

# The Challenges of Water Pollution, Threat to Public Health, Flaws of Water Laws and Policies in Pakistan

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## Abstract

In an era of unprecedented urbanization, population and industrial growth pressure is serious threat for the water management in Pakistan in present days. Water pollution from raw sewage, industrial wastes, and agricultural runoff limited natural fresh water resources in the country. Human health is facing serious problems due to deteriorating drinking water quality. Current review paper provides an insight to the water quality problems in Pakistan with an attempt to emphasize the challenges of water laws enforcement. Although Pakistan has developed many water laws the state of implementation is dominant, intermediate pollution crises are still remaining. We could come to the conclusion that strictly enforcement is compulsory for water environment regulations in Pakistan. Moreover, it is necessary to establish a reliable risk assessment system for water quality, human health and ecological safety.

## Keywords

Water Pollution, Population, Urbanization, Public Health, Contamination, Industrial and Agricultural Pollution, Water Laws and Policies

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## 1. Introduction

Relationships between water and other development-related sectors such as population, energy, food, and environment, and the interactions among them require analysis, as they together will determine future food security and pollution reduction [1].

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Everyday two million tons of sewage industrial and agricultural waste is discharged into the world's water. FAO [2] showed that pressure on water resources due to irrigation would be increased by 2050. The UN estimates that the amount of waste water produced annually is about 1500 km<sup>3</sup>, six times more water than exists in all the rivers of the world [3].

The world's 1.1 billion people lack access to basic water supplies and half of the developing world's population suffers from diseases due to water contamination [4]. Approximately 2.5 million people of the world live without improved sanitation which is most significant form of water pollution [5]. Unsafe or inadequate water cause approximately 3.1 percent of all deaths worldwide, and 3.7 percent of DALYS worldwide. Infectious diseases such as waterborne diseases are the number one killer of children under five years old [6].

Unsafe water causes 4 million diarrheal diseases and 2.2 million deaths in each year [7] 1.3 million People die of *malaria* [8], 160 million people are infected with *schistosomiasis* (A disease in sub-Saharan Africa) each year. 500 million people are at risk from *trachoma* and 1.5 million cases of clinical *hepatitis A* every year [9]. More than 5 million people die each year from water related diseases [10]. In Pakistan, water remains a critical resource for sustained well being of its citizens. The water availability in Pakistan is continuously declining, both in total amount of water and the per capita water availability. **Table 1** show that in 1951, when population was 34 million, per capita availability of water was 5000 cubic meters, which has now decreased to 1109 cubic meters, reached water scarcity level of 1000 cubic meters [11]. And alarming prediction is less than five hundred cubic meters per capita per year by 2020.

The water shortages and increasing competition for multiple uses of water has adversely affected the quality of water. Consequently, most of the reported health problems are directly or indirectly related to polluted water in the country [12]. A vast majority of Pakistan's population does not have to access to clean, portable and safe drinking water [13]. Water sources like surface and ground water are contaminated with Bacteriological, (Arsenic Nitrates and Fluoride) Contaminations; municipal, agricultural and industrial waste throughout the country. Despite high population of the country, water sources improved from 85% in 1990 to 92% in 2010, but water from these sources areas are not save to drink. However the water sector still has challenges and quality of services is poor. Drinking water quality is deteriorating continually due to biological contamination from human waste, chemical pollutants from industries and agricultural inputs. Piped water also gets contaminated because pipes are laid very close to sewerage lines or open drains and cause many serious water borne diseases. It was found that 45% of infant deaths have been attributed to diarrhea and about 60% to overall infectious water borne diseases in Pakistan. According to the World Health Organization (WHO) 25% - 30% of the diseases are gastrointestinal in nature [13].

In the provinces of Pakistan, Sindh 24%, NWFP 46% and Blochishtan 72% of population rely on unsafe water sources [14]. Pakistan is ranking 17 among countries facing watershortage [15] and 79 percent water is unsafe for drinking [16]. According PSLM Survey of 2010-11, [17] the main source of drinking water was: 32% tap water, 28% hand pump, 27% motor pump, 4% dug well and 9% others. Pakistan's 96% of urban and 89% of rural population have access in water pollution in broad definition and 57% of urban and 15% of rural population access houses connection water pollution.

**Table 1.** Per capita water availability.

Years	Population (million)	Per capita availability (m <sup>3</sup> )
1951	34	5000
1961	46	3950
1971	65	2700
1981	84	2100
1991	115	1600
2000	148	1200
2013	178	1105
2015	190	1000
2025	267	659

Sources: Hassan Ahmed Khan ppt on water pollution in Pakistan. 30 June 2010 that was consists on prediction but after five years now situation is different. So here are some changes according to current situation.

The reasons why the Pakistan continuously fails in protecting water sources from scarcity and pollution have many aspects. The main reasons including unclear strategies of laws and polices enforcement and no coordination between relevant departments, lack of accountability and transparency of water based regulatory authorities, corrupt and incompetent governmental functionaries, lack of public participation. 1) There should be a strict legislation system that would serve as a base for monitoring the implementation of water pollution laws and polices; 2) For environmental legislation to “work” it must not only be well designed but also efficiently and effectively enforced. Strategies must be developed; 3) Pakistan’s decision makers and those in power are not directly affected by water insecurities and have little incentive to change the system or make water management reform a priority

### 1.1. Population and Environmental Issues

There are alternative views on population-environment linkages [18]. Population and environment are closely intertwined in a complex and dynamic relationship. The relationship between population and environment is mediated by a number of socioeconomic, cultural, political, and developmental variables whose relative significance varies considerably from one context to another. Over the past three to four decades, some economists, biologists, and environmentalists have been debating the role of population in environmental degradation.

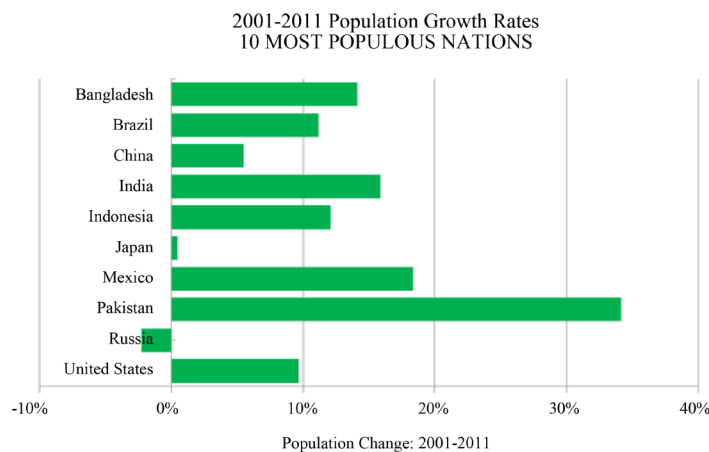
At the time of independence in 1947, 32.5 million people lived in Pakistan. By 2006-2007, the population is estimated to have reached 156.77 million. Thus, in roughly three generations, Pakistan’s population has increased by 124.27 million or has grown at an average rate of 2.6 percent per annum. The present population of the country is 188 million will increase to nearly 190 million by 2016, to over 220 million by 2020 and to almost 275 million by 2050, as Pakistan retains its position as the sixth most populous country in the world [19]. **Table 2** shows the population growth rate, urbanization, and industrialization in Pakistan from 1980 to 2025.

**Figure 1** shows that from the year 2001 to 2011 if we compare Pakistan to 10 most populous countries, it ranks first in increasing growth rate annually.

**Table 2.** Population, urbanization, and industrialization in Pakistan, 1980-2025.

Year	Population (million)	Population growth rate (%)	Urbanization (% of population)	Industrialization (share of manufacturing in real GDP in %)	Water demand for domestic use (MAF)
1980	84.9	3.0	24.1	13.8	
1990	110.8	2.6	34.7	17.4	4.1
2000	140.5	2.1	47.5	23.0	5.2
2010	177.1	2.1	36	25.4	
2025	228.8	2.4	49.3		9.7

Sources: Population Reference Bureau (2004); Ministry of Finance & Economic Affairs (2004, 2001); Federal Bureau of Statistics (1991); Kahlown and Majeed (2002).



**Figure 1.** Population growth rates.

## 1.2. Municipal, Industrial and Agriculture Water Pollution

The pressure on water resources caused by industrial growth also merits discussion due to their significant contribution to water pollution problems. It has been estimated that around 2000 million gallon of sewage is being discharge to surface water bodies everyday in Pakistan [20]. According to Sial [21] in Pakistan out of 6634 registered industries 1228 are considered to be highly polluting. Industrial units including textile, chemical, food processing, pulp and paper, poultry, dairy, plastic, paint, pesticides, leather, tanneries and pharmaceuticals directly discharged their waste into the canal system contaminating ground water level as well [22]. In Pakistan, only 1% of wastewater is treated by industries before being discharged directly into rivers and drains. In NWFP, 80,000 m<sup>3</sup> of industrial effluents containing a very high level of pollutants are discharged every day into the river Kabul. In Karachi, Sindh Industrial Trading Estate (SITE) and Korangi Industrial and Trading Estate (KITE), two of the biggest industrial estates in Pakistan, there is no effluent treatment plant and the waste containing hazardous materials, heavy metals, oil etc is discharged into rivers. In Multan, a fertilizer factory discharges its waste untreated to cultivated land causing death of livestock and increasing health risk to humans [23]. In Lahore, only 3 out of some 100 industries using hazardous chemicals treat their wastewater. All the big cities like Karachi dumped its 600 million-tones sewage daily into the sea. Lahore dumped about 200 million tones liquid and 100 million tones solid wastes into the river Ravi. Due to open dumping of industrial/municipal wastes, the underground quality of water is deteriorating. The discharge of wastewater from domestic, municipal and industrial sectors directly into water bodies without proper treatment is major cause of surface and groundwater pollution in Pakistan. Water pollution also influences the agriculture of Pakistan with excessive use of fertilizers and pesticides which are key pollutants as they dissolve in water and seep to the underground water bodies becoming the source of salinity and water logging at irrigated land decreases the fertility of soil, costing Pakistan 0.9 per cent of the GDP. The contribution of agricultural drainage to the overall contamination of the water resources exists but is marginal compared to the industrial and domestic pollution. For example, in Sindh, the pollution of water due to irrigation is only 3.21% of the total Pollution [24].

## 1.3. Bacteriological Contaminations and Drinking Water Quality

Arsenic Toxicity Investigations revealed the presence of excessive arsenic in many cities of Punjab and Sindh provinces was found to be 50 ppb five times higher than the prescribed limit of 10 ppb by WHO [25].

Detailed data analysis has identified 4 major water quality tribulations in drinking water sources of Pakistan *i.e.* bacteriological (68%), arsenic (24%), nitrate (13%) and fluoride (5%). The five years trend analysis has revealed that out of a total 357, only 45 water sources (13%) were found “Safe” and the remaining 312 (87%) were “Unsafe” for drinking purpose. The water quality monitoring (2001-2010) conducted in rural and urban areas of the country revealed that access to safe drinking water is only 15 percent in urban and 18 percent in rural areas.

**Table 3** shows bacterial contamination level in 23 cities of Pakistan from 2002 to 2006 which increased every year.

On the behalf of PCRWR survey published in 2012, 88% of the functional water supply schemes in Pakistan provide water that is unsafe for drinking because of microbiological contamination [26]. According to an official government document [27] increased arsenic, nitrate and fluoride contamination was detected in drinking water in various localities in Pakistan. A survey of drinking water samples in Karachi in 2007/08 found that, of 216 ground and surface water samples collected, 86% had lead levels higher than the WHO maximum acceptable concentration of 10 parts per billion (ppb). This mean lead concentration was 146 ppb in untreated ground water and 77 ppb in treated tap water [28]. Newspapers reported that a citizen of Karachi submitted a court petition asking the Karachi Water and Sewerage Board (KWSB) to fulfill its duty to provide clean water. In October 2012, the Sindh High Court issued a notice to the Board asking it to comment on the petition [29].

The Nation-wide Assessment Survey of more than 10,000 water supply schemes (1808 urban and 8320 rural water supply schemes) carried out by the PCRWR revealed that 72 percent schemes are operational and only 23 percent in urban and 14 percent in rural areas water supply schemes are supplying safe drinking water [30].

## 1.4. Water Pollution and Health Problems

In Pakistan contamination of drinking water with industrial wastes and municipal sewage coupled with lack of

**Table 3.** The bacterial contamination level in major cities of Pakistan.

Name of city	Contamination level in 2002 %	Contamination level in 2006 %
Islamabad	40	74
Faisalabad	38	79
Bahawalpur	52	75
Gujranwala	29	71
Gujrat	56	100
Kasur	40	50
Lahore	37	63
Multan	31	87
Rawalpindi	53	87
Sheikhupura	27	55
Sialkot	40	70
Sargodha	75	92
Khuzdar	62	100
Loralai	73	100
Quetta	48	68
Ziarat		100
Mangora	40	70
Mardan	75	83
Peshawar	31	77
Abbottabad	55	73
Hyderabad	73	100
Karachi	61	100
Sukkur	67	83

Sources: PCRWR report 2002-2006.

water disinfection practices and quality monitoring at treatment plants is the main cause of the prevalence of waterborne diseases [31].

Around 62 percent of Pakistan's urban and 84 percent of its rural population does not treat their water, resulting in 100 million cases of diarrheal diseases registered in hospitals, with 40 percent of deaths attributed to drinking polluted water. The diarrhea which is a water-linked disease, accounts for 14% of illnesses, One third of under-five deaths in children [32] and for 7% of all diseases in people of all ages in Pakistan [33]. Diarrheal rate in Pakistan is the second highest amongst 31 Asian countries. Although in the developed countries typhoid fever has been almost eliminated, in developing countries like Pakistan it is still a common disease and a major cause of morbidity and mortality due to lack of sewage and water treatment facilities [34]. Lack of effective prevention and control measures contribute in worsening the situation [35].

According to estimation 250,000 child deaths occur each year in Pakistan due to water-borne diseases [30] and more than 1.6 million DALYs are lost annually as a result of death and ailment due to diarrhea and almost 90,000 as a result of typhoid. Inadequate quantity and quality of potable water is associated with a host of illnesses. 20 - 40 percent of the hospital beds in Pakistan are occupied by patients suffering from water-related diseases [36].

## 2. Legal Framework and Its Enforcement

### 2.1. Legal Protection of Water from Pollution

In 1997 a regulatory framework known as PEPA Act 1997 was approved to regulate and monitor issues regard-

ing environmental protection in the country [37].

**Table 4** makes it clear that environmental legislation to sanction water pollution does exist in Pakistan. Under federal legislation, the relevant provisions relating to the human right to water, including the prevention of water pollution, provisions of the PEPA Act, 1997 relating to the disposal of wastes and effluents and Art. 20 relating to drinking water, of the amended Factories Act of 1934 [38]. The Pakistan Penal Code 1860 contains a criminal penalty for polluting the water of any public spring or reservoir [39]. Another relevant piece of legislation is PCRWR Act 2007, which set up the Pakistan Council of Research in Water Resources, which is primarily entrusted with improving the technology needed to advance, as well as to conserve existing water resources. This Body is also required to provide recommendations to the government, regarding the quality of water that needs to be maintained and how existing water sources may be utilized and conserved [40] furthermore, various water and sanitation based policies and guidelines have been approved by the national government. The IRSA Act 1992 implements the Water Accord which apportions the balance of river supplies, including flood surpluses and future storages among the provinces. The WAPDA Act 1958, Water User Ordinances 1982. The PIDA Acts

**Table 4.** Key water-related legislation in Pakistan.

Date	Legislation	Implementation	Key feature
1860	Pakistan Penal Code	Federal Penalizes	Water pollution as a public health issue
1873	Canal and Drainage Act	Federal and provincial	Governs irrigation water use
1882	Easement Act	Federal	Grants and limits rights for water pollution
1883	Land Improvement Loans Act	Provincial	Provides loans for water distribution, drainage, and reclamation
1905	Punjab Minor Canals Act	Provincial	Governs irrigation water use
1927	Forests Act	Federal and Provincial	Governs disposal of waste and effluent
1934	Factories Act	Federal	Penalizes pollution of water in forests
1949	Karachi Joint Water Board Ordinance	Municipal	Prohibits pollution of water supply; first water law at municipal level
1952	Punjab Development of Damaged Areas Act	Provincial	Allows government to construct sewage and drainage in "damaged areas"
1958	West Pakistan Water and Power Development Authority Act	Provincial and Federal	Establishes what is today the Water and Power Development Authority
1960	Indus Waters Treaty	International	Governs sharing of Indus River waters between Pakistan and India
1976	Territorial Waters and Maritime Zones Act	Federal, International	Declares maritime territory and boundaries
1980	Sindh Fisheries Ordinance	Provincial	Prohibits dumping of pollutants in water
1981	On-Farm Water Management and Water Users' Association Ordinance	Federal	Provides resources for improved irrigation water management
1991	Indus River System Accord	Provincial	Governs water sharing between provinces
1997	Provincial Irrigation and Drainage Authority Acts	Provincial	Implements irrigation reforms
1997	Environmental Protection Act	Federal	Governs protection, conservation, rehabilitation, pollution, and improvement of environment
2009	National Drinking Water	Federal	Provides institutional framework and guidelines for provinces to assure quality and supply of drinking water
2010	18th Amendment to the Constitution of Pakistan	Federal	Devolves Ministry of Environment to provinces, establishes forums for interprovincial dialogue
2011	Punjab Environmental Protection (Amendment) Bill	Provincial	Establishes Punjab Ministry of Environment

Source: Jawad Hassan, Environmental Laws of Pakistan (Lahore: Book Biz, 2006).



1997, The Sindh Irrigation Act 1879, Provincial legislation such as the BGWRA Ordinance, IX Of 1978, established regulatory and supervisory functions for the Provincial Water Board and a Water Committee to overlook the implementation of the policies of the Water Board [41]. Other laws related to pollution prevention of water bodies include the Canal and Drainage Act (1873) and the Punjab Minor Canals Act (1905), which prohibits the corrupting or fouling of canal water; Sindh Fisheries Ordinance (1980), which prohibits the discharge of untreated sewage and industrial waste into water, and The Greater Lahore Water Supply Sewerage and Drainage Ordinance (1967) all these legislation related to water rights. However, under the PLGO (2001), [42] a number of provincial functions including water management and sanitation have been entrusted to the TMAs. The CDG and the TMAs [43] are also responsible for the enforcement of punishment for offences, relating to the contamination or pollution of water, failure on the part of industries to dispose of hazardous waste, or offences relating to the provision of contaminated water for human consumption [43] Other forms of offences such as failure to stop leakage of drain pipes, the obstruction of water pipes etc. have been made punishable by the issuance of tickets rather than through court and are the responsibility of the Tehsil/Town Officer.

Furthermore, the National Government has approved various water policies and guidelines. In November 2002 national standards for drinking water quality were introduced. Similarly other policies including National Environment Policy 2005, [44] National Sanitation Policy 2006 [45] and National Drinking Water Policy 2009 [46] have been approved. The National Environment Policy, 2005, provides a framework for various environmental issues, particularly the pollution of fresh-water bodies. It recognizes the need to meet international obligations effectively and in line with national objectives [47] and concerns regarding public health and environment. In addressing water supply and management, it lists a number of guidelines by which the government can ensure sustainable access to safe water resources [48].

Under the National Drinking Water Policy 2009, water was the basic human right of every citizen [49]. The policy aims at providing safe drinking water to the entire Pakistani population by 2025, including the poor and vulnerable, at an affordable cost [50].

As per policy mandates that the safe drinking water be accessible to both urban and rural areas. The policy declares that various forms of legislation are to be enacted to ensure the implementation of these measures, including the Pakistan Safe Drinking Water Act [51]. Policy's objectives briefly described in **Table 5**.

## 2.2. Weaknesses in the Enforcement Status

Although Pakistan has comprehensive national laws and policies related to water pollution control and institutional framework for environmental management, yet there are significant weaknesses in the current administrative and implementation capacity. Water disputes in Pakistan are chronic. The perennial irrigation water shortages create conflict between provinces. The lack of water laws that define water rights often pit users against each other. Most of the water-related legislation and regulations, dating back to colonial rule as evident in **Table 3**. The Pakistan Penal Code 1860 and the Factories Act 1934 are quite old and very weakly enforced, defining penalties which are no longer effective. Although IRSA 1992, relatively effective in distributing water to the provinces in the past, the authority has recently indicated that it expects acute water shortages for irrigation coordination and communication between federal, provincial and local administrative entities is curtailed. Unclear policies definition plans and targets is another Impuissance. Pakistan's policy approach, which is oriented in supply-side interventions, is also lacking. Over the past decade, Islamabad drafted a number of policies and strategies to address the country's various water challenges. These include the Environment Policy (2005), National Sanitation Policy (2006), the Drinking Water and Sanitation Policy (2009), but have yet to be adopted in real sense.

Although ordinances, acts and policies have been approved from time to time, therefore clear strategies are so far from their implementation. As a result, after appropriate and necessary administrative capacity on paper, its effectiveness is seriously curtailed in practice. The industries do not follow the national standards for pollutants in their waste effluents. Industrial effluent is to be regulated by environment protection agencies through self-monitoring and reporting programmes under PEPA Act, but proverbially, enforcement is lax [52]. The municipal wastewater treatment facilities in Karachi and in Islamabad have not been able to achieve the performance standards set under the NEQS. Groundwater or surface water can be acquired at a lower cost in Punjab and NWFP where supply is generally abundant, and the only option available is disposal of the treated effluent into the open drains. This option can be exercised, but will require stricter monitoring particularly when the canals are closed or in low flow conditions.

**Table 5.** Objectives of national drinking water policy 2009.

Targeting strategy	Provide water to un-served or under-served areas where the access to clean drinking water have walk of 0.5 KM
Legislative strategy	Encourage the participation of private sector. community participation, public-private partnership and role of NGOs
Protection of water resources	Protection of surface and ground water sources in urban and rural areas
Institutional strategy	Strengthen the institutions and their services of providing drinking water at federal, provincial and local government level
Technical strategy	Technical assistance to the provincial and local agencies, support clean drinking water initiative project by the federal government and provincial water filtration plants at tehsil and union council level
Operation and maintenance (O&M) strategy	WASA and TMA are responsible for the O&M in urban areas. TMA is only responsible for O&M in rural areas
Drinking water quality standards	Using the WHO's drinking water quality guidelines both in urban and rural areas
Water quality monitoring and surveillance	PQCA and PCRWR ensure the water quality standard through surveillance of water quality from different sources
Gender strategy	Female participation in decision making at the district, tehsil and union council tiers
Communication and dissemination strategy	<i>Disseminating information</i> on drinking water quality standards through articles in the national press, leaflets, newsletters and spreading information to schools, through NGOs, civil societies, and citizen community boards (CCBs).
Financial strategy	Provision of water supply and sanitation services at affordable rates is Promised in the <i>financial strategy</i> . funds are given to CCBs at local level for drinking water schemes
Monitoring and evaluation strategy (M&E),	Ministry of environment will be responsible for reporting of <i>State of Drinking Water in Pakistan</i> , whereas, the local government department and WASAs will be responsible for monitoring the coverage of drinking water supply in rural and urban areas respectively.
Research strategy	Pilot tests for new approaches and innovative ideas in the drinking water sector, especially those which help to improve access, efficiency, effectiveness and sustainability.

Government has introduced different programs to control water pollution, but unfortunately no one is implemented appropriately due to weak law enforcement and the problems remained the same. Policy is not the only challenge, Citizen Education is also necessary to overcome the public's apathy toward water pollution. But citizen education requires support from the government in terms of legislation, conservation strategies, and law enforcement, which is currently nonexistent. There is a deep mistrust among stakeholders and decision makers, partly explaining the stalemate in passing meaningful water policies and strategies. The lack of consensus on water sector priorities not only creates a vacuum for improved resource management but also leaves the security around water that much more volatile. Thus it is crucial to correct these misperceptions if there is to be any significant shift in water policy and management. Water stakeholders and policymakers would be better served using their collective skills, knowledge, and expertise to develop an effective strategy that tackles Pakistan's precarious water environment and off sets any violence over water resources.

### 3. Conclusions

Growing population, poor management services, water pollution, lack of public awareness and weak enforcement of environmental laws and policies causes great environmental degradation and health problems.

The issues of water quality and quantity are still major problems in Pakistan. Water pollution and its effects over environmental sustainability in Pakistan provoke political instability when other problems and grievances already exist. As shortages become more widespread, it is crucial that the government invest greater political capital to regulate water pollution and provide quality water services to all communities. A number of factors need to be highlighted and addressed in order to improve, protect and maintain the quality of freshwater resources of the country. The Government does not give the priority to the treatment of sewage and industrial effluents. The level of commitment from government authorities to treat waste water and to improve the quality of



freshwater is very low. Therefore, there is a need to bring provision of clean water back as a top priority.

There is need to establish legal rules and regulations at the earliest to cover the risks of ground water extraction. Even when there are relevant laws in the country like PEPA 1997, their enforcement is extremely weak and therefore the level of compliance is low particularly in the industrial and housing sector. And policies like NEP 2005, NWP 2006 and NDWP 2009, etc. are in place, there is no clear strategy devised so far to implement them. A clear and practical strategy needs to be defined to implement these policies.

Effective management can only come from domestic reform, and dependence on foreign aid will not render lasting solutions. This study is by no means a complete analysis of the pollution challenges facing Pakistan's water sector. Its goal is to demonstrate how policymakers and water lawyers seem to underestimate the extent of the potential threats to water and its economic future. More data and analysis are needed to understand the extent of each of these challenges and subsequent security threats to pinpoint potential hot spots. In particular, effective laws and policies require greater supply and demand linkages, as opposed to the field's supply-oriented literature. The future of Pakistan's water sector does not have to be ominous. There are great opportunities to address these challenges and avert violent conflict. Ultimately, change starts with political will.

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