

Article

Water Scarcity and Sustainability in an Emerging Economy: A Management Perspective for Future

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Abstract: Water scarcity is rising as a global issue, because the planet earth is facing a global water crisis, which is considered something that can destroy environmental sustainability of our planet. The fact is that humanity's demand is depleting natural resources faster than nature can replenish itself; if human habits and unsustainable use of water resources do not change, water scarcity will inevitably intensify and become a major cause of conflict among different nations of the world. The water scarcity issue is a crucial issue but unfortunately it has not received due attention in past. Pakistan, which once was a water abundant country, now facing a situation of water scarcity. Pakistan has a poor irrigation system which results 60% loss of its water; Pakistan uses more water for crop production than other countries. Likewise, the country harvests water from rainfall, rivers, snow, and glaciers. The country is facing a serious water crisis that is caused by different factors, such as changing climatic conditions, rising population, poor irrigation system, poor political will, and rapid urbanization. The water crisis of Pakistan is expected to worsen in coming years. This is a drastic situation which calls for emergency measures. With this background, the present study provides a detailed view of the water situation in the country with challenges to water management. The study also suggests some recommendations for policymakers to improve the water crisis situation in the future.

Keywords: water scarcity; sustainable development; emerging economy; environmental sustainability; surface water; groundwater; Pakistan



Citation: Zhang, D.; Sial, M.S.; Ahmad, N.; Filipe, J.A.; Thu, P.A.; Zia-Ud-Din, M.; Caleiro, A.B. Water Scarcity and Sustainability in an Emerging Economy: A Management Perspective for Future. *Sustainability* **2021**, *13*, 144. <https://dx.doi.org/10.3390/su13010144>

Received: 30 November 2020

Accepted: 21 December 2020

Published: 25 December 2020

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1. Introduction

Water is not only an important source for life, but also plays a key role in the social, economic, and environmental development of the world. Today, it remains a common and unequally shared resource. There are water managers, users, and service providers who face many challenges in accessing sustainable, cost-effective, and equitable water services based on their growing sophisticated resources. Although global water crises are mainly attributed to water insufficiency, in some regions of the world, they are due to the lack of water management that leads to water scarcity [1,2]. In many countries, the abundance of water is no longer considered to remain the same in the future. Efficient water management can significantly impact water crises, keeping in view the issues pertinent to water such as climate change. It requires the joint commitment of different sectors including government,

society, and the private sector, and defines the roles and responsibilities of different actors in the development, management and use of water resources.

Pakistan faces water shortages that kill hundreds of thousands of people every year. Out of the total population of 207 million, 21 million people do not have access to clean water [3]. Water shortages have been a major obstacle to sustainable economic growth. The widening gap between water supply and demand leads to the deterioration of resources and increases disputes between stakeholders. Along with this widening gap, other issues such as climate change, a rising population, poor political will, urbanization, and little awareness among the general population is also a significant contributor towards water issues. The main cause of the water crisis in Pakistan are two-fold: incidental and operational, incidental causes relate to the conditions associated with poor water management policies; and operational causes relates to conditions associated with political issues (trans-boundary, provincial) and society (poor water management). To solve these problems, new knowledge and tools (technologies, policies and institutions) are needed, regarding social, economic, political and environmental issues in water management [2]. Several studies and reports by various agencies have confirmed that Pakistan is in a state of emergency in terms of water resources. Pakistan, with a rapidly growing population, is facing a water crisis and the threat of food security. The availability of surface water has decreased from 5260 cubic meters per capita in 1951 to 1000 cubic meters per capita in 2016. This figure may fall to about 860 cubic meters by 2025, which means that Pakistan is moving from “water pressure” in the country to “scarce water” [4–6]. Mainly, Pakistan faces water crises due to the lack of management, droughts, reduced rainfalls, and pollution [7].

There have been different governmental systems in Pakistan, including a mix of democratic structures and military rulers, but only one took serious step for devising a clear water policy in Pakistan. The country is facing water problems due to water shortages, climate change, increasing water demand and agricultural production. Many projects of water resource management programs are available nationally and regionally; however, none of them have been approved as a policy. The National Water Policy (NWP) project was first drafted in 2005 following a World Bank policy, but that policy has not been implemented fully. In 2010, it was decided to revise the NWP, considering developments in the water sector in terms of growing impact of climate change on water resources. A committee was set up to review water policy. In 2012, the committee submitted its final report to the Minister of Law; this is a regional issue, therefore the constitution does not provide for the provisions of the NWP. Reviewed in 2015 by the Prime Minister’s instructions, the NWP is available to all participants for proper testing and evaluation. Following negotiations between local and regional governments, in 2017, the NWP was sent to the Council of Common Interests, which is a constitutional body to resolve different issues related to power sharing between provinces of Pakistan—it was on the agenda, but it received little attention. The main reasons not for achieving the objectives of the above stated water policies lie in poor commitment, political will and climate change [8].

The International Monetary Fund (IMF) has ranked Pakistan e3rd in the world among countries which are facing water shortage, and it is estimated that by 2025 the country will have very little clean water [9]. Taking into account the deaths of 1832 children in the last four years due to droughts [10], the drying of lakes and rivers, declining water levels, overuse of water, lack of storage facilities, population explosions, and climate change, there are calls for emergency measures [5]. In addition, incorrect national water policy, lack of public and provincial interests, Pakistan–India water conflict, deforestation, threats to the country’s reserves, and poor water supply can adversely affect agriculture, ecosystems, and regional biodiversity [11,12]. The above facts paint a bleak picture of the future and highlight the urgency of the water scarcity issue in Pakistan.

Water in Pakistan is a political issue, and it requires a significant amount of time to build consensus among federations and provinces in order to make decisions that ultimately are acceptable to all provinces. Therefore, Pakistan needs to consider all sectors of the country and understand the fundamental changes to preserve its water resources

efficiently. Policies should be concise to set clear goals, objectives, implementation plans and deadlines for achievement. Pakistan has an agricultural economy, which accounts for 20% of GDP. Pakistan's highest growth rate per year during the years 2010–2020 was 5.28%, with considerable development in the agricultural sector from 0.27% to 3.46%. According to an estimate, a large amount of water in Pakistan is used for irrigation that contains both surface water and groundwater. In Pakistan, the groundwater is heavily utilized—it contributes almost 73% for irrigation use, whereas the remaining 27% of irrigation is dependent on surface water [13]. Hence, water is a precious resource which is essential for an agrarian-based country such as Pakistan. According to the Hisaar Foundation's water policy recommendations in Pakistan, water resources, if utilized efficiently, can generate billions of dollars in terms of agricultural output [8]. The purpose of this article is to discuss the complexities of Pakistan's water resource management, to evaluate the effectiveness of previous approaches, and to suggest future strategies, because these assets are important in maintaining the agricultural environment to ensure food security and environmental sustainability.

2. Water Scarcity and Environmental Sustainability in Pakistan

According to the IMF, Pakistan ranks third on the list of water-scarce countries (on the water scarcity index which compares national annual water availability with the total annual withdrawals percentage) [14]. According to a report by the Pakistan Academy of Science and Council of Research in Water Resources (PCRWR), by 2025 the country will be facing a "severe water shortage". The literature confirms that the Indus basin has been prone to droughts since the 19th century [15–17]. In a developing country, such as Pakistan, its dependence on agriculture has had a major impact on its economy and human health in general. Pakistan's population growth and urban planning mean that water demand is growing exponentially and supply remains difficult to forecast [18]. Currently, the limited and sustainable water supply in the country is a major threat due to climate change and rising pollution levels. Unless urgent action is taken, water security will cause more adversities and inequality for vulnerable groups in society [19].

The changing climatic conditions of Pakistan, such as increased heat waves, floods, and droughts, further aggravate the situation of food insecurity in the country. These changing climatic conditions also affect the lives and livelihoods of poor and deprived communities in Pakistan. Every three in four people living in poverty depends on farms and natural resources for their livelihood. Increased competition for water, and food insecurity due to climate change, rising population and extensive urbanization is a matter of life and death for poor people [20]. For example, water scarcity destroys not only natural resources but also wealth. Water is an essential element for management of the home, household, and business systems, therefore misuse of this key resource hinders development and affects a large proportion of the population and/or communities and societies.

Environmentally, water scarceness is not only a matter of depleting natural resources, but also a societal phenomenon, because the issue of water scarcity is directly related to the general population because it induces different social problems such as access to food, rising demand for clean water and health related issues. Water is a key component of the economy, therefore access to this primary resource halts development and affects many aspects of individual and/or public life. Water deficiency leads not only to economic downfall, but also to conflicts between nations, and competition between communities and cities. Insufficient capacity—the inability to save water discharged into the sea or treat wastewater—makes the situation even more worse because it creates more pressure on the already-reduced water resources for domestic users [21]. The country is now classified as a water-stressed country, having less than 1000 cubic meters of water per year for each person. If the situation continues and the country reaches the threshold of 500 cubic meters of water for each person, then by 2025, it will become land without water. Eighty percent of the population in the 24 main cities of Pakistan do not have accessibility to clean water, for

instance, in Karachi, more than 16 million of people do not have access to clean water [22]. The unprecedented climatic conditions of Pakistan, which includes variation in monsoons and the retreating glaciers impact on major rivers such as decreasing capacity of the Indus river, shrinkage of Mangla and Tarbela reservoirs, and unexpected floods and droughts continue to plague Pakistan, threatening food security and endangering lives, disrupting families and displacing poors far from their homes. Augmented rivalries for water and food shortages, aggravated by climate change, are a matter of life and death for deprived communities [23]. Water crises are at its peak in Pakistan, because its amount of water per capita has decreased drastically from 5600 cubic meter per capita in a year in 1947 to 1038 cubic meter per capita in 2010, which means a decrease of more than 400 percent. It is unfortunate that Pakistan, which was once recognized as a water-abundant country, now faces water-stressed conditions. Figure 1 deals with two specific issues, population and water per capita usage, describing the timeline of these two issues from 1951 to 2050. In 2017, per capita water availability further reduced to 908 cubic meters per capita from 1038 cubic meters per capita, which is a decrease of more than 12% cubic meters per capita (Figure 1). Currently, per capita water availability is further reduced from 908 cubic meter per capita to 866 cubic meters per capita in 2020. If this trend continues, then by 2050, the country will be in dire situation in terms of per capita water availability [24]. Mainly, this hugely water-stressed condition in Pakistan is attributed to a rapid increase in population along with inefficient utilization of water.

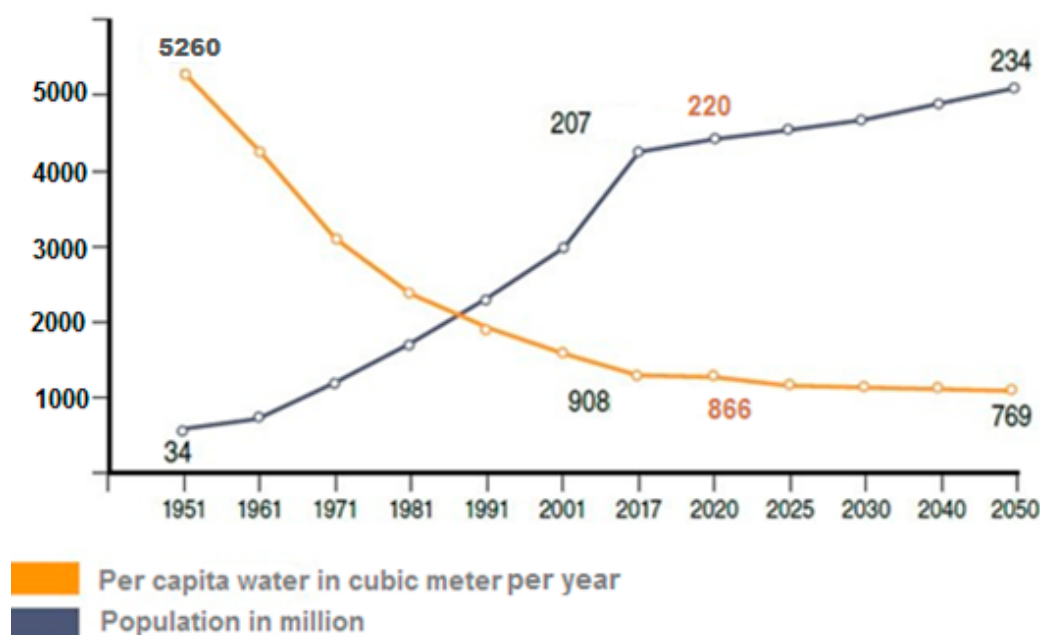


Figure 1. Per capita water in cubic meters per year in Pakistan: the above figure was originally taken from the work of Ikram Sehgal 2017 [25] and edited by the authors to show more recent trends.

While the accessibility of clean water poses a significant threat to human health, water scarcity has far-reaching effects, for all stakeholders. When rivers and streams are depleted, risks of infection may increase as the concentration of harmful pollutants increases. As water resources dwindle, wildlife can move and live closer to human settlements, drink water intended for human consumption, and pose a risk of insect-borne diseases. The effects of climate change have caused serious water complications around the globe, but further in emerging nations such as Pakistan, where many individuals live in villages and they depend on a subsistence livelihood. Climate change has led to the loss of crops, which has had a major impact on people's living standards, making them more likely to urbanize and commute regularly. Poverty in rural areas is linked to land resources, the scarcity of which can lead to massive urbanization. As water uncertainty increases, climate change

will worsen, and more droughts will occur [26]. Likewise, in the context of Pakistan, rapid urbanization along with a rising population, inefficient water usage in crop cultivation, poor water management, and lack of interest from the government will remain the constant reasons to further aggravate the water crises in Pakistan.

3. An Overview of Water Resources in Pakistan and International Water Agreements with Neighbors

Pakistan shares its water with two neighbors: India and Afghanistan. With India, Pakistan signed an important water treaty in 1960 that included the three eastern rivers—the Beas, the Ravi and the Sutlaj—and the three western rivers of Pakistan—the Indus, the Chenab and the Jhelum river. However, Pakistan claims that India violated the Indus Water Treaty when construction of the Baglehar Dam began in 1999. Pakistan has reiterated that India has raised the issue by launching new projects such as a project to construct a dam named “Rattle” on Chenab River Dam and the Kishan Ganga project which is to be constructed on the Neelum–Jhelum river. Completion of these projects, along with changes in the distribution of river water to Pakistan, may result in the loss of basic access to water to the people of the Indus basin, which is an area that relies heavily on rivers. Access to water is a “fundamental human right” embodied in various international conferences and statements. Therefore, blocking the flow of water to Pakistan by India would lead to a direct violation of human rights. Conversely, there is no agreement between Pakistan and Afghanistan on the Kabul river—one of the largest resources along the Indus River, which accounts for 10 to 12 percent of the Indus river system. The Kabul basin is the source of water for more than 20 million people, meaning that this population is very susceptible to the effects of climate change. Therefore, the co-riparian nations—Pakistan and Afghanistan—are vulnerable to climate change which is a threat to the entire region. Interestingly, both countries have a special situation on the Kabul river; they have territories located in upper and lower riparian areas. The Kabul river is an icy river that receives less contribution from glaciers [27].

As elsewhere, Pakistan’s water sector is a matter of demand and supply. As a result of harsh and dry environment in many regions of the country, irrigated cultivation is the main source of income. Direct precipitation covers just 15% of the total water needs of plants, and the remaining 85% is covered by other irrigation mechanisms. Pakistan’s ground water resources are being depleted at a rapid pace, and the disparity between water demand and supply for crop cultivation is usually fulfilled by groundwater abstraction [28]. Approximately 100 years ago, the Indus Basin Irrigation System (IBIS) was planned to increase yearly productivity (i.e., annual harvested capacity) by about 75%, with the goal of distributing irrigated water to as large a region as possible to increase resettlement capacity. The main purpose of irrigation expansion at that period was to preclude crop failures. Other characteristics of the design were the little administration and functioning requirements, which are useful but have their own shortcomings. Rising demand for food and rising commodity prices have encouraged farmers to increase annual production to meet the food growing needs to facilitate a growing population. Over time, many canals could not be designed due to landslides and coastal crossings. As a result, the availability of water in the canal per unit of irrigated land has been significantly reduced [29].

In the 1970s, insufficiency, inconsistency, and unreliability on the surface led to massive crop losses, land dilapidation, and social insecurity. Agricultural output declined due to land depletion and water shortages, resulting in mass relocations from rural to urban areas. As a result, the farm’s residents were rescued by installing groundwater wells to irrigate crops. Recognizing the benefits of groundwater cultivation, the government supported the expansion of irrigation facilities and energy supply to maintain high levels of production. Introduction of power supplies and small diesel engines increased tubewells from 10,000 in 1960 to 0.6 million in 2002 and 0.8 million in 2006 [30], whereas by 2020 the number of tubewells has increased to 1.2 million [13].

The estimated amount of groundwater abstraction from these tubewells is $51 \times 10^9 \text{ m}^3$ in relation to a recharge of $40 \text{ to } 60 \times 10^9 \text{ m}^3$. Approximately $33 \times 10^9 \text{ m}^3$ were produced

through individual tubewells, and the other $18 \times 10^9 \text{ m}^3$ came from public-owned tubewells. Mass abstraction and the use of groundwater in irrigated region of Pakistan began in 1961 with the introduction of salinity control and reclamation projects (SCARP). Thousands of large tubewells had been installed in the system to facilitate groundwater and connect irrigation equipment. This led to an increase in the number of farmers with individual tubewells with a standard capacity of $0.03 \text{ m}^3 \text{ s}^{-1}$ or less. The SCARP tubewells deepened groundwater levels from 1.5 to 2 million hectares, and from 3 to 4 million hectares, thus significantly influencing the problem of high congestion. This reduced salt-affected lands from 7 to 4.5 million hectares [31]. Excess water produced through the SCARP tubewells increased agricultural efficiency in many areas of SCARP from 80 to 120% during 1998, as mentioned in the database of International Waterlogging and Salinity Research Institute [32]. The free use of groundwater has proven to be important for food security of the poor, and a catalyst for economic prosperity in rural areas. In many water-deficit settlements in Pakistan, it transformed the vision of a small and changing crop shift to safer and more productive crops. Groundwater now provides more than 50% of the required amount of water (although most of the groundwater is reused in the surface irrigation methods, due to its flexibility and demand) [33]. The statistics around groundwater in Pakistan are even more worrying: it is estimated that during 2019, the contribution of groundwater for crop production increased to 60% which is an alarming figure. Similarly, it is also estimated that groundwater level in Pakistan lowers by one meter every year. The quality of groundwater is also depleting every year, with increasing bacteriological contamination and rising levels of metals such as arsenic [34].

The contribution of groundwater to develop plant support is growing, and will be further expanded in the future due to the increased burden to grow more foodstuffs, which will increase the causes of drought in the region [35]. Qureshi et al. [33] showed that during 2014, more than 70 percent of farmers in the province of Punjab depended directly or indirectly on groundwater to meet their needs. Without access to groundwater, farmers not only in the Punjab but also across the country will face food shortages, because more than 90% of wheat is produced in the Punjab province. To finance cultivated investment in Pakistan, it is important to invest a lot of effort and money into making this important resource sustainable. Over the past three decades, Pakistan has made some efforts to address resource depletion, maintain groundwater quality, and address the serious problem of land degradation due to water runoff. However, progress is limited [31].

The first effort to introduce a special environmental law in Pakistan was taken in 1977. In 1992, the country developed a National Conservation Strategy (NCS), and in 2001, the National Environmental Action Plan (NEAP) was sanctioned by the Pakistan Environment Protection Council. NEAP addresses environmental concerns, including air, water and sanitation, soil, and forestry issues, and it faced various challenges in addressing climate change. The National Environmental Policy was developed under the NEAP and published by the Environment Ministry in 2005, providing a comprehensive framework for addressing environmental issues arising from water pollution. This policy is aimed at protecting, preserving and restoring the national environment for sustainable development by improving the lives of citizens; moreover, it provides guidance to different classes [36].

Environmental assessment (EA) is still in the infancy stage in Pakistan. In 1970, the first set of EA rules and regulations were developed, but were not officially implemented until the late 1990s. Whereas, in the global context, EA is the frontier of public recognition and is more integrated. An important policy in Pakistan, including the EA as an important tool of the environmental crisis, is the federal government's program for sustainable development (2005–2010). It calls for the promotion of EA as a means of integrating the environment into policymaking. The International Union for Conservation of Nature (IUCN-Pakistan) 1994 established the environmental assessment services unit (EAS) in 1994 to implement Pakistan's National Environmental Guidelines by strengthening and supporting professionals and regulating institutional governance. Since its inception, the EAS has developed a wide range of services, including EAs for core policies, plans and

programs, and conducted seminars on environmental issues. Table 1, presents Pakistan's national water security index in comparison to its neighboring countries and other nation of Asia and others. In this regard, five key dimensions (KD) are reported in Table 1 including Household water security (KD1), Economic water security (KD2), Urban water security (KD3), Environmental water security (KD4) and Resilience (KD5). It is reported that security index of Pakistan is vulnerable for KD1, KD3, KD4 and KD5, which shows that the issue of water crises in Pakistan is at its peak in the majority of key dimensions as compared to other countries such as India, Sri Lanka, and Bangladesh. At present, the economic water security is not a huge threat for Pakistan as on average, the country still gains water for its major crops and yields, but if poor water management continues in future, than it is likely that economic water security (KD2) will rise to a rating of 1 (hazardous) on the water security index [37].

Table 1. Pakistan water security index in comparison to other countries source [37].

Countries	KD1	KD2	KD3	KD4	KD5	Total Rating	Index
Bangladesh	1	3	1	1	1	7	1
Cambodia	1	3	1	2	1	8	1
Pakistan	1	4	1	1	1	8	1
Nepal	1	3	1	2	3	10	2
Sri Lanka	3	4	1	1	2	11	2
China	3	4	2	2	2	13	2
India	1	3	1	1	2	8	1

KD= Key Dimension; KD1= Household water security; KD2= Economic water security; KD3= Urban water security; KD4 =Environmental water security; KD5= Resilience; 1 = Hazardous; 2 = Engaged; 3 = Capable; 4 = Effective; 5 = Model.

4. Recommendations and Conclusions

4.1. Recommendations

The following are a set of recommendations for managing water scarcity and environmental sustainability in Pakistan.

Storage and efficiency: More than 50% of the water abstracted from the Indus river system does not reach farms. In order to retain this water, efficient measures must be taken; for example, the country needs to rebuild its canal system to reduce water wastage in the form of leakages and illegal breaches of canals. Although efficient canals systems cannot be installed immediately, a rapid water supply system can reduce leakage by at least one-third. Similarly, groundwater conservation measures can be implemented by controlling their abstraction and use in irrigation efficiently. In the field of water demand management, special attention should be paid to maintenance and efficiency. The current policy is focused on supply. It is important to differentiate efficiency, which means reducing waste, from working more with less, and saving and reducing consumption.

Conservation: An important step in reducing the impact of climate change on water resources is conservation. If the rainfall is unstable and the annual rainfall is above average or the rainfall declines in the coming years, then storing more water becomes important to combat water crises, although relying only on storage is not a long-term solution. Similarly, a national conservation plan and irrigation system should be developed to consider water release, water storage, and water rehabilitation in the dry season. In addition, there is a great potential for small and medium-sized dams to improve the life of existing storage sites and to upgrade the infrastructure of the existing sites. Increasing the water reservoir increases water availability for irrigation and other users. However, there are some potential issues associated with water conservation, especially with water that is preserved in large dams—these are destroy carbon sinks in oceans, destroy habitats, and displace poor communities.

Technologically: In order to deal with water scarcity issue in Pakistan, the adoption of new technologies is urgently required, including wastewater treatment and the reuse of

water so that water efficiency may be increased in different parts of the country. Likewise, recycling seawater, using GIS technology to prepare an efficient water inventory, and monitoring and control of the actual water supply would be beneficial. Increased innovation in the water sector should be encouraged as much as possible, including investment in initiatives that promote the development of vision, demand management, and agricultural production.

Integrated water management (IWRM): Water management is moving from a sectorial approach to an integrated approach. In the context of Pakistan, an integrated water strategy is required to deal with the issue of water scarcity in the long-term. To achieve this, the integration of all water stakeholders is required, which may range from the efficient utilization of water, conservation of water, and a national consensus to manage water for future sustainability.

Fundamentals of integrated governance: The first effort to introduce a special environmental law in Pakistan was taken in 1977. In 1992, the country developed a National Conservation Strategy (NCS), and in 2001, the National Environmental Action Plan (NEAP) was sanctioned by the Pakistan Environment Protection Council. NEAP addresses environmental concerns, including air, water and sanitation, soil, forestry issues, and it faces various challenges in addressing climate change. The central government must play a key role in formulating policies to ensure sustainable surface and groundwater use, industrial use, and wastewater management. Food safety, water safety and energy security are closely interrelated, and a proper management system must address all related issues, including groundwater pollution, wastewater treatment, and emissions.

Agriculture sector: The agriculture sector is the largest user of water resources in Pakistan, but unfortunately, water used by the agriculture sector is poorly managed. In this regard, government needs to encourage farmers to adapt to modern irrigation technologies.

4.2. Conclusions

More than 70% of the rural population in Pakistan, including some of the most disadvantaged in the country, rely heavily on natural resources for survival. Efficient management is required if the precious resource of water is wasted on a daily basis. Awareness of all possible environmental alternatives requires a high return rate and reduced abstraction rate. The problem of water scarcity needs to be thoroughly studied, and a viable solution should be developed and implemented. The increase in the density of cities along river sides, has led to the abstraction of fresh water and it has a negative impact on water quality of rivers. Therefore, water balance, water quality, and water statistics are very important for a sustainable water supply. Likewise, the government should introduce effective land reforms, because large land is more productive than small land, and land ownership needs to be increased to address this issue. Effective and efficient policies for the agricultural sector will undoubtedly enhance water management efficiency of the country. Water policy is about promoting the sustainable use of water resources by improving water efficiency. There is a strong possibility of increasing the water supply by increasing the canal water efficiency (reducing leakages and illegal breaches of canals) from 33% to 90%, comparably with developed countries. Suitable solutions to reduce water leaks, efficient metering, and improving water efficiency should be encouraged. Pakistan uses only 10% of its water flow from rivers per annum, as compared to the global average of 40% [38]. The scarcity of these resources will offset huge financial costs. For example, repeated three-year floods in 2010, 2011 and 2012 severely damaged the national economy along with other issues such as the global financial crisis of 2009–2010, the devaluation of Pakistan currency, and the trade deficit. halved potential economic growth. Instead of a growth rate of 6.5%, the economy grew at an average rate of 2.9% per annum [8].

At the international level, the Indus Water Convention regulates Pakistan's right to access water in Indus basin. Although environmental and economic pressures across the border are the significant contributor to water conflict, the agreement has endured. Water policy does not include the impact of climate change on surface water use and water

resources, therefore there is a need for further actions to be taken by the officials of water policy. Provincial water management, from a regional perspective, should be adopted with India.

Water policy should strive to improve water quality for all purposes. In Pakistan, the percentage of wastewater discharged to the rivers, without treatment is 82%. Priority should be given to the development and adoption of cost-effective water treatment and disinfection technology in the construction and operation of water treatment plants to ensure safe water use. Contaminated drinking water is estimated to cause up to 40% of all diseases in Pakistan, costing between PKR 25 billion to PKR 58 billion a year. This is detrimental to economic growth, because this amount is 0.6–1.44% of GDP [39].

To reap the benefit from water resources, the entire water chain of Pakistan requires fundamental adjustments. In addition, although Pakistan once was water abundant country, it could not develop proper human resources for efficient water management. The country is now a water-stressed country, and there is urgent need for investment in human resources, particularly water managers to solve problems in this sector through scientific knowledge and research. As Pakistan approaches its 74th anniversary of independence, the government must move beyond speaking on water issues in the context of national climate change, environmental sustainability, and national water policy, to address the water crisis the country faces.

Author Contributions: All authors have contributed equally to all sections of this manuscript. All authors have read and agreed to the published version of the manuscript.

Funding: The research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data of present study, will be available on request from corresponding author.

Acknowledgments: We would like to thank Nguyen Tat Thanh University, Ho Chi Minh City, Vietnam for the support of time and facilities for this study.

Conflicts of Interest: The authors declare no conflict of interest.

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