Hisaar Foundation
a foundation for water, food and livelihood security

Think Tank on the Rational Use of Water

First Report

October 2016

Recommendations for Pakistan's Water Policy Framework

Drought Management and Arid Zones
Understanding Droughts, Early Warning Signs And Drought Resilience

The Great Betrayal
Unfulfilled Promise of the Water Economy

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Foreword

It is our pleasure to share the first publication by Hisaar Foundation's Think Tank on Rational Use of Water. The Think Tank aims to provide meaningful and innovative solutions to Pakistan's key water issues as well as advancing these solutions into a mainstream national agenda.

This body came into existence in 2014 and, through strenuous efforts of the members of its Think Tank and the staff of the Hisaar Foundation, it has accomplished a great deal since its inception. From identifying the major challenges facing Pakistan in the water sector to setting priorities for the work to be undertaken in the initial phase, the Think Tank has strived to fulfill its obligations in a timely manner.

While the Think Tank began its work by identifying five key priority areas: efficient management of the Indus basin; Balochistan groundwater management; drought management and arid zones; urban water management; and the Indus Water Treaty/Transboundary water, fast emerging realities resulted in expansion of our focus.

It was at the Hisaar Foundation's second international conference on water held in November 2015, entitled "Securing Sustainable Water for All 2015– Innovation, Integration and Inclusion," experts and participants reached the consensus that the government of Pakistan must formulate a national water policy. Therefore, the Think Tank was charged with developing a set of recommendations as well as a call to action for the formulation of a national water policy.

A core value of the Foundation is that water is everyone's business and diversity of views will only enrich the solutions to the many challenges we face. Hisaar Foundation invited a unique mix of professionals to form the Think Tank. The composition of the Think Tank members offer a blend of water experts and prominent leaders with diverse backgrounds. Each individual truly believes in the cause of water and the spirit of volunteerism thereby generously offering their time and valuable experiences.

Three leading national experts on water were invited to join this group including Khalid Mohtadullah, a leading authority on water who is also an engineer by profession, Dr. Daanish Mustafa, a geographer and an academician and Simi Kamal, founding chair of Hisaar Foundation and a geographer by profession. Dr. Salman Shah, economist and a former finance minister of Pakistan, Aliuddin Ansari, a well-known name in the corporate sector and a former chief executive officer of Engro Corporation, Dr. Sarosh Lodi, Dean of Civil Engineering Faculty of the Karachi-based NED University of Engineering and Technology and also the chair of the Universities for Water Network of Hisaar Foundation, Seema Taher Khan, a media and communication specialist, and myself in my capacity as the chairman of Hisaar Foundation and specialist in strategy and institutional development. We also appreciate the valuable contributions made by Mirza Qamar Beg, a former member of this group.

We aim to advance the conversation on Pakistan's water challenges not only by disseminating this publication widely but also by interacting with the various stakeholders on the issue. I am grateful and obliged to our Think Tank members who worked tirelessly in bringing out this document. I would also like to especially acknowledge the contribution of Zofeen Ebrahim towards editing of this publication. Finally, I must mention that without the zeal and determined effort of the Hisaar Foundation's staff who demonstrated commitment to the cause by putting in long hours, this milestone would not have been achieved.

I thank you.

Zohair Ashir
Chairman

The Think Tank was established with the mission to provide national leadership in Pakistan on the crucial issue of promoting the rational use of water, its improved management, and providing policy directions. Specific goals included establishing a national forum for discourse on rational use of water, developing and presenting policy alternatives, and carrying out advocacy at the highest levels of the government, civil society, and corporate sectors.

After two years of hard work, I am happy to present the first set of outputs:

1. Recommendations for Pakistan's Water Policy Framework
2. A paper on Drought Management and Arid Zones: Understanding drought, early warning signs and drought resilience
3. An article on "The Great Betrayal: The unfulfilled promise of Pakistan's water economy"

The Think Tank supports and encourages academic explorations, research, and individual viewpoints, as well as builds consensus on policy through discursive engagements.

The policy recommendations included here are the result of intensive discussions and consensus building among the Think Tank members and incorporation of viewpoints from two international conferences and several consultations across Pakistan. In the endeavor to formulate a comprehensive water policy framework the Think Tank held discussions with representatives of international non-governmental organizations, local civil society organizations, representatives from the business and corporate sectors, members of the Lahore and Karachi chambers of commerce and industry, representatives from donor agencies, farmers, women's groups, media, academia, university students, teachers, professors, as well as elected representatives.

In "Drought Management and Arid Zones: Understanding drought, early warning signs and drought resilience" Dr. Daanish Mustafa and Sanaa Baxamoosa study the regional specific experiences of drought in Pakistan.

In the article "The Great Betrayal: The unfulfilled promise of Pakistan's water economy", Dr. Salman Shah shares his views on the immense potential of the water economy of Pakistan.

Having developed a "universe of priorities" encompassing the water challenges faced by Pakistan, members of the Think Tank aim to develop policy, position papers and/or research outputs for each of the twenty five priority action areas identified.

It is our hope that together we can lobby with the government in instituting an appropriate water policy, as outlined in this publication.

Simi Kamal

Convener Think Tank & Chair of the Academic Committee

Recommendations for Pakistan's Water Policy Framework

Proposed by Members of the
Hisaar Foundation Think Tank on the Rational Use of Water

Preamble

This framework has been developed over three years of hard work covering two international conferences organized by Hisaar Foundation on 'Water Cooperation in Action - From the Global to The Grassroots' (December 2013) and 'Securing Sustainable Water for All: Inclusion, Integration and Innovation' (November 2015) and numerous sessions of the Hisaar Foundation Think Tank on Rational Use of Water[1] and the Universities for Water Network[2], as well as several stakeholder sessions and meetings with water experts, government functionaries, the corporate sector, the business community, international agencies, academia, women's groups, youth groups, civil society and the media. This also includes discussion in various documents[3].

This policy framework covers the following **five focus areas:**

- Improving access to water for the poor and landless, and maximizing water use efficiency
- Financing the urban and rural water economies and the water value chain
- Safeguarding the Indus Basin, its aquifers and its infrastructure
- Improving governance and management of water institutions
- Building a base for science, technology and the social aspects of water

This is a call to action to federal and provincial governments and will continue until Pakistan has a feasible and actionable national water policy in place.

Land and water belong to the people of Pakistan and form their endowment and entitlement. They are Pakistan's main natural and economic resources for which there is substantial physical infrastructure available and where a very large segment of the population is provided livelihood opportunities. This water policy framework postulates that Pakistan's water must be a source of development, dignity and prosperity for all citizens. Pakistan has recently committed to Agenda 2030 and has become signatory to Sustainable Development Goals (SDGs) where Goal 6 calls, among others, for ensuring availability and sustainable management of water and sanitation for all, water use efficiency and integrated water resources management. The UN World Water Development Report 2016 highlights that most of the global work force is directly or indirectly dependent on water resources[4]. The Organization for Economic Co-operation and Development 2016 report links water, growth and finance and calls for financing investments in water security and sustainable growth[5].

Pakistan's economy is a 'water economy' with 60 percent of the population directly engaged in agriculture and livestock and 80 percent of Pakistan's exports based on these sectors. Approximately 95 percent of surface water[6] and almost all fresh groundwater in Pakistan is currently used in agriculture.

Therefore, Pakistan needs a long term plan for its water requirements and the federal government should take the lead in defining the long term roadmap up to 2050 in a climate-challenged world. Pakistan's Vision 2025 aims to increase water storage capacity, improve efficiency in agriculture by 20 percent and ensure

1 Think Tank Members: Mr. Aliuddin Ansari, Dr. Daanish Mustafa, Mr. Khalid Mohtadullah, Dr. Salman Shah, Professor Dr. Sarosh Hashmat Lodi , Ms. Seema Taher Khan, Ms. Simi Kamal and Mr. Zohair Ashir

2 UWN members: NED University of Engineering and Technology, Mehran University of Engineering and Technology, University of Karachi, Habib University, Lasbela University of Agriculture, Water and Marine Sciences, University of Agriculture, Faisalabad, Lahore University of Management Sciences (LUMS), University of Peshawar, MNS University of Agriculture Multan, Karakoram International University

3 Kamal S, Amir P, Mohtadullah K, 'Development of Integrated River Basin Management (IRBM) for Indus Basin - Challenges and Opportunities', WWF Pakistan, 2011
Shah S, presentation on 'Rejuvenating Pakistan's Water Economy: Policies, Institutions and Infrastructure', presented in 'Securing Sustainable Water for All – Inclusion, Integration, Innovation', Hisaar Foundation's international water conference (November 2015)
Briscoe J and Qamar U, Pakistan's Water Economy: Running Dry,The World Bank report, November 2005

4 Water and Jobs, United Nations World Water Development Report, 2016

5 OECD Economic Outlook, Volume 2016, Issue 1, OECD Publishing, Paris.

6 Pakistan 2025, One Nation-One Vision, approved by National Economic Council, May 2014, Planning Commission, Ministry of Planning, Development & Reform, GoP, pp 64

clean drinking water to all Pakistanis[7]. It speaks of water security goals that include technologies to minimize wastage, more effective allocations, establishment of institutional mechanisms and a minimum baseline for suitable water to every person in Pakistan.[8] With a growing population, Pakistan is a water-scarce country now, and with water security goals in its vision statements, Pakistan needs to work in smarter, less water-intensive ways.

These recommendations for a policy framework have been developed to cover the next 10 years, with a vision, goals and strategies to achieve the goals. It is offered to the government of Pakistan for consideration and the Pakistani public to lobby with the government for requisite actions.

1. Situational Analysis of Water and Unused Potential

Given the present level of development in the country, a runway population and increasing climate change impacts, the best option for sustainable economic and social development is to make the needed investments in Pakistan's water sector to ensure equitable access to the fruits of development to all, while at the same time conserving this vital resource. Therefore, it is necessary to first have in place a sound water policy that provides the framework for optimal and balanced development, management and conservation of Pakistan's water resources and assets.

Pakistan's total surface water from all rivers is 154 million acre feet (MAF) on average but the flow fluctuates widely in different years. The average flow to the sea is approximately 40 MAF but is very variable[9]. For example, the flow was 92 MAF in 1994 -95 per year and 0.77 MAF in 2000-01[10]. Approximately 10 MAF is systems losses each year[11]. On average 104 MAF of water is diverted into the irrigation system, against the 114.35 MAF mentioned in the Indus Water Accord[12]. Pakistan also has about 50 MAF[13] of fresh groundwater of which 79 percent is in Punjab and 28 percent in Sindh. [14]The canal irrigation water efficiency is around 33 percent i.e. only one-third of the water mobilized in the irrigation system reaches the farm gate. In comparison, other countries have achieved efficiency levels exceeding 90 percent. Waterlogging and salinity have not yet been effectively tackled. Pakistan has lost 3.2 million hectares[15] (canal command area) to water logging and salinity. Thirty-three million tonnes of salt is coming into the system annually and we are only capable of discharging 9 million tonnes per year[16], leading to net accumulation of salt in the system. However there is a potential to achieve a favourable salt balance in the Indus basin through effective drainage management.

The potential hydro generation capacity embedded in the Indus river system is about 59,000 MW[17] of which Pakistan has exploited only 6,595 MW[18]. Pakistan's total land area is around 196 million acres out of which 77 million acres are suitable for agriculture. Currently 55 million acres have access to irrigation[19]. Therefore, there is a potential of bringing 22 million acres of additional land under irrigation by extending the Indus basin irrigation network to the arid areas of Pakistan.

Annual agriculture GDP for 55 million acres of irrigated land is under US$500 million for every

7 Pakistan 2025, One Nation-One Vision, Planning Commission, Ministry of Planning, Development & Reform, GoP, pp 102
8 Ibid, pp 62
9 The Pakistan Water Situational Analysis, the World Commission on Dams – Consultative Process in Pakistan (WCD CPP) Project, IUCN, 2002, pp 1
10 Khan, RIA, Water Resource Development in Pakistan, presented at Roundtable Discussion on Agriculture and Water in Pakistan, World Bank, IRSA 2011
11 Pakistan Water Sector Strategy, National Water Sector Profile, Ministry of water and Power, Volume 5, October 2002, pp 2
12 Pakistan Water Accord, 1991
13 The Tenth Five Year Perspective Plan-Investing in People, 2010-15, Planning Commission GoP, Islamabad, pp 291
14 The Pakistan Water Situational Analysis, the World Commission on Dams – Consultative Process in Pakistan (WCD CPP) Project, IUCN, pp 3
15 MINFA 2008 quoted in The Tenth Five Year Perspective Plan-Investing in People, 2010-15, Planning Commission GoP, Islamabad, pp 59
16 The Tenth Five Year Perspective Plan-Investing in People, 2010-15, Planning Commission GoP, Islamabad, pp 293
17 WAPDA report November 2011 quoted in Report on An Overview of Electricity Sector in Pakistan, ICCI, pp 11
18 Hydel Potential in Pakistan, Ministry of Water and Power, GoP, 2013, pp 15
19 Issues of Water Resources in Pakistan, Briefing Paper No. 7 for Pakistani Parliamentarians. PILDAT. 2003. pp 11

MAF of water. This makes total agriculture GDP of around US$50 billion per year[20]. There is a potential to raise this substantially and build upon and expand the water 'value chain'.

The cost of replacing the Indus basin system is approximately US$ 300 billion[21]. The Indus basin system is our asset and we must leverage it to generate local investment from within Pakistan for repair and maintenance of this infrastructure. We should also build new infrastructure where needed, through cooperative, institutional and innovative financing models.

In this endeavour we should learn from global experiences including the Murray Darling basin of Australia which is an extremely relevant comparative study for Pakistan in achieving salt balance, regulating and managing both groundwater and surface water through use of economic, environmental and social instruments, and the principles of integrated water resources management (IWRM).

2. National Water Vision

Pakistan Vision 2025 states that "Pakistan's ultimate aspiration is to see Pakistan among the 10 largest economies of the world by 2047, the centennial year of our independence". We believe that this cannot be done unless we develop Pakistan's water economy and provide clean, safe and accessible water for all citizens as a right, balanced with affordable and efficient water supply for economic and social development with benefits for all areas of Pakistan, and for both women and men.

This vision is built upon depoliticized consideration of water movement, water storage, water use, water recycling and water conservation in the interest of Pakistan, and for promoting and achieving equitable distribution of costs and benefits of the water economy across Pakistan, especially benefiting the poor.

To circumvent the long debates that have strangled rational use of water in Pakistan, we propose concrete goals over a ten-year period to kick-start the process of widening the benefits of the water economy to embrace deprived areas and groups, and encourage water efficiency in agriculture and other uses.

2.1 National Water Goals over Next 10 Years

These goals reflect the vision and the five focus areas which are feasible and manageable in a ten-year time frame.

1. Extend the irrigation system to the arid districts of eastern Sindh, southern KPK, eastern Balochistan and southern Punjab, bringing at least five million new acres under cultivation for distribution to poor and landless farmers.
2. Mobilize five MAF of additional surface water each year to reach the farm gate by third year of this policy (40 MAF instead of current 35 MAF), and 10 MAF each year by the seventh year of the policy (45 MAF instead of current 35 MAF) including savings in current system (lining canals in downstream areas, changes in cropping patterns and water saving measures) and new/enhanced storages of different sizes at different levels, as appropriate in different areas.
3. Improve water efficiency from the current level of 33 percent to approximately 43 percent (i.e. 45 MAF instead of 35 MAF of irrigation water available at the farm gate).
4. Achieve one billion dollar output for every MAF of water used in agriculture.
5. Preserve, maintain, repair and add to the existing water infrastructure assets.
6. Revise abiyana to reflect the real value of water, make it pro rata and geographically specific.
7. Control withdrawals in fresh groundwater areas and line watercourses in saline groundwater areas.
8. Generate additional 10,000 megawatts (MW) [22]indigenous hydropower and reduce reliance on thermal power.

20 This is based on calculating 20% of Pakistan's GDP from Pakistan Economic Survey 2016

21 Briscoe J and Qamar U (eds), Pakistan's Water Economy: Running Dry, The World Bank, November 2005

22 State of Industry Report 2015, National Electric Power Regulation Authority, Govt. of Pakistan. pp. 5

9. Institute coordination among water, agriculture and industry for maximum benefits.
10. Make investment in water infrastructure and hydropower a core part of the China Pakistan Economic Corridor (CPEC).

3. Strategies for Achieving Goals

For achieving the 10 goals, comprehensive strategies are proposed under each of the five focus areas:

3.1 Focus Area 1 - Improving Access to Water for the Poor and Landless and Maximizing Water Use Efficiency

Several of the 10 goals refer to increasing access and benefits of water to all. While many barani areas of Pakistan may not benefit from the possible reach of the Indus system, those that can should be brought under irrigation. Other methods are suggested for difficult and dry areas, where irrigation system cannot be extended. Some of these initiatives can be taken up under the CPEC arrangements.

3.1.1 Thinking Differently about Water Use Efficiency

Water use efficiency in the Indus irrigation system is low on many counts, not least in terms of water lost through seepage, estimated at two-thirds of total diverted water (69 MAF out of 104 MAF).

We must recognize the different geology, hydrology and geography of various areas in the Indus basin and allow water seepage where the 'lost' water contributes to sweet groundwater. But we must save current water losses downstream where seepage water is lost by mixing in saline groundwater. This will be done by lining the canals in saline areas and investing in this intervention on priority basis. Improving water efficiency from 33 percent to 45 percent will mean beginning with additional five MAF of saved water which can be channeled into the proposed Rainee/Thar canals, Katchi canal and others, to bring new areas into cultivation.

Work will commence on working out entitlements of provinces, areas and districts based on all available sources of water (groundwater, surface water and precipitation), rather than only surface water. So if one district has large supplies of groundwater, its share from surface water will be reduced. This will require hard negotiations, but will lead to efficiency and equity.

3.1.2 Bringing Deprived Cultivable Areas under Irrigation

This policy framework calls for extending the irrigation system to the arid districts of eastern Sindh, southern KP, eastern Balochistan and southern Punjab, bringing at least five million new acres under cultivation for distribution to poor and landless farmers.

This would include the eastern districts of Sindh like Kashmore, Ghotki, Sukkur, Khairpur, Sanghar, Umerkot, Mirpurkhas, Tharparkar, Thatta and Badin; the southern Punjab with Pakpattan, Bahawalnagar, Bahawalpur, Muzzafargarh, Lodhran, Rajanpur, DG Khan, Layyah and Bhakkar; the eastern Balochistan with Barkhan, Kohlu, Dera Bugti, Naseerabad, Jafarabad, Jhal Magsi, and Khuzdar districts and the southern KP districts of DI Khan, Tank, Lakki Marwat and Karak.

3.1.3 Zoning for Improving Water and Crop Productivity

Pakistan's crop productivity per unit of water is very low at0.13 kg/m3[23]. Time is needed to bring about a more positive change to this. In certain instances, existing cropping patterns will have to be readjusted in line with changing water availability and emerging opportunities. Such changes have to take place in a programmed manner that takes cognizance of ground realities, population trends, market trends and trade opportunities. Irrigation water efficiency will have to be enhanced by improving the delivery systems, establishing benchmarks for minimum crop water requirements, rehabilitating

23 Tariq S, Water Productivity, presented in National Seminar on Integrated Water Resources Management, Islamabad, Dec 2005

traditional systems and adopting new conservation technologies (for example atmospheric moisture harvesting, rainwater harvesting, drip irrigation etc.) that help save water.

Zoning land according to water productivity and water/irrigation efficiency potential will be undertaken at both macro and micro levels. This framework will identify the yield gaps to be bridged in each zone, to ensure that optimal annual productivity of the systems bring marked improvements in the farming sector, while also conserving the basis of these improved yields.

We need to grow only those crops that need less water, discontinue or vastly reduce crops that require huge amounts of water (such as some variety of rice and sugar cane) and get growers to pay for water at higher rates for such crops. Once water is treated as a cost of production in the water economy, the market will adjust and cropping pattern will change.

Farmers are an integral part of participatory processes in management, planning and implementation of water distribution, collection of water rates and the management of tertiary irrigation systems.

A paradigm shift is required to recognize the role of the farmer (not absentee land owners) as fundamental in the irrigation and agricultural production process, and the cornerstone of the water economy.

Emphasis is required on protecting the livelihoods of small and tenant farmers, inland and coastal fishermen.

3.1.4 Allocating Water for the Expanding Urban Economy

With over 50 percent of Pakistan's population living in urban areas, and the proportion likely to grow, entitlement of urban areas for domestic, municipal and industrial uses cannot be pushed under the carpet in the current political rhetoric and must be tackled head-on. In principle every person moving to an urban area must bring his or her domestic water 'entitlement' with them as a right, and the water supply to the city adjusted accordingly[24]. Industries, trade and business, all require water over and above individual requirements, and these uses must be reasonably factored into the water quantum supplied to cities.

The water entitlement of each urban area will be determined and supplied by provincial governments from their share of water and municipal governments will manage this water under equitable systems and control of wastage, charging as per entitlement and use.

Water recycling, wastewater management, water treatment, water conservation, greening, water harvesting from rain and atmosphere and innovation will become realities in the cities and towns.

3.1.5 Allocating Water for Barani, Hard Rock and Desert Areas of Pakistan

Policy makers often forget the most difficult desert, hard rock, and barani areas, which receive sporadic rain and sometimes none in years. A large proportion of such areas lie in the Balochistan, Salt Range and the Potohar plateau.

These areas will have priority for groundwater development and use, but with licensing and control to prevent mining of aquifers. Innovative methods for obtaining water, based on the differences in day-time and night-time temperatures, harnessing flash floods and novel ways of harvesting water from the atmosphere will be developed for these areas.

3.2 Focus Area 2 - Financing the Water Economy and the Water Value Chain

Pakistan's water economy and its value chain needs to be protected so that the gains of proposed expansion of this economy, its water use efficiency and equitable sharing of benefits can be institutionalized. This also means consciously building better links among agriculture, pastoral outputs and industry, in ways that allows young farmers to stay on the land and

24 The WHO standard is between 50 and 100 litres of water per person per day.

keep producing, while maintaining an amenable lifestyle in rural areas.

3.2.1 Financing Maintenance, Repairs and New Infrastructure

The average cost of irrigation development in public schemes is an estimated US$ 1300/hectare, while the cost of drainage development is around US$ 2650/ha. The average cost of operation and maintenance (O&M) is US$ 65/ha per year. The average cost of sprinklers and micro-irrigation for on-farm installation is US$ 1500/ha and US$ 1750/ha respectively[25]. This requires stupendous amounts of money to keep our water infrastructure in working order and add to it as envisaged in the vision of this policy.

While this policy proposes that some of the cost of maintenance, repairs and new infrastructure is recovered through improved revenue streams and revised abiyana to reflect the real value of water, Pakistani banks will be persuaded to develop products to meet the gap in financing.

3.2.2 Financing Value Chain for Increasing Water Productivity to Maximize Returns to Farmers and Businesses Based on Agricultural and Pastoral Outputs

One of the goals of this policy is to achieve one billion dollar output for every MAF of water used in agriculture, fish-farming, livestock and related areas. This requires investment for on-farm improvements and better productivity as well as value-added businesses and industries from micro, through small and medium enterprises, to small and large industries, to release the potential of prosperity in all these sectors, targeting men and women, as well as young people.

Potential value chains based on the productivity of zones, as described in the section above, will form the bases of financing packages that commercial banks can be encouraged to develop. Not only will this boost economic opportunities for farmers and support rural-based businesses, it makes good financial sense for lending by banks.

Pakistani public and private sector banks and investment companies will be encouraged to lend for water value chains and help connect agricultural, fisheries and pastoral livelihoods with small, medium and large businesses.

3.2.3 Financing Hydropower Generation

In 2015, the total installed electricity generation capacity of Pakistan was 24,823 MW out of which the share of thermal plants was 16,814 MW followed by hydel power plants 7,116 MW, nuclear power plants 787 MW and wind power plants 106 MW[26]. It is one of the drawbacks of Pakistan that its power production is dominated by thermal power plants that run on oil and gas. Pakistan is heavily dependent on imports of oil and spent US $6572.68 million on import of 8.04 million tonnes of crude oil during the year 2013-14[27]. In addition, the total coal imported into the country during 2013-14 was 3.12 million tonnes that cost approximately US $310.72 million[28].

It is clear that at least for the next 10 years hydropower is the smartest and cheapest option for Pakistan, and hydropower schemes can be small and medium, as well as big, and the power generated can be put into the national grid immediately. This policy framework proposes 10,000 megawatts of hydroelectric power over the next 10 years, financed by the private sector.

Pakistani public and private sector banks will come forward to take up this winning proposition, and Pakistani businesses will get into this sector, where there is already an established market in place.

3.2.4 Building a National Investment Base for the Water Economy

This policy calls for reducing reliance on international donors and building a national investment

25 Accessed online http://www.fao.org/nr/water/aquastat/countries_regions/Profile_segments/PAK-IrrDr_eng.stm

26 State of Industry Report 2015, National Electric Power Regulation Authority, pp. 123

27 Ibid. pp. 77

28 Ibid. pp. 77

base where Pakistani banks, financial institutions and investors become the 'owners' and backers of water infrastructure, hydropower, agricultural development and the water value chain.

Pakistan will raise 'water bonds' and other financial instruments to fund the proposed rehabilitation, maintenance and repair of existing systems and new development on a fast track basis. Pakistani public and private sector banks, as well as investment houses, will become integral part of funding water infrastructure and water value chain.

3.3 Focus Area 3 - Safeguarding the Indus Basin and its Infrastructure

Pakistan has many wastage, drainage, pollution and distribution problems in the Indus basin. Since the 1970's Pakistan is experiencing an increase in floods, droughts and extreme weather events and now climate change is having a direct impact on its water resources and water availability. Pakistan must act now to safeguard the Indus basin and its infrastructure – the largest contiguous irrigation system in the world.

3.3.1 Ensuring Physical Sustainability and Integrity of Rivers, Water Bodies, Catchment Areas and Groundwater

The water sources, basins, catchments, groundwater and coastlines of Pakistan have to be secured and safeguarded from degradation, over-exploitation and destruction so they continue to be available for multiple and sustained uses and remain the backbone of Pakistan's economy and social well-being. This has to be the job of the federal government.

Unregulated groundwater development (tubewell installation) has led to mining of aquifers and adverse penetration of salt water into fresh water aquifers. It is essential to revisit the hydrology of both surface and groundwater systems of the Indus Basin to correct this imbalance.

In the barani areas, ground water regimes need to be restored through planned recharge and harvesting rain and flood waters by building small dams and other systems. The first right on groundwater should be for drinking, domestic and livelihood uses, and not for intensive commercial agriculture which is the case presently.

Practical steps will be designed for regulation of groundwater across Pakistan that are environmentally sound, socially acceptable, economically viable and legally enforceable.

Introduction of appropriate conservation methods (which may be different for different areas) will achieve salt balance in the Indus basin through a phased programme covering improved drainage and other measures.

Under integrated flood control and drought management, flood water will be added to Pakistan's water supply and will be stored in over ground and underground storage systems throughout the country like the aquifers, old river courses, lakes, storm water courses and terai areas.

All water initiatives will be carefully screened for their resilience to climate change and appropriate measures included to enable both mitigation and adaptation perspectives, as seen appropriate.

3.3.2 Protecting Indus Delta and Pakistan's Coastlines

One of the most devastating results of system inefficiency of the Indus waters has been the destruction of the Indus delta and Pakistan's coastlines. Although the Water Accord recognizes a fixed quantum of environmental flows, these are not released in a consistent way each year. The inconsistency is justified on the grounds that there is an 'average' over time, when flood flows 'even out' the dry years. Calculations of average will have to be changed from mean to mode (most frequently occurring) to determine water flows released to the sea.

This policy will ensure a regular, controlled minimum flow each year to the sea, to safeguard

delta areas and the coastline, to be guaranteed through strict regulation and implementation and a GIS based monitoring system.

3.3.3 Water Conservation

Water savings are a must for a more efficient use of water and its conservation and for realizing the national vision. Techniques that facilitate water harvesting at all levels will be encouraged to help preserve water during periods of high rainfall flow for use during lean periods.

Traditional water harvesting systems such as tonka system, Rod Kohi agriculture and Karez systems will be preserved as they help conserve water in dry lands and harsh ecologies.

Steps will be taken at all levels through widespread media campaigns and public private partnerships to raise awareness and implement water conservation through appropriate incentives and penalties. The greatest water savings will be targeted where there is greatest use – in agriculture.

3.3.4 Improving Surface Storage, Groundwater Storage and Inter-Seasonal Transfer Facility

The nature of surface water flows in the Indus system is highly variable with 75 to 80 percent of water being available in three months of the year and only a trickle in the remaining nine months of the year. Carryover capacity is almost nonexistent. Adequate facilities are, therefore, needed to store water to move it from one season to the other, and also to store water in water surplus years. Also, interface of groundwater and surface water needs to be seen as a basis for proposing new infrastructure in some parts of the Indus system. If surface water is seeping into the soil and maintaining vast quantities of groundwater, the need for surface storages has to be seen in that context.

Pakistan will enhance/create water storage facilities at different levels to capture the additional five MAF of water each year from its Indus River Basin system (starting in the seventh year of this policy) to meet irrigation and power needs and also to mitigate the negative impacts of floods and droughts. However, these will be undertaken after extensive environmental assessment to mitigate the impact on biodiversity and the environment, cost-benefit assessment of investment and after fixing the downstream distribution system to minimize losses. Pakistan will make necessary investment in downstream areas to prevent water losses in regions underlain with saline water, and tackle inefficiencies in the drainage system.

At the same time Pakistan will develop a serious and extensive plan to use local ponds, wetlands, lakes as aquifers as natural expanded storages under water stewardship concepts.

3.3.5 Strengthening National Security through Trans-boundary Cooperation on Shared Water Resources

Pakistan's national security is inextricably linked to its management of shared water resources with its neighboring countries. The Indus basin is shared between India, Afghanistan and China, with the bulk of the basin lying in Pakistan. Trans-boundary water bodies have the potential to be sources of conflict over competing scarce resources, but also of cooperation. The Indus Waters Treaty of 1960 is a testament to the potential of cooperation of trans-boundary waters.

This policy calls for a concerted effort to shift the paradigm of thinking about trans-boundary water resources management from competing for scarce resources to one of cooperation and benefit sharing. Pakistan needs to explore the potential of developing a treaty with Afghanistan to share the Kabul river. Pakistan should also explore cooperation with China on the Indus waters.

3.4 Focus Area 4 - Improving Water laws, institutions, Governance and Management

Pakistan has to demonstrate the political will to let Pakistan's water economy take its course

in building prosperity for all Pakistanis. In an environment where power is demonstrated by flouting rules, making people in power to act within the ambit of the law and take action for the benefit of the many (rather than the few) is a big challenge.

3.4.1 Improving Trust and Transparency in Interprovincial Water Sharing

In order to improve sharing of water resources and sharing the benefits of water resources, all the water sources available to a province must be taken into account. This will improve trust and transparency, and will also be fairer than before.

The existing surface water sharing formula will be applied in a spirit of goodwill each season, and monitored by an independent body, until such time that the provinces can sit down together to work out all water available (surface water, groundwater and precipitation) for all uses in each province and territory and determine the shares accordingly. This will be further broken down for establishing water allocations and rights at the district level.

3.4.2 Establishing Per-capita Water Entitlement, Water Rates and Water law

Drinking water, domestic water and sanitation are social entitlements of each Pakistani and each one must receive a fixed amount in this context. Beyond this entitlement, water rates need to reflect the value of the resource to users, provide incentives and bring about efficiency within the economy, and help protect the environment. Currently the common perception does not include awareness that irrigation water and water for other uses is being provided far below its economic value.

Per capita water entitlement will be fixed and used for calculating and supplying water for domestic use to rural areas, cities and towns. This means that everyone will get free water up to established entitlement[29]. For that over and above, people would have to pay.

Water rates will be evaluated in line with economic and social realities to bring them close to the "true" value of water. All explicit and implicit subsidies on water will be rationalized. Everyone who uses water will pay for it, just as they pay for electricity and gas. Once users pay for it, they will not waste it and also there will be money available for maintenance, repairs, improvements and conservation. Access and right to water for agricultural or other activities will be separated from ownership of land.

Pakistan will put into place a comprehensive set of water laws that define water rights, uses, value, conservation and principles of pricing, subsidies, licenses and polluter penalties.

3.4.3 Creating a Coalition of Stakeholders to Promote Citizens Social Responsibility on Water Issues

In today's world, water has become everyone's business. The sustenance and growth of Pakistan's political, economic and social agenda depends largely on whether water resources are managed equitably and fairly.

This policy calls for all key stakeholders – government, civil society, farmers, businesses and corporations, women's groups, youth groups, the marginalized, academia and media to be included in its management and inducted in the process of key policy decisions on water. Water related information and data must be shared with the public at large to build consensus, reduce polarization and increase awareness of citizens' responsibility in protecting the water resources.

3.5 Focus Area 5 - Building a Base for Science, Technology and the Social Aspects of Water

Linkages are essential between science, research and practice, and between the sociology and psychology of water use and water behavior to bring water studies into the modern era and prepare the water professionals of the future. The actions required under this policy framework mean capacity building and new skills across the board.

29 The WHO lower limit 50 litres of water per person per day

Pakistani universities will become the strongest link in developing the person-power and skill-base for propelling the vision of this policy framework, developing new courses and degrees to prepare thousands of men and women to serve in the water sectors, including planning with a very long-term perspective.

This policy will support universities and research institutions to develop interdisciplinary and multidisciplinary water studies in consonance with Pakistan's requirements and make strong linkages among the academia, the industries, agriculture and technologies across the water value chain.

This policy will also provide incentive for greater use of technology to bring efficiency and innovation to overcome water challenges.

4. Demonstrating Leadership

Decades of stalling over a national water policy, low levels of debate and discussion, politicization of whatever water discourse did take place and the low priority afforded to water issues within the government and in the country as a whole, has meant that difficult and uneasy decisions over water have not been taken judiciously and in a timely manner. Science, technology and policy need to work in tandem. This requires a strong political will, trained personnel with authority to take decision independently and adequate financial resources.

This policy calls for on the government to get serious, provide clear leadership and put up a well-resourced permanent water commission (that could be an empowered existing water institution or a new one) led by people of integrity and knowledge and which can deliver the intent of rational use of water in Pakistan.

4.1 Responsibilities for Action at Government Level

Implementation of this policy requires the following clearly defined actions at four levels:

- **Federal level:** Protecting the integrity of the Indus basin, all other basins and other water resources, building infrastructure, regulation, investment, financing mechanisms and conservation.
- **Provincial level:** Managing and maintaining infrastructure, running irrigation and drainage systems in a sustainable and equitable manner. This requires making the provincial Irrigation and Drainage Departments financially autonomous, and responsible for getting water to each district as per allocation.
- **City level:** Managing municipal and industrial water in sustainable and equitable manner.
- **Local level:** Managing local water, for all its uses, in sustainable and equitable manner. It is essential that a well-resourced, autonomous, empowered and functioning local government is in place to deliver the intent of this policy.

Drought Management and Arid Zones

Understanding Droughts, Early Warning Signs And Drought Resilience

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Drought Management and Arid Zones

Introduction

Drought is one of the most contested and insidious hazards of nature. It is commonly referred to as a "creeping phenomenon" and its impacts vary from region to region. In the naturalistic common parlance, drought is a natural but temporary imbalance of water availability consisting of a persistent lower-than-average precipitation, of uncertain frequency, duration and severity, resulting in diminished water resources availability and reduced carrying capacity of the ecosystems[1] . In this paper we review the interplay between natural and social systems that lead to drought in the Pakistani context; argue that drought is as much of a social, as it is a natural phenomenon, which varies in its manifestations from one geographical context to the other.

We start the narrative with a review of some definitional issues with regard to drought in section 2. As we review various definitions of drought, we propose some modifications in the standard definitions in the literature to fit them to the Pakistani context. Armed with a Pakistani specific understanding of drought we proceed to outline the institutional context within which drought hazard is being managed contemporaneously in Pakistan. The section 3 briefly reviews some of the key impacts of droughts as they have been experienced in Pakistan to lead into the main analytical section about drought early warning in section 4. In this section we leverage the global literature on drought early warning to argue that the technologically sophisticated remotely sensed drought early warning has to be combined with people based risk assessment and vernacular early warning systems to provide timely and actionable early warning to decision makers, and more importantly, populations exposed to drought hazard. We mainly argue in the conclusion that drought understanding, management and response is context-specific, and that global literature has to be enriched by local knowledge, and vice-versa, in order to mitigate vulnerability to this silent hazard.

1 Yevjevich V. et. al. Coping with Droughts, Water Resources Publications, Littleton, Colorado, 1983.

Some Definitional Issues

In the most general sense, drought originates from a deficiency of precipitation over an extended period of time - usually a season or more - resulting in a water shortage for some activity, group, or environmental sector. Its impacts result from the interplay between the natural event (less precipitation than expected) and the demand people place on water supply. In this paper, however, we do not just subscribe to a naturalistic understanding of drought. We are mindful that with changes in technology, e.g., human ability to extract water from different sources, as well as to make unprecedented demands upon water resources, droughts are increasingly more a function of societal manipulation of the hydrological regimes, and expectations from water than any failure of precipitation.

Wilhite and Glantz[2] define four different categories of drought: meteorological, hydrological, agricultural, and socioeconomic. The first three drought categories are largely based upon the physical aspects of the hydrologic system. The socioeconomic drought is, however, defined in terms of socially inflected supply and demand, thereby tracking the effects of water shortfall as it ripples through socioeconomic systems.

Meteorological drought is defined usually on the basis of the degree of dryness (in comparison to some "normal" or average amount) and the duration of the dry period. Definitions of meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

Agricultural drought refers to the differences between actual and potential evapotranspiration, soil water deficits and deficiencies in topsoil moisture at various stages of the germination process. Technically, agricultural drought can be measured by measuring deficiencies in plant water demand. However, in an operational sense, an agricultural drought can also be precipitated by lack of adequate food storage.

2 Wilhite, D. A. and Michael H.G. "Understanding the Drought Phenomenon: The Role of Definitions". Water International 10.3, 1985. pp: 111-120. Web.

Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (i.e., streamflow, reservoir and lake levels, groundwater). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Hydrological droughts occur when there is a marked depletion of surface water causing low stream flow and drying of lakes, reservoirs and rivers. It may also result in recession of spring flows and glaciers due to insufficient regeneration of seasonal snow cover. Hydrological droughts are usually out of phase with the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and groundwater and reservoir levels.

Socioeconomic definitions of drought associate the supply and demand of some economic good with elements of meteorological, hydrological, and agricultural drought. It differs from the aforementioned types of drought because its occurrence depends on the time and space processes of water supply and demand, and the human economic and social activities dependent thereupon.

The above four definitions make it clear that drought is a highly complex phenomenon that occurs on many different levels with wide-ranging impacts. However, there are issues regarding its definition, which we will seek to clarify in this paper, especially in the Pakistani context.

Definitional Geographies of Drought in Pakistan

Pakistan is a country with varying agro-climatic zones and the different regions of Pakistan experience droughts in very different ways.

For all intents and purposes, in this paper, we have divided the arid regions of Pakistan in the following four categories of irrigation practices:

- Canal irrigated plains
- Upland groundwater
- Spate irrigated areas
- Agro-pastoralist areas

Canal Irrigated Plains

In the global western literature, the stages of drought are defined as follows: meteorological→ agricultural→ hydrological→ socioeconomic.

However, this is not necessarily the case in the Pakistani context. In the canal irrigated plains, for instance, a meteorological drought is followed by a hydrological drought and not an agricultural drought. Despite low levels of rainfall, the supply of canal water from the rivers, and ground water storage in fresh groundwater zones, ensures that crops have their demand during the growth process. Thus there is no marked reduction in the final yield or output. However, if the meteorological drought persists, this necessarily impacts recharge of surface and groundwater supplies which results in a hydrological drought and ultimately leads to an agricultural drought.

Upland Groundwater

The upland groundwater zones are almost entirely dependent on groundwater supplies for their irrigation needs. Aquifer recharge is highly contingent on rainfall, precipitation and snowfall. In the upland groundwater areas of Pakistan (Zhob-Loralai, Pishin, Quetta, Swat, Chitral, Kohat, Waziristan and Gilgit-Baltistan districts etc.) agricultural droughts manifest themselves after meteorological droughts because the impacts of reduced precipitation are more immediately discernible. However, these agricultural droughts are temporary and can be managed by extracting groundwater to meet plant water demand. Upland groundwater dependent areas are worst affected by hydrological droughts.

Spate Irrigated Areas

The spate irrigated areas of Balochistan, Kacchi Sibbi plains and Kharan etc. are primarily dependent upon but also highly vulnerable to flash flooding. Meteorological droughts

translate almost immediately into agricultural droughts and consistent periods of meteorological droughts ultimately lead to hydrological droughts in these regions. Hydrological droughts undermine the local resource base and ultimately force the inhabitants to migrate.

Agro-Pastoralist Areas

Agro-pastoralism is predominantly found in the Tharparkar district, the Cholistan desert, Bahawalpur and the Nara areas. Rearing livestock and growing crops is the main source of livelihood in these areas. Meteorological droughts in these regions almost always lead to agricultural droughts. However, agricultural droughts occur more as a result of lack of water and food storages and not a result of climatic variability. An indicator of agricultural drought is reflected in the fall of meat prices. Producers store value in livestock including sheep, buffalo, camels, and goats. In good years, herds increase rapidly, with up to 200 percent annual returns in fast-reproducing species like goats and sheep. In times of distress, producers cut their losses through animal sales, thus averting disaster (Robbins, 1999). In arid regions, wild grasses are often planted alongside crop species. These wild species make excellent fodder, but more importantly, can be stored for up to a decade if carefully piled and stacked. With reserves in storage for ten years, producers are not forced to migrate with their animals with every bad rainfall period. Desert households usually keep one and sometimes two years of grain in storage against the possibility of total crop failure and use a variety of carefully adapted techniques to protect fodder and grain in the interim. When there is a lack of such storages, then an agricultural drought is set in motion exacerbated by the meteorological drought in play. However, it is important to note that meteorological drought in agro-pastoral areas does not always lead to a food crises because there are complex mediations of the socio-economic system that can blunt the impact of meteorological, hydrological and even agricultural drought, because of the highly mobile nature of the pastoral communities. Consequently, we would argue that the agro-pastoral communities, it is more the socio-economic changes that can be the trigger for drought like conditions in the production systems.

Keeping the above regional variation in the experience of drought in perspective we turn to the discussion to the institutional landscape and vulnerability in Pakistan. Vulnerability to drought depends on various factors. Understanding people's vulnerability to drought is complex yet essential for designing drought preparedness, mitigation, and relief policies and programs. At the micro level, determinants of vulnerability include: the physical asset base of the household—e.g. land, livestock, cash etc; the human capital like productive labor; the social capital with claims that can be made on other households within the community, perhaps for productive resources, food, or labor. All of these refer to the asset base of the household. Generally speaking, the stronger and more diverse the household's asset base, the more drought resilient it is likely to be, and the greater its options in terms of switching between different livelihood strategies in response to drought. Thus, the most impoverished communities are also usually the most vulnerable to drought, because they have fewer assets to buffer them.

Vulnerability to drought in Pakistan is further exacerbated and perpetuated by the complacency of the various institutions and actors responsible for assessing and implementing drought management policies. What happens as a result of a wide range of principal actors taking part in drought management is that every institution uses its own specific mechanisms and there is no integrated framework or mechanism in place for drought management[3]. Drought management in Pakistan is typically the responsibility of both the federal and provincial governments. Both have various short, medium and long term programs for drought management . However, to date, Pakistan has

3 Ahmad, S. et al. "Working Paper 85: Drought Mitigation in Pakistan: Current Status and Options for Future Strategies". International Water Management Institute. 2004. Web.

no integrated drought management programs or mechanisms.

At the federal level, the relevant institutions that play a major role in drought management and relief activities are the Planning Commission, Water and Power Development Authority (WAPDA), Ministry of Climate Change (MOCC), the National Health Emergency Preparedness and Response Network(NHPREN), Ministry of National Food Security & Research (MNFSR), National Disaster Management Authority(NDMA), Pakistan Agricultural Research Council (PARC), Pakistan Meteorological Department (PMD) and Space and Upper Atmosphere Research Commission (SUPARCO)[4].

At the provincial level, it is the Planning and Development, Food, Health, Livestock, Forest, Agriculture, Irrigation, Provincial Disaster Management Authority (PDMA), Provincial Nutrition Cell and the Revenue Department[5] that are activated. Moreover, to coordinate, monitor and implement the drought strategy at the provincial level, relief commissions have been established in each of the provinces. In addition to these, the provinces have their own mechanisms to strengthen the relief-support activities within provincial jurisdictions.

In addition, international agencies like the World Food Programme (WFP), United Nations Children's Fund (UNICEF), Food and Agriculture Organization (FAO), World Health Organization (WHO), United Nations Development Program (UNDP) and other international NGOs also play a minor role in drought management and drought preparedness policies and action. However, these international agencies lack the power to impact drought management directly, as they work under a restricted framework. They can render support only in terms of expertise or financial resources, but lack the social and political power necessary for implementing strategies. With no streamlined drought policy in place, the power play between different institutions further intensifies drought impacts which results in greater human suffering.

Drought Impacts and Response Strategies

Drought impacts are less obvious but spread over a large geographical area as compared to the damages that results from other natural hazards. Consequently drought affects more people than any other environmental hazard. According to the Economic Survey of Pakistan, drought is one of the most significant factors responsible for the less than anticipated growth performance of the country. The drought of 2014 wreaked havoc, especially impacting rain-fed and rangeland areas, and caused devastation and loss of human lives in semi-arid areas. Massive migration from rural to urban areas is also a common occurrence during times of drought. It has been observed that drought has a number of direct and indirect impacts on the people and economy of Pakistan. Some of the typical adverse effects of droughts are listed below[6]:

- Decreased income for farmers
- Reduced employment opportunities for agricultural labourers
- Reduced government revenues and foreign exchange earnings as a result of a decline in agricultural exports
- Increased prices of staple foods
- Increased inflation rate within the economy
- Inability of certain groups within the population to afford increased food prices
- Increased stress and deaths due to migration to better water sources
- Reduced food intake leading to nutritional deficiencies and reduction in the ability to resist infection
- Drying up of water resources leading to reduction in water quality
- Increase in time and distance to access and fetch water from nearby sources
- Increased competition for access to remaining water sources which lead to increase in instances of local disputes/conflicts
- Loss of livestock

4 Shariff, K. "Drought in Pakistan". 2015. Presentation.
5 Ibid.
6 Ministry of Finance, Economic Survey of Pakistan. Government of Pakistan, 2015. Print.

In general, there is a trend to reduce vulnerability and switch to alternate sources of food and incomes. There is also a tendency of the affected population to display behavior such as the ones listed below:

1. Switching to cheaper and less preferred foods
2. Reduction in overall food consumption, especially impacting women
3. Increase in loans in order to maintain food intake
4. Selling assets to raise funds for their sustenance
5. Engaging in alternative income earning activities
6. Migrating in search of employment opportunities
7. Migrating to a place where relief food is being distributed

The responses to drought in Pakistan can at best be defined as reactive, ad hoc and on an emergency basis. There is no clear plan or strategy in place to cope and mitigate drought-stress. It is thus imperative to devise strategies that may improve water use efficiency and enable vulnerable communities to better manage in a drought-stressed environment.

The first strategy includes managing and mitigating the impacts of drought by means of agronomic practices i.e. improved soil and water conservation practices that are commonly associated with plant production such as the tillage system, weed control, fertility management, optimized plant population, improved forage/ livestock/grains integration and rotation, avoidance of mono cropping and the diversification of farming[7].

Another strategy to mitigate the impacts of drought is to improve the "crop-drought tolerance" to manage drought stress. Ludlow, 1989 states that there are three aspects of crop-drought resistance: The first is drought escape which refers to the crop completing its life cycle before the onset of drought[8]. However, drought escape is usually associated with lower yields and biomass. The second aspect is the avoidance of drought where the crop maximizes its water intake and minimizes its water loss. Crops that have very deep roots are enabled to do so because they can tap into water reserves deep underground. The third aspect and perhaps the most relevant in the Pakistani context is drought-tolerance where the crop continues to grow despite reduced water inputs.

Studies have shown that the most important aspect of the impact of reduced moisture on crops is the stage of plant growth at which the stress occurs[9]. This is because the deficit of moisture to crops at different stages of germination inherently impact yield production. Sometimes water stress or reduced moisture during flowering stage results in greatest reduction of yield. On the other hand, yield production could be negatively impacted due to reduced moisture to crops during the vegetative stage. Earlier studies showed that the greatest reduction in yield occurred when stress was imposed at the flowering stage. That is, crops received inadequate water input during the flowering stage which resulted in low yield production. In their study, Mbagwu and Adesipe, 1987[10] observed that moisture stress during the pod filling stage resulted in more than 70 percent reduction in fruit yield of okra, while the lowest reduction in fruit yield was observed when moisture stress occurred during the vegetative stage. However, some later studies suggested that the flowering stage is more sensitive to stressful conditions[11] . Even later studies recommended that the selection of crop genotypes

7 Blum, A. "Drought Resistance, Water-Use Efficiency, And Yield Potential–Are They Compatible, Dissonant, Or Mutually Exclusive?" Aust. J. Agric. Res. 56.11, 2005. pp: 1159. Web.

8 Ludlow, M. M., "Strategies In Response To Water Stress". In Structural And Functional Responses To Environmental Stresses: Water Shortage. eds. Kreeb H.K., Richter H. and Hinkley T.M. The Hague, Netherlands: SPB Academic Press, 1989. pp: 269 - 281. Print.

9 Salter, P.J. and Goode, J.E. Crop Responses To Water At Different Stages Of Growth. Farnham Royal (Bucks.): Commonwealth Agricultural Bureaux, 1967. Print. pp: 246

10 Mbagwu, J.S.C. and Adesipe, F.A... Response of three okra (Abelmoschus esculentus L. Moench) cultivars to irrigation at specific growth stages. Scientia Horticult. 31, 1987. pp: 35-43. Print.

11 Bänziger, M. and Araus, J.L.. "Recent Advances In Breeding Maize For Drought And Salinity Stress Tolerance". Advances in Molecular Breeding Toward Drought and Salt Tolerant Crops, 1999. pp: 587-601. Web.

that have increased tolerance to midseason drought stress has been found to result in improved broad adaptation and specific adaptation to drought environments[12] . In the context of Pakistan, this means a careful selection of crops that have tolerance to drought and water-stressed conditions.

Drought by itself does not trigger an emergency. Whether it becomes an emergency or disaster depends on its impact on local communities and the environment. And that, in turn, depends on the vulnerability of people and the environment to such a "shock". Drought results in substantial impacts in both developing and developed countries, although the characteristics of these impacts differ considerably. The ability to cope with drought also varies considerably from country to country and from one region, community, or population group to another. Drought early warning systems become a necessary part of the drought mitigation and play a central role in drought preparedness and drought response. Which brings us to our next section in which we argue that a combination of technologically sophisticated remotely-sensed drought early warning has to be combined with people-based risk assessment and relevant vernacular early warning systems so that decision makers and vulnerable communities can take timely measures to assuage the immediate concerns.

Drought Early Warning Systems

Early warning is a major element of disaster risk reduction and disaster preparedness. Early warning can be defined as a process of monitoring certain indicators (economic, climatic etc.) which assist in determining a future event and thus help in raising awareness and caution of the impending threat ahead of its occurrence. In essence, the warning should trigger timely and appropriate measures. The formal UN definition describes the term early warning as: "The provision of timely and effective information, through identifying institutions, that allow individuals exposed to hazard to take action to avoid or reduce their risk and prepare for effective response"[13].

The UN Inter-Agency Secretariat of the International Strategy for Disaster Reduction (UN/ISDR) has identified four key elements of an early warning system, namely risk knowledge, monitoring and warning service, dissemination and communication and response capability[14]. These four elements have been described in detail below:

1. **Risk Knowledge -** Prior knowledge of the risks faced by communities: It means that the vulnerable communities have to be aware of the existence of the risk, which is not always given for drought in the Pakistani context. Risks arise from both the hazards and the vulnerabilities that are present. Risk assessments are necessary to gain knowledge of the geography of the risk distribution. Risk assessment could be based on historic experience and human, social, economic, and environmental vulnerabilities. Such prior risk assessment if ever done in Pakistan is largely focused on the physical parameters and rarely addresses social vulnerability profiles. Those vulnerability profiles, for example, could be best collected by the provincial revenue department which has the most presence and knowledge of the local conditions.

2. **Technical monitoring** and warning service for the risks: There is a need to develop a sound scientific basis that will enable one to predict the impending risks that will be faced by the vulnerable communities. Therefore it is necessary to devise mechanisms that will allow for constant monitoring of possible disaster signs in order to create accurate warning systems in an efficient and appropriate manner.

12 Chapman, et. al, " Genotype by environment effects and selection for drought tolerance in tropical maize. II. Three mode pattern analysis." Euphytica 95, 1997. pp:11-20. Print.

13 UNISDR, Developing Early Warning Systems: A Checklist. Third International Conference on Early Warning. 2006. Web.

14 UNISDR, Developing Early Warning Systems: A Checklist. Third International Conference on Early Warning. 2006. Web

3. **Dissemination** and communication of understandable warnings to those at risk: The ultimate objective of early warning systems is that the warning should reach the vulnerable communities in time. Additionally, the vulnerable and at-risk communities should understand the warnings so that they are able to take timely action to protect themselves. Therefore, the warnings need to contain useful and relevant information that will perpetuate appropriate responses and actions. For this reason, proper communication channels need to be identified and it is necessary to be able to synthesize multiple sources of warning at the local level. The key point being that the best and most accurate warning in the world is useless if it is not credible, understandable or timely.

4. **Response capability -** knowledge and preparedness to act: It is imperative that vulnerable communities understand their risks. It is also important for vulnerable to communities to respect the warning services provided and thus respond to the warning signs by taking mitigating actions. To develop the response capability of vulnerable communities, it is necessary to include participation of formal and informal education sectors as well as to address the broader concepts of risk and vulnerability.

In general, disaster risk reduction is aimed at motivating societies at risk to become engaged in the proactive management of risk and the conscious reduction of vulnerability. The objective of an early warning system is not just to issue accurate and timely warning signs, rather the primary objective is to save lives and property from disasters.[15] While determining the need to warn and consequently issuance of warnings is a very important component of an early warning system, effective early warning systems must focus on perpetuating early action.[16] However, In the case of the drought early warning in Pakistan, the focus is on scientific prediction and then accuracy of that warning, i.e., emphasis is laid on technical monitoring and warning service for the risks instead of a focus on timeliness and actionable warning, as we discuss below.

15 "Smallholder Livestock Development." Weblog, The International Fund for Agricultural Development (IFAD) Web.
16 Ibid.

Drought Early Warning Systems in Pakistan

The worst drought to hit Pakistan was during the period 1999-2001. Following that, the Pakistan Meteorological Department took an initiative to establish the National Drought/Environment Monitoring and Early Warning Centre (NDMC) in 2004-05. The primary objective of the centre is to monitor the drought conditions in the country and issue warnings ahead of time. The NDMC has one national center located in Islamabad and four regional drought monitoring centers that are based in Lahore, Karachi, Peshawar and Quetta[17]. These centers are pivots and serve as focal points for the monitoring, collection, collation and analysis of drought-related data from all possible sources across the country. In order to strengthen the network and increase its efficacy, in recent times the NDMC has installed 50 automatic weather stations in different drought prone regions across the country as well as install 335 ordinary rain gauges at district levels in the four provinces[18]. (see figure 1). Through these weather stations, the data of eleven meteorological parameters namely air temperature, humidity, wind speed, wind direction, dew levels, sea level pressure, station level pressure, solar radiations, soil moisture and snow levels are transmitted every three hours through satellite and GPRS technology[19].

The NDMC uses different indices to measure drought conditions and rainfall. These include indices such as standard precipitation index (SPI), normalized difference vegetation index (NDVI), cumulative precipitation anomaly (CPA), rainfall anomaly index (RAI), percent of normal, probability of occurrence, percentage departure and soil moisture analysis etc[20].

17 "Pakistan Drought Bulletin December", Pakistan Meteorological Department. 2015. Web
18 Ibid.
19 Ibid.
20 Ibid.

The standardized precipitation index (SPI) was developed with the objective of defining and monitoring drought (McKee et. al, 1993) but it is not a drought prediction tool. It is used to analyse accumulated precipitation or historical rainfall data of a given weather station over a fixed given period of time to determine the probability of rainfall and assess whether rainfall in the given location will be more or less than the historic average[21].

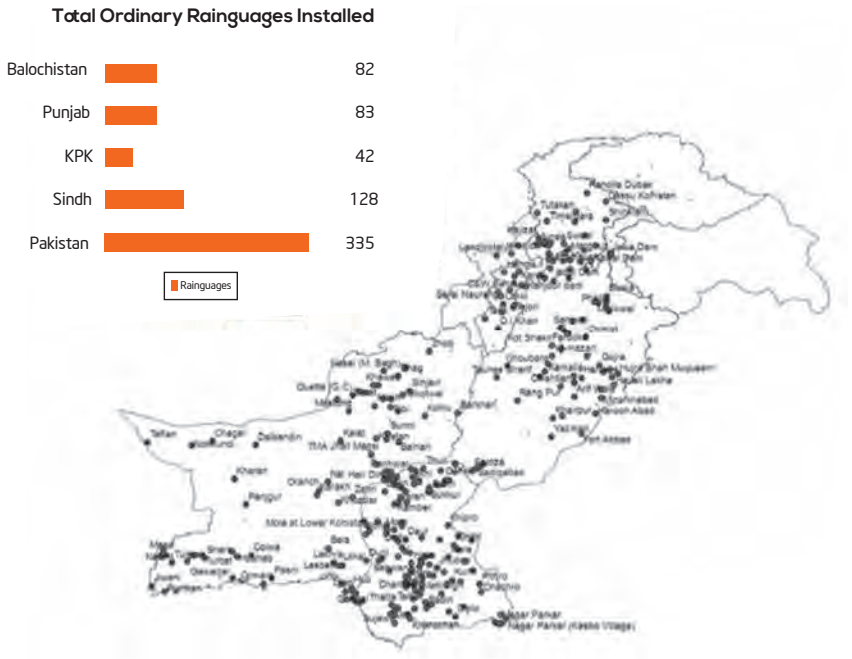

Figure 1: Rain gauges in Pakistan conveying data to N & RDMCs . Source: Pakistan Drought Bulletin, 2015[22]

The cumulative precipitation anomaly (CPA) is used to evaluate the progressive correlation of rainfall with surface and ground water reserves. It is an important hydrologic measure to determine both abundant or meagre rainfall, and its consequent effect on the hydrology of a given location over a given period of time[23].

The soil moisture anomaly (SMA) index measures drought on the basis of water supply and demand and, crop moisture instead of precipitation or levels of rainfall. Emphasis is laid on soil moisture differences and deficiencies. The SMA index analyses four aspects of water balance, namely evapotranspiration, runoff, soil recharge and crop moisture[24].

Measuring the water level of reservoirs is another method used to determine drought in Pakistan. Pakistan has two main storage reservoirs for water – the Tarbela and the Mangla dams. The dead level of Tarbela is 1,378 feet and its maximum conservation level is 1,550 feet. The dead level of Mangla is 1,040 feet while its maximum conservation level is 1,242 feet. During periods of good monsoon rains, the reservoirs are filled to their technical capacity when possible[25].

The percent of normal is one of the simplest measurements to determine rainfall for a specific location. It is calculated by dividing actual precipitation at a given region by the normal precipitation – usually determined to be the average of a 30 year period -- and then multiplying the result by 100. However, the percent of normal method is a simplistic measure of rainfall and does not give the most accurate results[26].

As can be seen from the different measures of drought illustrated above, it is critical that numerous and varied natural indicators of drought should be monitored frequently and regularly to determine the onset and end of drought and to assess its spatial variability. The severity of the drought should also be monitored and evaluated continuously and regularly over a fixed time period. Even though droughts originate from a deficiency of precipitation, this measure alone cannot determine the severity

21 Accessed online at: http://drought.unl.edu/portals/0/docs/spi-program-alternative-method.pdf
22 Ibid.
23 Weber, K and Stewart, M. "A Critical Analysis Of The Rainfall Departure Concept". Ground Water 42.6-7, 2004. pp: 935 - 938. Web.
24 Zargar, A et. al, "A Review of Drought Indices". Environ Review 19. 2011. pp: 333-349 Web.
25 "Pakistan Drought Bulletin December", Pakistan Meteorological Department. 2015. Web.
26 Accessed Online at: http://drought.unl.edu/Planning/Monitoring/ComparisonofIndicesIntro/PercentofNormal.aspx

of the drought and its associated risks. It is important that effective drought early warning systems should include and incorporate precipitation data with other data such as streamflow, snowpack, groundwater levels, reservoir and lake levels and soil moisture conditions.

Effective drought early warning systems must integrate various physical, natural and social indicators. Pulwarty and Verdin, 2013 state that assessments of drought early warning and information systems illustrate that the most successful early warning systems include the following components: (1) integrate social vulnerability indicators with physical variables across timescales; (2) embrace risk communication as an interactive social process and; (3) support governance of a collaborative framework for early warning across spatial scales[27].

Indigenous Early Warning Systems

Indigenous communities have developed their own parameters for determining early warning signs. Indigenous indicators in Tharparkar embrace parameters such as the rolling out of sparrows in the sand to predict good quality rain. Another such indigenous indicator is that when migratory birds/Siberian birds fly back home during the April/May season on a lower altitude, good quality rain in higher frequency is expected.

Similarly, other examples of indigenous early warning signs from around the world include practices from Swaziland; where drought and occasional floods are common disasters. In Swaziland, indigenous communities determine the onset of floods by measuring the height of the nests of the emahlokohloko bird (Ploceus spp.) on trees growing by the river banks. When the incidence of floods is high, then the nests are also very high. Conversely, if there is low likelihood for floods to occur, the nests of the birds are lower down[28]. The indigenous Swazis also use the sounds of certain birds to predict rain, and monitor the yields of certain wild fruit plants to predict famine. Other indigenous methods used by the Swazis to predict natural hazards include assessing the direction of the wind, and looking at the shape of the moon. They also monitor the behavior of certain animals to predict droughts and floods. In Tanzania for instance, animals feature prominently in the predictions of drought and famine. For example, by reading signs on goat intestines, specialized Maasai elders can deduce drought and predict the onset of famine or disease[29].

For the agro-pastoralist communities of Pakistan, there are common economic conditions surrounding drought that transcend national and cultural differences. In the early stages of drought, the terms of trade turn against producers: the price of essential grains rises and the sale value of livestock falls. During this time, herders may have to sell classes of animals such as pregnant females that would not normally be put up for sale, in order to meet short-term food security needs. When the rainfall levels rise again and the pastoralists try to restock, the price of domestic stock goes up again. But, with limited capital, many producers are unable to restock to sufficient levels and thus they remain vulnerable to the next climatic hazard. Therefore the price of livestock in agro-pastoralist zones is perhaps the best local indicator of the drought onset in Pakistan.

Drought Contingency Planning and Mitigation in Pakistan

Traditional risk management strategies have proven effective in managing drought and have enabled pastoral societies to survive in harsh environments for years. In Pakistan too, agro-pastoralist societies have developed their own strategies for coping with the harsh conditions of drought. These include[30]:

27 Pulwarty, R. and Verdin, J. "Crafting Early Warning Information Systems: The Case of Drought". In: Birkmann, J. (Ed.), Measuring Vulnerability to Natural Hazards: Towards Disaster Resilient Societies, 2nd ed. United Nations University Press, 2013. pp: 124–147. Print.

28 Indigenous Disaster Early Warning Preparedness. UNEP, 2016. Web.

29 Ibid.

30 Shafiq, M and Kakar, M.A. "Effects of Drought on Livestock Sector In Balochistan Province Of Pakistan". International Journal of Agriculture and Biology 9.4, 2007. pp: 657 - 665. Web.

- Mobile and temporary grazing practices that reduce the risks of having insufficient grazing land limited to one location.
- Mutual grazing arrangements with distant communities that enable vulnerable populations to access their resources during drought years.
- Adjustment of flock sizes and stocking rates as the rainy season approaches, to match available grazing resources.
- Herding extra animals that can be easily liquidated in a drought, either for food or cash.
- Investing in water availability and water storages such as wells, cisterns, and water harvesting to cope with drought conditions
- Diversification into crops and livestock (agro-pastoralism), storage of surplus grain, straw and fodder as a reserve in good rainfall years.
- Diversification among animal species (sheep, goats, cattle, camels, donkeys) and different breeds within species.
- Income diversification into non-agricultural occupations, particularly seasonal migration for off-farm employment such as labourers etc.

But despite their advantages, traditional drought management strategies can have associated negative externalities. Therefore, to ensure the successful implementation of an integrated national drought monitoring and forecasting system, partnering with local communities on drought management is absolutely necessary and involving them at all stages in mitigation of drought impacts is vital in order to create a hybrid of scientifically advanced practices which are effective and relevant yet rooted in tradition.

The key message of this section is that in Pakistan the focus of formal drought warning is on data collection, analysis and then conveyance of drought warning to formal institutions with little regard to regional and local variations, vulnerability profiles, tailoring of the risk message to make it understandable or any understanding of the local communities' capacity to respond. Engaging in a dialogue with vulnerable communities may not be in the ethos of the formal state institutions. For the drought early warning to be effective, it is imperative that it is understandable, credible and hence actionable. Without those components all the science in the world that may go into to making the most accurate models for drought early warning is likely to be useless.

Conclusion - Way Forward

The first message of this paper is that drought in Pakistan has strong regional variations, which deviate considerably from the standard drought progression outlined in the international literature. In the canal colonies the meteorological drought is mediated by the highly manipulated hydrology of the Indus basin. Therefore, there is rarely a straight forward progression from meteorological drought to agricultural and then hydrological drought. Instead system management can cause an agricultural and even a socio-economic drought without there being any meteorological drought. In highland groundwater based systems, excessive groundwater pumping can mimic hydrological drought without there being a meteorological drought. In fact, if anything, that makes the communities more susceptible to turning a meteorological drought into a hydrological one. In the flood irrigation zones, there is a direct linkage between meteorological and agricultural drought. In agro-pastoral zones again, the classic progression from meteorological to agricultural to hydrological holds, but that too is again mediated by indigenous communities' coping strategies which are in desperate need of enhancement by the state and non-state actors.

The second and critical message of this report is to focus on drought early warning. Good early warning must have the component of risk knowledge, i.e., the vulnerable communities as well as the decision makers are aware of the existence of the hazard. Risk assessment is key to that, something that is done to a limited extent for physical risk but not for the social vulnerability profiles of at risk communities. A good early warning system must have

the technical capability to address the physical processes that may cause extreme events. Pakistan seems to have a moderate capacity in that. In fact, that is the only thing that it has any capacity in. Early warning systems must also be able to disseminate warning to at risk communities, and that warning message should be timely, understandable and credible. Pakistani early warning system is seriously lacking on this count, partially because the formal institutions simply do not have participatory ethos required to fulfill this condition.

And lastly, an early warning system must have the component of building the capacity of the vulnerable communities to respond to the threat. Failing that, the warning message should include information on what to do, which should be commensurate with the capacity of the vulnerable populations to respond. Here again the Pakistani early warning system is largely useless for reasons discussed in this paper.

Since the times of the Mughals one of the main government institutions engaged with drought management was the revenue department. More recently because of the scienticization of drought early warning and management the institution has become irrelevant to the enterprise. It would be very useful if the revenue departments' presence at the local scale was leveraged to undertake necessary data collection for risk and vulnerability assessment and it is made a conduit for undertaking the type of participatory interventions alluded to in this report. It is true that the revenue department like most Pakistan government departments has an imperial ethos of separation from the people, but every couple of hundred years institutions do become ripe for transformation, course correction and mission redefinition. Drought could be a conduit for precisely such a reinvention of the provincial revenue departments.

It is essential that formal institutions and civil society get into the habit of meaningfully engaging with the indigenous communities, not only to understand their coping mechanisms, but also to understand their vulnerabilities so as to design more effective warning systems. This paper is not meant to be exhaustive, but rather to be exploratory. It points to specific issues of drought definition and progression by region and then shortcomings in the early warning system that must be addressed. Hopefully this paper can be a cause for initiating a debate in Pakistan on how to address the deficiencies pointed here. The country owes at least that much to the poor and vulnerable of Pakistan.

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The Great Betrayal:

Unfulfilled Promise of the Water Economy

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Since 1947 Pakistan's policy makers have been on a twin quest for national security and national prosperity encompassing foreign and economic policy. Securing Pakistan against a very large hostile neighbour and ensuring a reasonable level of prosperity for the teeming millions in a poverty-ridden Pakistan has been the perennial narrative of our establishment and political elites. The former colonial power Britain, had for long, eyed Pakistan as a lynch-pin state in the critical Muslim countries of the Middle East. A report prepared for British Prime Minister Clement Richard Attlee (1945-1951) on the eve of Independence stated that:

> The Indus valley, Western Punjab and Balochistan are vital to any strategic plans for the defense of the all-important Muslim belt..... the oil supplies of the Middle East. If one looks upon this area as a strategic wall, the five most important bricks in the wall are Turkey, Iran, Iraq, Afghanistan and Pakistan..... If the British Commonwealth and the United States of America are to be in a position to defend their vital interests in the Middle East, then the best and most stable area from which to conduct this defense is from Pakistan territory.... Pakistan is the keystone of the strategic arch of the wide and vulnerable waters of the Indian ocean.[1]

Therefore, it was no surprise when Pakistan became the most allied of all allies of the United States through membership in The Southeast Asia Treaty Organization (SEATO) and the Central Treaty Organization (CENTO) alliance. As part of allaying itself and casting its lot with the west, Pakistan was destined to be the first Korea of the fifties and the sixties, simultaneously achieving both national security and national prosperity. The Harvard group was sitting in Pakistan's Planning Commission and devising its economic strategy around the twin pillars of agriculture and industrialization. This was critical as without the underpinning of a strong economy the role as a keystone front-line state was not possible. So while the west could finance the building up of the military might of Pakistan, sustaining it and ushering in prosperity for the people required a rapidly growing economy.

Initially, the model worked well and Pakistan was able to build a strong army, coupled with a fast growing economy. Further, Pakistan also became a role model for western-oriented countries. In the agricultural sector particularly, it had spectacular success; it was able to conclude the Indus Basin Water Treaty with India, build two large dams, that provided critical water storage capacity for its farm lands, expand its irrigation networks to new virgin lands, establish world class networks of outstanding agricultural research institutions and usher in a Green Revolution. Furthermore, the dams provided the dividend of cheap hydropower for industrialization.

The unraveling of the economic miracle started with the ill-advised 1965 war with India that ultimately led to the breakup of Pakistan in 1971. Post breakup, the economic policy was turned upside down with nationalization of many private banks and industries created earlier. However, worst of all, the water economy that had performed so well in the past came to a screeching halt. The consensus on water projects broke down and Kalabagh dam that was to be built after the completion of Tarbela dam in 1976, became politicized and subsequently three provincial assemblies voted against its construction.

Since then Pakistan has gone through many changes - it has gone from sanctions imposed by its allies after the defeat of the Soviet Union, to 9/11 and becoming a non-North Atlantic Alliance (NATO) military ally, to the current launching of the China Pakistan Economic Corridor (CPEC). It has experimented with nationalization, denationalization, privatization,

1 Sarila, N.S. "The Shadow of the Great Game. The untold story of India's Partition" 2005

liberalization and deregulation. It has tried dictatorship followed by democracy, followed by martial law and democracy again. And it has also gone from a planned capitalism, to crony socialism to crony capitalism and Islamization without much success.

During these forty years of monumental change, one thing that it has steadfastly not tried is to restart the water economy that had derailed since 1976. This refusal has now come home to roost. The economy has run out of steam and in the process accumulated trillions in public debt including US$ 70 billion in external debt. Pakistan has gone through several IMF programs and structural reforms but nothing seems to work on a sustainable basis. The mammoth scale of its people's deprivation has been deeply entrenched and if the remittance boom in Pakistan had not occurred, the country's poverty and hunger levels would have been far graver. With hindsight, it is evident that the leadership that has been instrumental in depriving its people from fully utilizing their water resources has also condemned them to a life of poverty and hunger. These leaders have been guilty of a major criminal breach of trust with the people of Pakistan.

The International Fund for Agriculture Development relays an apt description of Pakistan's rural poverty situation on its website as follows:

> Pakistan ranks 146th out of 187 countries on the United Nations Development Programme's 2013 Human Development Index – a comparative measure of life expectancy, literacy, education and standards of living for countries worldwide. And poverty in Pakistan is predominantly a rural problem. While rural people make up two-thirds of the population, they account for 80 percent of the country's poor people. Agriculture is at the heart of the rural economy and accounts for roughly one-fifth of the economy. Most of the land is arid, semi-arid or rugged, and not easily cultivated. Water resources are scarce in most of the country, and finding water for irrigation is a critical challenge for the agriculture sector – particularly in remote areas.[2]

Land, water and geography form the natural endowment and entitlement of the people of Pakistan. This endowment is Pakistan's main advantage and provides a very large segment of the population with livelihood opportunities. The water resource comprises the Indus river and its tributaries that on an average brings down to the plains about 154 million acre feet (MAF) of water annually. Groundwater adds another 55 MAF[3]. Pakistan's total land area is around 196 million acres out of which 77 million acres are suitable for agriculture with only 55 million acres having access to irrigation[4]. There is a potential of bringing 22 million acres of additional land under irrigation by extending the Indus basin irrigation networks to the arid areas of Pakistan; mostly in eastern Sindh, southern Punjab, southern KP and eastern Balochistan.

The water infrastructure currently manages the approximately 200 MAF of surface and ground water, but a large proportion is lost before reaching the farm gate. At the farm gate, water availability is estimated to be around 100 MAF irrigating around 50 million acres of land (two feet per acre). That provides us with an annual agricultural GDP of around US$ 50 billion or US$ 500 million output for every MAF of water. The canal irrigation water efficiency is around 33 percent i.e., out of around 150 MAF of river flow only about 50 MAF reaches the farm gate. In comparison, advanced countries have achieved efficiency levels exceeding

2 http://www.ruralpovertyportal.org/country/home/tags/pakistan
3 The Pakistan Water Situational Analysis, the World Commission on Dams – Consultative Process in Pakistan (WCD CPP) Project, IUCN, pp 1
4 Issues of Water Resources in Pakistan. Briefing Paper No. 7 for Pakistani Parliamentarians. PILDAT. 2003. pp 11

90 percent. Furthermore the potential hydel energy generation capacity embedded in the Indus river gradient amounts to around 59,000 MW of which Pakistan has exploited only 6500 MW[5]. For a country that is enmeshed in an energy crisis of shortages and high cost thermal power not exploiting the green hydel power potential makes no economic sense.

From a national security point of view a buoyant and growing economy is the underpinning for an effective defense posture. Sri Mulyani Indrawati vice president for South Asia at the World Bank in a recent speech at the Higher Education Commission, in Islamabad, said:

> For the past two decades, Pakistan's growth rate has been half of India and China. If current trends continue by 2050, India's economy will be 40 times larger than Pakistan's [6]

Clearly if these trends continue Pakistan can kiss national security good bye.

Pakistan's economy is a 'water economy'. A large part of the off-farm output is directly or indirectly connected to agriculture. Pakistan's exports are also largely related to the agricultural output. In addition, rising rural incomes generate a huge consumer market for urban manufacturing and employment. Thus agriculture plays the role of engine of growth for the economy. Therefore, it must build upon and expand the water 'value chain'. If Pakistan, with a population of 200 million people with 60 percent under the age of 25, has to achieve accelerated economic growth to create millions of new employment opportunities for the youth bulge, there is no better option than to fully utilize its water, land and people resources.

David Grey the eminent water expert, at the Oxford University states:

> Almost all developed countries have followed a broadly similar path of early and extensive investment in water resources institutions and infrastructure to achieve water security and underpin growth -- There will of course be other reasons why societies are poor or rich, but we postulate that the significance of water investment is considerable – and little recognized[7]

If the Indus basin had been located in the developed part of the world its infrastructure would have been 100 percent installed and its full agriculture and hydro power potential would have long been exploited. In USA, Europe, Australia and Japan, water development has been the major catalyst for economic growth in the early years of their growth strategies. The surpluses created in agriculture fueled the rapid economic growth of these countries. The epic Tennessee Valley Authority in USA pulled the entire South East region of the USA out of poverty and backwardness.

In arid Australia, the Murray-Darling river system shared by several provinces contributes hugely to the economy of south-east Australia. This region's farmers are able to extract around US$ two billion from every MAF of irrigation water through agriculture output of high value added crops, employing modern on-farm management, technology and water management. The storage capacity on the rivers exceeds 900 days of flow. Every drop of water is effectively used. If Pakistan could generate even a billion dollar for every one MAF of Indus water, it could have had agriculture GDP of US$ 200 billion versus the current US$ 50 billion. The multiplier impact on the rest of the off farm urban economy is four to five times. This clearly indicates that to propel Pakistan on to a high economic

5 Hydel Potential in Pakistan, Ministry of Water and Power, GoP, 2013 http://www.nepra.org.pk/Policies/Hydel%20Potential%20in%20Pakistan.pdf

6 http://www.pakistantoday.com.pk/2016/07/03/comment/economic-governance-under-pml-n/

7 Water for Growth and Development. A theme document of the 4th World Water Forum. World Bank. Pp 11. http://siteresources.worldbank.org/INTWRD/Resources/FINAL_0601_SUBMITTED_Water_for_Growth_and_Development.pdf

growth path, it has to invest in the entire water value chain from water storage, water distribution, water use efficiency, modern farm management, modern seeds, modern inputs and modern agriculture markets.

Since the last major storage was built at Tarbela in the mid-seventies, Pakistan's water vision has stalled. The institutions that built the storages and associated paraphernalia have fallen into disrepair. The existing infrastructure has deteriorated. Neglect of the last forty years has imposed a huge opportunity cost on Pakistan. In agriculture alone without taking off-farm impacts into consideration my estimate is that the country has conservatively lost more than US$ 1000 billion dollars of output over these years. Compared to its current foreign indebtedness of US$ 70 billion, this amount is a staggering number.

In addition non-development of low-cost hydel power generation has plunged Pakistan into an economic crisis over the last decade. The direct loss to the economy has been around two to three percent of the GDP per year. Conservatively speaking 80,000 MW capacity on the Indus could have generated 240 billion units of power per year valued at US $24 billion annually based on current costs of alternate power sources. This cheap power would have been the main competitive advantage for Pakistan's industry to compete in global markets. The multiplier effect on the rest of the economy needless to say, would have been manifold. The country has inflicted such huge volume of poverty , damage and vulnerability on itself that no enemy could have successfully inflicted the same.

In 2002, General Pervez Musharaf initiated a major Rainee Canal irrigation project designed to bring water to the water starved districts of Sindh. Eastern Sindh represents the backward part of Sindh. From Kashmore to Mithi, eastern Sindh has almost 60 percent of the land mass of Sindh. It has almost 40 percent of the population of rural Sindh, but comparatively has a much larger share of poverty, unemployment, stunted children and malnutrition. Its backwardness is rooted in the fact that it is the most water-starved area of Sindh, encompassing districts of Kashmore, Ghotki, Sukkur, Sanghar, Khairpur, Umerkot, Mirpurkhas, Tharparkar, Badin and Thatta. It has around sixteen members of parliament who have never bothered to speak about the deprivation of their area. Due to eastern Sindh's deprivation, the urban rural economic divide in Sindh is growing and rural poverty is rapidly expanding.

There is no doubt that eastern Sindh is rapidly falling behind. Lack of water resources is spreading rural poverty; landless hari's lack the means of survival; youth unemployment is increasing and despondency is increasing with no hope in sight. The rural GDP is stagnating, industrial development is lagging and investment is shrinking. Millions of acres of state land could have been developed and allocated to the haris but ruling classes of Sindh want to appropriate water resources and state land for themselves representing a clear conflict of interest.

In short, eastern Sindh is experiencing the worst declines in average per capita income since long. Over 50 percent of the population lives below the poverty line. This combination of low per capita incomes, low calorie intake, as well as unemployment, inadequate access to education, sanitation, health facilities, an unhygienic environment, and insecure access to productive land and water resources represents an explosive mixture.

Recognizing the situation, the Rainee and Thar canal projects were initiated in eastern Sindh. The idea was to bring water from the Indus river to the arid districts of Sindh and thus lay the foundations of sustained growth in this vital region of Pakistan. In the first phase the project was to irrigate around 113,000 acres of new land in district Ghotki; in the second it was supposed to irrigate almost 300,000 acres in Ghotki, Sukkur and Khairpur districts. In the third and final phase the canals were to be extended to Thar. However, before these life-sustaining major irrigation projects could be fully completed General Musharraf was removed from

power in 2008. The status update on the project from the Water and Power Development Authority (WAPDA) reveals the following:

Status:

- Phase-I of Rainee canal from RD 0+000 to 363+000 has been completed along with its distribution system
- Phase-II of Rainee canal from RD 363+000 to 556+000 has yet to commence based on when concurrence from the Government of Sindh (GoS) is received.
- The proposed Thar canal as shown in the map with the dotted blue line which will off take from Rainee canal RD 181+000 will be constructed after completion of the feasibility study. The concurrence of GoS is still awaited before a feasibility study of Thar canal can be undertaken by WAPDA.
- GoS has been approached for taking over of the completed Phase-I of Rainee canal project for operation and maintenance and which is still in the process.

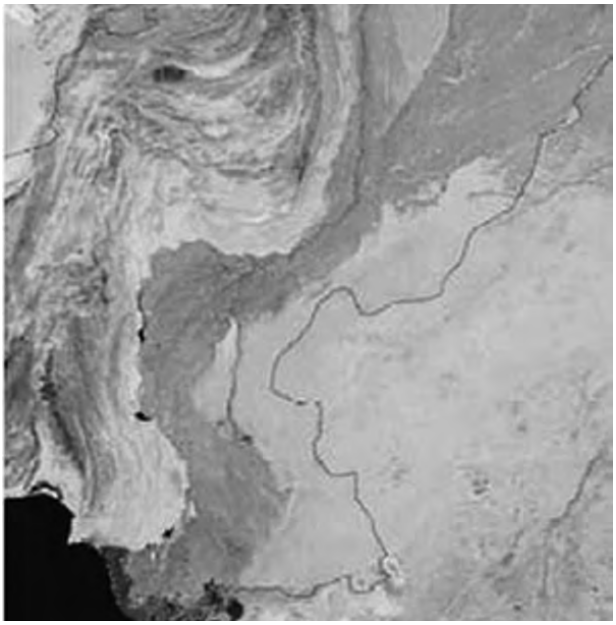
The Pakistan People Party led government came into power both at the federal and the provincial levels after the 2008 elections. Khursheed Ahmed Shah, the leader of the opposition who belongs to Sukkur division in the parliament and Qaim Ali Shah from Khairpur division was the chief minister of Sindh from 2008 to 2016. Sadly, and for inexplicable reasons, the projects that benefited Sindh and their own constituencies have been left incomplete. The promise of development has been snatched away from the people and since then thousands more, especially children have died in eastern Sindh due to poverty and malnutrition and nobody has been held accountable for this deliberate lapse.

This project depicts the apathy, callousness and deep vested interests at play in the development of the water sector of Pakistan.

The satellite map of Pakistan clearly shows the water-rich and water-starved areas of Pakistan. The water deprived areas of eastern Sindh, southern Punjab, southern KP and eastern Balochistan are clearly visible.

The eastern Sindh districts that may benefit from getting a share of the Indus water include the districts of Kashmore, Ghotki, Sukkur, Khairpur, Sanghar, Umerkot, Mirpurkhas, Tharparkar, Thatta and Badin. In southern Punjab the districts include Pakpattan, Bahawalnagar, Bahawalpur, Muzzafargarh, Lodhran, Rajanpur, DG Khan, Layyah and Bhakkar. In eastern Balochistan the districts include Barkhan, Kohlu, Dera Bugti, Naseerabad, Jafarabad, Jhal Magsi, and Khuzdar. In southern KP the districts include DI Khan, Tank, Lakki Marwat and Karak.

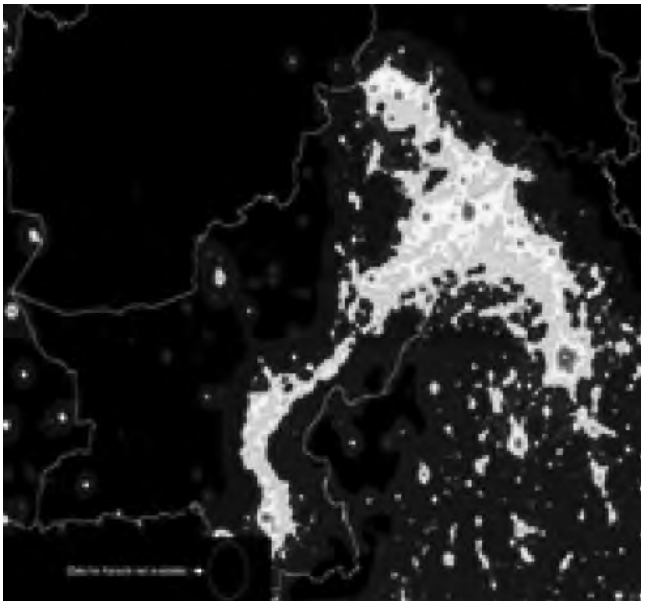
Satellite image of Pakistan



The night satellite image of Pakistan clearly shows that the lit up regions of Pakistan mimic the irrigated regions of Pakistan. This shows very dramatically that water is the source of life, light and prosperity. Wherever the state has taken the irrigation network, progress has followed. Wealth has been generated and the land and water combination opens up resources for modernization and even industrialization. This cycle of exploiting land and water resources opening up doors of progress, modernization and wealth generation has been disrupted for the last forty years in Pakistan and needs to be reactivated. Water is the key input in agriculture, industry, energy, transport, healthy ecosystems and urbanization. Poor management of water resources brings much anguish and

destruction which Pakistan has amply experienced in the form of floods, droughts, landslides, erosion, inundation, desertification, contamination and disease. Optimal management and use of the water resource can lead to progress and prosperity.

The night image of Pakistan



Achieving basic water security for all regions, harnessing the productive potential of water and limiting its destructive impacts, has to be the focus of Pakistan's water strategy. Water resources development and management remain at the heart of the struggle for growth, sustainable development and poverty reduction in the developing world. We have to learn from the industrialised countries that have invested early and heavily in water infrastructure, institutions, management capacity and sharing agreements.

It is still not too late for Pakistan. The leaders have to commit to wipe out poverty in Pakistan in a single generation. This will only be possible through effectively leveraging its water potential. The national vision for integrated water resources development, management and conservation must therefore ensure that Pakistan fully utilizes its water, land and human resources for the benefit and prosperity of the people of Pakistan. It is imperative that in an uncertain global environment, before remittances start to slow down, Pakistan must rejuvenate its water economy.

The 1991 water accord spells out the water sharing rights of the provinces. However, within each province the water distribution is skewed towards districts that are existing users of water. Therefore, for more equity in distribution of benefits, the network has to be expanded to the arid and water deprived districts of each province through more efficient and judicious use of our natural resource. Rural Pakistan has the highest levels of poverty in Pakistan and the water deprived rural areas are the worst off. Thus water rights for these areas have to be established.

The people of Pakistan and its leadership must make a concerted effort for developing national consensus on depoliticized decision making on water storages, water movement, water use and water conservation and build support for equitable distribution of costs and benefits of the water economy across Pakistan.

Financing the vision would require innovative organizational and financing mechanisms. Water projects have the highest economic rate of returns in Pakistan. The trick would be to translate economic returns into sustainable financial flows to service the financial instruments. This would require establishing and organizing infrastructure as corporate entities that are able to harness and monetize some of the economic benefits for the investors. Public private partnerships and tapping the domestic and global capital markets would be an essential ingredient of the financial plans. With 59,000 MW[8] of power and 150 MAF of valuable water, this is a viable proposition.

8 Hydel Potential in Pakistan, Ministry of Water and Power, GoP, 2013, http://www.nepra.org.pk/Policies/Hydel%20Potential%20in%20Pakistan.pdf

About Hisaar Foundation

About Hisaar Foundation

- Registered in 2003 as a not for profit entity, a volunteer organization
- PCP and SECP approved entity

What We Do?

Developing solutions

Creating partnerships for change

Emergency relief

Major Projects

- Think Tank on the Rational Use of Water (2014 – ongoing)
- Universities for Water Network (2014- ongoing)
- Project Aab-e-Thar (2014 – ongoing) – Construction of new deep dugwells, rehabilitation of existing dugwells, installation of handpumps, livestock distribution, installation of solar panels
- Jurio Project (2014) – Construction of Rainwater harvesting and storage tanks at household, community and village levels and kitchen gardening programmes to promote fodder tree plantations and ber grafting
- Project Aab-o-Daana(2013) – Kitchen Gardening Programme to promote home based agriculture in urban and rural areas
- Project Aab (2011-12) – Total Water Solution and installation of filtration plants in flood affected areas
- Installation of Water Filtration plants nationwide (ongoing)
- School Rehab Programme (2010 – ongoing) Rehabilitation of Water and Sanitation Infrastructure in Public Schools of Karachi
- Karachi Water Partnership – 12 urban, peri-urban and rural water partnerships
- Women and Water Networks – 25 urban, peri-urban and rural women and water networks
- Women and Water in Central and South Asia (2013 – 2015)
- 15 relief campaigns covering water, sanitation, food supplies and other interventions in all natural calamities of Pakistan
- Water advocacy and Training Workshops on Water Conservation and Better Management of Water
- 12 Annual Ramazan Appeals (2005 – ongoing)

Impact to Date

- **Over 1.0 million** beneficiaries provided water and food support
- **Over 150** Water Systems across Pakistan (including deep and shallow wells, pipe systems, hand pumps, storage systems and others)
- **Over 120** Water Filtration Plants installed through its own resources, and in collaboration with government and implementing partners
- **4,400** kitchen garden activists trained in building food security
- **4000** teachers and students trained in water conservation and management
- **93,283** women trained, supported and oriented in building food security (kitchen gardening, tree planting, microcredit training)
- **25 government** schools of Karachi provided drinking water and sanitation facilities

Support Organizations

The efforts of Hisaar Foundation are supported by thousands of individuals and Pakistani institutions. Our biggest supporters are listed below:

- Engro Foundation
- United Bank Limited
- Faysal Bank Limited
- Old Associates of Kinnaird Society (Karachi Chapter)
- Global Water Partnership
- Capacity Development in Sustainable Water Management (Cap-Net)
- United Nations Development Programme (UNDP)
- Pakistan Poverty Alleviation Fund (PPAF)
- Affiliated Network for Social Accountability South Asia Region (ANSA-SAR)
- Embassy of Hungary


PROJECT AAB


Kitchen Gardening Workshop
Hisaar Foundation

Think Tank on Rational Use of Water

2013

Conceived at the First International Water Conference held by Hisaar Foundation in December 2013 entitled "Water Cooperation in Action – From the Global to the Grassroots"

2014

Launched in June 2014 and officially named as "Think Tank on Rational Use of Water"

2015

Meetings and consensus building with stakeholders

2016

Pakistan's National Water Policy and Water Economy of Pakistan

Vision

To provide national leadership in Pakistan on the crucial issue of promoting rational use of water, its improved management and providing policy directions

Major Activities Since Inception

- The Think Tank has held six consultative sessions to date, each lasting at least two days
- The Think Tank has held separate consensus-building sessions with various stakeholders:
- Water sector stakeholders in Karachi
- Water sector stakeholders in Lahore
- Business sector (FPCCI, OICCI, Pakistan Business Council)
- Banks and corporate sector
- Civil society and NGOs
- International NGOs and donor agencies
- Academia and Pakistani universities
- Women's groups and women-led NGOs
- Media
- Farmers in Kasur
- WAPDA

Think Tank Universe of Priorities

- Dams (large)
- Indus Waters Treaty
- Indus Basin Management
- Saline Groundwater/Water Management
- Outside Indus Basin Groundwater (Artesian)
- Water Management in Barani (rain-fed) Areas
- Watershed Management
- Delta Ecosystem
- Coastal Urban
- Coastal Fisheries
- Urban Water Supply
- Water Quality (Agri/Urban)
- On Farm Water Management
- Flood Management
- Drought
- System Maintenance
- Water Rotation Schedule
- User Charges
- Urban Landscape
- Riparian Ecosystem
- Rights vs. Commodity
- Urban Aquatic Ecology
- Preservation of Lakes (Alpine/Riparian)
- Industry Impact
- Indigenous Systems

Priority Areas to be Addressed by the Think Tank in its First 3 Years (2014 to 2017)

1. Balochistan Groundwater Management
2. Drought Management and Arid Zones
3. Efficient Management of the Indus Basin
4. Urban Water Management
5. Transboundary Waters Management
6. Recommendations on National Water Policy Framework (add-on)
7. Pakistan Water Economy (add-on)

Goals

- Establish a national forum for discourse on rational use of water
- Develop and present water policy alternatives as an aid to the government to come up with a comprehensive and viable water policy for Pakistan
- Bring together creative minds from across development and corporate sectors to work with water experts for deliberations on key water issues and solutions
- Carry out advocacy and networking on rational use of water at the highest levels of government, civil society and the corporate sector
- Provide guidance to Pakistani universities (through Hisaar Foundation's Universities for Water Network

Profiles of Think Tank Members

Aliuddin Ansari

Aliuddin Ansari is a business executive and former president of Engro Corporation since May 2012. He is a graduate of the Institute of Business Administration with a specialization in finance and investments. He started his career as an investment manager at the Bank of America in London. Prior to joining Engro, he worked as the chief executive officer Pakistan and later as chief executive officer for Emerging Europe for Credit Lyonnais Securities Asia. In 2006 he partnered with an oil and gas company to form Dewan Drilling, Pakistan's first independent drilling company. Mr. Ansari is a member of the board of directors of Engro Corporation Limited and the Chairman of Engro Corporation's subsidiaries along with being a member of Sindh Engro Coal Mining Company, Dewan Drilling Limited, Pakistan Chemical and Energy Sector Skill Development Company and Pakistan Business Council. He has chaired a number of Securities & Exchange Commission of Pakistan (SECP) committees and has also served on the boards of the Karachi Stock Exchange, Dawood Hercules Corporation Limited, Hubco, Lucky Cement and Al Meezan Investment Management amongst others.

Daanish Mustafa

Dr. Daanish Mustafa is a reader in politics and environment at the department of geography at King's College, London. His core research interests are at the intersection of water resources, environmental hazards and development geography. He also maintains a side research interest in critical geographies of violence and terror. His research has been funded by the US National Science Foundation, National Geographic Society, Patel Center for Global Solutions at the University of South Florida, Department for International Development (DFID), Belmont Forum, and International Development Research Center (IDRC). His research and publications have focused on the effects of social power dynamics on water and its other dimensions. His research is geographically diverse covering Pakistan, Azerbaijan, Belize, United States and Jordan. Pakistan, however, has been the main focus of his research efforts. He has published extensively in major scholarly journals and was the 2011 recipient of the Excellence in Teaching Award at King's College, London's School of Social Science and Public Policy.

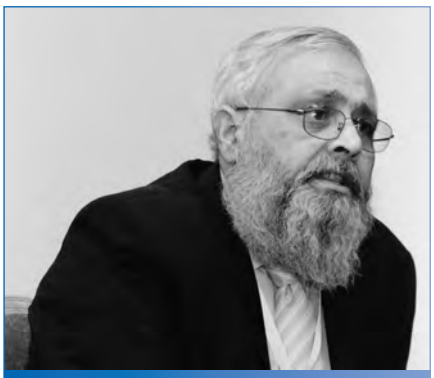
Khalid Mohtadullah is a former member WAPDA. He is a civil engineer by training with vast experience in water resources policy, strategy, institutional development, planning, project preparation, research, implementation and management. He possesses advanced degree and diploma in engineering and management from the Massachusetts Institute of Technology and the Harvard Business School, in the U.S. respectively. He retired as the managing director and member of WAPDA and remained director of the International Water Management Institute (IWMI) and later its deputy director general. He has served as the executive secretary of Global Water Partnership (GWP) in Stockholm, in Sweden. He has worked mostly in multidisciplinary environments to incorporate economic, social and environmental considerations in water resources management, and combines the experience of working in the government, semi-government and with international organizations including the UN system in Pakistan and abroad. Until recently he served as the country director IWMI, in Pakistan. He is also a senior advisor to GWP and ICIMOD and a special advisor to IWMI. He also sits on several boards of development organizations.

Khalid Mohtadullah

Dr. Salman Shah served as Pakistan's finance minister in 2004-2008, a period of extensive economic reform and changes. His tenure was significant for the development of the private sector, large foreign direct investment flows into the country and a successful return to international capital markets with the issuance of global depositary receipts, Eurobonds and Islamic Sukookbonds. He was a member of numerous committees at major national financial institutions such as the State Bank of Pakistan, the Securities & Exchange Commission of Pakistan (SECP) and the National Institute of Banking and Finance among others. As the finance minister, he has negotiated with international finance institutions, investment banks, foreign investment houses, hedge funds, rating agencies and multinational corporate investors besides other national governments and major trading partners. He has a doctorate in finance from Indiana University, U.S. and has also taught at the University of Toronto, Indiana University and the University of Michigan.

Salman Shah

Profiles of Think Tank Members



Sarosh H. Lodi

Dr. Sarosh H. Lodi is dean, Civil Engineering & Architecture, at the NED University of Engineering and Technology (Karachi). He has a Ph.D. from Heriot-Watt University, Edinburgh, UK. He has also served as registrar, NED University and has been actively involved in academic, research and academic administration activities. He has also served as a member of many national committees including Council for Works and Housing Research, Ministry of Science and Technology, National Highway Council, Pakistan Building Code - Seismic Provisions Committee, Pakistan Engineering Council, Traffic Management Board, Seismic Hazard Assessment of Pakistan, Pakistan Engineering Council, Task Force for Implementation of Energy Building Code of Pakistan, and co-chair of Hisaar Foundation's Universities for Water Network. He has over 90 international publications. He has helped manage planning, development and execution of earthquake simulation laboratory and advanced structural engineering laboratory in addition to managing numerous small development projects for the department and the NED University. He is also the co-chair of the Universities for Water Network established in conjunction with Hisaar Foundation.

Seema Taher Khan

Seema Taher Khan is a media specialist and co-founded Interflow Communication with her husband in 1983. Ms. Khan has created a large number of campaigns for leading national and multinational brands. She has also produced and directed over 300 commercials and documentaries. In 2005, she moved to jointly head Airwaves Media as CEO of TVOne, Newsone and Waseb TV. While managing the operations of the three channels, Ms. Khan has been instrumental in producing and directing a variety of political talk shows, reports, documentaries, popular drama serials and stage shows. Ms. Khan is also actively involved in welfare projects. She sits on the executive board of Fatimid Foundation, Think Tank of Hisaar Foundation and has been the head of the Women in Media forum as well as the Cancer Society. Ms. Khan is also a member of the executive committee of Indus Valley School of Art and Architecture, patron-in-chief of Daachi Foundation and is involved in numerous gender equity programmes.

Simi Kamal was the founding chairperson of Hisaar Foundation. She is a water and gender specialist. A geographer from the University of Cambridge, she has 30 years of experience in the water, environment, and women development sectors. She is currently chief of party of the USAID-supported five-year Gender Equity Program (GEP) of Aurat Foundation, based in Pakistan. She has founded, chaired and managed several non-profit and for-profit organizations in Pakistan, been a consultant to Pakistani government departments, UN agencies, the World Bank, Asian Development Bank and numerous international development organizations. She has carried out consulting assignments, conducted studies and been a speaker in over 40 countries and authored over 450 reports, papers, manuals, articles and book chapters. She has served on many boards, task forces and committees in Pakistan and abroad, including the National Commission on the Status of Women, the South Asia Technical Advisory Committee and the global Technical Committee of the Stockholm-based Global Water Partnership.

Simi Kamal

Zohair Ashir is a management specialist. He is a senior partner with the firm Grant Thornton Consulting and heads its People & Culture and Social Policy practice. He has over 30 years of professional experience in strategy management, and institutional development. He has been associated with organizations in the United States, the Middle East and Pakistan. He has served as advisor with the World Bank, USAID, ADB, JICA, SBP and many other organizations. He served in senior management capacity with Aga Khan University Hospital, Baptist Memorial Hospital and Aetna Life & Casualty Insurance Company. Mr. Ashir is the chair of the board of Hisaar Foundation in a voluntary capacity and continues to be associated with many boards and associations. He completed his post-graduation in hospital management from the University of Minnesota and BBA from the University of Memphis. He spends his leisure time listening to music, playing sports, travelling and working with civic bodies.

Zohair Ashir

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Sarfaraz Ali	Water Aid
Shahnaz Wazir Ali	SZABIST
Shamsuddin Sheikh	Sindh Engro Coal Mining
Tomoyuki Hashizume	Mitsubishi
Zafar Mahmood	WAPDA

Institutions

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Food and Agriculture Organization
HELP
Lahore Chambers of Commerce and Industry
Lyari Community Development Project
Mahvash & Jahangir Siddiqui Foundation
Members of Universities for Water Network
Overseas International Chambers of Commerce and Industry
Shirkatgah
Social Policy and Development Centre
Urban Unit
Women and Water Network Members

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