ecological Implications of Green Revolution in Punjab with Special Reference to Water Resources

Inderjeet Singh, Professor, Economics Department, Punjabi University, India

Abstract

International evidence is indicative of the fact that agriculture revolution has generated the much needed food security and at the same time it has raised alarming signs for the ecology too. Worldwide the ground water quantity and the quality has been the first victim of this revolution; next are the health and the existence of species. Punjab has been the leader of Green Revolution in India. To meet the ever-growing demand of the country, food grain production has been increased by increasing productivity through intensive use of water and other inputs like fertilizer, insecticides and pesticides. The adoption of this strategy has raised many development related issues on the economic, social and environmental fronts. The model of intensive agriculture is presently being questioned about its sustainability from the point of view of its adverse impact on ecology, in general, and on the water resources, in particular. Falling water table and groundwater overdraft has become a serious problem in the state. In this context, the paper is an attempt to analyse the ecological implications of agricultural development in Punjab, with special reference to water resources.

Keywords: Agriculture, Ecology, Water Resources

Introduction

The modern economists emphasise the catalytic role that technological changes play in the growth of an economy. The technological changes bring about an increase in per capita income, either by reducing the amount of inputs per unit of output or by yielding more output for a given amount of input.[1] Technological change in an economy, therefore, refers to changes in the input-output relations of production activities. Consequently, as the economy moves from lower to higher stages of development, there occurs a shift from simpler to more modern and complicated techniques of production on the one hand and ecological fallouts on the other.[2] International evidence is indicative of the fact that agriculture revolution has generated the much needed food security and at the same time it has raised alarming signs for the ecology also.

Worldwide the ground water quantity and quality has been the first victim of agricultural revolution.[3] Next are the health and the existence of species. From the ecological perspective, heavy and indiscriminate use of chemicals and pesticides has contaminated the surface and ground water, damaged fisheries, destroyed freshwater ecosystems, entered the food chain in a subtle way and the very human existence of mankind is facing an extreme danger.[4] Punjab, the food grain capital of India has been the leader of the Green Revolution. Although the growth of agriculture output in Punjab has led to higher per-capita income and better standards of living, the falling water table and groundwater overdraft have become a serious problem in the state. The paper is an attempt to analyze the ecological fallout of the agriculture model, followed by the state, with special reference to water.

Analysis

The state of Punjab has an area of 50362 square kilometers falling between latitude 29°32'–32°28' and longitude 73°50'–77°00'. Presently, there are 20 districts and 141 blocks in the state. It is the most developed State of India where all villages are approachable by metaled roads and are cent-percent electrified. The State is flat alluvial plain except in a thin belt along north eastern border, where it is mountainous and in the South-Western where stable sand dunes are seen dotting the landscape. The climate of the State is semi-humid and semi-arid. The rainfall decreases progressively from 125 cm in Northeast (Dhar Kalan) to about 30 cm in Southwest (Ferozepur). The State has a well-defined rainy period in summer from July to September and a long dry spell further puts pressure on man-made irrigation systems. The ground water level varies from

almost near surface to about 65m below the ground level. The deep water levels are recorded in the Kandi belt and water logging conditions exist in some parts of Southwestern districts.

The State of Punjab is a part of the Indus River System in the north and north-west of the Indian Sub-continent. It is separated from the Ganga basin by the Ghaggar River. It flows only seasonally and is famous for its flash floods in the south-eastern parts of the state. Other significant perennial rivers of the Indus system, which flows through Punjab, are Ravi, Beas and Satluj that together carry 40.5 x 109 m3 of water. Himalayan glaciers melt account for about 58 percent of the source water supply of these rivers. All these rivers are tapped by using dams at different levels in the catchment areas and stored water is utilised for irrigation through a strong network of canals in the command areas. These rivers feed a vast network of canal system in the State and provide water to the neighbouring states Haryana and Rajasthan.

Problem

The Green Revolution in the state has been a chemical centered agriculture system. Agriculture in Punjab has undergone a significant structural change since the advent of Green Revolution in the mid-sixties. The traditional agriculture has progressively given way to modern and commercial agriculture. The production of wheat and rice has increased many-fold in the Green Revolution era. Since 1960's, the main focus has been on increasing agricultural production, especially of the food grains.

Apart from high yielding varieties of wheat and rice, what facilitated the process has been the consolidation of land holdings, expansion of irrigation facilities, higher use of chemicals fertilizers and pesticides, farm mechanization, power and road infrastructure and easy access to inputs and market support mechanism for output. To meet the ever-growing demand of the country, food grain production has been increased by increasing productivity through intensive use of water and inputs like fertilizer, insecticides and pesticides. The adoption of this strategy has raised many development related problems on economic, social and environmental fronts.

Punjab is predominantly an agrarian State having 85 percent of its geographical area under cultivation with an average cropping intensity of 189 percent. Water is the only natural resource available and the state is devoid of any other mineral or natural resources. Punjab's agriculture being highly intensive is dependent on heavy requirement

of water. The present cropping pattern and the efforts to increase the productivity of food grains has led to immense strain on irrigation system due to limited surface water resources, which are grossly inadequate to meet requirements and this is causing stress on ground water resources. In the State, the surface water resources are being fully utilised through well-organised canal irrigation system. The available surface water is unable to meet the demand of agriculture; as such there is an increasing pressure on the ground water resource.

The ground water is being over exploited to meet the ever increasing demand for diverse uses, i.e., for irrigation, industry, power generation and household use. In respect of ground water, the state is facing a dual phenomenon of rising and falling water table. The water table, mostly in South-Western parts, is rising because water extraction is limited due to blackish/saline quality. The water table is falling in North-Western, Central, Southern and South-Eastern parts of the State, where ground water is generally fresh and fit for irrigation. This has far reaching implication for the ecology of the region.

Availability and Deficit of Surface Water

Punjab, the major riparian State, has a limited share in its three perennial rivers (Sutlej, Ravi and Beas). It has been allocated only 1.795 Million HaM (14.54 MAF) 2 out of a total average availability of 4.24 Million HaM (34.34 MAF)2. Its replenishable ground water resources are estimated at about 2.144 Million HaM (17.37 MAF)2. The total available water resources are 31.91 MAF against an estimated demand of 50 MAF3, showing a deficit of 38 percent for a major riparian State. Continuous Growth in population, sowing of high-water consuming and high yielding cash crops and also expansion of economic activities has led to increasing demand of water for diverse purposes, causing a great stress on available water resources in the State.

Punjab has about 14500 km long canal network (table 1) and about 1 lakh km of watercourses, providing irrigation to 1.15 million hectare, which is 28.19 percent of total cultivable area of the State (Year 2006-07 P). However, the network of canals, which is more than 150 years old, is unable to take its full discharge, as it requires major rehabilitation and rejuvenation. As a result of reduced carrying capacity of the system and decreased availability of surface water, the net-area irrigated by canals has gone down from 55 percent in 1960-61 to 28 percent in 2006-07.

At present the canal water allowance, which has been in vogue since long, is 5.5 cusec per thousand acres in Eastern Canal system and 3.5 cusec per thousand acres in Sirhind Feeder system, which are getting water logged. But it is 1.95 cusec per thousand acres in Bist Doab Canal system, which is facing depletion in ground water. The canal water allowances need to be diverted from water logged areas to areas facing depletion in ground water.

Table 1: River water system in Punjab

HEADWORK	RIVER	CANALS
Nangal Headwork	Satluj	Bhakhra Main Line Anandpur Hydel Channel
Ropar Headwork	Satluj	Sirhind Canal Bist Doab Canal
Shah Nehar Canal System	Beas	Mukerian Hydel Channel Kandi Canal
Madhopur Headwork	Ravi	UBDC Canal Kashmir Canal
Harike Headwork	Satluj and Beas	Rajasthan Feeder Sirhind Feeder
Hussainiwala Headwork	Satluj and Beas	Bikaner Canal Eastern Canal

Source: Statistical Abstract, Govt. of Punjab, various issues

Agriculture in Punjab is primarily an artificial irrigation based, i.e., using surface as well as ground water resources. Intensive agriculture, based on wheat-rice rotation, has led to a serious imbalance in use and availability of ground resources. The total water supply of 3.13 m ham falls short by 1.27 m ham of the total water demand of 4.40 m ham (Table 2). The deficit is met by over-exploitation of groundwater reserves through tube-wells and wells.

Table 2: Status of water resources in Punjab

DETAIL	M HAM
Annual canal water at head-works	14.54
Annual canal water at outlets	1.45
Annual ground water available	1.68
Total annual available water resources	3.13
Annual water demand	4.40
Annual water deficit	1.27

Source: A.K. Jain and Raj Kumar (2007)

As a result, groundwater has become a major source of irrigation in the State. To relieve stress on ground water, a greater emphasis is needed on efficient conveyance and distribution system for optimal utilization of available surface water. Punjab needs to be given greater share in its river waters to decrease stress on ground water resources and power consumption.

Water Use by Source of Irrigation

An analysis of net area irrigated in Punjab by source of irrigation (table 3) is indicative of the fact that only 28 percent of the total area is irrigated by surface water or canals and rest 72 percent area is irrigated by tube-wells and wells. The historical dependence on canals and other sources of surface water has gradually beem reduced in favour of groundwater. In Punjab, there are only two major sources of irrigation; the govt. canals and tube-wells and wells.

On the eve of Green Revolution, there was an even dependence on both the sources of irrigation (table 3). The net area irrigated by canals came down from 44.53 in the year 1970-1971 to 42.28 percent in 1980-1981. It slightly rose to 42.47 percent in the year 1990-1991. It has settled around 27 to 28 percent in the last few years. On the other hand, because of easy availability of cheap or free electricity, the dependence on groundwater has drastically increased especially during the decade of 1990s. Presently, more than 70.68 percent of the net area irrigated in Punjab is dependent on tube-wells and wells, i.e., the groundwater. The availability of surface water resources is unable to meet the demand for agriculture and as such there is an increasing pressure on underground water resources. The ground water is being over exploited to meet increasing demand for diverse purposes i.e., intensive irrigation, drinking, industry and power generation.

Table 3: Net Area Irrigated in Punjab by Source ('000 Hectare)

YEAR	GOVT. CANALS	PRIVATE CANALS	TUBE-WELLS	OTHERS	TOTAL
1970-71	1286	6	1591	5	2888
	(44.53)	(0.21)	(55.09)	(0.17)	(100)
1980-81	1430	-	1939	13	3382
	(42.28)	-	(57.33)	(0.38)	(100)
1990-91	1660	9	2233	7	3909
	(42.47)	(0.23)	(57.12)	(0.18)	(100)
2000-01	1002	-	3017	2	4021
	(24.92)	-	(75.03)	(0.05)	(100)
2002-03	1148		2880	7	4035
	(28.45)	-	(71.38)	(0.17)	(100)
2003-04	1129	-	2889	10	4028
	(28.03)	-	(71.72)	(0.25)	(100)
2004-05	1101	7	2919	8	4035
	(27.29)	(0.17)	(72.34)	(0.20)	(100)
2005-06	1134	4	2914	8	4060
	(27.93)	(0.10)	(71.77)	(0.20)	(100)
2006-07	1148	-	2878	46	4072
	(28.19)	-	(70.68)	(1.13)	(100)

NOTE: FIGURES IN PARENTHESES DENOTE THE PERCENTAGES.
Source: Statistical Abstract, Govt. of Punjab, various issues

Another important fact underscored by growth of number of tube-wells (table 4) is that in Punjab there are two types of tube-wells: diesel operated and electric operated. The total number of tube-wells that was 1.92 lakh in 1970-1971; rose to 6 lakhs in 1980-1981; to 8 lakhs in 1990-1991; to 9.3 lakh in 2000-01 and finally touched the level of 12.76 lakh in the year 2008-09. So over a span of past four decades, the number of tube wells has grown by more than 6 times. Further break-up of number of tube-wells into diesel and electric operated is indicative of the fact that with minor variations, the number of diesel operated tube-wells has remained fairly stable but the number of electric operated tube-wells has increased nearly by 10 times in the 30 years and much of this increase can be attributed to the current decade. The share of electric operated tube-wells has crossed the mark of 80 percent. The end of decade of 1990 has been characterized by concession to the farmers in the form of free electricity.

Table 4: Number of Tube-wells in Punjab (Lakhs)

YEAR	DIESEL OPERATED		ELECTRICITY OPERATED		TOTAL
	No.	Percent	No.	Percent	No.
1970-71	1.01	52.60	0.91	47.40	1.92
1980-81	3.20	53.33	2.80	46.67	6.00
1990-91	2.00	25.00	6.00	75.00	8.00
1998-99	1.70	88.54	7.45	81.42	1.92
1999-00	1.70	18.38	7.55	81.62	9.25
2000-01	1.70	18.18	7.65	81.82	9.35
2001-02	1.75	18.42	7.75	81.58	9.50
2002-03	2.91	25.30	8.59	74.70	11.50
2003-04	2.88	25.17	8.56	74.83	11.44
2004-05	2.88	24.66	8.80	75.34	11.68
2005-06	2.88	24.14	9.05	75.86	11.93
2006-07	2.80	22.73	9.52	77.27	12.32
2007-08	2.75	22.07	9.71	77.93	12.46
2008-09	2.80	21.94	9.96	78.06	12.76

Source: Statistical Abstract, Govt. of Punjab, 2009

The free electricity along with convenience of use has led to ever before pressure on groundwater. Widespread rural electrification coupled with a flat-fee electricity subsidy that has led to a dramatic increase in the number of wells, groundwater-based irrigation now far surpasses surface water use.

Ground Water Draft and Fluctuations in Water Table

In the absence of any systematic policy to regulate the demand for water, the unconstrained mining of this resource has resulted in over exploitation of groundwater. As per table 5, the present groundwater development is 145 percent as on March 2004. Out of 137 blocks of the state, 103 blocks are "over exploited", 5 blocks are "critical", 4 blocks are "semi-critical" and 25 blocks are in "safe category". A look on the temporal dimension of categorization of blocks shows that in year 1984 only 44.92 percent were the "overexploited" blocks and about 49 percent blocks were semi-critical or safe. But in the year 1992, 52 percent of the blocks went into the category of "over exploitation" and share of semi-critical and safe went down to 40 percent. Presently as per the 2004 statistics, the number of "over exploited" blocks has gone to 75.18 percent and the number of "semi-critical" and "safe" blocks has shrunk to 21 percent. Thus, over exploitation of groundwater and reduced share of canal water is drastically depleting the only resource of the Punjab economy.

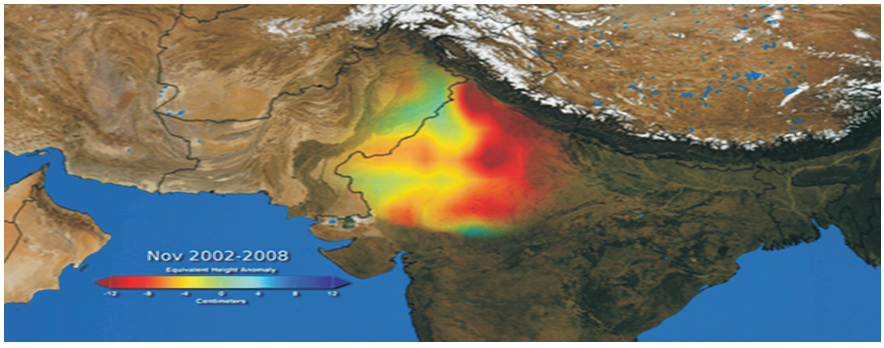
Table 5: Categorization of Blocks on the Basis of Groundwater Draft in Punjab

Year	1984		1986		1989		1992		1999		2004	
Category of Block	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Dark (Over-Exploited)	53	44.92	55	46.61	62	52.54	63	53.39	73	52.90	103	75.18
Dark/ Critical	07	05.93	09	07.63	07	05.93	07	05.93	11	07.97	05	03.65
Grey/ Semi Critical	22	18.64	18	15.25	20	16.95	15	12.71	16	11.59	04	02.92
White/ Safe	36	30.51	36	30.51	29	24.58	33	27.97	38	27.54	25	18.25
Total	118		118		118		118		138		137	

Source: Central Ground Water Board, Punjab

The alarming situation is shown by the following NASA satellite image of the region. Region marked in blue indicates areas with water surplus; yellow shows the beginning of a deficit. Red areas show regions experiencing severe groundwater depletion.

Pic 1: Satellite image showing the groundwater crisis in Punjab, India.



Source: NASA

The long term water table situation (pre-monsoon) is depicted in table 6. The long term water table fluctuations for the period 1979-98 indicated decline in nearly 76 percent area in the State. During this period, a fall in water table is 0-3m is in 35 percent of area, between 3-5m in 17 percent of area and more than 5m in 25 percent area of the state. In the period 1984-2002, there was a decline of water level in 78 percent area of the state. During this period water table fall is 0-3m in 34 percent of the area; between 3-5m in 21 percent of the area and of more than 5m in 23 percent of the area. Maximum fall in the water table is 12.92 meter in Shaina block of Sangrur District followed by 10.85 meters in Nakodar block in Jalandhar district. The maximum depth of the water level is 69.92 meter in Mahilpur of Hoshiarpur followed by 38.18 meter in Hoshiarpur-II block.

Table 6: Temporal water table fluctuation in Punjab, India

YEAR	RANGE OF FALL (% OF STATE SHARE)		
	0-3 m	3-5 m	>5 m
1979-80	49	30	03
1979-94	34	23	29
1979-97	39	18	20
1979-98	35	17	24
1979-99	31	21	20
1984-00	43	22	07
1984-01	39	24	16
1984-02	34	21	23

Source: Central Ground Water Board, Punjab.

As per 2004 estimates of Central Groundwater Board, the area of the State where depth of the ground level is 0-10m is approximately 53 percent, 10-15m is approximately 30 percent; above 15m are approximately 14 percent of the state and rest of 3 percent area of the state falls in hilly category. The most affected areas fall in district Amritsar, Jalandhar, Ludhiana, Patiala, Fatehgarh Sahib, Sangrur and Moga. The main factors contributing to depletion of water is over-exploitation because of demand for irrigation. The continuous fall of ground water level is in about 94 percent blocks of the state.

Further, the disaggregated picture giving block level scenario of ground water exploitation is given in table 7. Overall level of state of ground level development is 145 percent. As already said, out of 137 blocks, 25 of the blocks fall in the safe category, out of these 25 safe blocks 9 of the blocks are characterized by poor quality of water. Poor quality of water mainly due to salinity is found in district Bhatinda , Faridkot, Ferozpur Mansa, Moga and Muktsar. In district Bhatinda and Mansa more than 68 percent area is

endowed with poor quality water. The proportion of such area in Mansa district is 52 percent, 42 percent in Muktsar and 30 percent is in Faridkot.

Table 7: Categorization of Blocks According to Groundwater Draft in Punjab, 2004

District	No. of Blocks	Over-Exploited	Critical	Semi-Critical	Safe	State of Ground Water Develo-pment	Total Ground Water Assess-ment (Hect.)	Poor Quality Area (hect.)	Poor Quality as % of Total Area
Amritsar	16	16				152	498670	241200	68.00
Bhatinda	7	4			3	93	354720	43500	30.66
Faridkot	2	2				106	141860		
Fatehgarh Sahib	5	5				161	111670	63300	11.63
Ferozepur	10	7	1		2	105	544190		
Gurdaspur	14	7	2	1	4	107	351310		
Hoshiarpur	10	2		2	6	85	333140		
Jalandhar	10	10				254	263350		
Kapurthala	5	5				204	161810		
Ludhiana	11	10	1			144	358690		
Mansa	5	5				175	207090	140900	68.04
Moga	5	5				62	217220	109100	50.23
Muktsar	4				4	178	265610	112700	42.43
Nawan Shahr	5	3			2	175	132540		
Patiala	9	8		1		165	378260		
Ropar	7	2	1		4	93	207950		
Sangrur	12	12				183	508900	85000	16.70
Total	**137**	103	5	4	25	145	5036980	795700	15.80

Source: Central Ground Water Board, Punjab.

Rainfall and Recharge of the System

The rainfall, positively, and rice area, negatively, determine the recharge during the monsoon season. The average recharge (table 8) during 1974 to 2005 has been around one meter in the rice zone in Mazha and Doaba but little less than 0.5 meters in Malwa. The average recharge in Majha and Malwa remains about the same during 1990-2005 as it was during 1984-1987 but improved significantly in Doaba where it doubled during 1990-2005 than during 1974-1987. It has been primarily due to investment in watershed programmes in Kandi area and due to floods of 1988. The average Rabi withdrawal has also changed significantly over time. The average Rabi withdrawal in Majha zone was

1.03 meters during 1974-1987 which was more intensively irrigated even earlier. It increased to 1.08 meters during 1990-2005, i.e. by about 15 percent. But the increase was about 100 percent in Malwa, from 0.44 meters to 0.85 metres, and 140 percent in Doaba, from 0.67 meters to 1.60 meters. The Doaba region not only has the lowest canal irrigation (2.4 percent as compared to 39.3 percent and 29.7 percent in Malwa) but is also now known for its highly water intensive crops in rabi season like sugarcane, potato, sunflower and lately winter maize. The first three crops covered 16.1 percent of irrigated area in Doaba region compared with 4.5 percent Majha and only 1.9 percent in Malwa.

Table 8: Rainfall, recharge, Rabi withdrawal and change in water table, Punjab

YEAR/ PERIOD	RAINFALL (MMS)	AVERAGE RECHARGE IN MONSOON (METERS)			AVERAGE CHANGE IN WA TER TABLE (METERS)			RABI WITHDRAWAL (METERS)		
		Majha	Doaba	Malwa	Majha	Doaba	Malwa	Majha	Doaba	Malwa
1988	1123	2.25	3.58	1.86	0.40	1.40	0.92	1.86	2.17	0.94
1990	755	1.71	1.99	1.37	0.40	0.24	0.46	1.31	1.74	0.91
1995	794	1.77	2.96	1.38	0.46	1.22	0.55	1.31	1.74	0.84
1997	709	1.35	2.46	0.73	0.14	0.66	-0.14	1.21	1.80	0.87
1999-2005	430	0.53	0.67	-0.10	-0.61	-0.83	-0.87	1.14	1.50	0.77
Avg 1974-87	645	0.96	0.58	0.38	-0.07	-0.09	-0.05	1.03	0.67	0.44
Avg 1990-05	539	0.89	1.21	0.42	-0.29	-0.39	-0.43	1.18	1.60	0.85
Avg 1974-05	603	0.95	0.99	0.44	-0.19	-0.23	-0.26	1.14	1.22	0.70

Source: Karam Singh (2007)

It is high time to improve the water use efficiency in the State by using alternatives such as appropriate planting time, irrigation scheduling, mulching, tillage, weed control, land leveling etc.

Demand Side of the System

On the whole, the area underlain by groundwater of unfit quality is around 7957 square kms which comes out to be 16 percent of Punjab State. In addition, the state has gone from growing a previously healthy mix of crops such as wheat, maize, pulses and vegetables to devoting nearly 80 percent of its crop area to rice and wheat, two of the most water-intensive crops. Overall, central and state level agriculture policy–consisting of minimum support prices, effective procurement of selected crops, input subsidies benefiting farmers in electricity, fertilizer, and irrigation and the increased availability of credit facilities over the years–has played a key role in pushing farmers to grow primarily wheat and rice–at enormous detriment to water resource sustainability in the country.

The scope to address the supply side of water is limited and the major scope lies in managing the demand side of water. The rice crop has been the most remunerative crop relative to other Kharif crops. As shown in table 9, it is also the most water intensive crop, using about 24000 cubic meters of water per hectare, which is about six times more than maize, almost 20 times than groundnut and about 10 times more than pulses.

Table 9: Water requirements of different crops in Punjab, India

CROP	WATER REQUIREMENTS (CUB M PER HA)*	ELECTRIC MOTOR (HRS PER HA)**
Paddy	24181	290
Wheat	5504	60
Maize	5474	50
Barley	4486	35
Kharif Pulses	2355	35
Gram	2243	30
Rabi Pulses	2187	30
Groundnut	1123	35

Source: Karam Singh and K.K. Jain (2002)

The blame for deteriorating water table goes to the state government's long-standing policy of giving free power to farmers. As power in Punjab is heavily subsidised, its 11 lakh agricultural consumers feel free to run their powerful submersible motors to draw groundwater. The supply of free power to farmers is directly linked with underground water. It leads to over exploitation of this scarce natural resource. During the years when electric supply was free in Punjab, the water table in some districts had gone down considerably and farmers are still going deeper in search of water by installing deep submersible pumps using heavy-duty motors consuming more power. Political considerations should not overlook the ground realities. A few years more of this honeymoon with free power will render many areas in Punjab and elsewhere barren. People won't get water even for drinking, leave aside irrigation.

Punjab has been overusing water because it is expected to feed the entire nation. The State should be suitably compensated in much the same manner as states with mineral reserves are given royalty on coal and bauxite. There is a point in this argument; Punjab's virtual water exports amount to 20.9 billion cubic meters every year. “Virtual water” refers to the water embedded in commodities. For instance, a kg of basmati rice takes up to 7,500 liters of water to produce. An equivalent amount of water is deemed to be “exported” along with the rice. Food-surplus states are usually water exporters and the food-deficient ones, like Bihar, the importers. Keeping in view the alarming situation of

over exploitation of Ground water as described above, there is an urgent need to formulate guidelines for release of electricity connection for agriculture pump sets.

Rice has benefitted the most from its state managed effective minimum support price as well as from the electric supply (there are 8.56 lakh electric tube-wells out of 11.44 lakh), and even more so from the free electricity supply during 1997-2002 and beyond. The subsidized and sometimes even totally free electricity to the farm sector in Punjab has done more harm than good. Some of the studies are indicative of the fact that even if the electricity is priced at cost and charged on use basis (metered), rice still remains to be the profitable alternative.[5] This is high time to reduce the area under paddy and introduction of alternative crops particularly in the Malwa region, to restore the water balance in the long run. The alternative crops (like groundnut, maize, pulses: arhar and moong) have to be made competitive with paddy. In addition to water saving, the society will benefit in terms of improvement/decline in soil degradation of fertility in the long run, improvement in sanitation and health, improvement in environment and power saving. A big chunk of Govt. budget goes for buying costly power from other states or diverts from high value added sectors to this sector. Such savings need a detailed study.

Floods and Water Logging

Despite the infrastructure of dams and large head works on all major rivers and low dams on excessive discharging rivulets of the State, occasional excessive flood waters, which cannot be impounded upstream of the dams, have to be passed downstream keeping in view the regulation norms based on the safety of dams. Sometimes even water has to be released in the interest of power generation when there are no irrigation requirements. Table 10 is an indicative of the damage caused by such floods in the immediate past. Almost every year several towns and villages are affected by floods and a significant loss is caused to land, human life and cattle in the region.

Table 10: Effect of floods during rainy season in Punjab in India

YEAR	VILLAGES/ TOWNS EFFECTED (NO.)	AREA AFFECTED (IN SQ. KM.)	POPULATION AFFECTED (NO.)	HUMAN LIVES LOST (NO.)	CATTLE HEADS LOST (NO.)
1980	1191	489	85724	44	117
1990	755	471	90465	13	275
2000	81	127	319	5	88
2003	43	47	25	3	0
2004	480	610	60157	15	511
2005	93	31	125	11	48
2006	442	211	405933	10	23
2007	1033	1035	405911	7	3
2008	2001	5004	389116	34	104

Source: Statistical Abstract, Govt. of Punjab, various issues

Also, non-perennial River Ghaggar is a flashy river causing huge devastation during monsoon season. Distribution of flood prone villages according to extent of damage due to floods is given in table 11. Extent of damage due to floods may be defined as the area damaged as a percentage of total area of a region. With extent of overall damage of 60.50 percent, Anadana block is the worst hit in Sangrur district. This figure of damage stands at 66.36 percent for Moonak (urban) and at 59.53 percent for rural. The rural affected area constitutes twenty five villages. Uniformly the extent of damage is more than forty percent. Temporal statistics given in table are indicative of the fact that over the years the position has not changed much. Year after year, same villages are being affected by the flood in Kharif season.

Table 11: Distribution of villages according to extent of flood caused by Ghaggar River

Village	Total land as per records (Acres)	Acres of area damaged in Kharif season				Maximum damage (Acres)	Extent of Damage (%)
		1993	1994	1995	2008		
Ganota	548	110	-	98	222	222	40.51
Andana	4151	855	446	853	1680	1680	40.47
Hamirgarh	2770	540	130	650	1121	1121	40.47
Makorarh Sahib	3850	504	664	1243	1558	1558	40.47
Baoupur	1744	586	480	626	706	706	40.48
Ghamur Ghat	1159	7	-	470	469	470	40.55
Banarshi	2755	1152	1259	1300	1115	1300	47.19
Mandvi	6088	3000	1952	2961	2464	3000	49.28
Fulad	1853	1030	525	800	750	1030	55.59
Rampur Gujran	1584	920	-	675	641	920	58.08
Bajidpur Nava Abad	801	485	338	365	324	485	60.55
Salemgarh	1957	1238	28	760	792	1238	63.26
Sahpur Therri	870	500	516	578	352	578	66.44
Nava Gaon	3002	1250	1800	2120	1215	2120	70.62
Chandu	1275	-	895	903	516	903	70.82
Karhel	1742	1250	398	752	705	1250	71.76
Bhundrh Bhaini	1043	850	82	400	422	850	81.50
Hotipura	1332	1050	800	1120	539	1050	78.83
Kundani	553	473	2	323	224	323	58.41
Bushera	2943	2605	980	2400	1191	2605	88.52
Khanauri Kalan	1678	540	374	540	679	679	40.46
Handa	1070	1020	476	1022	435	1022	95.51
Surjan Bhaini	617	573	513	590	250	590	95.62
Kabirpur	677	539	131	649	274	649	95.86
Banga	2738	951	1733	2700	1108	2700	98.61
Total	48800	22028	14522	24898	19752	29049	59.53
Moonak (Urban)	8063	5351	2490	5203	3263	5351	66.36
Grand Total	56863	27379	17012	30101	23015	34400	60.50

Source: Office of Deputy Commissioner, Sangrur.

The problem of floods calls for, from planning perspective, short term, medium term and long term measures that may be specific to the block. To counter floods, a number of river taming works are to be annually constructed on the river. The rivers, Ravi and Sutlej near international border have to be paid special attention to counter the floods menace due to counter protective works constructed by neighbouring country and shifting of course of rivers. There is a need to adopt coordinated management approach to minimise the floods in the state, to have suitable drainage policy for annual maintenance of drains and to ensure optimum utilization of created hydropower and irrigation potential.

The net impact of water logging is that about 1.04 lakh (104,000) hectare area out of 2.16 lakh (216,000) hectare area of Muktsar has become critically water logged, making the land unfit for any worthwhile purpose. In low lying areas, the land stands submerged and totally unfit for cultivation, as a result not only agriculture production of this area has declined over the last few years, soil quality has deteriorated quite substantially.

Water Pollution

Another important aspect is water quality, which is impacted by untreated or inadequately treated industrial effluents and sewage flowing into 'nallahs' and rivers. The problem is further compounded by the mixing of storm water and sewage in various municipal towns as these carry solid waste, bio-medical waste and hazardous waste from city roads into the water bodies. The pollution and contamination of water resources due to industrial waste, sewage and excessive use of chemical/pesticides in agriculture has led to high pH, BoD, DO, feacal coliform and concentrations of Arsenic etc. At some places, it has become toxic due to high concentration of heavy metals, such as, mercury, copper, chromium, lead, iron, nickel, cyanides and pesticides like DOT, BHC, endosulfan and aldrin. This can adversely affect the health of the populace and may cause diseases like cancer, skin diseases and miscarriage cases etc. Toxic water may even enter the food chain and alter genotoxicity or damage DNA, causing irreparable loss to both human beings and wildlife. The chemical quality of groundwater is also getting deteriorated due to natural release of selenium and fluorides at some places. As such, special attention would have to be given to these aspects to provide safe water. Improvements in existing strategies, innovation of new cost effective techniques resting on a strong science and technology base are needed to eliminate the pollution of surface and ground water resources. Technology and training have to play important roles in the development of water resources and their management.

Health Effects

Free electricity and easy water availability has acted as a catalyst for enhancing the chemical use. Quantum of chemical inputs like fertilizers and pesticides are a best determinant of the ecological damage being done to a region. Chemical fertilizer consumption in Punjab is relatively on the higher side. Presently the Punjab, with only 1.57 percent of the geographical area is consuming 15 percent of the pesticides and more than 8 percent of chemical fertilizers of India. The health ailments are alarmingly on the rise and are closely identified with indiscriminate chemical use in agriculture. These are the statistics which have emerged from the recorded sales figures. Actual ground reality is worse. In Punjab, the pesticide retailing is a free for all trade. Worst hit is the economically and socially backward cotton growing region of the state. In this region, low literacy level coupled with low income has facilitated the pesticide traders to make the area a dumping ground of chemicals. A lot of unrecorded and spurious product trade is a common phenomenon in the peak season. The pesticides (especially the POPs) that were banned a decade ago are freely available and being actively used. Farmers and retailers are using their own formed cocktail formulations without being aware of the ecological fallout of the same.

Table 12 relates the number of health ailments data with fertilizer consumption, pesticide consumption and the per capita net state domestic product. An interesting fact that comes to light is that all the states that are leaders in Green Revolution are also leaders in consumption of fertilizers and pesticides. Fertilizer consumption per hectare in Punjab is the highest as compared to other states. Punjab ranks at number one in terms of total quantity of pesticide consumed. In terms of health ailments, rural Punjab scores at 136 per thousand as compared to 53 in Bihar, 57 in Rajasthan and 77 in Orissa. The urban situation in health ailments is relatively better, it is 107 per thousand. So, the total health ailments incidence in Punjab is almost 2.5 times of what it is in Bihar. It is followed by West Bengal, U.P. and Haryana in order. Thus, heavy chemicalization of agriculture has no doubt raised the per capita income of the region but has at the same time led to increase in health aliments.

The presence of POPs in blood samples and cancer concentrations found (PGIMER, Chandigarh and CSE Studies) in the cotton belt is also an indication towards the bad health effects of pesticides. ICMR report on cancer cases registered in selected big medical institutions shows that the cancer is also emerging as a big disease in the region.[6] In this report, number of cases shown in Bhatinda, Faridkot, Mukatsar district are only

those who came to the sampled hospitals and the sample itself is very small. Due to poor literacy levels, many are unaware of the very existence of such disease. Even if they come to know, due to misbelieves and non-affordability they get into the trap of quacks. More than a half of the people leave the treatment after one or two procedures. In such a dismal scenario, by just rough approximation, the ICMR results are just a fraction of the ground reality. Hence, the occurrence of cancer cases in the pesticide users' belt is an alarming bell for the ecology of the region.

Table 12: No. of Health Ailments in Relation to Chemical Consumption, 2004

State	Fertilizer Consumption		Pesticide Consumption		Per Capita NSDP		No. of Ailments/ 1000			
	Per Hectare	Rank	MT Tech. Gr.	Rank	NSDP	Rank	Rural	Rank	Urban	Rank
Andhra Pradesh	155.8	3	2133	9	20757	9	90	8	114	4
Assam	41.6	13	170	15	13139	12	82	9	83	9
Bihar	85.7	10	850	11	5780	15	53	15	63	13
Gujrat	106.8	8	2900	6	26979	4	69	11	78	10
Haryana	166.2	2	4520	3	29963	1	95	5	87	8
Karnataka	110.8	7	2200	8	21696	7	64	12	57	14
Kerala	67.4	11	360	14	24492	5	255	4	240	1
Madhya Pradesh	56.0	12	749	12	14011	11	61	13	65	12
Maharashtra	97.7	9	3030	5	29204	2	93	7	118	3
Orrisa	40.4	14	692	13	12388	13	77	10	54	15
Pujab	192.5	1	6900	1	27851	3	136	2	107	6
Rajasthan	36.6	15	1628	10	15486	10	57	14	72	11
Tamil Nadu	152.9	4	2466	7	23358	6	95	6	96	7
Uttar Pradesh	125.5	6	6855	2	10118	14	100	4	108	5
West Bengal	129.0	5	4000	4	20896	8	114	3	157	2

Source: 1. Statistical Abstract, Punjab, 2004

2. NSSO Report on Mortality and Morbidity, 2004

Policy Dimension of the System

Recently the State has come up with a policy initiative, 'Punjab State Water Policy (2008)' but yet a lot needs to be done. Scarcity of water is a serious problem for the last two decades, but the investment in research and development in water use efficiency has not picked up. Thus the R&D programmes on water use efficiency need to be given a top priority in all dimensions. There is a need to develop a long-term policy for ground water use and recharge to maintain an optimum balance. The negative balance between annual available water supply and actual use needs to be corrected by using multi-pronged

strategies like: (a) making maximum use of surface water; (b) Increasing recharge; (c) addressing urban sector; and (d) reducing demand for water. The state government passed the 'Preservation of Subsoil Water Ordinance' in 2008 to institutionalize delayed sowing of paddy. If Punjab is to continue as the food grain capital of India, modern agricultural practices will have to take into account the reality of the water situation and create a feasible long run plan for a sustainable future.

Conclusion

The broad conclusion is that the 'Punjab model' of agriculture has deteriorated the ecology of the region, in general, and the water resources in particular. The repercussions have started to show up in the form of depleted ground water, wide spread salinity, deteriorating water quality and specific kind of disease patterns in human beings. Clearly, over the years, a number of issues and challenges have emerged in the development and management of water resources. The shortage of surface water availability, development and over-exploitation of ground water resources and deteriorating water quality of water resources of State have raised the concern and need for judicious and scientific resource management and conservation. All these concerns need to be addressed on the basis of common policies and strategies with a vision of a new considered approach by adopting emerging research in science and technology.

References

Dung, N.H. and Dung, T.T.T. (1999): "Economic and Health Consequences of Pesticide Use in Paddy Production in the Mekong Delta, Vietnam", EEPSEA Research Report Series (www.eepsea.org)

Dung, N.H., Thien, T.C. and Others (1999). "Impact of Agro-Chemical Use on Productivity and Health in Vietnam". EEPSEA Research Report Series, Available at: http://www.eepsa.org.

Gill, Karam Singh (2003), Punjab Agricultural Policy Review, Report for the World Bank, New Delhi.

Huan, N.H. and Le Van Thiet (2000). "Results of Survey for Confidence, Attitude and Practice in Safe and Effective Use of Pesticides", In, Agro-Chemicals Report, Vol. II, No. I, January-March 2002.

Jain, A.K. and Kumar, Raj (2007): "Water Management Issues, Punjab-North West India", Website: http://akicb.ifas.ufl.edu/upload/proceedings/jainak_water_management.pdf

Kishi, M., N. and Hirschhorn, Qjajadisastra, M. and others (1995), "Relationship of Pesticide Spraying to Signs and Symptoms in Indonesian Farmers", Scandinavian Journal of Work & Environmental Health, 21:124-133.

Leontief, W.W. (1963): Studies in the Structure of American Economy , Oxford University Press, New York.

Mathur, P. N. (1953) : "An Efficient Path of Technological Transformation of an Economy" , in Barna, T.(ed), Structural Dependence and Economic Development, Macmillan.

Pimental, D., H. and Acquay M. Biltonen (1992), "Environmental and Economic Costs of Pesticide Use", Bioscience, 42, 750-60

Singh Karam (2007): Punjab, the Dance of Water Table, The Punjab Farmers Commission, Govt. of Punjab, p 13.

Singh, Karam and Jain, K.K. (2002), Dynamics of Structural Shifts in Cost and Returns in Farm Economy in Punjab, Report for ACCP, Agro Economic Research Centre, PAU, Ludhiana, Mar.

Tardiff, R.G. (1992): The e-pesticide Manual: A World Compendium, 13th Edition, Alton, Hampshire

WHO (1990), Public Health Impact of Pesticides Used in Agriculture, World Health Organization: New York, USA.

Endnotes:

1. (Mathur, 1953)
2. (Leontief, 1963)
3. (World Bank, 1990)
4. (Dung and Dung, 1999; Dung et al., 1999; Huan et al., 2000; Kishi and Hirschborn, 1995; and Tardiff, 1992)
5. (Karam Singh Gill, 2003)
6. (Inderjeet Singh and Parmod Kumar, 2010)

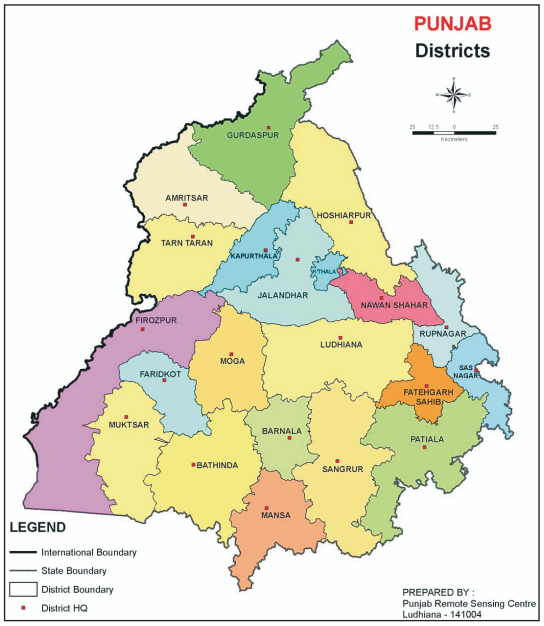
6.1.4 Water management strategies in Punjab, India

A K Jain, Professor and Head, Department of Soil & Water Engineering, Punjab Agricultural University

Introduction

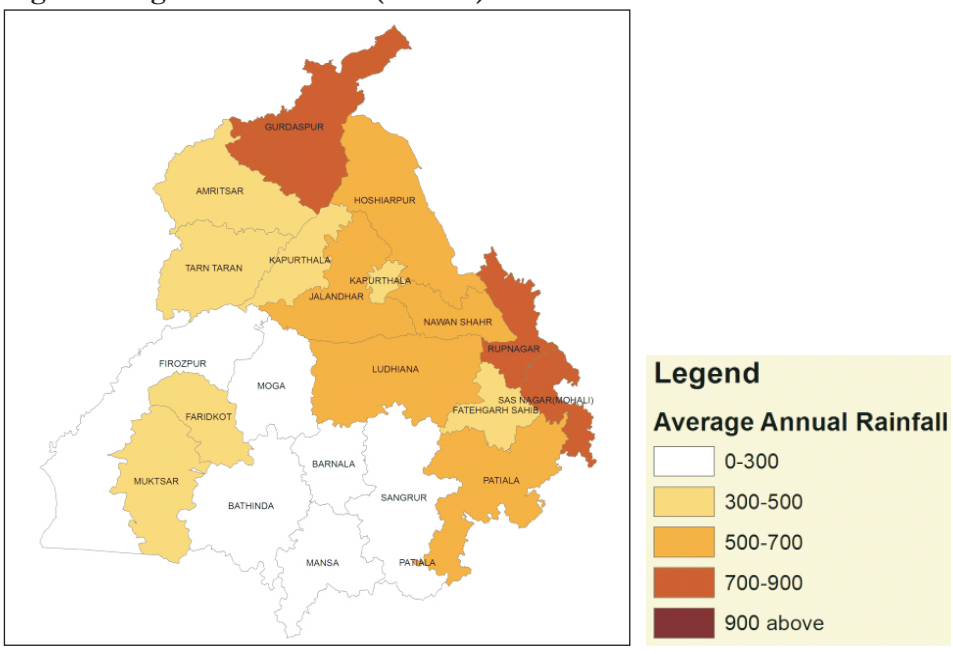
Punjab (India) with geographical area of 5.036 million ha (1.5% of country's total geographical area) is a part of Indo-Gangetic plains in the north-west of Indian Sub-continent and lies between 29033'-32031'N and 73053'-76055'E (Fig. 1) Three perennial rivers, namely the Sutlej, Beas and Ravi, flow through the state. In addition, Ghaggar which is almost a seasonal river, flows through the south western part of Punjab. The water from the rivers is utilized for irrigation through a network of canal systems (14,500 kms) such as Sirhind canal, Sirhind feeder, Eastern canal, Upper Bari Doab Canal, Bhakra canal and Bist Doab canal. The state has experienced a phenomenal increase in agricultural production during the last three decades, mainly due to extensive adoption of rice-wheat cropping system with assured irrigation facilities and has helped India in achieving self-sufficiency in food. Total food grain production in the state is 274 lakh tones. Punjab contributes about 55 per cent of wheat and 42 per cent of rice to the central pool of the country.

Fig. 1 Map of Punjab



Total population of the state is 277 lakh and about two thirds live in rural area comprising 12,278 villages. The annual rainfall (southwest monsoon) varies from 300-1000 mm (Fig. 2) with average value 530 mm and most of it (about 80%) is received during July, August and September.

Fig. 2 Average annual rainfall (2000-08)



Due to spatial and temporal non-equitable distribution of rainfall, agriculture has to depend on other sources of water to meet the crop water requirement. With the expansion of irrigation facilities and rapid mechanisation of various agricultural

operations, the cropping intensity has increased from 133 per cent in 1971 to 190 per cent in 2009 (Table 1).

Table 1. Basic agriculture statistics of Punjab

TOTAL GEOGRAPHICAL AREA	50.33 LAKH HA
Inhabited villages	12278
Average rainfall	530 mm
Net area sown	42.01 lakh ha
Area under cultivation (%)	86
Area under irrigation (%)	98
Cropping intensity (%)	190
Area under rice	27 lakh ha.
Arera under wheat	35 lakh ha
Average yield	Rice – 40 q/ha Wheat – 45 q/ha
Tractors	4.2 lakh
Irrigation pumps	12.86 lakh

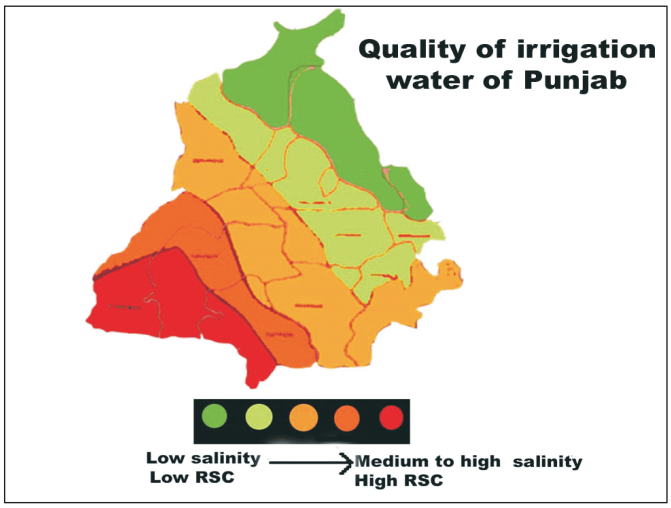
The state has 86 per cent cropped area and 96 per cent of this is under irrigation that uses nearly 84 per cent of the state water resources, out of which rice uses 34 per cent, wheat 30 per cent and other crops 36 per cent. Out of total irrigated land 73 per cent is irrigated by tube wells and remaining by canal network system. Most of the canal network exists in the south-western districts of the state. The dominance of rice-wheat cropping system has caused reduction in area under low water requiring crops, which led to over-exploitation of ground water resource, as the surface water is not adequate to meet the irrigation needs.

The water demand of 3.65 M ha-m in 1980 has increased to 4.76 M ha-m. The total available water resources of 3.48 M ha-m falls short by 1.28 M ha-m of the total water demand of 4.76 M ha-m. This deficit is met through over-exploitation of groundwater as the number of tube wells has increased from 1.9 lakh in 1971 to 12.86 lakh in 2010.

Based on the ground water statistics worked out by the Directorate of Water Resources(Punjab), 110 blocks are over exploited in which the groundwater withdrawal is more than 100 %, 3 blocks are at critical stage where groundwater withdrawal is between 90-100 %, 2 blocks are at semi critical stage where the withdrawal is between 70-90 % and 23 blocks are safe having groundwater withdrawal less than 70 %. The safe blocks are located either in foot-hill region that has deep groundwater or in the region having poor quality groundwater. The groundwater quality status of Punjab is shown in Fig. 3. The indiscriminant development of groundwater has lead to fast depletion of

groundwater resource in the state. The average groundwater exploitation is 166 per cent. During the last decade the average fall of water table in the state was 0.55 m/year. The general direction of groundwater flow is from North-east to South-west. Water table decline has serious economic impact on the farmers as they have to install deep submersible pumps to draw water from deeper aquifers also resulting in higher energy consumption for pumping. Additionally the water scarcities are being forecasted in the light of climate change and competitions from various sectors as a consequence of demographic growth, rapid industrialisation and urbanisation.

Fig. 3 Status of water quality in Punjab



Water management issues:

Based on the hydrologic and climatic conditions, the state can be divided into three zones (north-eastern, central and south-west) that have distinct water management issues.

i) North-eastern Zone

The north-eastern part covers an area of 0.95 M ha(19 % of state geographical area) which includes Shiwalik ranges of foothills(known as kandi area that occupies 10.6 % of state geographical area) has undulating topography. The annual rainfall varies from 700 mm to 1000 mm. The distribution of rainfall in the region is uncertain in the region. The rainfall-induced runoff and the ensuing soil erosion are major concerns. Almost 40 per cent of water is lost as runoff. Intense rains coupled with undulating terrains and poor vegetative covers lead to heavy soil erosion that damages the agricultural land through the formation of rills and gullies. The quality of groundwater is good. Although aquifers are deep and soil is rocky, these are now being exploited through community tubewells.

Out of total 37 blocks in this zone; 6, 17, 9, 4, 1 blocks have water table depth <5m, 5-10m, 10-15m, 15-20 and >20 m, respectively.

ii) Central zone

The central part which covers an area of 2.36 M ha (47 % of state geographical area) is highly productive and is underlain with good quality groundwater. The rainfall varies from 400 to 700 mm. This region is facing the problem of declining water table due to over-exploitation of groundwater resource to supplement the water requirement of intense rice-wheat cropping sequence. The average annual fall in water table was 0.09 m during 1974-85, it increased to 0.20 m during 1986-2000 and further to 0.75 m during 2000-2010. Out of 74 blocks in this zone, 2, 10, 18, 22, 22 blocks had water table depth < 5, 5-10, 10-15, 15-20 and >20m, respectively revealing that in several parts of this zone water level has gone very deep. This has forced the farmers to install deep submersible pump sets in place of centrifugal pumps resulting in huge additional expenditure, extra power consumption and may even cause subsidence of land due to continuous over-exploitation of groundwater being of good quality. With large scale installation of tube-wells (two-third of state's tube-wells are located in this zone), almost 99 per cent cropped area has assured irrigation. Only 14 per cent area is irrigated with canal water supplies. The area having water table depth below 10 m increased from 3 per cent in 1973 to over 85 per cent in 2009. About thirty per cent area in this zone has water table depth more than 20m. The cumulative fall in groundwater in this zone during last three decades was more than 9 m. It is also feared that reversal of flow from adjacent shallow water table area having poor quality water towards this central zone may occur, if the declining trend is not checked immediately.

iii) South-west zone

The south-western part covering an area of 1.71 Mha (34 % of state geographical area), being recognized as the cotton belt of the state, has groundwater quality problem that prevents its withdrawal. The annual rainfall varies from 100 mm to 400 mm. Seventy per cent of the area is canal irrigated, while the ground water is brackish in nature with high EC (2.0 to 12.5 dsm-1) and residual sodium carbonate (RSC) ranging from 3.0 to 35 mel-1. High concentration of fluorine (F) in groundwater has also been observed at a few locations. The area is affected with water logging, salinity and alkalinity problem, and has experienced rise in water level during the last two decades vis-à-vis salt accumulation within the soil profile, mainly due to excess canal irrigation, inadequate drainage system,

less extraction of groundwater due to its poor quality. Out of 27 blocks in this zone, 8, 12, 5, 2 blocks have water table depth less than 5, 5-10, 10-15, 15-20 m, respectively. According to an estimate about 75,000 ha of land covering 330 villages is affected by water logging. It has adversely affected the agriculture production and economic status of farmers. At some locations a thin layer of good quality water lies over the brackish water.

Water management strategies

It is evident from the above zone specific issues that effective water management in each region of the state is immediately required.

(i) Management strategies for North-eastern zone:

To address soil & water problems in the north-eastern part, following management strategies on watershed scale are being adopted:

i) Managing runoff water through construction of storage tanks (water harvesting structures) and earthen dams offer a useful option in the Shiwalik foothills area. The additional water helps in bringing more area under cultivation and also to provide life-saving irrigation to crops.

ii) Levelling of fields has been an effective erosion control and water conservation measures. Bench terracing is recommended on lands with slops between 5 to 30 per cent. Wheat straw mulching greatly reduces the runoff losses and helps to conserve water in the fields.

iii) The water saving techniques such as optimal irrigation scheduling, irrigation methods (drip/micro sprinkler) should be adopted. In addition, the crop varieties suited for rain fed cultivation needs to be adopted that will significantly reduce water requirements.

(ii) Management strategies for central zone:

The indiscriminate development of groundwater coupled with reduced recharge due to urbanization and growth of industries, has led to fast depletion of groundwater resource. The following measures in respect of water management would be effective for regulating the groundwater withdrawal to sustainable levels.

i) The extensive rice-wheat cultivation in this zone has caused fast depletion of groundwater. Therefore, efforts should be made to shift some area under

high water requiring crop (rice) during kharif to low water requiring crops (basmati, maize and pulses), and in rabi some area under wheat needs to be replaced with raya and chickpea.

ii) The adoption of On-farm water saving technologies would improve crop water productivity and increase in water use efficiency and thus would minimise the groundwater use. The various on farm water saving technologies, which have been successfully adopted are listed below :

a) Laser levelling of fields (precision land levelling)
b) Timely transplanting of rice (low evaporative demand)
c) Optimal irrigation scheduling
d) Growing of short/medium duration varieties
e) Efficient irrigation methods (Drip/sprinkler/furrow)
f) Efficient water conveyance system (lining of water courses, underground pipe line system)
g) Mulching (moisture conservation)
h) Zero tillage (happy seeder)
i) Puddling in the rice fields (reducing percolation losses)
j) Aerobic rice cultivation (Direct seeded rice)
k) Optimal plot size (as per soil type and stream size)

iii) The groundwater potential can be increased by recharging of aquifers either from surface runoff or harvested roof top water. The surface runoff available in grounds/ roads/farms can be used for recharge of shallow aquifers. However, it should be ensured that the quality of runoff water is suitable for recharge. Rainwater harvested from rooftop being free from contamination in general, should be utilised for recharging groundwater by constructing suitable recharge structure.

iv) The sewage water after treatment can be utilised to supplement irrigation. Estimates are that sewage water can irrigate about 0.096 million ha land annually with substantial contribution of nutrients.

v) With the passage of time, there has been a major shift in cropping pattern and the demand of water has changed in different areas. So the canal water allowance/capacity factors/operational schedule needs to be revised based upon present cropping pattern.

vi) The renovation of village ponds would enhance availability of water, that can be used for irrigation and also this would increase percolation of stored water.

vii) There is need to look into the possibility of virtual water trade in terms of import of water-intensive commodities to the water scare areas and vice versa, for better management of available water resources.

(iii) Management strategies for south-western zone:

The following management strategies could be adopted in the south-west zone having brackish groundwater.

i) Cyclic/conjunctive use of canal water and tube well water is recommended for this area. The application of canal waters twice followed by tube well water once or alternatively mixing both the waters such that the salinity attained after mixing is within the permissible limit to use for irrigation.

ii) The properly designed and constructed surface drains, allow quick flow of rainwater in a short time that prevents water logging. These drains are low cost structures and can be easily maintained.

iii) Sub-surface drainage system that consists of a network of perforated PVC pipes buried below ground surface with suitable slope and an outlet could be adopted to keep the water table at a pre-determined level.

iv) To tap good quality water floating over the brackish water, the multiple well point system (skimming well technology) can be adopted successfully.

v) Bio-drainage as plantation of eucalyptus can also be adopted in severely waterlogged salt affected soils.

vi) Fish farming in saline water is another option, which could be adopted in abounded areas of south-west part.

vii) The brackish water after desalinisation can be reused for secondary purposes.

6.1.5 Groundwater Legislation in Pakistan

Shah Bakht Sohail, Research Scholar, Development Policy Research Centre, Lahore University of Management Sciences, Pakistan

The dynamic interactions between ground water and surface water are governed by the hydrogeologic principle of Darcy's Law, which explains "that when an aquifer is hydraulically connected to a stream, the flow into or out of the stream is proportional to the difference between the stream stage elevation and water table elevation."[1] Ground water, in Pakistan, has become a major source of water for agricultural as well as domestic use. Apart from agricultural use, as high as 70 percent of the population of Pakistan uses groundwater for domestic use and drinking purposes.[2] Furthermore, it is estimated that since 1976, owing to restraints on large-scale surface water development, agricultural expansion in Pakistan can be largely attributed to the development of more than 600,000 private tube wells in the country. It is further estimated that 75 percent of the increase in water supplies in the last three decades owes to the public and private ground water exploitation. In addition, many industries use the relatively clean ground water to meet their water needs.[3]

However, it is striking to note, given the importance of the groundwater resource as a source of water that it continues to be taken as granted, neither being systematically monitored, nor managed. In two of the four provinces of Pakistan, there is an almost non-existence of any laws to regulate the use of groundwater. In Baluchistan and Sindh even though the legislation actually exists, its implementation is still a question mark which has hindered the provinces to reap fruits of the effort put in drafting the legislation. This paper looks at the existing allocation of the groundwater rights in Pakistan, and suggests the course of action that should be taken by the responsible

authorities in devising the laws for the exploitation of groundwater, and its preservation. In doing so, this paper also reflects upon the problems and issues that are part and parcel of the overexploitation of the groundwater resources.

Legislation in Pakistan related to ground water exploitation:[4]

The first piece of legislation for the management of groundwater was the Punjab Soil Reclamation Act, 1952, which was promulgated to control the water logging and salinity in the country through the development and operation of drainage tube wells. A Soil Reclamation Board was formed under this Act, which was not only in control of the groundwater management, but could also "instigate a licensing procedure, permitting land owners to install private tube wells."[5] Later on, the executive powers of the Board were transferred the Provincial Irrigation and Power Department as the Board was suspended. This department framed the licensing rules once in 1965, yet they were never enacted. The 1958 legislation, Pakistan Water and Power Development Authority Act was enacted to cover the same grounds, creating the Water and Power Development Authority. According to this Act, WAPDA, a federal agency, had control over the underground water resources, and could issue area-specific use of the groundwater resources. These rules, however, were never enacted. The next effort to monitor groundwater use was by the Government of Baluchistan in 1978 with the enactment of Groundwater Rights Administration Ordinance, which was introduced to control groundwater mining. Under this ordinance, a procedure was laid down to issue permits for the development of new karezes, dug wells and tube wells, however "specific guidelines for each region were never issued and […] Ordinance did not make a noticeable impact on the groundwater rush that continued unabated" in the next three decades."

The Environment Protection Agency Act, 1996 has voiced the concern over water quality in Pakistan for the very first time, also covering the groundwater quality. The federal and provincial Environment Protection Councils are supposed to set quality standards of groundwater amongst other things, however, so far, the Councils have not dealt with groundwater quality.

Lastly, the Provincial Irrigation and Drainage Authorities Act, 1997 (replaced in Sindh by Sindh Water Management Ordinance, 2002) forms the basis of the formation of Provincial Irrigation and Drainage Authorities. These authorities, along with responsibilities regarding irrigation and drainage, are supposed to ensure that the groundwater monitoring is undertaken, and have a mandate to "initiate policies to

address groundwater management problems." So far, nothing of the sort has been done. In Punjab and Khyber Pakhtoonkhwah, the Irrigation and Drainage Authorities are largely invisible, let alone non-functional.

All the legislation in Pakistan, however insignificant, related to groundwater management, has a common denominator: it has suffered at the stage of implementation. According to F. van Steenbergen, the groundwater policy of Pakistan can be summarised as follows:

"The focus of groundwater policy was on control of water logging and the stimulation of private tube well development. Government interventions were supply driven there was little concern about over exploitation of aquifers or deteriorating groundwater quality.

Groundwater policy relied on public investment and subsidies rather than on regulation. Legislation was not enforced. It was not clear whether the federal government or the provincial governments should regulate groundwater exploitation. All policies were initiated or implemented at federal and provincial level. The involvement of local government was minor. There was no involvement of local farmers' organisations. Local governments and farmers' organizations are weak in Pakistan."[6]

Problems with Over-Exploitation of Ground Water:

Due to the inadequate provision of drainage facilities during the development of the canal irrigation system in the Indus Basin, water logging occurred throughout the Basin. Associated with water logging was the phenomenon of salinisation of the soil from capillary rise and evaporation of the mineralised groundwater. Water logging and salinity left irrigation areas unfit for irrigating. The Government's response to this was the crash program for reclamation of land known as the Salinity Control and Reclamation Projects (SCARP), combating high water tables primarily through vertical drainage. "In 1954, the large tube well drainage scheme started and soon a second benefit of the drainage tube wells was realized: where the tube wells pumped fresh groundwater, they not only lowered ground water tables, but they also augmented surface irrigation supplies."

In much of the affected areas, the programme did wonders, converting the saline land into productive land. In fresh groundwater areas, the SCARP drainage tube wells

doubled as an as additional source of water. Also, the government in several ways supported private groundwater exploitation. Foremost was the provision of power supply to tube well owners. The electric charges moreover were subsidized. For tube well owners in Punjab and Sindh they were 40 percent less than the normal rate and in Baluchistan and NWFP the subsidy even amounted to 60 percent. Tube well development was further promoted through a series of government programs, which provided free pump sets, well and tube well loans under soft conditions.

However, groundwater in not an everlasting source, as thought by some initially. It is depleting fast, and its management in Pakistan offers certain challenges. The overexploitation of the groundwater during the SCARP Programme, as well as afterwards when the government offered subsidies for the exploitation of groundwater in the form of soft loans and cheaper fuel for the purposes, has led to the reverse problem of falling water tables in Punjab. Punjab in this sense is a paradox: it has places where the water table is so high that it leads to water-logging. Those are the areas where the tube wells have not been installed yet. Then, there are those areas where ground water has been over exploited leading to a fall in the water table, leaving the area unfit for irrigation.

According to Steenbergen, "the spectacular increase in the number of private tube wells has changed the setting entirely and invalidated the old policies. In several fresh groundwater areas in the Indus Plain, there has been a complete volte-face. Where 30 years ago high groundwater tables were the major threat, groundwater levels have now declined due to private tube well development. Salinisation through capillary rise is no longer a threat, but the intense pumping poses other threats to soil and water quality."

Outside the canal-irrigated areas of the Indus Plain, the promotion of private tube well development is outdated. Groundwater is no longer the limitless resource it once was. In the absence of effective regulation, the large numbers of tube wells have resulted in groundwater mining. In addition, the social issue of distribution of access to groundwater has come to the fore.

Main challenges in groundwater management in Pakistan are five-fold:

(i) Addressing groundwater quality deterioration;
(ii) Protecting groundwater from pollution;
(iii) Reversing the continuous lowering of groundwater tables, especially in the barani areas and the canal commands in Punjab;
(iv) Addressing remaining water logging, particularly in Sindh;

(v) Addressing the issue of accessibility to groundwater of those people who do not privately own tube wells; and
(vi) Setting the finances and institutions right.

These problems call for a reduction in ground water extraction, balancing carefully the combination of pumping, irrigation, drainage and control of groundwater pollution.

Right now, in Pakistan, due to the lack of any accountability mechanisms and effective legislation, land owners drill and pump as they like. The main question that needs to be asked is: "what type and to what extent law is needed, what kind of institutional framework is needed, and which solutions are needed in case specific legal and administrative bottlenecks occur?"

According to J. M. Otto, in Groundwater Law and Administration in Developing Countries, the general answers to these questions, attracting a general consensus are as follows:

1. "There must be a legal limit to the freedom of landowners to drill and pump as they like;
2. There must be a Lower Groundwater Institution (LGI) at a regional or local level;
3. The LGI must register all wells and users in its area;
4. The LGI must regulate and re-allocate rights to drill and use groundwater, either through a licensing system or otherwise;
5. The LGI must conduct direct monitoring and supervision;
6. There must be a Higher (national or provincial) Groundwater Institution (HGI);
7. The HGI has the task and powers to collect and analyze hydrological data on groundwater;
8. The HGI also has the task and powers to make a classification of areas according to the urgency of groundwater problems and the specific management regime needed;
9. The HGI has the task and powers to co-ordinate its policy with other higher government institutions;
10. The HGI has the task and powers to oversee groundwater management at a higher level."

However, the landowners will resist the limits on their rights to use their land in whatever way they like. Literature on Common Law countries suggest that any such limitation would be against the law. As commonly suggested, none of the four common law doctrines allow for state control over the freedom of landowners to use and sell the groundwater they extract from underneath their own property. The four doctrines are shortly discussed as under:

1. The Riparian Doctrine or Absolute Ownership Doctrine: this is the oldest of the common law doctrines, which scarcely limits the rights of the landowners to extract groundwater; implicitly, their share is absolute.
2. Doctrine of Reasonable Use: Riparian Doctrine is read in combination with the doctrine of reasonable use. According to this, the groundwater rights are limited to "reasonable use" on overlying land.
3. Doctrine of Correlative Rights: this doctrine has been developed in the United States. It states that in times of scarcity, the court, if called upon, would permit the overlying owners, as correlative or co-equal owners, to have access to their proportionate shares. Hence, the court would limit the rights to proportionate share with reasonable use.
4. The Doctrine of Prior Appropriation: As all the previous doctrines attribute rights to land owners, this doctrine is developed by the common law jurists to rescue the rights of the tenants and landless labour, especially when they have had access to ground water in the past. This doctrine states that first water rights are vested in those who were first in time, regardless of land ownership.

Therefore, limits have already been set according to reasonable use of land and proportionate share in the Common Law. In the Dutch Civil Code, it is stated "that the property of land includes, unless the law states otherwise, the groundwater that has come to the surface by a source, well, or pump. The legislator assumes that groundwater is res nullius (nobody's thing) until it has been brought' to the surface. In other words, until it is pumped up to the surface, it is no one's property. Whether a landowner is allowed to extract it, and how, and in which quantity, can certainly be decided by administrative law. Moreover groundwater will become the landowner's property 'unless the law states otherwise.' Therefore, in this continental code, there is no legal problem in groundwater control. Similarly, under common law, as discussed above, groundwater becomes the landowner's property through accession but environmental law can put limits on usage by the owner.

Following the recommendations stated above, by Otto, a thorough legislation needs to be put in place in Pakistan. One way to do this is to revive the Groundwater Rights Administration Ordinance, 1958 in Baluchistan, and to introduce similar legislations in other provinces as well. Under this legislation, rules should be devised to introduce licensing for digging new tube wells or extracting groundwater in any part of Pakistan. The basis for issuing these licenses/permits should be laid down very clearly, so that there is little room for confusion, and challenging the decision of the authority. Also, this should be noted that for making any such legislation a successful one, there is a dire need to involve the people in this process who would be most directly affected by the legislation.

One example of a similar law elsewhere is that of the state of Washington in USA.[7] 1945 Groundwater Code supplements the 1917 Surface Water Code in Washington. As in the case of surface water, in 1945, permit system was introduced to groundwater as well. Essentially, the legislature had rejected the correlative rights and the reasonable use doctrines, and extended the prior appropriation and beneficial use principles of surface water code to ground waters. By expressly extending the prior appropriation doctrine to groundwater, the Legislature also extended the notion of public ownership to such waters. In defining the management of this public resource, the legislature made the acquisition of rights dependent on compliance with the exclusive permit system of the surface water, and now the groundwater as well. It should be noted however that the enumerated use of relatively minor amounts are exempted from the permit requirement. The 1945 code was a comprehensive ground water rights system, from which the rights vested prior to the code were not excluded. For instance, the code provided for the issuance of water rights certificates to "any person, firm, or corporation claiming a vested right to withdraw public ground waters of the state by virtue of prior beneficial use of such water." To obtain such a certificate, however, a comprehensive procedure was laid down in the Code itself, to be complied with, within three years of the enactment of the Code. Further, the Code is unambiguous in requiring a permit to withdraw groundwater pursuant to this law enacted in 1945. The code is comprehensive enough to provide four major classes of exemptions under the ground water right permit system:

1. Stock watering purposes;
2. The watering of a lawn or of a non-commercial garden not exceeding one-half in area;
3. Single or group domestic uses in an amount not exceeding five thousand gallons a day; and
4. An industrial purpose not exceeding five thousand gallons a day.

According to the code, persons qualifying under one or more of the exemptions withdrawing water regularly, and using it beneficially, were entitled to a right equal to that established by a permit issued under the provisions of the code, also giving due consideration to the instances where small withdrawals might also affect the water system.

Since groundwater is no longer the unlimited resource it once was, or was once thought to be, it shall be used with utmost care now; therefore the need for groundwater legislation is more pressing than ever, that too which is implemented effectively. The legislature should make sure that laws are enacted which invite participation of affected parties of the laws on the lowest level of the hierarchy, as it is the most definite way to make the laws effective. Any law which does not include the participation of those at the lowest level, the implementation end is bound to meet the fate of its 'predecessor laws'. Provincial laws, on the lines of the 1945 code of ground water rights in Washington, in all the provinces of Pakistan, with the involvement of local government etc. is a dire need in the present depleting/ deteriorating situation of Pakistan.

Bibliography

An Introduction to Washington Water Law Christine O. Gregoire, James K. Pharris, P. Thomas McDonald, Published by: Office of Attorney General
Article Stable URL: http://www.atg.wa.gov/uploadedFiles/Home/About_the_Office/Divisions/Ecology/Intro%20WA%20Water%20Law.pdf

Asia's Irrigation Management in Transition: A Paradigm Shift Faces High Transaction Costs, K. William Easter, Review of Agricultural Economics, Vol. 22, No. 2 (Autumn - Winter, 2000), pp. 370-388, Published by: Oxford University Press on behalf of Agricultural & Applied Economics Association
Article Stable URL: http://www.jstor.org/stable/1349800

Benefits from Groundwater Management: Magnitude, Sensitivity, and Distribution
Eli Feinerman and Keith C. Knapp, American Journal of Agricultural Economics
Vol. 65, No. 4 (Nov., 1983), pp. 703-710, Published by: Oxford University Press on behalf of the Agricultural & Applied Economics Association
Article Stable URL: http://www.jstor.org/stable/1240458

Developing Groundwater Resources: Merits and Demerits, B. D. Dhawan
Economic and Political Weekly, Vol. 26, No. 8 (Feb. 23, 1991), pp. 425-429, Published by: Economic and Political Weekly
Article Stable URL: http://www.jstor.org/stable/4397370

Ground Water and Administration in Developing Countries, J. M. Otto
Supporting Papers
Article Stable URL: citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.131.9572

Groundwater Development and Management in Pakistan, Frank van Steenbergen, M. Shamshad Gohar, Experiences from Developing Countries

Groundwater Management and Salinity Control: A Case Study in Northwest Mexico
James W. McFarland, American Journal of Agricultural Economics , Vol. 57, No. 3 (Aug., 1975), pp. 456-462, Published by: Oxford University Press on behalf of the Agricultural & Applied Economics Association
Article Stable URL: http://www.jstor.org/stable/1238408

Ground Water Resource Management in Pakistan, F. van Steenbergen, W. Oliemans
Experiences from Developing Countries, Article Stable URL: http://www2.alterra.wur.nl/Internet/webdocs/ilri-publicaties/special_reports/Srep9/Srep9-h6.pdf
Lush Fields and Parched Throats: Political Economy of Groundwater in Gujarat, Bela Bhatia,

Economic and Political Weekly, Vol. 27, No. 51/52 (Dec. 19-26, 1992), pp. A142-A170 , Published by: Economic and Political Weekly
Article Stable URL: http://www.jstor.org/stable/4399241

Modern Water Rights, Theory and Practice, Stephen Hodgson, Published by: FAO Legal Office
Article Stable URL: ftp://ftp.fao.org/docrep/fao/010/a0864e/a0864e00.pdf

The Journal of Asian Studies Vol. 27, No. 5, Bibliography of Asian Studies 1967 (Sep., 1968), pp. 252-260 , Published by: Association for Asian Studies
Article Stable URL: http://www.jstor.org/stable/2942831

Principles and Problems of Environmental Pollution of Groundwater Resources with Case Examples from Developing Countries, B. C. E. Egboka, G. I. Nwankwor, I. P. Orajaka and A. O. Ejiofor, Environmental Health PerspectivesVol. 83, (Nov., 1989), pp. 39-68
Published by: Brogan & Partners
Article Stable URL: http://www.jstor.org/stable/3430648

Endnotes:

1. Washington Water Law Treatise, p. V:2
2. Groundwater Development and Management in Pakistan, p. 2
3. Ibid.
4. Ibid.
5. Ibid.
6. Groundwater Resource Management in Pakistan
7. An Introduction to Washington Water Law

6.1.6 The Effects of Modernity and Development on Water Management; Lessons Learnt from 2010 Floods in Pakistan

Muhammad Azeem Ali Shah, Senior Researcher, Development Policy Research Centre, Lahore University of Management Sciences, Pakistan

There is no doubt that climate change has much to do with the 2010 floods that displaced more than 14 million people in Pakistan, causing a humanitarian crisis that is considered to be larger than the combined effects of the three worst natural disasters to strike in the past decade. The culprit river, Indus, one of the world's great rivers can only hold so much water. While floods are nothing new to it–in fact, its flood plains have been home to one of the earliest civilizations that we know of–the monsoons that contributed to its flow were unprecedented in human memory. In August 2010, more than half of the normal monsoon, typically spread over 3 months, fell in only one week. This resulted in a flow which exceeded the normal levels by several times.

It is also not hidden from anyone that climate change is largely a result of rampant consumerism which reduces nature to resources meant for our consumption, but which is necessary to generating ever higher profits or sustain economic growth in capitalist economies. So in the larger scheme of things, our relentless, drive for economic growth, is to blame for these changing weather patterns.

However, the 2010 floods in Pakistan demonstrate more than simply what we can expect from unsustainable development. The devastation caused by the floods was also a manifestation of the particular type of development path that Pakistan has followed

over the years, its socio-political structure and massive inequalities in resource distribution.

Contrary to the claims of the Pakistani government (or the late Richard Holbrook for that matter, who described this as an 'equal opportunity disaster'), the devastation caused by the floods was neither equal nor inevitable. There is no direct correlation between the intensity of the floods and the destruction it unleashed. Instead, this relationship is heavily mediated by Pakistan's unequal social structure and developmental experience.

Take for instance, the intensity of the floods. In the north-west of Pakistan, where the flood originated, devastating scenes of destruction were witnessed. Bridges, houses, and other man-made structures were swept away with the sheer force of the torrent as if they were made from paper. This intensity was in part a result of deforestation that has gradually spread through Pakistan. The speed of flowing water increases manifold when there are no trees to hinder the passage of water. Similarly, with trees no longer holding top soil down, landslides become far more frequent. Deforestation represents a rather typical case of the Pakistani government allowing various interests (in this case, the 'timber mafia', which in turn supplies other businesses) to get away with pillaging the country's resources (in this case forests) and government officials making a quick buck at the expense of long turn sustainability.

Similarly, the fact that water levels more than eight feet high were sustained in places like Nowshera for several days has less to do with the quantity of water which flowed into these localities and more with the fact that all kinds of modern construction has pervaded what were flood plains. Water got trapped within these man-made structures for several days producing disease and destruction.

The state has continuously followed a policy of pillaging the environment and 'modernising' 'primitive' communities with scant regard for the ecological disasters that are resulting in the wake of this 'laissez-faire' policy. That deforestation could magnify the effect of a flood, and cause landslides does not appear to be a major concern of the Environment Protection Agency, a body propped up to pay lip service to sustainable development and the environmental movement. Despite having been around for13 years and having 'qualified' people on board, it has only been running standard environmental awareness campaigns, or implementing National Environmental Quality Standards (which have been superseded by ISO standards), unsurprisingly, with little effect. Connecting forests or flood plains to communities' livelihoods appears to be beyond its mandate.

In fact, the entire government machinery is configured in a way that makes coordination or the attainment of a bigger social goal as difficult as it can possibly be. Forests fall under the Forest department, and environment under EPA. Floods are the concern of the meteorological department, irrigation department and the newly created disaster management authorities. Different barrages are operated by different entities. Even within these organisations, coordination is absent, rendering their existence a mere ritual of governance. Take the meteorological department (Met) for instance. Just prior to the flood, the different divisions of the Met, e.g., FFD (flood forecasting division), NWFC (National weather forecasting centre) and R&D (research and development) had their own forecasts which presented a fragmented and sometimes conflicting picture of the magnitude and nature of weather system developing at that point in time.

For instance, NWFC started issuing forecasts from the mid of July that there was some unusual weather system developing in the Bay of Bengal. FFD, however, issued no forecasts about its consequences until 27th of July 2010. It was only when they had real time data available that they issued their first qualitative forecast. This again, did not mention the possibility of floods. Meanwhile, the R&D department, for its part, did not issue even a single annual report about its research on climate change, global warming and this pattern of changing Monsoon system, confining itself instead to the publication of an academic journal with articles by its employees.

What happened at the barrages presents further evidence of the ritualistic nature of state institutions. Barrages were the most important man-made structures that the torrents encountered on their way to the Arabian sea. Barrages raise the water level in rivers so that irrigation canals can be fed. In making barrages, the natural course of the river is diverted. Because of the pressure the river exerts on the sides when its course is being changed, barrages are preceded by training works, guide bunds, and marginal bunds. These structures must withstand the water pressure if neighbouring communities are to be protected. Because of their critical importance, standard operating procedure dictates that all maintenance and development works on these structures must end before the flood season starts on 15th of June every year. This was openly violated in the case of Jinnah Barrage located at Kalabagh. An emergency repair work, incidentally started over a year ago, on the downstream Apron of the Jinnah Barrage was still in progress when the flood hit the barrage in late July. Due to this work, around 10 gates out of a total of 56 gates of the barrage were closed, leaving 46 gates to take all the pressure. This resulted in increased pressure on the barrage and its allied structures as the closed gates provided an obstruction to the flow of water. As the Irrigation department tried to get these gates

opened, a swirling action of waves resulted in a parallel flow alongside the Left Guide Bund of the barrage, which collapsed exposing the neighbouring communities to bear the brunt.

Further downstream, similar panic was witnessed at the recently rehabilitated Taunsa barrage. With World Bank funding, this barrage was recently equipped with a state of the art control system to operate the gates. When the flood hit this newly constructed structure its control room was not operational. The reason is again illustrative of Pakistan's modernisation movement surging ahead leaving actual department far behind. The whole thing was funded (to the tune of Rs 600 million) and installed by foreign agencies using technology that was too advanced for the irrigation department. As a result, there were no trained technicians available to operate it, rendering the entire control room useless.

This state of unpreparedness was similarly reflected in the disaster management authorities that were created following the 2005 earthquake in Kashmir. Political rivalry between the centre (dominated by the Pakistan People's Party) and Punjab (ruled by the Pakistan Muslim League – Nawaz) meant that unlike other provinces and the centre, there was no provincial disaster management authority in Punjab, Pakistan's most densely populated province. At the centre too, things had stopped moving after the creation of the National Disaster Management Authority. Four years after its creation, the NDMA had no national disaster management plan ready. As for district level disaster management authorities, that were to be created as part of the original plan, they never came into existence.

Readiness for disasters such as this aside, the dynamics that transpired during the floods also reveals much about the Pakistani state. As the mighty Indus flows through Pakistan, it not only irrigates vast swathes of land in Punjab and Sindh, but also shapes the political structure of this traditionally agrarian country. Unsurprisingly, most of the land on both sides of the river is owned by prominent political figures of the country, who have vested interests in protecting their area of cultivated land from any kind of eventualities/calamities. These interests came to the fore as the Indus threatened to flood areas several miles to its left or right. State resources were blatantly used to build Bunds and breach canals. The result was always the same: exposing those most vulnerable to the floods while protecting those who were least. While the practice was universally applied, the poor people of Sindh, perhaps Pakistan's most feudal province with the least land reforms, suffered most. Inhabitants of cities such as Kherpur, Karampur or Jampur paid with their lives to save properties of their feudal masters.

All of the state's resources were effectively put at the disposal of the landed elite. If the poor wanted to save themselves or access these resources they could only do it through the feudals in their district. The system in Pakistan is based on political patronage in the best of times. During the floods, it became the only way out for the poor, reinforcing their subordination to the landed elite.

The dependency relationship between the peasants and the feudal elite was not the only one that was strengthened during the floods. The same dynamics were apparent at the State level, which used the floods to extract more loans out of countries that it regularly accused of not respecting its sovereignty. The relief and rehabilitation work that ensued with the pledged $1.7 billion and the millions that were collected in charity, was completely uncoordinated. Four months after the floods, people are still living in camps while waiting for support from the government. Meanwhile, the government used this opportunity to pass on new inflationary taxes that it had agreed with the IMF long ago but had not implemented for fear of a backlash. The post flood debate in the country's political set up has largely focussed on implementing flood taxes and reformed general sales taxes, leaving most people wondering if the reformed GST was such an important issue then why was the government waiting for the floods to implement this? Naomi Klein would call it disaster capitalism, and she wouldn't be far off the mark. The politicians have used the relief funds in a blatantly partisan manner to oblige their constituencies. Industrialists have claimed corporate social responsibility brownie points. The army has used it to redeem their much tarnished image, and the Americans to further their hearts and minds campaign, with little impact it has to be said.

In sum, as the Indus retreats, it renders visible the desperate plight of a people, their chronic dependence on their feudal masters, and the contours of a society premised on inequality and oppression. Nothing has really changed in Pakistan. The flood will soon be forgotten, and with it, the displaced families who, having lost their livestock and abodes, are still struggling to survive one more day. It is doubtful if the state will discard its modernising impulse fuelled by borrowed money in favour of a more community-based, eco-friendly model of development. It is also improbable that the next flood will bring any less misery. The way things are going in Pakistan, the vulnerability of people will only have increased by then. Even if the Meteorological department is able to get its act together, and the irrigation department fortifies all the barrages, poverty will still ensure millions will be inhabiting river banks and living in shacks, entirely at the mercy of their feudal lords. Forests meanwhile will continue to disappear, and unplanned construction will continue to litter the flood plains, preparing traps for flood waters. And

whichever government is in power will probably still be waiting to pass on new taxes to the hapless public. As tragic as the floods are, in the case of Pakistan, they appear to be a smaller disaster than the one they encounter on the ground!

6.2 Background for Media Content Analysis

6.2.1 Article Details: Pakistan - Spring

S.No	Title	Date	Publication	Type	Length	By-line
1	Generators for Wasa tubewells out -of-order	4/2/2010	The Nation	News	247	Khalid Malik
2	Citizens slam 34% hike in vegetable prices	4/5/2010	The Daily Times	News	159	-
3	Water talks	4/5/2010	The Dawn	Feature	1143	Ashfak Bokhari
4	Talks with India	4/5/2010	The Nation	Editorial	343	-
5	Environment: Mission mangroves	4/11/2010	The Dawn	Feature	841	Rehan Ali
6	Power shortage will be reduced in a month: Pervez Ashraf	4/11/2010	The Nation	News	117	-
7	Islamabad first city to have Rainwater Harvesting Prog ramme	4/13/2010	The Daily Times	News	522	-
8	Food security: New initiatives in offing to increase agri productivity	4/14/2010	The Daily Times	News	405	-
9	Water shortage likely to deal severe blow to mango	4/15/2010	The Dawn	News	656	Mohammad Hussain Khan
10	Spot rate increases to Rs 6,300/maund	4/24/2010	The Daily Times	News	277	-
11	Power crisis dispute	4/24/2010	The Dawn	Editorial	350	-
12	Threat to mango crop	4/26/2010	The Dawn	News	625	A. B. Arisar
13	Pak wants Saarc focus on water	4/26/2010	The Nation	News	266	-
14	Pakistan for regional approach to tackle South Asian water issue	4/26/2010	The Pak Tribune	News	512	-
15	Water Issue & SAARC Summit	4/28/2010	The Pak Tribune	Feature	1242	Zaheerul Hassan
16	PM Gilani urges Saarc to ensure judiciou s water management Wants a common front for economic growth, against forces of extremism	4/29/2010	The Pak Tribune	News	1212	-
17	Sowing of cotton may suffer amid reduced water flow in canals	5/1/2010	The Dawn	News	467	Mansoor Mirani
18	Pakistan to move arbitration court on Kishanganga project	5/3/2010	The Dawn	Feature	686	Khaleeq Kiani
19	AJK PM on India	5/3/2010	The Nation	News	338	-
20	Water shortage cuts cotton sowing by half	5/5/2010	The Dawn	News	299	Qamaruddin
21	Saudi-Indian ties to help Pak: Envoy	5/10/2010	The Nation	News	288	-
22	Mangla filling till June 30 in doldrums	5/11/2010	Pakistan Observer	Feature	465	Shah Hasan
23	Call for Kalabagh Dam	5/13/2010	The Nation	Editorial	382	-

Continued

24	Railway Colony protests against water shortage	5/14/2010	The Daily Times	News	78	-
25	Pindi hit by water shortage	5/14/2010	The Dawn	News	487	Aamir Yasin
26	Water supply to Thatta canals suspended	5/16/2010	The Dawn	News	364	Iqbal Khwaja
27	'Powerless' Pakistan	5/17/2010	The Dawn	Feature	816	Dr Charles K. Ebinger & Kashif Hasnie
28	CDA, WASA planning for water rationing	5/24/2010	Pakistan Observer	News	191	-
29	Lawmakers raise water shortage issue	5/25/2010	The Nation	News	233	Ramzan Chandio
30	Water crisis	5/26/2010	Pakistan Observer	Comment	147	Ghazanfar Ali Astori
31	Punjab boycotts IRSA meeting	5/26/2010	The Daily Times	News	387	Zeeshan Javaid
32	India's water hegemony	5/26/2010	The Nation	Comment	329	S.m. Hali
33	Rs31,400m for water sector	5/26/2010	The Nation	News	226	-
34	Punjab likely to contact CCI for Indus water release	5/29/2010	The Pak Tribune	News	445	-
35	Water shortage to hurt 30% standing crops in Sindh	5/30/2010	The Daily Times	News	587	Razi Syed
36	India assures Pakistan of addressing 'legitimate' water concerns	5/31/2010	The Pak Tribune	News	439	-
37	AT blames govt for Sindh's water crisis	6/1/2010	The Dawn	News	364	-
38	Pakistan, India meet over Indus waters	6/2/2010	Pakistan Observer	News	88	-
39	India violating Indus Water Treaty: FO	6/4/2010	The Nation	News	301	Kaswar Klasra
40	Agriculture sector did not perform well, says survey	6/5/2010	The Dawn	News	418	Amin Ahmed
41	India's water hegemony	6/8/2010	Pakistan Observer	Comment	1289	Lubna Umar
42	Water shortage may cripple cotton growth, experts fear	6/14/2010	The Nation	News	380	Javaid-ur-rahman
43	Farmers decry water shortage	6/15/2010	The Dawn	News	287	-
44	Deployment of Rangers at water regulator sought	6/16/2010	The Dawn	News	424	-
45	Pakistan and US agree on water sector partnership	6/18/2010	The Pak Tribune	News	225	-
46	Shortage of water triggers protests	6/19/2010	The Dawn	News	491	-
47	Rabbani asked to resolve Sindh - Balochistan water row Stresses construction of more dams	6/19/2010	The Pak Tribune	News	409	-
48	Water availability per person down by 80.2pc	6/25/2010	Pakistan Observer	News	315	Shah Hasan
49	Sharply reducing water for citizens	6/26/2010	Pakistan Observer	Editorial	322	-
50	Population growth to reduce water availability in future	6/27/2010	The Daily Times	News	659	Ijaz Kakakhel

6.2.2 Article Details: India - Spring

S.No	Title	Date	Publication	Type	Length	By- Line
1	It's for India, Pakistan to work out Kashmir, water issues: US	2/04/2010	The Times of India	News	357	-
2	Punjab farmers to face water crisis	3/04/2010	The Times of India	News	484	Dinesh K Sharma
3	Waters of discontent	4/04/2010	The Tribune	Comment	1336	M.S. Menon
4	FARMERS' WOES - State policies have reduced Indian agriculture to a parlous state	5/04/2010	The Telegraph	Comment	1245	S.L. RAO
5	'India didn't block water even dur ing war'	6/04/2010	The Times of India	News	445	-
6	'Pakistan must improve storage to avoid water woes'	6/04/2010	The Hindu	News	492	Sandeep Dikshit
7	Tempers rise as water becomes scarce again	12/04/2010	The Hindu	News	483	Afshan Yasmeen
8	Next Indo-Pak war could be over water: Saeed	13/04/2010	The Indian Express	News	166	-
9	Pakistan: perceptions, prejudices & policies	14/04/2010	The Hindu	Feature	1379	Chinmaya R. Gharekhan
10	Old pipelines, leakage affect water supply in seven cities	17/04/2010	The Hindu	News	468	-
11	Water: 30 -40 per cent distribution losses common in cities, says civic chief	22/04/2010	The Indian Express	News	459	-
12	Forget rural areas, even urban centres face water crisis	23/04/2010	The Times of India	Feature	851	Swati Mathur
13	PM, Gilani to hold 'limited dialogue'	26/04/2010	The Indian Express	News	482	Amitav Ranjan , Shishir Gupta
14	The water challenge	30/04/2010	The Tribune	News	332	-
15	Pakistan mismanaging Indus water: Qureshi	1/05/2010	The Indian Express	News	453	-
16	New power balance in Pak led to thaw	2/05/2010	The Hindustan Times	News	279	-
17	Pak forms legal team to take water issue with intl court	3/05/2010	The Hindustan Times	News	375	-
18	UT water hopes drying, Punjab dams supply proposal	5/05/2010	The Indi an Express	News	444	-
19	Water crisis: Court asks govt to spell out strategy	6/05/2010	The Times of India	News	413	-
20	NOT A SINGLE DROP TO DRINK	6/05/2010	The Telegraph	Feature	1194	Manipadma Jena
21	Save 1 litre water daily, people urged	6/05/2010	The Times of India	News	346	Nidhi Singhi
22	Pak must keep option of force over water row with India: JuD	10/05/2010	The Indian Express	News	424	-
23	No law in sight to regulate groundwater extraction	10/05/2010	The Indian Express	News	361	Tanvir A Siddiqui
24	Govt mulls water supply through PPP scheme	19/05/2010	The Times of India	News	419	TNN

Continued

25	ENVIRONMENTAL CHALLENGE - Few see that India's future depends on its ecological sustainability	22/05/2010	The Telegraph	Comment	1226	Ramachandra Guha
26	India-Pakistan Water Commissioners to meet next week	25/05/2010	The Hindu	News	346	-
27	China's Himalayan plan: Dam on Brahmaputra	26/05/2010	The Hindustan Times	News	439	-
28	Water crisis of east & west Punjab	28/05/2010	The Hindu	Feature	1269	M. S. Gill
29	National Water Mission gets nod of Council on Climate Change	28/05/2010	The Times of India	News	382	PTI
30	India rubbishes Pak charges on water theft	30/05/2010	The Indian Express	News	421	-
31	Indus Water talks today	30/05/2010	The Hindu	News	245	Gargi Parsai
32	India rubbishes Pak charges on water theft	30/05/2010	The Times of India	News	432	PTI
33	Indus Water talks: Pak seeks design change in Nimmo -Bazgo	2/06/2010	The Indian Express	News	275	-
34	Climate change failed two crop cycles	2/06/2010	The Hindustan Times	News	369	Zia Haq
35	Delay in water release for irrigation	4/06/2010	The Hindu	News	428	K. Raju
36	User fee for water even in agri sector?	4/06/2010	The Times of India	News	333	Prabhakar Sinha & Dipak Kumar Dash
37	Regulatory authority for w ater resources?	6/06/2010	The Hindu	News	238	-
38	Signature campaign on water crisis	6/06/2010	The Hindu	News	327	-
39	'PPP model can help govt face water challenge	6/06/2010	The Indian Express	News	420	-
40	Conservation of water resources emphasised	7/06/2010	The Hindu	News	240	-
41	Climate council's water mission for India	8/06/2010	The Hindu	Feature	859	T. N. Narasimhan
42	Farmers seek water release	9/06/2010	The Hindu	News	142	-
43	Free power emptying Punjab groundwater: Montek	9/06/2010	The India n Express	News	214	Priyadarshi Siddhanta
44	Punjab can't demand royalty on water: Hooda	12/06/2010	The Hindu	News	113	-
45	As water level dips, farmers' debts rise	12/06/2010	The Tribune	News	579	Jangveer Singh
46	Study of region's contour can help res olve water crisis	12/06/2010	The Times of India	News	276	TNN
47	Kishenganga water dispute: Pakistan on strong wicket	17/06/2010	The Times of India	Feature	573	TNN
48	Troubled waters	18/06/2010	The Indian Express	Feature	1336	Ravish Tiwari
49	CROSSING THE GROWTH BAR - India needs determination to go beyond the tipping point	22/06/2010	The Telegraph	Comment	1616	Ashok Ganguly
50	Pak Indus Waters Commissioner an 'Indian agent': JuD	28/06/2010	The Indian Express	News	298	-

6.2.3 Article Details: Pakistan – Winters

S. No.	Title	Date	Publication	Type	Length	Byline
1	Agriculture sector on verge of collapse: growers	1/4/2010	The Dawn	News	557	Aziz Malik
2	Indian doctrine of 'cold start' to be repelled strongly, says Kasuri	1/8/2010	The Daily Times	News	283	-
3	Govt 'apathy' over Indian water theft criticized	1/11/2010	The Dawn	News	158	-
4	India stealing Pakistan's water	1/15/2010	Pakistan Daily	Editorial	996	Sultan M Hali
5	Climate change affecting crop output, says Oxfam	1/16/2010	The Dawn	News	511	Khaleeq Kiani
6	Global War - Indian Hegemony over water	1/22/2010	The Pak Tribune	Comment	300	-
7	CDA's inefficiency main cause of water shortage	1/23/2010	The Daily Times	News	399	Mahtab Bashir
8	Quest for plan to cope with drought	1/25/2010	The Dawn	Feature	555	Khaleeq Kiani
9	Sindh Assembly session: Power plant at link canal opposed	1/29/2010	The Daily Times	News	637	-
10	Farmers fear 50pc fall in wheat production	2/1/2010	The Dawn	News	448	M.B. Kalhoro
11	FM wants bilateral resolution on Indo -Pak water crisis	2/2/2010	The Dawn	News	138	-
12	'India wants to make Kashmir issue a water conflict'	2/3/2010	The Dawn	News	115	-
13	IPCC fails to resolve Sindh -Balochistan water dispute	2/3/2010	The Pak Tribune	News	452	-
14	Pakistan on brink of mass starvat ion: LCCI	2/6/2010	The Nation	Comment	562	-
15	Shortage of water goes up to 34pc	2/7/2010	The Dawn	News	395	Kalbe Ali
16	PML-Q plans adjournment motions for NA session	2/8/2010	The Daily Times	News	277	-
17	MNAs seek solution to Sindh -Punjab water rift	2/10/2010	The Pak Tribune	News	596	-
18	Accord on roadmap to settle Pak -India water dispute	2/11/2010	The Dawn	News	421	Ahmad Fraz Khan
19	Water shortage a threat to wheat crop in Sindh	2/15/2010	The Dawn	Feature	884	Saleem Shaikh
20	Water scarcity and riparian rights	2/15/2010	The Dawn	Feature	1175	Ashfak Bokhari
21	MNAs slate India for water terrorism	2/17/2010	The Nation	News	657	-
22	Pakistan to raise water issue on international forum	2/19/2010	The Dawn	News	161	-
23	Delegation ready for talks ov er water issue	2/19/2010	The Dawn	News	154	-
24	Water war with India?	2/20/2010	The Dawn	Comment	916	Ahmer Bilal Soofi
25	'US mediating between Pak, India to resolve water issue'	2/20/2010	The Daily Times	News	133	-
26	Water crisis deepens in lower Sind h: farmers	2/21/2010	The Dawn	News	394	Qamaruddin

Continued

27	Do they really care?	2/21/2010	The Daily Times	Comment	1261	Mohammad Ali Talpur
28	Sindh, Punjab to resolve water issue under 1991 accord	2/21/2010	The Pak Tribune	News	332	-
29	Sindh trying to resolv e issue once and for all: CM	2/23/2010	The Dawn	News	565	Mohammad Hussain Khan
30	Sindh, Punjab agree on water distribution	2/23/2010	The Nation	News	312	-
31	Consensus reached: Punjab asks Irsa to stop water flow to link canal	2/23/2010	The Pak Tribune	News	388	-
32	Country's water reservoirs depleting fast	2/27/2010	The Dawn	News	364	Kalbe Ali
33	Brinkmanship to statesmanship	3/1/2010	The Nation	Comment	778	Khalid Iqbal
34	Senators want government to resolve all water issues	3/2/2010	The Daily Times	News	439	-
35	Threat to Peace - Water Ambitious India	3/3/2010	The Pak Tribune	Comment	1364	Zaheerul Hassan
36	Future laden with hydrological warfare	3/3/2010	The Pakistan Observer	Comment	1415	Gauhar Zahid Malik
37	The looming water crisis	3/9/2010	The Dawn	Editorial	968	Ahmad Hayat
38	Thar facing acute water shortage	3/10/2010	The Dawn	Feature	721	Qurban Ali Khushik
39	Water shortage may affect sugarcane, rice crops in Kharif season	3/17/2010	The Daily Times	News	728	Ijaz Kakakhel
40	Water conservat ion strategy crucial	3/17/2010	The Daily Times	News	133	-
41	Govt urged to take up water issue with India	3/19/2010	The Dawn	News	303	-
42	Urgent measures to avert water crisis in Sindh urged	3/23/2010	The Dawn	News	538	-
43	The coming water disaster	3/23/2010	The Nation	Comment	853	M. Zahur-ul-Haq
44	Water problems: Alliance with friendly countries needed: Shamsul Mulk	3/26/2010	The Daily Times	News	512	-
45	Kisan Council for resolution against India	3/27/2010	The Nation	News	245	-
46	PEPCO, WAPDA sq ueezing the 'power' out of consumers	3/28/2010	The Daily Times	News	552	Zeeshan Javaid
47	'India not violating Indus Water Treaty'	3/28/2010	The Daily Times	News	218	-
48	Concern over water conveyed to India	3/29/2010	The Dawn	News	290	-
49	India asks P akistan to stop blaming it for water crisis	3/29/2010	The Daily Times	News	388	Iftikhar Gilani
50	A veritable tinderbox	3/29/2010	The Nation	Comment	487	-

6.2.4 Article Details: India - Winters

S.No.	Title	Date	Publication	Type	Length	Byline
1	Arsenic in water may be major cause of cancer: PA	1/1/2010	The Tribune	News	537	Naveen S Garewal
2	State faces power crisis	1/7/2010	The Tribune	News	409	-
3	Thirty new waterworks to quench thirst of Mohali villages	1/9/2010	The Indian Express	News	303	-
4	Cancer Express	1/16/2010	The Hindustan Times	Feature	1202	Praveen Donthi
5	Water tariff: civil society asks for consultations across state	1/22/2010	The Indian Express	News	412	-
6	Pak pleads helplessness on attacks - Can't guarantee that 26/11 will not b e repeated, Gilani tells US	1/23/2010	The Telegraph	News	447	-
7	Farmers in Lakhandur, Paoni cry for water	1/24/2010	The Times of India	Feature	597	-
8	MAKING OF A SUPERPOWER - India must do the things necessary to give its people a good life	1/25/2010	The Telegraph	Comment	1256	S.L. Rao
9	'Can't totally depend on IPCC, India to have own climate panel'	2/4/2010	The Hindustan Times	News	437	-
10	Jal Board plans ban on use of groundwater for 14 industries	2/6/2010	The Indian Express	News	372	Geeta Gupta
11	Water crisis sparks cave -in fears up north	2/8/2010	The Times of India	News	456	Prithvijit Mitra
12	Punjab rejects water bill	2/9/2010	The Tribune	News	205	-
13	Saving the day, drip by drip	2/12/2010	The Indian Express	Feature	544	Manoj Prasad
14	Wa ter to be shifted to concurrent list	2/12/2010	The Tribune	News	527	Vibha Sharma
15	A reminder from terrorists: We don't want India -Pakistan talks	2/14/2010	The Hindu	News	518	Siddharth Varadarajan
16	Pilot water project boon to villagers	2/14/2010	The Tribune	News	291	Jangveer Singh
17	Water supply in Sirsa, Fatehabad to be augmented	2/14/2010	The Tribune	News	330	Sushil Manav
18	Pune speech on Pak soil - Glare on Lashkar front meet in Islamabad 10 days ago	2/15/2010	The Telegraph	News	457	ARCHIS MOH AN

Continued

19	Water crisis grips Kalka, Pinjore	2/23/2010	The Indian Express	News	181	Girish Sharma
20	Water Pakistan's diversionary tactic?	2/23/2010	The Times of India	News	633	-
21	Water supply goes hi -tech	2/23/2010	The Tribune	News	139	Megha Mann
22	No w orry on water -front: Sheila	2/24/2010	The Indian Express	News	387	Geeta Gupta
23	Uproar in House over Hadoti water crisis	2/24/2010	The Times of India	News	417	-
24	Water plan	2/25/2010	The Times of India	News	108	-
25	Indo-Pak talks end without much h eadway	2/25/2010	The Tribune	News	751	Ashok Tuteja
26	Major initiative to tide over water crisis facing the State	2/26/2010	The Hindu	News	273	-
27	Resolving Kashmir, water issues with India imperative for peace: Bashir	3/6/2010	The Indian Express	News	250	-
28	BMC reopens Mulund pool even as lakes dry up	3/8/2010	The Hindustan Times	News	296	Rajendra Aklekar
29	Do Pakistan’s claims over the Indus hold water?	3/12/2010	The Indian Express	Comment	779	B.G. Verghese
30	Pak muddies waters: ‘don’t build any power plant in J&K’	3/12/2010	The Indian Express	News	679	Ravish Tiwari
31	Severe water crisis stares Kandi areas in the face	3/12/2010	The Tribune	News	489	Dinesh Manhotra
32	Paver blocks affect groundwater levels	3/12/2010	The Hindustan Times	News	245	Bhavika Jain
33	Water shortage hits groundnut sowing in state	3/13/2010	The Indian Express	Feature	472	-
34	Pakistan for new measures to energise Indus Treaty	3/13/2010	The Hindu	News	262	Sandeep Dikshit
35	Be ready to face 35% water cut for a fe w days	3/16/2010	The Hindustan Times	News	114	-
36	MCC focussing on power supply to check water shortage	3/17/2010	The Times of India	News	464	-
37	Water crisis around the corner	3/17/2010	The Tribune	News	287	Neena Sharma

Continued

38	Water leakage cost govt e xchequer Rs 235 crore	3/18/2010	The Times of India	News	334	Akhilesh Sourav Jha
39	Water-starved, paddy crop dying	3/18/2010	The Hindu	News	92	K. Raju
40	Parched Chas cries for water	3/18/2010	The Telegraph	News	410	SHASHANK SHEKHAR
41	City may face 35 % water cut next week	3/20/2010	The Times of India	News	449	Sukhada Tatke
42	City heading for a water crisis too	3/21/2010	The Times of India	News	429	Sunil Mungara
43	Coca Cola to pay Rs 216 cr fine?	3/22/2010	The Indian Express	News	443	-
44	Tough tim e ahead as water crisis grips city	3/22/2010	The Times of India	News	431	P J Joychen & Akhilesh Saurav Jha
45	Arsenic-free water supply hit in Malda - Late melting of glaciers & dry spell decrease ganga flow	3/22/2010	The Telegraph	News	501	-
46	Water con servation projects a big success	3/23/2010	The Times of India	News	337	Rachna Singh
47	Cauvery water dispute back in limelight	3/23/2010	The Tribune	News	243	N Ravikumar/TNS
48	Hanamkonda set to face water crisis	3/25/2010	The Hindu	News	316	Gollapudi S rinivasa Rao
49	TN needs sound water management to overcome scarcity: CM	3/29/2010	The Times of India	Feature	372	-
50	Land acquisition for restoring canals begins	3/31/2010	The Hindu	News	217	K. Lakshmi

6.2.5. Coding Schedule: Pakistan - Spring

Article No.		01	02	03	04	05	06	07	08	09	10
News Paper		The Dawn	The Daily Times	The Dawn	The Nation	The Dawn	The Nation	The Daily Times	The Daily Times	The Dawn	The Daily Times
Author		Khalid Malik	-	Ashfak Bokhari	-	Rehan Ali	-	-	-	Mohammad	-
Length		247	159	1143	343	841				Hussain Khan	
Type of Article		News	News	Feature	Editorial	Feature	117	522	405	656	277
Date		April 02, 2010	April 05, 2010	April 05, 2010	April 05, 2010	April 11, 2010	News	News	News	News	News
POLITICAL DISCOURSE							April 11, 2010	April 13, 2010	April 14, 2010	April 15, 2010	April 24, 2010
1	Has the IWT been put forth as the reason for water shortage/challenge?	4	4	1	4	4	4	4	4	4	4
2	Has Indian action and/or transgression been presented as a reason for water shortage/ challenge?	4	4	1	1	4	4	4	4	4	4
3	Has political pressure against India been presented as a solution to water shortage?	4	4	1	3	4	4	4	4	4	4
4	Has water shortage led to negative sentiments towards India?	4	4	1	4	4	4	4	4	4	4
5	Has increased cooperation between Pakistan and India been presented as a solution to water issues?	4	4	1	3	4	4	4	4	4	4
6	Has water shortage led to conflict between stakeholders (People, institutions, political parties)?	4	4	4	4	4	4	4	4	1	4
7	Has inter-provincial water distribution/unfair implementation of domestic water sharing accord been argued to be the cause of water shortage?	4	4	4	4	4	4	4	4	1	4
8	Implementation of domestic water sharing arrangements in letter and spirit	4	4	4	4	4	4	4	4	4	4
9	Have administrative lapses or challenges at the local, regional or national level been argued to be the cause of water shortage?	1	4	3	4	1	4	4	4	3	4
10	Should public water management be improved to solve water shortage?	1	4	3	4	1	4	4	4	3	4
11	Has insufficient water provision and storage infrastructure been argued to be the cause of water shortage?	1	4	1	4	4	4	4	4	4	4
12	Will investment/attention/technology solutions to water provision and storage infrastructure decrease water shortage?	1	4	4	4	1	4	1	1	4	4
PEOPLE, PRACTICE AND ENVIRONMENT											
13	Have changing climate/rainfall conditions caused water shortage?	4	4	1	4	4	1	4	4	4	4
14	Has water shortage led to environmental degradation?	4	4	4	4	3	4	4	4	4	4
15	Has undergound water been affected?	4	4	4	4	4	4	4	4	4	4
16	Has the agricultural/agro dependent rural sector suffered due to water shortage?	4	1	1	4	1	4	4	1	1	1
17	Has water shortage affected domestic consumption?	1	1	4	4	1	4	4	4	4	4
18	Is crop diversification, or changing cropping patterns a solution to water shortage?	4	4	4	4	4	4	4	1	4	4
19	Is training/awareness mentioned as a solution to improve water efficiency ?	4	4	4	4	4	4	4	1	4	4
	1: Yes										
	2: No										
	3: Ambiguous: weak assertions or difficult to comprehend										
	4: Not Mentioned: Query not applicable or not referred										
	** This is the unedited questionnaire that the main text draws on										

Continued

6.2.5. Coding Schedule: Pakistan - Spring

Article No.		11	12	13	14	15	16	17	18	19	20
News Paper		The Dawn	The Dawn	The Nation	The Pak Tribune	The Pak Tribune	The Pak Tribune	The Dawn	The Dawn	The Nation	The Dawn
Author		-	A. B. Arisar	-	-	Zaheerul Hassan	-	Mansoor Mirani	Khaleeq Kiani	-	Qamaruddin
Length		350	625	266	512	1242	1212	467	686	338	299
Type of Article		Editorial	News	News	News	Feature	News	News	Feature	News	News
Date		April 24, 2010	April 26, 2010	April 26, 2010	April 26, 2010	April 28, 2010	April 29, 2010	May 01, 2010	May 03, 2010	May 03, 2010	May 05, 2010
POLITICAL DISCOURSE											
1	Has the IWT been put forth as the reason for water shortage/challenge?	4	4	4	4	4	4	4	4	1	4
2	Has Indian action and/or transgression been presented as a reason for water shortage/ challenge?	4	4	4	4	1	4	4	1	1	4
3	Has political pressure against India been presented as a solution to water shortage?	4	4	4	4	1	4	4	1	1	4
4	Has water shortage led to negative sentiments towards India?	4	4	4	4	1	4	4	4	1	4
5	Has increased cooperation between Pakistan and India been presented as a solution to water issues?	4	4	3	3	3	1	4	3	3	4
6	Has water shortage led to conflict between stakeholders (People, institutions, political parties)?	4	4	4	4	4	4	3	4	4	3
7	Has inter-provincial water distribution/unfair implementation of domestic water sharing accord been argued to be the cause of water shortage?	1	3	4	4	4	4	4	4	4	4
8	Implementation of domestic water sharing arrangements in letter and spirit	1	4	4	4	4	4	4	4	4	4
9	Have administrative lapses or challenges at the local, regional or national level been argued to be the cause of water shortage?	1	4	4	4	4	4	1	4	4	1
10	Should public water management be improved to solve water shortage?	1	4	4	4	4	4	1	4	4	1
11	Has insufficient water provision and storage infrastructure been argued to be the cause of water shortage?	4	4	4	4	4	4	4	4	4	4
12	Will investment/attention/technology solutions to water provision and storage infrastructure decrease water shortage?	1	4	4	4	4	4	4	4	4	1
PEOPLE, PRACTICE AND ENVIRONMENT											
13	Have changing climate/rainfall conditions caused water shortage?	4	4	4	4	4	4	4	4	4	4
14	Has water shortage led to environmental degradation?	4	4	4	4	1	4	4	4	4	4
15	Has undergound water been affected?	4	4	4	4	4	4	4	4	4	4
16	Has the agricultural/agro dependent rural sector suffered due to water shortage?	4	1	4	4	1	4	1	4	1	1
17	Has water shortage affected domestic consumption?	4	4	4	4	1	4	4	4	4	4
18	Is crop diversification, or changing cropping patterns a solution to water shortage?	4	1	4	4	4	4	4	4	4	4
19	Is training/awareness mentioned as a solution to improve water efficiency ?	4	1	4	4	4	4	4	4	4	4
	1: Yes										
	2: No										
	3: Ambiguous: weak assertions or difficult to comprehend										
	4: Not Mentioned: Query not applicable or not referred										
	** This is the unedited questionnaire that the main text draws on										

Continued

6.2.5. Coding Schedule: Pakistan - Spring

Article No.		21	22	23	24	25	26	27	28	29	30
News Paper		The Nation	Pakistan Observer	The Nation	The Daily Times	The Dawn	The Dawn	The Dawn	Pakistan Observer	The Nation	Pakistan Observer
Author		-	Shah Hasan	-	-	Aamir Yasin	Iqbal Khwaja	Dr Charles k. Ebinger & Kashif Hasnie	-	Ramzan Chandio	Ghazanfar Ali Astori
Length		288	465	382	78	487	364	816	191	233	147
Type of Article		News	Feature	Editorial	News	News	News	Feature	News	News	Comment
Date		May 10, 2010	May 11, 2010	May 13, 2010	May 14, 2010	May 14, 2010	May 16, 2010	May 17, 2010	May 24, 2010	May 25, 2010	May 26, 2010
POLITICAL DISCOURSE											
1	Has the IWT been put forth as the reason for water shortage/challenge?	4	4	4	4	4	4	4	4	4	4
2	Has Indian action and/or transgression been presented as a reason for water shortage/ challenge?	4	4	1	4	4	4	4	4	4	4
3	Has political pressure against India been presented as a solution to water shortage?	4	4	3	4	4	4	4	4	4	4
4	Has water shortage led to negative sentiments towards India?	4	4	1	4	4	4	4	4	4	4
5	Has increased cooperation between Pakistan and India been presented as a solution to water issues?	3	4	3	4	4	4	4	4	4	4
6	Has water shortage led to conflict between stakeholders (People, institutions, political parties)?	4	3	4	1	3	4	4	4	1	4
7	Has inter-provincial water distribution/unfair implementation of domestic water sharing accord been argued to be the cause of water shortage?	4	4	4	4	4	4	1	4	1	4
8	Implementation of domestic water sharing arrangements in letter and spirit	4	4	4	4	4	4	4	4	1	4
9	Have administrative lapses or challenges at the local, regional or national level been argued to be the cause of water shortage?	4	1	1	4	1	1	1	4	1	1
10	Should public water management be improved to solve water shortage?	4	1	4	4	1	1	1	4	1	1
11	Has insufficient water provision and storage infrastructure been argued to be the cause of water shortage?	4	4	4	4	4	4	4	4	4	1
12	Will investment/attention/technology solutions to water provision and storage infrastructure decrease water shortage?	4	4	1	4	4	4	1	4	4	1
PEOPLE, PRACTICE AND ENVIRONMENT											
13	Have changing climate/rainfall conditions caused water shortage?	4	4	4	4	4	4	1	4	4	4
14	Has water shortage led to environmental degradation?	4	4	4	4	4	4	4	4	4	4
15	Has undergound water been affected?	4	4	4	4	4	4	4	4	4	4
16	Has the agricultural/agro dependent rural sector suffered due to water shortage?	1	1	1	4	4	1	3	4	1	4
17	Has water shortage affected domestic consumption?	4	4	1	4	1	1	4	1	1	1
18	Is crop diversification, or changing cropping patterns a solution to water shortage?	4	4	4	4	4	4	4	4	4	4
19	Is training/awareness mentioned as a solution to improve water efficiency ?	4	4	4	4	4	4	4	4	4	4
	1: Yes										
	2: No										
	3: Ambiguous: weak assertions or difficult to comprehend										
	4: Not Mentioned: Query not applicable or not referred										
	** This is the unedited questionnaire that the main text draws on										

Continued

6.2.5. Coding Schedule: Pakistan - Spring

Article No.		31	32	33	34	35	36	37	38	39	40
News Paper		The Daliy Times	The Indian	The Nation	The Pak Tribune	The Daily Times	The Pak Tribune	The Dawn	Pakistan Observer	The Nation	The Dawn
Author		Zeeshan Javaid	S.M. Hali	-	-	Razi Syed	-	-	-	Kaswar Klasra	Amin Ahmed
Length		387	329	266	445	587	439	364	88	301	418
Type of Article		News	Comment	News	News	News	News	News	News	News	News
Date		May 26, 2010	May 26, 2010	May 26, 2010	May 29, 2010	May 30, 2010	May 31, 2010	June 01, 2010	June 02, 2010	June 04, 2010	June 05, 2010
POLITICAL DISCOURSE											
1	Has the IWT been put forth as the reason for water shortage/challenge?	4	4	4	4	4	4	4	4	4	4
2	Has Indian action and/or transgression been presented as a reason for water shortage/ challenge?	4	1	4	4	4	3	4	1	1	4
3	Has political pressure against India been presented as a solution to water shortage?	4	3	4	4	4	4	4	3	4	4
4	Has water shortage led to negative sentiments towards India?	4	1	4	4	4	4	4	4	4	4
5	Has increased cooperation between Pakistan and India been presented as a solution to water issues?	4	3	4	4	4	1	4	3	1	4
6	Has water shortage led to conflict between stakeholders (People, institutions, political parties)?	3	4	4	1	1	4	1	4	4	4
7	Has inter-provincial water distribution/unfair implementation of domestic water sharing accord been argued to be the cause of water shortage?	1	4	4	1	1	4	1	4	4	4
8	Implementation of domestic water sharing arrangements in letter and spirit	4	4	4	4	4	4	4	4	4	4
9	Have administrative lapses or challenges at the local, regional or national level been argued to be the cause of water shortage?	4	4	4	4	4	1	4	4	4	4
10	Should public water management be improved to solve water shortage?	4	4	4	4	4	4	4	4	4	4
11	Has insufficient water provision and storage infrastructure been argued to be the cause of water shortage?	4	4	4	4	4	4	4	4	4	4
12	Will investment/attention/technology solutions to water provision and storage infrastructure decrease water shortage?	4	4	1	4	4	4	4	4	4	4
PEOPLE, PRACTICE AND ENVIRONMENT											
13	Have changing climate/rainfall conditions caused water shortage?	4	1	4	4	4	4	4	4	4	1
14	Has water shortage led to environmental degradation?	4	1	4	4	4	4	4	4	4	4
15	Has undergound water been affected?	4	4	4	4	4	4	1	1	4	4
16	Has the agricultural/agro dependent rural sector suffered due to water shortage?	4	1	4	1	1	4	1	4	4	1
17	Has water shortage affected domestic consumption?	4	1	4	4	4	4	1	4	4	4
18	Is crop diversification, or changing cropping patterns a solution to water shortage?	4	4	4	4	4	4	4	4	4	4
19	Is training/awareness mentioned as a solution to improve water efficiency ?	4	4	4	4	4	4	4	4	4	4
	1: Yes										
	2: No										
	3: Ambiguous: weak assertions or difficult to comprehend										
	4: Not Mentioned: Query not applicable or not referred										
	** This is the unedited questionnaire that the main text draws on										

Continued

6.2.5. Coding Schedule: Pakistan - Spring

Article No.		41	42	43	44	45	46	47	48	49	50
News Paper		Pakistan Observer	The Nation	The Dawn	The Dawn	The Pak Tribune	The Dawn	The Pak Tribune	Pakistan Observer	Pakistan Observer	The Daily Times
Author		Lubna Umar	Javaid-Ur-Rahman	-	-	-	-	-	Shah Husan	-	Ijaz Kakakhel
Length		1289	380	287	424	225	491	409	315	322	659
Type of Article		Comment	News	News	News	News	News	News	News	Editorial	News
Date		June 08, 2010	June 14, 2010	June 15, 2010	June 16, 2010	June 18, 2010	June 19, 2010	June 19, 2010	June 25, 2010	June 26, 2010	June 27, 2010
POLITICAL DISCOURSE											
1	Has the IWT been put forth as the reason for water shortage/challenge?	4	4	4	4	4	4	4	4	4	4
2	Has Indian action and/or transgression been presented as a reason for water shortage/ challenge?	1	4	4	4	4	4	4	4	1	4
3	Has political pressure against India been presented as a solution to water shortage?	1	4	4	4	4	4	4	4	3	4
4	Has water shortage led to negative sentiments towards India?	1	4	4	4	4	4	4	4	4	4
5	Has increased cooperation between Pakistan and India been presented as a solution to water issues?	3	4	4	4	4	4	4	4	4	4
6	Has water shortage led to conflict between stakeholders (People, institutions, political parties)?	4	4	1	1	4	1	1	4	4	4
7	Has inter-provincial water distribution/unfair implementation of domestic water sharing accord been argued to be the cause of water shortage?	1	4	4	1	1	4	1	4	4	4
8	Implementation of domestic water sharing arrangements in letter and spirit	4	4	4	4	4	4	1	4	4	4
9	Have administrative lapses or challenges at the local, regional or national level been argued to be the cause of water shortage?	1	4	4	1	1	1	4	4	1	1
10	Should public water management be improved to solve water shortage?	4	4	1	1	1	1	4	4	1	1
11	Has insufficient water provision and storage infrastructure been argued to be the cause of water shortage?	1	4	4	4	4	4	4	1	1	1
12	Will investment/attention/technology solutions to water provision and storage infrastructure decrease water shortage?	4	1	4	4	4	4	4	1	1	1
PEOPLE, PRACTICE AND ENVIRONMENT											
13	Have changing climate/rainfall conditions caused water shortage?	4	4	4	4	4	4	4	4	4	1
14	Has water shortage led to environmental degradation?	4	4	4	4	4	4	4	4	4	1
15	Has undergound water been affected?	4	4	1	4	4	4	4	4	4	4
16	Has the agricultural/agro dependent rural sector suffered due to water shortage?	1	1	1	1	4	1	4	4	1	1
17	Has water shortage affected domestic consumption?	4	4	1	1	4	1	4	4	1	4
18	Is crop diversification, or changing cropping patterns a solution to water shortage?	4	4	4	4	4	4	4	4	4	4
19	Is training/awareness mentioned as a solution to improve water efficiency ?	4	4	4	4	4	4	4	4	4	4
	1: Yes										
	2: No										
	3: Ambiguous: weak assertions or difficult to comprehend										
	4: Not Mentioned: Query not applicable or not referred										
	** This is the unedited questionnaire that the main text draws on										

6.2.6 Coding Schedule: India - Spring

Article No.		01	02	03	04	05	06	07	08	09	10
News Paper		The Times of India	The Times of India	The Tribune	The Telegraph	The Times of India	The Hindu	The Hindu	The Indian Express	The Hindu	The Hindu
Author		-	Dinesh K. Sharma	M.S. Menon	S.L. Rao	-	Sandeep Dikshit	Afshan Yasmeen	-	Chinmaya R. Gharekhan	-
Length		357	484	1336	1245	445	492	483	166	1379	468
Type of Article		News	News	Comment	Comment	News	News	News	News	Feature	News
Date		April 02, 2010	April 03, 2010	April 04, 2010	April 05, 2010	April 06, 2010	April 06, 2010	April 12, 2010	April 13, 2010	April 14, 2010	April 17, 2010
POLITICAL DISCOURSE											
1	The provision of the IWT being unfair/or flawed is the reason for water shortage?	4	4	1	4	4	4	4	4	4	4
2	Has regional water shortage lead Pakistan to accuse India of breaching water agreements?	4	4	1	4	3	3	4	1	3	4
3	Have Pakistan's assertions of India not abiding by the water agreements suggested as being unreasonable?	4	4	1	4	1	1	4	4	1	4
4	Should Pakistan and India intensify cooperation to resolve water issues?	1	4	1	4	4	4	4	4	4	4
5	Has uneven inter-provincial water distribution/usage been argued to be the cause of water shortage/issue?	4	1	1	4	4	4	4	4	1	4
6	Has water shortage lead to conflict/disagreement between stakeholders (People, Institutions, Political Parties)?	4	4	4	4	4	4	1	4	4	4
7	Has water been employed as a socio-political tool by extremist elements?	4	4	4	4	4	4	4	1	1	4
GOVERNANCE											
8	Have administrative lapses or challenges at the local, regional or national level been argued to be the cause of water shortage/ issue?	4	1	1	1	1	1	1	4	1	1
9	Public water management/Regulation should be improved to solve water shortage?	1	4	4	1	4	4	4	4	4	4
10	Has insufficient water/supply provision and storage infrastructure been argued to be the cause of water shortage/issue?	4	4	4	1	1	1	1	4	1	1
11	Would investment in water provision/technology provision and storage infrastructure improve water shortage?	1	4	4	1	4	4	4	4	4	1
12	Has public-private partnership/better water pricing partnership been suggested to improve water provision?	4	4	4	4	4	4	4	4	4	4
PEOPLE, PRACTICE AND ENVIRONMENT											
13	Have changing climate/rainfall conditions caused water shortage?	4	4	4	4	4	4	1	4	4	4
14	Has water shortage led to environmental degradation?	4	4	4	1	4	4	4	4	4	4
15	Has undergound water been affected?	4	1	4	1	4	4	1	4	4	4
16	Has the agricultural/agro dependent rural sector suffered due to water shortage?	4	1	1	1	4	4	4	4	4	4
17	Has water shortage affected domestic consumption?	4	4	4	4	4	4	1	4	4	1
18	Is crop diversification, or changing cropping patterns a solution to water shortage?	4	4	4	4	4	4	4	4	4	4
19	Is training/awareness mentioned as a solution to improve water efficiency ?	4	4	4	4	4	4	4	4	4	4
	1: Yes										
	2: No										
	3: Ambiguous: weak assertions or difficult to comprehend										
	4: Not Mentioned: Query not applicable or not referred										
	** This is the unedited questionnaire that the main text draws on										

Continued

6.2.6 Coding Schedule: India - Spring

Article No.		11	12	13	14	15	16	17	18	19	20
News Paper		The Indian Express	The Times of India	The Indian Express	The Tribune	The Indian Express	The Hindustan Times	The Hindustan Times	The Indian Express	The Times of India	The Telegraph
Author		-	Swati Mathur	Amitav Ranjan Shishir Gupta	-	-	-	-	-	-	Manipadma Jena
Length		459	851	482	332	453	279	375	444	413	1194
Type of Article		News	Feature	News	News	News	News	News	News	News	Feature
Date		April 22, 2010	April 23, 2010	April 26, 2010	April 30, 2010	May 01, 2010	May 02, 2010	May 03, 2010	May 05, 2010	May 06, 2010	May 06, 2010
POLITICAL DISCOURSE											
1	The provision of the IWT being unfair/or flawed is the reason for water shortage?	4	4	4	4	4	4	4	4	4	4
2	Has regional water shortage lead Pakistan to accuse India of breaching water agreements?	4	4	1	4	3	2	1	4	4	1
3	Have Pakistan's assertions of India not abiding by the water agreements suggested as being unreasonable?	4	4	1	4	1	4	4	4	4	1
4	Should Pakistan and India intensify cooperation to resolve water issues?	4	4	3	4	4	3	4	4	4	1
5	Has uneven inter-provincial water distribution/usage been argued to be the cause of water shortage/issue?	4	4	4	4	4	4	4	1	4	1
6	Has water shortage lead to conflict/disagreement between stakeholders (People, Institutions, Political Parties)?	4	4	4	4	4	4	4	3	4	4
7	Has water been employed as a socio-political tool by extremist elements?	4	4	4	4	4	4	4	4	4	4
GOVERNANCE											
8	Have administrative lapses or challenges at the local, regional or national level been argued to be the cause of water shortage/ issue?	1	1	4	1	1	4	4	1	1	1
9	Public water management/Regulation should be improved to solve water shortage?	4	1	4	1	4	4	4	4	1	1
10	Has insufficient water/supply provision and storage infrastructure been argued to be the cause of water shortage/issue?	1	1	4	4	1	4	4	4	4	1
11	Would investment in water provision/technology provision and storage infrastructure improve water shortage?	4	1	4	1	4	4	4	4	1	1
12	Has public-private partnership/better water pricing partnership been suggested to improve water provision?	4	4	4	4	4	4	4	4	4	4
PEOPLE, PRACTICE AND ENVIRONMENT											
13	Have changing climate/rainfall conditions caused water shortage?	4	4	4	1	4	4	4	4	4	1
14	Has water shortage led to environmental degradation?	4	4	4	4	4	4	4	4	4	1
15	Has undergound water been affected?	4	4	4	1	4	4	4	1	1	1
16	Has the agricultural/agro dependent rural sector suffered due to water shortage?	4	4	4	1	4	4	4	4	4	3
17	Has water shortage affected domestic consumption?	4	1	4	1	4	4	4	3	1	4
18	Is crop diversification, or changing cropping patterns a solution to water shortage?	4	4	4	1	4	4	4	4	4	3
19	Is training/awareness mentioned as a solution to improve water efficiency ?	4	4	4	1	4	4	4	4	4	4
	1: Yes										
	2: No										
	3: Ambiguous: weak assertions or difficult to comprehend										
	4: Not Mentioned: Query not applicable or not referred										
	** This is the unedited questionnaire that the main text draws on										

Continued

6.2.6 Coding Schedule: India - Spring

Article No.		21	22	23	24	25	26	27	28	29	30
News Paper		The Times of India	The Indian Express	The Indian Express	The Times of India	The Telegraph	The Hindu	The Hindustan Times	The Hindu	The Times of India	The Indian Express
Author		Nidhi Singhi	-	Tanvir Siddiqui	TNN	Ramachandra Guha	-	-	M. S. Gill	PTI	-
Length		346	424	361	419	1226	346	439	1269	382	421
Type of Article		News	News	News	News	Comment	News	News	Feature	News	News
Date		May 06, 2010	May 10, 2010	May 10, 2010	May 19, 2010	May 22, 2010	May 25, 2010	May 26, 2010	May 28, 2010	May 28, 2010	May 30, 2010
POLITICAL DISCOURSE											
1	The provision of the IWT being unfair/or flawed is the reason for water shortage?	4	4	4	4	4	4	4	4	4	4
2	Has regional water shortage lead Pakistan to accuse India of breaching water agreements?	4	4	4	4	4	1	4	1	4	1
3	Have Pakistan's assertions of India not abiding by the water agreements suggested as being unreasonable?	4	4	4	4	4	1	4	4	4	1
4	Should Pakistan and India intensify cooperation to resolve water issues?	4	4	4	4	4	4	4	1	4	3
5	Has uneven inter-provincial water distribution/usage been argued to be the cause of water shortage/issue?	4	4	4	4	4	4	4	4	4	4
6	Has water shortage lead to conflict/disagreement between stakeholders (People, Institutions, Political Parties)?	4	4	4	4	4	4	4	4	4	4
7	Has water been employed as a socio-political tool by extremist elements?	4	1	4	4	4	4	4	4	4	4
GOVERNANCE											
8	Have administrative lapses or challenges at the local, regional or national level been argued to be the cause of water shortage/ issue?	1	1	1	3	1	4	4	1	4	1
9	Public water management/Regulation should be improved to solve water shortage?	4	4	1	1	1	4	4	1	1	4
10	Has insufficient water/supply provision and storage infrastructure been argued to be the cause of water shortage/issue?	4	4	4	1	4	4	4	1	4	4
11	Would investment in water provision/technology provision and storage infrastructure improve water shortage?	1	4	4	3	4	4	4	1	1	4
12	Has public-private partnership/better water pricing partnership been suggested to improve water provision?	4	4	4	4	4	4	4	4	4	4
PEOPLE, PRACTICE AND ENVIRONMENT											
13	Have changing climate/rainfall conditions caused water shortage?	4	4	4	4	4	4	4	4	1	4
14	Has water shortage led to environmental degradation?	4	4	4	4	4	4	4	4	4	4
15	Has undergound water been affected?	1	4	1	1	1	4	4	1	4	4
16	Has the agricultural/agro dependent rural sector suffered due to water shortage?	4	4	4	4	4	4	4	1	4	4
17	Has water shortage affected domestic consumption?	3	4	4	1	1	4	4	4	4	4
18	Is crop diversification, or changing cropping patterns a solution to water shortage?	4	4	4	4	4	4	4	1	4	4
19	Is training/awareness mentioned as a solution to improve water efficiency ?	1	4	4	4	4	4	4	4	1	4
	1: Yes										
	2: No										
	3: Ambiguous: weak assertions or difficult to comprehend										
	4: Not Mentioned: Query not applicable or not referred										
	** This is the unedited questionnaire that the main text draws on										

Continued

6.2.6 Coding Schedule: India - Spring

Article No.		31	32	33	34	35	36	37	38	39	40
News Paper		The Hindu	The Times of India	The Indian Express	The Hindustan Times	The Hindu	The Times of India	The Hindu	The Hindu	The Indian Express	The Hindu
Author		Gargi Parsai	PTI	-	Zia Haq	k. Raju	Prabhakar Sinha & Dipak Kumar Dash	-	-	-	-
Length		245	432	275	369	428	333	238	327	420	240
Type of Article		News	News	News	News	News	News	News	News	News	News
Date		May 30, 2010	May 30, 2010	June 02, 2010	June 02, 2010	June 04, 2010	June 04, 2010	June 06, 2010	June 06, 2010	June 06, 2010	June 07, 2010
POLITICAL DISCOURSE											
1	The provision of the IWT being unfair/or flawed is the reason for water shortage?	4	4	4	4	4	4	4	4	4	4
2	Has regional water shortage lead Pakistan to accuse India of breaching water agreements?	1	1	1	4	4	4	4	4	4	4
3	Have Pakistan's assertions of India not abiding by the water agreements suggested as being unreasonable?	1	1	1	4	4	4	4	4	4	4
4	Should Pakistan and India intensify cooperation to resolve water issues?	1	1	3	4	4	4	4	4	4	4
5	Has uneven inter-provincial water distribution/usage been argued to be the cause of water shortage/issue?	4	4	4	4	4	4	4	4	4	4
6	Has water shortage lead to conflict/disagreement between stakeholders (People, Institutions, Political Parties)?	4	4	4	4	4	4	4	4	4	4
7	Has water been employed as a socio-political tool by extremist elements?	4	4	4	4	4	4	4	4	4	4
GOVERNANCE											
8	Have administrative lapses or challenges at the local, regional or national level been argued to be the cause of water shortage/ issue?	4	4	4	4	4	4	1	1	4	4
9	Public water management/Regulation should be improved to solve water shortage?	4	4	4	4	4	1	1	1	4	3
10	Has insufficient water/supply provision and storage infrastructure been argued to be the cause of water shortage/issue?	4	4	4	4	4	4	1	4	3	4
11	Would investment in water provision/technology provision and storage infrastructure improve water shortage?	4	4	4	4	4	4	1	4	1	3
12	Has public-private partnership/better water pricing partnership been suggested to improve water provision?	4	4	4	4	4	4	4	4	1	4
PEOPLE, PRACTICE AND ENVIRONMENT											
13	Have changing climate/rainfall conditions caused water shortage?	4	4	4	1	1	4	4	4	4	1
14	Has water shortage led to environmental degradation?	4	4	4	4	4	4	4	4	1	4
15	Has undergound water been affected?	4	4	4	4	4	1	4	4	1	4
16	Has the agricultural/agro dependent rural sector suffered due to water shortage?	4	4	4	1	1	3	4	3	4	4
17	Has water shortage affected domestic consumption?	4	4	4	4	1	4	4	1	4	4
18	Is crop diversification, or changing cropping patterns a solution to water shortage?	4	4	4	4	4	4	4	4	4	4
19	Is training/awareness mentioned as a solution to improve water efficiency ?	4	4	4	4	4	4	4	4	4	4
	1: Yes										
	2: No										
	3: Ambiguous: weak assertions or difficult to comprehend										
	4: Not Mentioned: Query not applicable or not referred										
	** This is the unedited questionnaire that the main text draws on										

Continued

6.2.6 Coding Schedule: India - Spring

Article No.		41	42	43	44	45	46	47	48	49	50
News Paper		The Hindu	The Hindu	The Indian Express	The Hindu	The Tribune	The Times of India	The Times of India	The Indian Express	The Telegraph	The Indian Express
Author		T.N. Narasimhan	-	Priyadarshi Siddhanta	-	Jangveer Singh	TNN	TNN	Ravish Tiwari	Asok Ganguly	-
Length		859	142	214	113	579	276	573	1336	1616	298
Type of Article		Feature	News	News	News	News	News	Feature	Feature	Comment	News
Date		June 08, 2010	June 09, 2010	June 09, 2010	June 12, 2010	June 12, 2010	June 12, 2010	June 17, 2010	June 18, 2010	June 22, 2010	June 28, 2010
POLITICAL DISCOURSE											
1	The provision of the IWT being unfair/or flawed is the reason for water shortage?	4	4	4	4	4	4	4	4	4	4
2	Has regional water shortage lead Pakistan to accuse India of breaching water agreements?	4	4	4	4	4	4	1	1	4	3
3	Have Pakistan's assertions of India not abiding by the water agreements suggested as being unreasonable?	4	4	4	4	4	4	1	3	4	4
4	Should Pakistan and India intensify cooperation to resolve water issues?	4	4	4	4	4	4	3	3	4	4
5	Has uneven inter-provincial water distribution/usage been argued to be the cause of water shortage/issue?	4	1	4	1	4	4	4	4	4	4
6	Has water shortage lead to conflict/disagreement between stakeholders (People, Institutions, Political Parties)?	4	1	4	1	4	4	4	4	4	4
7	Has water been employed as a socio-political tool by extremist elements?	4	4	4	4	4	4	4	4	4	1
GOVERNANCE											
8	Have administrative lapses or challenges at the local, regional or national level been argued to be the cause of water shortage/ issue?	4	3	4	4	4	4	4	4	4	4
9	Public water management/Regulation should be improved to solve water shortage?	1	4	1	4	4	4	4	4	1	4
10	Has insufficient water/supply provision and storage infrastructure been argued to be the cause of water shortage/issue?	4	4	4	4	4	4	4	4	4	4
11	Would investment in water provision/technology provision and storage infrastructure improve water shortage?	1	4	4	4	4	4	4	4	1	4
12	Has public-private partnership/better water pricing partnership been suggested to improve water provision?	4	4	4	4	4	4	4	4	1	4
PEOPLE, PRACTICE AND ENVIRONMENT											
13	Have changing climate/rainfall conditions caused water shortage?	1	4	4	4	4	4	4	4	4	4
14	Has water shortage led to environmental degradation?	4	4	4	4	4	4	4	4	4	4
15	Has undergound water been affected?	1	4	4	4	1	1	4	4	4	4
16	Has the agricultural/agro dependent rural sector suffered due to water shortage?	4	4	1	4	1	4	4	4	4	4
17	Has water shortage affected domestic consumption?	4	4	4	4	4	4	4	4	1	4
18	Is crop diversification, or changing cropping patterns a solution to water shortage?	4	4	4	4	4	4	4	4	4	4
19	Is training/awareness mentioned as a solution to improve water efficiency ?	1	4	4	4	4	1	4	4	4	4
	1: Yes										
	2: No										
	3: Ambiguous: weak assertions or difficult to comprehend										
	4: Not Mentioned: Query not applicable or not referred										
	** This is the unedited questionnaire that the main text draws on										

6.2.7 Coding Schedule: Pakistan - Winter

Article No.		01	02	03	04	05	06	07	08	09	10
News Paper		The Dawn	The Daily Times	The Dawn	Pakistan Daily	The Dawn	The Pak Tribune	The Daily Times	The Dawn	The Daily Times	The Dawn
Author		Aziz Malik	-	-	Sultan M Hali	Khaleeq Kiani	-	Mahtab Bashir	Khaleeq Kiani	-	M.B. Kalhoro
Length		557	283	158	996	511	300	399	555	637	448
Type of Article		News	News	News	Editorial	News	comment	News	Feature	News	News
Date		January 04, 2010	January 08, 2010	January 11, 2010	January 15, 2010	January 16, 2010	January 22, 2010	January 23, 2010	January 25, 2010	January 29, 2010	February 01, 2010
POLITICAL DISCOURSE											
1	Has the IWT been put forward as the reason for water shortage/challenge?	4	3	4	1	4	4	4	4	4	4
2	Has Indian action and/or transgression been presented as a reason for water shortage/challenge?	4	3	1	1	4	1	4	4	4	4
3	Has political pressure against India been presented as a solution to water shortage?	4	4	1	1	4	1	4	4	4	4
4	Has water shortage lead to negative sentiments towards between India?	4	4	1	1	4	1	4	4	4	4
5	Has the increased cooperation between Pakistan and India been presented as a soultion to water issues?	4	1	3	3	4	3	4	4	4	4
6	Has water shortage lead to conflict between stakeholders (People, institutions, political parties)?	3	3	4	4	4	1	4	4	1	3
7	Has inter-provincial water distribution/unfair implementation of domestic water sharing accord been argued to be the cause of water shortage?	3	4	4	4	4	4	4	4	1	4
8	Has implementation of domestic water sharing arrangement in letter and spirit been presented as a solution?	1	1	4	4	4	1	4	4	4	4
GOVERNANCE											
9	Have administrative lapses or challenges at the local, regional or national level been argued to be the cause of water shortage?	1	4	1	3	4	4	1	4	4	1
10	Public water management should be improved to solve water shortage?	1	1	4	3	4	4	1	1	4	1
11	Has insufficient water provision and storage infrastructure been argued to be the cause of water shortage?	1	4	4	1	4	4	4	4	4	1
12	Would investment/attention/technology solutions to water provision and storage infrastructure improve water shortage?	1	4	4	1	4	4	4	4	4	4
PEOPLE, PRACTICE AND ENVIRONMENT											
13	Has changing climate/rainfall conditions caused water shortage?	4	4	4	1	1	4	4	1	4	1
14	Has water shortage lead to environmental degradation?	4	4	4	4	4	4	4	4	4	4
15	Has undergound water been affected?	4	4	4	4	4	4	4	4	4	4
16	Has the agricultural/agro dependent rural sector suffered due to water shortage?	1	4	1	1	1	1	4	1	1	1
17	Has water shortage affected domestic consumption?	3	4	4	4	4	4	1	4	1	4
18	Is crop diversification, or changing cropping patterns a solution to water shortage?	4	4	4	4	4	4	4	4	4	4
19	Is training/awareness mentioned as a solution to improve water efficiency ?	4	4	4	1	4	4	4	4	4	4
	1: Yes										
	2: No										
	3: Ambiguous: weak assertions or difficult to comprehend										
	4: Not Mentioned: Query not applicable or not referred										
	** This is the unedited questionnaire that the main text draws on										

Continued

6.2.7 Coding Schedule: Pakistan - Winter

Article No.		11	12	13	14	15	16	17	18	19	20
News Paper		The Dawn	The Dawn	The Pak Tribune	The Nation	The Dawn	The Daily Times	The Pak Tribune	The Dawn	The Dawn	The Dawn
Author		-	-	-	-	Kalbe Ali	-	-	Ahmad Fraz Khan	Saleem Shaikh	Ashfak Bokhari
Length		138	115	452	562	395	277	596	421	884	1175
Type of Article		News	News	News	Comment	News	News	News	News	Feature	Feature
Date		February 02, 2010	February 03, 2010	February 03, 2010	February 06, 2010	February 07, 2010	February 08, 2010	February 10, 2010	February 11, 2010	February 15, 2010	February 15, 2010
POLITICAL DISCOURSE											
1	Has the IWT been put forward as the reason for water shortage/challenge?	3	4	4	1	4	4	4	3	4	4
2	Has Indian action and/or transgression been presented as a reason for water shortage/challenge?	3	1	4	1	4	1	4	3	4	1
3	Has political pressure against India been presented as a solution to water shortage?	3	3	4	1	4	1	4	2	4	1
4	Has water shortage lead to negative sentiments towards between India?	4	4	4	1	4	4	4	4	4	1
5	Has the increased cooperation between Pakistan and India been presented as a soultion to water issues?	1	3	4	3	4	3	4	1	4	3
6	Has water shortage lead to conflict between stakeholders (People, institutions, political parties)?	4	4	1	4	4	4	1	4	4	1
7	Has inter-provincial water distribution/unfair implementation of domestic water sharing accord been argued to be the cause of water shortage?	4	4	1	4	1	4	1	4	4	1
8	Has implementation of domestic water sharing arrangement in letter and spirit been presented as a solution?	4	4	1	4	1	4	1	4	4	1
GOVERNANCE											
9	Have administrative lapses or challenges at the local, regional or national level been argued to be the cause of water shortage?	4	4	4	4	4	1	3	4	1	1
10	Public water management should be improved to solve water shortage?	4	4	4	4	4	4	3	4	1	4
11	Has insufficient water provision and storage infrastructure been argued to be the cause of water shortage?	4	4	4	4	4	4	4	4	1	4
12	Would investment/attention/technology solutions to water provision and storage infrastructure improve water shortage?	4	4	4	1	4	4	4	4	1	4
PEOPLE, PRACTICE AND ENVIRONMENT											
13	Has changing climate/rainfall conditions caused water shortage?	4	4	4	4	1	4	4	1	1	1
14	Has water shortage lead to environmental degradation?	4	4	4	4	4	4	1	4	4	4
15	Has undergound water been affected?	4	4	4	4	4	4	4	4	4	4
16	Has the agricultural/agro dependent rural sector suffered due to water shortage?	4	4	4	1	4	4	1	4	1	1
17	Has water shortage affected domestic consumption?	4	4	4	1	4	4	1	4	4	4
18	Is crop diversification, or changing cropping patterns a solution to water shortage?	4	4	4	4	4	4	4	4	4	4
19	Is training/awareness mentioned as a solution to improve water efficiency ?	4	4	4	4	4	4	4	4	4	4
	1: Yes										
	2: No										
	3: Ambiguous: weak assertions or difficult to comprehend										
	4: Not Mentioned: Query not applicable or not referred										
	** This is the unedited questionnaire that the main text draws on										

Continued

6.2.7 Coding Schedule: Pakistan - Winter

Article No.		21	22	23	24	25	26	27	28	29	30
News Paper		The Nation	The Dawn	The Dawn	The Dawn	The Daily Times	The Dawn	The Daily Times	The Pak Tribune	The Dawn	The Nation
Author		-	-	-	Ahmer Bilal Soofi	-	Qamaruddin	Mohammad Ali Talpur	-	Mohammad Hussain Khan	-
Length		657	161	154	916	133	394	1261	332	565	312
Type of Article		News	News	News	Comment	News	News	Comment	News	News	News
Date		February 17, 2010	February 19, 2010	February 19, 2010	February 20, 2010	February 20, 2010	February 21, 2010	February 21, 2010	February 21, 2010	February 23, 2010	February 23, 2010
POLITICAL DISCOURSE											
1	Has the IWT been put forward as the reason for water shortage/challenge?	1	4	4	3	4	4	4	4	4	4
2	Has Indian action and/or transgression been presented as a reason for water shortage/challenge?	1	1	4	3	4	4	4	4	4	4
3	Has political pressure against India been presented as a solution to water shortage?	3	4	4	2	4	4	4	4	4	4
4	Has water shortage lead to negative sentiments towards between India?	1	3	4	4	4	4	4	4	4	4
5	Has the increased cooperation between Pakistan and India been presented as a soultion to water issues?	1	4	4	1	1	4	4	4	4	4
6	Has water shortage lead to conflict between stakeholders (People, institutions, political parties)?	1	4	1	4	4	1	1	3	4	4
7	Has inter-provincial water distribution/unfair implementation of domestic water sharing accord been argued to be the cause of water shortage?	1	4	1	4	4	4	1	1	1	3
8	Has implementation of domestic water sharing arrangement in letter and spirit been presented as a solution?	1	4	1	4	4	4	1	1	1	1
GOVERNANCE											
9	Have administrative lapses or challenges at the local, regional or national level been argued to be the cause of water shortage?	3	1	4	4	4	1	1	4	4	4
10	Public water management should be improved to solve water shortage?	3	4	4	4	4	1	3	4	4	4
11	Has insufficient water provision and storage infrastructure been argued to be the cause of water shortage?	4	4	4	4	4	1	1	4	4	4
12	Would investment/attention/technology solutions to water provision and storage infrastructure improve water shortage?	4	4	4	4	4	4	4	4	4	4
PEOPLE, PRACTICE AND ENVIRONMENT											
13	Has changing climate/rainfall conditions caused water shortage?	1	4	4	3	4	4	4	4	4	4
14	Has water shortage lead to environmental degradation?	4	4	4	4	4	4	1	4	4	4
15	Has undergound water been affected?	4	4	4	4	4	4	4	4	4	4
16	Has the agricultural/agro dependent rural sector suffered due to water shortage?	1	4	4	4	4	1	1	1	4	4
17	Has water shortage affected domestic consumption?	4	4	4	4	4	1	1	4	4	4
18	Is crop diversification, or changing cropping patterns a solution to water shortage?	4	4	4	4	4	4	4	4	4	4
19	Is training/awareness mentioned as a solution to improve water efficiency ?	4	4	4	4	4	4	4	4	4	4
	1: Yes										
	2: No										
	3: Ambiguous: weak assertions or difficult to comprehend										
	4: Not Mentioned: Query not applicable or not referred										
	** This is the unedited questionnaire that the main text draws on										

Continued

6.2.7 Coding Schedule: Pakistan - Winter

Article No.		31	32	33	34	35	36	37	38	39	40
News Paper		The Pak Tribune	The Dawn	The Nation	The Daily Times	The Pak Tribune	The Pakistan Observer	The Dawn	The Dawn	The Daily Times	The Daily Times
Author		-	Kalbe Ali	Khalid Iqbal	-	Zaheerul Hassan	Gauhar Zahid Malik	Ahmad Hayat	Qurban Ali Khushik	Ijaz Kakakhel	-
Length		388	364	778	439	1364	1415	968	721	728	133
Type of Article		News	News	Comment	News	Comment	Comment	Editorial	Feature	News	News
Date		February 23, 2010	February 27, 2010	March 01, 2010	March 02, 2010	March 03, 2010	March 03, 2010	March 09, 2010	March 10, 2010	March 17, 2010	March 17, 2010
POLITICAL DISCOURSE											
1	Has the IWT been put forward as the reason for water shortage/challenge?	4	4	4	4	4	4	4	4	4	4
2	Has Indian action and/or transgression been presented as a reason for water shortage/challenge?	4	4	1	3	1	1	4	4	4	4
3	Has political pressure against India been presented as a solution to water shortage?	4	4	4	3	1	3	4	4	4	4
4	Has water shortage lead to negative sentiments towards between India?	4	4	4	3	1	1	4	4	4	4
5	Has the increased cooperation between Pakistan and India been presented as a soultion to water issues?	4	4	1	1	3	3	4	4	4	4
6	Has water shortage lead to conflict between stakeholders (People, institutions, political parties)?	4	4	4	4	4	4	4	4	4	4
7	Has inter-provincial water distribution/unfair implementation of domestic water sharing accord been argued to be the cause of water shortage?	3	4	4	1	4	4	4	4	4	4
8	Has implementation of domestic water sharing arrangement in letter and spirit been presented as a solution?	4	4	4	1	4	4	4	4	4	4
GOVERNANCE											
9	Have administrative lapses or challenges at the local, regional or national level been argued to be the cause of water shortage?	4	4	4	1	4	4	1	4	4	1
10	Public water management should be improved to solve water shortage?	4	4	4	4	4	4	1	4	4	1
11	Has insufficient water provision and storage infrastructure been argued to be the cause of water shortage?	4	4	4	4	4	4	1	4	4	4
12	Would investment/attention/technology solutions to water provision and storage infrastructure improve water shortage?	4	1	4	4	4	4	1	1	4	1
PEOPLE, PRACTICE AND ENVIRONMENT											
13	Has changing climate/rainfall conditions caused water shortage?	4	1	4	4	4	4	1	1	1	4
14	Has water shortage lead to environmental degradation?	4	4	4	4	4	4	4	4	4	4
15	Has undergound water been affected?	4	4	4	4	4	4	1	1	4	4
16	Has the agricultural/agro dependent rural sector suffered due to water shortage?	4	1	4	1	1	1	1	1	1	1
17	Has water shortage affected domestic consumption?	4	4	4	1	4	4	1	1	4	4
18	Is crop diversification, or changing cropping patterns a solution to water shortage?	4	4	4	4	4	4	4	4	1	4
19	Is training/awareness mentioned as a solution to improve water efficiency ?	4	4	4	4	4	4	1	4	1	1
	1: Yes										
	2: No										
	3: Ambiguous: weak assertions or difficult to comprehend										
	4: Not Mentioned: Query not applicable or not referred										
	** This is the unedited questionnaire that the main text draws on										

Continued

6.2.7 Coding Schedule: Pakistan - Winter

Article No.		41	42	43	44	45	46	47	48	49	50
News Paper		The Dawn	The Dawn	The Nation	The Daily Times	The Nation	The Daily Times	The Daily Times	The Dawn	The Daily Times	The Nation
Author		-	-	M. Zahur-Ul-Haq	-	-	Zeeshan Javaid	-	-	Iftikhar Gilani	-
Length		303	538	853	512	245	552	218	290	388	487
Type of Article		News	News	Comment	News	News	News	News	News	News	Comment
Date		March 19, 2010	March 23, 2010	March 23, 2010	March 26, 2010	March 27, 2010	March 28, 2010	March 28, 2010	March 29, 2010	March 29, 2010	March 29, 2010
POLITICAL DISCOURSE											
1	Has the IWT been put forward as the reason for water shortage/challenge?	1	1	4	4	4	4	4	4	4	4
2	Has Indian action and/or transgression been presented as a reason for water shortage/challenge?	1	1	1	1	1	4	3	3	2	1
3	Has political pressure against India been presented as a solution to water shortage?	3	3	1	4	3	4	4	4	4	1
4	Has water shortage lead to negative sentiments towards between India?	3	1	1	3	3	4	4	4	4	3
5	Has the increased cooperation between Pakistan and India been presented as a soultion to water issues?	3	3	2	4	1	4	1	1	4	4
6	Has water shortage lead to conflict between stakeholders (People, institutions, political parties)?	3	1	4	4	4	4	4	4	4	4
7	Has inter-provincial water distribution/unfair implementation of domestic water sharing accord been argued to be the cause of water shortage?	1	1	4	4	4	4	4	4	4	4
8	Has implementation of domestic water sharing arrangement in letter and spirit been presented as a solution?	1	1	4	4	4	4	4	4	4	4
GOVERNANCE											
9	Have administrative lapses or challenges at the local, regional or national level been argued to be the cause of water shortage?	4	1	1	1	1	4	4	4	4	1
10	Public water management should be improved to solve water shortage?	1	4	4	1	4	4	4	4	1	4
11	Has insufficient water provision and storage infrastructure been argued to be the cause of water shortage?	1	4	4	1	4	4	4	4	1	4
12	Would investment/attention/technology solutions to water provision and storage infrastructure improve water shortage?	1	4	4	4	4	4	4	4	1	4
PEOPLE, PRACTICE AND ENVIRONMENT											
13	Has changing climate/rainfall conditions caused water shortage?	4	4	1	4	4	1	4	4	4	4
14	Has water shortage lead to environmental degradation?	4	4	4	4	4	4	4	4	4	4
15	Has undergound water been affected?	4	4	1	4	4	4	4	4	4	4
16	Has the agricultural/agro dependent rural sector suffered due to water shortage?	1	1	1	1	1	4	4	4	4	4
17	Has water shortage affected domestic consumption?	4	1	4	1	4	4	4	4	4	1
18	Is crop diversification, or changing cropping patterns a solution to water shortage?	4	4	4	4	4	4	4	4	4	4
19	Is training/awareness mentioned as a solution to improve water efficiency ?	1	4	4	4	4	4	4	4	4	4
	1: Yes										
	2: No										
	3: Ambiguous: weak assertions or difficult to comprehend										
	4: Not Mentioned: Query not applicable or not referred										
	** This is the unedited questionnaire that the main text draws on										

6.2.8 Coding Schedule: India - Winter

Article No.		01	02	03	04	05	06	07	08	09	10
News Paper		The Tribune	The Tribune	The Indian Express	The Hindustan Times	The Indian Express	The Telegraph	The Times of India	The Telegraph	The Hindustan Times	The Indian Express
Author		Naveen S Garewal	-	-	Praveen Donthi	-	-	-	S.L. Rao	-	Geeta Gupta
Length		537	409	303	1202	412	447	597	1256	437	372
Type of Article		News	News	News	Feature	News	News	Feature	Comment	News	News
Date		January 01, 2010	January 07, 2010	January 09, 2010	January 16, 2010	January 22, 2010	January 23, 2010	January 24, 2010	January 25, 2010	February 04, 2010	February 06, 2010
POLITICAL DISCOURSE											
1	The provision of the IWT being unfair/or flawed is the reason for water shortage?	4	4	4	4	4	4	4	4	4	4
2	Has regional water shortage lead Pakistan to accuse India of breaching water agreements?	4	4	4	4	4	3	4	4	4	4
3	Have Pakistan's assertions of India not abiding by the water agreements suggested as being unreasonable?	4	4	4	4	4	4	4	4	4	4
4	Should Pakistan and India intensify cooperation to resolve water issues?	4	4	4	4	4	1	4	4	4	4
5	Has uneven inter-provincial water distribution/usage been argued to be the cause of water shortage/issue?	4	4	4	4	4	4	4	4	4	4
6	Has water shortage lead to conflict/disagreement between stakeholders (People, Institutions, Political Parties)?	4	3	4	4	4	4	1	4	4	4
7	Has water been employed as a socio-political tool by extremist elements?	4	4	4	4	4	4	4	4	4	4
GOVERNANCE											
8	Have administrative lapses or challenges at the local, regional or national level been argued to be the cause of water shortage/ issue?	4	4	3	1	1	4	1	1	4	3
9	Public water management/Regulation should be improved to solve water shortage?	4	4	3	3	1	4	1	1	4	1
10	Has insufficient water/supply provision and storage infrastructure been argued to be the cause of water shortage/issue?	4	4	3	4	4	4	4	3	4	4
11	Would investment in water provision/technology provision and storage infrastructure improve water shortage?	4	4	1	4	4	4	4	3	4	4
12	Has public-private partnership/better water pricing partnership been suggested to improve water provision?	4	4	4	4	4	4	4	4	4	4
PEOPLE, PRACTICE AND ENVIRONMENT											
13	Have changing climate/rainfall conditions caused water shortage?	4	4	4	4	4	4	4	4	1	1
14	Has water shortage led to environmental degradation?	1	4	4	3	4	4	4	4	4	4
15	Has undergound water been affected?	1	4	4	4	4	4	4	1	4	1
16	Has the agricultural/agro dependent rural sector suffered due to water shortage?	4	4	1	1	4	4	1	1	1	4
17	Has water shortage affected domestic consumption?	4	4	4	4	4	4	3	4	4	3
18	Is crop diversification, or changing cropping patterns a solution to water shortage?	4	4	4	4	4	4	4	4	4	4
19	Is training/awareness mentioned as a solution to improve water efficiency ?	4	4	3	4	4	4	4	4	4	4
	1: Yes										
	2: No										
	3: Ambiguous: weak assertions or difficult to comprehend										
	4: Not Mentioned: Query not applicable or not referred										
	** This is the unedited questionnaire that the main text draws on										

Continued

6.2.8 Coding Schedule: India - Winter

Article No.		11	12	13	14	15	16	17	18	19	20
News Paper		The Times of India	The Tribune	The Indian Express	The Tribune	The Hindu	The Tribune	The Tribune	The Telegraph	The Indian Express	The Times of India
Author		Prithvijit Mitra	-	Manoj Prasad	Vibha Sharma	Siddharth Varadarajan	Jangveer Singh	Sushil Mahav	Archis Mohan	Girish Sharma	-
Length		456	205	544	527	518	291	330	457	181	633
Type of Article		News	News	Feature	News	News	News	News	News	News	News
Date		February 08, 2010	february 09, 2010	february 12, 2010	february 12, 2010	February 14, 2010	February 14, 2010	February 14, 2010	Febtruary 15, 2010	Febtruary 23, 2010	Febtruary 23, 2010
POLITICAL DISCOURSE											
1	The provision of the IWT being unfair/or flawed is the reason for water shortage?	4	4	4	4	4	4	4	4	4	4
2	Has regional water shortage lead Pakistan to accuse India of breaching water agreements?	4	4	4	4	1	4	4	4	4	1
3	Have Pakistan's assertions of India not abiding by the water agreements suggested as being unreasonable?	4	4	4	4	3	4	4	3	4	1
4	Should Pakistan and India intensify cooperation to resolve water issues?	4	4	4	4	4	4	4	4	4	4
5	Has uneven inter-provincial water distribution/usage been argued to be the cause of water shortage/issue?	4	4	4	1	4	4	4	4	4	4
6	Has water shortage lead to conflict/disagreement between stakeholders (People, Institutions, Political Parties)?	4	4	4	4	4	4	4	4	4	1
7	Has water been employed as a socio-political tool by extremist elements?	4	4	4	4	1	4	4	1	4	1
GOVERNANCE											
8	Have administrative lapses or challenges at the local, regional or national level been argued to be the cause of water shortage/ issue?	1	3	4	4	4	1	4	4	1	4
9	Public water management/Regulation should be improved to solve water shortage?	1	3	3	1	4	3	4	4	4	4
10	Has insufficient water/supply provision and storage infrastructure been argued to be the cause of water shortage/issue?	4	4	1	4	4	1	1	4	1	4
11	Would investment in water provision/technology provision and storage infrastructure improve water shortage?	4	4	1	4	4	1	1	4	4	4
12	Has public-private partnership/better water pricing partnership been suggested to improve water provision?	4	4	4	4	4	1	4	4	4	4
PEOPLE, PRACTICE AND ENVIRONMENT											
13	Have changing climate/rainfall conditions caused water shortage?	4	4	1	4	4	4	4	4	4	1
14	Has water shortage led to environmental degradation?	1	4	4	1	4	4	4	4	4	4
15	Has undergound water been affected?	1	1	4	1	4	4	4	4	4	4
16	Has the agricultural/agro dependent rural sector suffered due to water shortage?	4	4	1	1	4	1	3	4	3	4
17	Has water shortage affected domestic consumption?	4	4	3	4	4	1	3	4	3	4
18	Is crop diversification, or changing cropping patterns a solution to water shortage?	4	4	4	4	4	4	4	4	4	4
19	Is training/awareness mentioned as a solution to improve water efficiency ?	4	4	3	4	4	4	4	4	4	4
	1: Yes										
	2: No										
	3: Ambiguous: weak assertions or difficult to comprehend										
	4: Not Mentioned: Query not applicable or not referred										
	** This is the unedited questionnaire that the main text draws on										

Continued

6.2.8 Coding Schedule: India - Winter

Article No.		21	22	23	24	25	26	27	28	29	30
News Paper		The Tribune	The Indian Express	The Times of India	The Times of India	The Tribune	The Hindu	The Indian Express	The Hindustan Times	The Indian Express	The Indian Express
Author		Megha Mann	Geeta Gupta	-	-	Ashok Tuteja	-	-	Rajendra Aklekar	B.G.Verghese	Ravish Tiwari
Length		139	387	417	108	751	273	250	296	779	679
Type of Article		News	News	News	News	News	News	News	News	Comment	News
Date		February 23, 2010	February 24, 2010	February 24, 2010	February 25, 2010	February 25, 2010	February 26, 2010	March 06, 2010	March 08, 2010	March 12, 2010	March 12, 2010
POLITICAL DISCOURSE											
1	The provision of the IWT being unfair/or flawed is the reason for water shortage?	4	4	4	4	4	4	4	4	3	4
2	Has regional water shortage lead Pakistan to accuse India of breaching water agreements?	4	4	4	4	4	4	1	4	1	1
3	Have Pakistan's assertions of India not abiding by the water agreements suggested as being unreasonable?	4	4	4	4	1	4	3	4	1	1
4	Should Pakistan and India intensify cooperation to resolve water issues?	4	4	4	4	4	4	1	4 4	1	1
5	Has uneven inter-provincial water distribution/usage been argued to be the cause of water shortage/issue?	4	1 4	1	4	4	4	4	1	4	4
6	Has water shortage lead to conflict/disagreement between stakeholders (People, Institutions, Political Parties)?	4		1	4	4	4	4		4	4
7	Has water been employed as a socio-political tool by extremist elements?	4	4	4	4	4	4	4	4	1	1
GOVERNANCE											
8	Have administrative lapses or challenges at the local, regional or national level been argued to be the cause of water shortage/ issue?	4	1 4	1	4	4	4	4	1	4	4
9	Public water management/Regulation should be improved to solve water shortage?	4	1	4	4 4	4 4	1	4	1 4	4	4
10	Has insufficient water/supply provision and storage infrastructure been argued to be the cause of water shortage/issue?	4	1	4			1	4		4	4
11	Would investment in water provision/technology provision and storage infrastructure improve water shortage?	1	4	4	1	4	1	4	4	4	4
12	Has public-private partnership/better water pricing partnership been suggested to improve water provision?	4	4	4	4	4	4	4	4	4	4
PEOPLE, PRACTICE AND ENVIRONMENT											
13	Have changing climate/rainfall conditions caused water shortage?	4 4	4 4	4	4 4	4 4	4	4	1 4	1	4
14	Has water shortage led to environmental degradation?	4	4	4	4	4	4	4	4	4	4
15	Has undergound water been affected?	4	4	4	3	4	1	4	4	4	4
16	Has the agricultural/agro dependent rural sector suffered due to water shortage?	4	4	1 3	4 4	4	4	4	1	4	4
17	Has water shortage affected domestic consumption?	4	4	4		4	4	4	4	4	4
18	Is crop diversification, or changing cropping patterns a solution to water shortage?	4		4	4	4	4 1	4	4	4	4
19	Is training/awareness mentioned as a solution to improve water efficiency ?							4		4	4
	1: Yes										
	2: No										
	3: Ambiguous: weak assertions or difficult to comprehend										
	4: Not Mentioned: Query not applicable or not referred										
	** This is the unedited questionnaire that the main text draws on										

Continued

6.2.8 Coding Schedule: India - Winter

Article No.		31	32	33	34	35	36	37	38	39	40
News Paper		The Tribune	The Hindustan Times	The Indian Express	The Hindu	The Hindustan Times	The Times of India	The Tribune	The Times of India	The Hindu	The Telegraph
Author		Dinesh Manhotra	Bhavika Jain	-	Sandeep Dikshit	-	-	Neena Sharma	Akhilesh Sourav Jha	K. Raju	Shashank Shekhar
Length		489	245	472	262	114	464	287	334	92	410
Type of Article		News	News	Feature	News	News	News	News	News	News	News
Date		March 12, 2010	March 12, 2010	March 13, 2010	March 13, 2010	March 16, 2010	March 17, 2010	March 17, 2010	March 18, 2010	March 18, 2010	March 18, 2010
POLITICAL DISCOURSE											
1	The provision of the IWT being unfair/or flawed is the reason for water shortage?	4	4	4	3	4	4	4	4	4	4
2	Has regional water shortage lead Pakistan to accuse India of breaching water agreements?	4	4	4	3	4	4	4	4	4	4
3	Have Pakistan's assertions of India not abiding by the water agreements suggested as being unreasonable?	4	4	4	3	4	4	4	4	4	4
4	Should Pakistan and India intensify cooperation to resolve water issues?	4	4	4	1	4	4	4	4	4	4
5	Has uneven inter-provincial water distribution/usage been argued to be the cause of water shortage/issue?	4	4	4	4	4	4	4	4	4	4
6	Has water shortage lead to conflict/disagreement between stakeholders (People, Institutions, Political Parties)?	4	4	4	4	4	1	4	4	4	4
7	Has water been employed as a socio-political tool by extremist elements?	4	4	4	4	4	4	4	4	4	4
GOVERNANCE											
8	Have administrative lapses or challenges at the local, regional or national level been argued to be the cause of water shortage/ issue?	4	4	4	4	4	4	3	1	1	1
9	Public water management/Regulation should be improved to solve water shortage?	4	4 4	4	4	4	4	1	1	1	3
10	Has insufficient water/supply provision and storage infrastructure been argued to be the cause of water shortage/issue?	4		4	4	1	1	3	1	4	1
11	Would investment in water provision/technology provision and storage infrastructure improve water shortage?	1	4	4	4	3	1	1	1	4	1
12	Has public-private partnership/better water pricing partnership been suggested to improve water provision?	4	4	4	4	4	4	4	4	4	4
PEOPLE, PRACTICE AND ENVIRONMENT											
13	Have changing climate/rainfall conditions caused water shortage?	1	4 4	1	4	4	4	1	4	1	4
14	Has water shortage led to environmental degradation?	4	1	4	1	4	4	4	4	4	4
15	Has undergound water been affected?	1	4	4	4	4	4	4	4	4	1
16	Has the agricultural/agro dependent rural sector suffered due to water shortage?	4	4	1	4	4	4	3	4	1	4
17	Has water shortage affected domestic consumption?	1	4	4	4	4	1	1	4	4	1
18	Is crop diversification, or changing cropping patterns a solution to water shortage?	4	4	4	4	4	4	4	4	4	4
19	Is training/awareness mentioned as a solution to improve water efficiency ?	4		4	4	4	4	4	4	4	4
	1: Yes										
	2: No										
	3: Ambiguous: weak assertions or difficult to comprehend										
	4: Not Mentioned: Query not applicable or not referred										
	** This is the unedited questionnaire that the main text draws on										

Continued

6.2.8 Coding Schedule: India - Winter

Article No.		41	42	43	44	45	46	47	48	49	50
News Paper		The Times of India	The Times of India	The Indian Express	The Times of India	The Telegraph	The Times of India	The Tribune	The Hindu	The Times of India	The Hindu
Author		Sukhada Tatke	Sunil Mungara	-	P J Joychen & Akhilesh Saurav Jha	-	Rachna Singh	N Ravikumar/ TNS	Gollapudi Srinivasa Rao	-	K.Lakshmi
Length		449	429	443	431	501	337	243	316	372	217
Type of Article		News	News	News	News	News	News	News	News	Feature	News
Date		March 20, 2010	March 21, 2010	March 22, 2010	March 22, 2010	March 22, 2010	March 23, 2010	March 23, 2010	March 25, 2010	March 29, 2010	March 31, 2010
POLITICAL DISCOURSE											
1	The provision of the IWT being unfair/or flawed is the reason for water shortage?	4	4	4	4	4	4	4	4	4	4
2	Has regional water shortage lead Pakistan to accuse India of breaching water agreements?	4	4	4	4	4	4	4	4	4	4
3	Have Pakistan's assertions of India not abiding by the water agreements suggested as being unreasonable?	4	4	4	4	4	4	4	4	4	4
4	Should Pakistan and India intensify cooperation to resolve water issues?	4	4	4	4	4	4	4	4	4	4
5	Has uneven inter-provincial water distribution/usage been argued to be the cause of water shortage/issue?	4	4	4	4	4	4	1	4	4	4
6	Has water shortage lead to conflict/disagreement between stakeholders (People, Institutions, Political Parties)?	4	4	1	4	4	4	1	4	4	4
7	Has water been employed as a socio-political tool by extremist elements?	4	4	4	4	4	4	4	4	4	4
GOVERNANCE											
8	Have administrative lapses or challenges at the local, regional or national level been argued to be the cause of water shortage/ issue?	4	4	4	4	4	4	4	3	3	4
9	Public water management/Regulation should be improved to solve water shortage?	4	4	4	4	4	4	4	4	1	4
10	Has insufficient water/supply provision and storage infrastructure been argued to be the cause of water shortage/issue?	1	4	4	1	4	4	4	3	3	4
11	Would investment in water provision/technology provision and storage infrastructure improve water shortage?	1	4	4	4	4	3	4	3	1	1
12	Has public-private partnership/better water pricing partnership been suggested to improve water provision?	4	4	4	4	4	4	4	4	4	4
PEOPLE, PRACTICE AND ENVIRONMENT											
13	Have changing climate/rainfall conditions caused water shortage?	4	4	4	1	1	3	4	1	4	4
14	Has water shortage led to environmental degradation?	4	4	1	4	4	4	4	4	4	4
15	Has undergound water been affected?	1	1	1	4	1	1	4	1	1	4
16	Has the agricultural/agro dependent rural sector suffered due to water shortage?	4	4	4	4	4	3	4	4	4	4
17	Has water shortage affected domestic consumption?	1	1	4	1	3	3	4	1	4	4
18	Is crop diversification, or changing cropping patterns a solution to water shortage?	4	4	4	4	4	4	4	4	4	4
19	Is training/awareness mentioned as a solution to improve water efficiency ?	4	4	4	4	4	4	4	1	4	4
	1: Yes										
	2: No										
	3: Ambiguous: weak assertions or difficult to comprehend										
	4: Not Mentioned: Query not applicable or not referred										
	** This is the unedited questionnaire that the main text draws on										