HYDRO-MANAGEMENT CRISIS IN PAKISTAN: AN EMERGING NON-TRADITIONAL SECURITY ISSUE

(1999-2022)

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Abstract

This research project sheds light on the hydro-management crisis in Pakistan as an emerging non-traditional security issue, from 1999 to 2022. The study consists of four chapters that explore the historical roots of Pakistan's hydro-management policies, trace the link between historical policies and the current water scarcity crisis, evaluate the effectiveness of current water management policies, and develop a conceptual framework for the relationship between hydro-management and non-traditional security issues in the context of international relations. The nature of this work is qualitative and based on secondary sources of data, including books, articles, and journals from reputable sources. The data analyzed in this study focuses on policies related to water management in Pakistan, with a historical perspective, and includes steps to address the worsening water crisis in Pakistan and the South Asian region. The research project aims to contribute to the academic field of international relations, particularly in the area of non-traditional security and water management. The study's significance lies in identifying the hydro-management crisis in Pakistan as a non-traditional security issue and providing recommendations for better water management policies to address the crisis. The hypothesis is that the hydro-management crisis in Pakistan has far-reaching implications, not only for Pakistan but also for the South Asian region, and effective water management policies are crucial to address the crisis and prevent its escalation into a security threat.

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List of Abbreviations

ADB	Asian Development Bank
AKRSP	Aga Khan Rural Support Program
BRBD	Bambanwala-Ravi-Bedian-Dipalpur
CCI	Council of Common Interests
CWM	Command Water Management
FAO	Food and Agriculture Organization
FFC	Federal Flood Commission
GDP	Gross Domestic Product
GLOFs	Glacial Lake Outburst Floods
IBDP	Indus Basin Development Plan
IMF	International Monetary Fund
IRSA	Indus River System Authority
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
IWT	Indus Water Treaty
KPK	Khyber Pakhtunkhwa
LBOD	Left Bank Outfall Drain
LDA	Lahore Development Authority
MOWR	Ministry of Water Resources
NGOs	Non-Governmental Organizations

NWFP	North West Frontier Province
OWM	On-Farm Water Management
PHEDs	Public Health Engineering Departments
PHEDs	Public Health Engineering Departments
PMLN	Pakistan Muslim League Nawaz
PPP	Pakistan People's Party
PTI	Pakistan Tehreek-e-Insaf
PWC	Pakistan water Charter
RAP	Revised Action Plan
RBOD	Right Bank Outfall Drain
TMA	Tehsil Municipal Authority
TMAs	Tehsil Municipal Authority
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USDA	United States Department of Agriculture
WAPDA	Water and Power Development Authority
WASA	Water and Sanitation Agency

CHAPTER I

INTRODUCTION

The world is threatened with water scarcity and water issues currently. Water plays an important role in the economic development of states as well as is beneficial and an integral part of the ecosystem. Clean, accessible water is the basic need of every human on earth. But today countries are being affected by the unavailability of water and as per reports it will get worse. The worsening of water resources forces us to look at the preservation and management of those resources handled by the state structures. Hydro-management becomes the key development challenge as it also impacts other sectors as well, such as agriculture, environment, health, land, energy, industry and others (Rafik et al., 2017).

According to the United States Department of Agriculture (USDA), Hydro-Management can be defined as securing and controlling the water movement to minimise the damage it might pose (United States Department of Agriculture). Its main objective is supplying water to the required source whenever it is needed. As opposed to a traditional security threat, the hydro-management crisis is being labelled as a non-traditional one since its main focus moves to security of humans on ground level. Non-traditional security focuses on a global level as it affects not one or two but all the nations of the world. With our world consisting of 71% of water, water security has become an international agenda (Mustafa et al., 2013). For example, increase in population growth, urbanisation, and clean water and migration are resulting in the need of water resources. Moreover, the water's availability is being affected by change in climate, deforestation etc. which in turn are increasing interstate competition on water assets. UN-Water has declared that water security challenges may have a direct impact on the conflicts (UN-water, 2021).

All this global phenomena also tickles down to South Asia which faces high monsoon rain but has low water storage capacity, uncontrolled use of groundwater, shortage of water, lack of water supplies etc which are all leading to disputes and conflicts. Natural events which occur globally, almost 40% are recorded in South Asia this includes droughts, floods, and storms (Rafik et al., 2017). This region is highly densely-populated consisting of 23.7% of world population and it only has 4.6% of renewable water resources which makes it the most vulnerable to climate

change (Hirji, et al., 2017). These statistics make water management a key aspect for ensuring sustainable water. South Asian countries like Pakistan and India are heavily dependent on water because of its important role in the economic development related to agriculture bases. It is argued that the current water crisis that the world faces and especially the developing countries is because of failure in water management. Transboundary water resources also play a key role in the emergence of water crises especially in South Asia. Pakistan and India share the Indus River Basin which supplies 90% of water for food and 25% to economic development to Pakistan (Qureshi, 2011).

The water crisis of Pakistan could be understood by the fact that Pakistan is among the top ten countries that are most affected by climate change and its water availability is reducing from 5,000 to 1,000 cubic meters per year with growing population. According to the World Bank report (2018) the rate of reduction will be lessened more by year 2035. Being an agrarian country, Pakistan is heavily dependent on its agriculture which is directly affected by water (Qureshi, 2011). Pakistan is currently facing serious water shortage problems and by corollary, a threat to food and energy security. this water Even after being located in a water rich area and a contiguous irrigation system. Pakistan is facing severe water problems due to a myriad of reasons, such as poor distribution, irrational water management schemes, poor town and water management planning etc. (Khoso et al., 2015).

The provincial governments in Pakistan are responsible for managing the water and sanitation. Multiple institutional actors are involved in water management and governance such as Ministry of Water Resources (MOWR), Public Health Engineering Departments (PHEDs), Tehsil Municipal Authority (TMAs), Water and Sanitation Agency (WASA), Water and Power Development Authority (WAPDA), Indus River System Authority (IRSA) and even NGOs are also responsible for water and sanitation in some cities as well as maintenance and operation. The problem arises as State Bank of Pakistan also stated is in the overlapping of the responsibilities and the duplication of the work. Water availability is not the problem but rather hydro-management and governance (Cooper, 2018). WAPDA on the other hand pointed out that provinces even after knowing about the looming water crisis have not taken any action to develop water storages (Haq, 2018). By not managing water crisis and with increasing natural events in the country, Pakistan’s food, energy, and health security are bound to get worse.

Experts believe data gathering, reducing water losses, and improved and new distribution system can address the factors of the hydro-management crisis. A multi-sectoral approach is required for hydro-management as it is not limited to a certain area but rather affects all. A way forward can be addressed by efficiency and preservation, public awareness and education on water conservation, use of renewable water resources, modernization of irrigated agriculture and lastly efficient governance and an inter-provincial committee to facilitate Pakistan in dealing with this resource crisis successfully. This research work will look into four decade of water policies starting from military rule of Musharraf era (1999-2008), then the civilian rule of Pakistan People's Party (PPP) government (2008-2013), Pakistan Muslim League-N's (PMLN) government (2013-2018) and Pakistan Tehreek-e-Insaf's (PTI) government (2018-2022). Hydro-Management by these four governments will be scrutinised and determine the positives and negatives of each administration. It will highlight the challenges that hydro-management faces in Pakistan while suggesting ways to overcome the disputes related to water (internal and external). Transboundary water sharing problems especially between Pakistan-India will be examined closely for promotion of peaceful coexistence and development.

1.1 SIGNIFICANE OF STUDY

This significance of this research lies in identifying the hydro-management crisis in Pakistan as an emerging non-traditional security issue not only in South Asia but all over the world. All the regions of the world are now trying to protect and manage their water resources through new and effective ways. The research project has provided a comprehensive understanding of the hydro-management crisis in Pakistan from an interdisciplinary perspective, which can help policymakers and academics gain a holistic view of the issue. Through exploration of the historical roots of Pakistan's hydro-management policies, the research project can help identify gaps and limitations in existing policies and suggest ways to improve them. The geopolitics of South Asia over the water issues highlights the fact that these water related issues have their direct effect on the interstate relations in the region. The research highlights the challenges of water development such as mismanagement of internal and shared water resources and also suggests ways to overcome water-sharing disputes between Pakistan-India for promotion of peaceful coexistence and sustainable water management policies.

1.2 PURPOSE AND DESIGN OF STUDY

1.2.1 AIMS AND OBJECTIVES

- To understand and explore the concept of hydro-management and connect it with Non-Traditional Security under International Relations.
- To analyse the historical factors that are aggravating the hydro-management crisis in Pakistan in the recent decade.
- To analyse the hydro-management policies of previous governments of Pakistan for better understanding the current hydro-management scenario.
- To understand the existing governmental policies in the recent decades and to gauge the executional process of these policies.
- To interpret the hydro-management complications and suggest ways to counter this crisis in the regional as well as Pakistani context.

1.2.2 RESEARCH QUESTIONS

- What is the concept of hydro-management and how is it interlinked with Non-Traditional Security under International Relations?
- Why is it important to understand the historical factors influencing the non-traditional security issues that are affecting Pakistan's hydro-management?
- How did the previous hydro-management policies impact the current water scarcity crisis in Pakistan?
- How the current policies of water management have been effective in water crisis in Pakistan?
- How can hydro-management issues be resolved and alternative options be opted in Pakistan as well as in South Asia?

1.3 NATURE OF STUDY

This research study is qualitative and secondary sources of data have been used in conducting the study. The articles, books, journals etc. are all relevant to the study and are taken by reputed sources. All resources have also been cited in the reference list. Data selected consists of work on policies of Pakistan on water management and the steps taken with historical perspective as well

as how to avert the worsening water crisis in Pakistan and the South Asian region. The themes start from water management and its relation to non-traditional security in Pakistan. The main focus is on the existing hydro-management crisis in Pakistan and also in the South Asian region.

1.4 LITERATURE REVIEW

The literature of this research study is designed in thematic order following the issues raised due to the hydro-management crisis in Pakistan. Emergence of non-traditional security threat not limited to one country or a region but globally.

Chellaney, B. (2013) in his book 'Water, Peace and War: Confronting the Global Water Crisis' gives an overview of water crises in Africa, Asia and the Middle East. Chellaney has discussed that water scarcity is connected with International peace and security which is why ways to mitigate the crisis should be looked upon. He has discussed the unconventional water wars which have been waged between the riparian states in the world which is leading to mistrust between the states which might ultimately lead to an armed conflict.

Challaney, B. (2011) in 'Water: Asia's New Battleground' has defined the scarcity of water in Asia. According to him, climate change will affect Asian region the most and will ultimately affect its economic growth. Competition for water among the asian states is increasing as transboundary water resources are in abundance. Tibet provides water to 11 countries including India and Bangladesh through Brahmaputra River but China is planning to build dams on it which will ultimately raise problems with other South Asian countries.

Amjad, R & Burki, S, (2015) in their book have covered Pakistan's economic progress from a historical perspective. Review of Pakistan's growth from macro to micro levels and have also suggested ways for inclusive growth in the country. They have focused on all key sectors which include the water sector as it is connected to other sectors such as energy, agricultural sectors etc. Lastly they have recommended government improvements in the public policies and its implementation for better results.

Ebrahim, Z. T. (2020) in the book 'Water Issues in Himalayan South Asia' overviews the internal water issues of Pakistan in the chapter "Is Pakistan Running Dry?". There are seven chapters and each discusses a case study of seven South Asian countries. The main focal point of

the book is to discuss internal water challenges as well as the transboundary water disputes in the South Asian region. It also talks about the mismanagement, pollution, population increase and lack of policies which have affected the water crisis in Pakistan as well as in South Asia.

Lytton, L, Ali, A, et al. (2021) in this World Bank report have highlighted the groundwater in Pakistan's Indus Basin. According to them, groundwater has huge future prospects to be the most reliable source of water in Pakistan. By giving historical examples of how groundwater started getting extracted in the 1960's provided Pakistan's agriculture and domestic usage a huge input. But by 2020 Pakistan is about to face a severe groundwater crisis. This report also highlights where Pakistan went wrong and how hydro-mismanagement has caused these new water challenges to arise.

Hirji, R et al. (2017) in this report have highlighted water management as the main challenge to development in South Asia. This region is highly densely-populated consisting of 23.7% of world population and it only has 4.6% of renewable water resources which makes it the most vulnerable to climate change. Water management through a reliable and efficient system will ensure stable water supply for agriculture, people, energy and industry. This needs to be done quickly as the changing climate will affect it more in the coming years making it difficult to control.

Young, W, Anwar, A. et al. (2019) in 'Pakistan: Getting more from Water' a World Bank report has provided a comprehensive view of water security in Pakistan. The report focuses on challenges that Pakistan faces in water-related issues which ultimately will hinder the economic and human development. Economic growth and poverty reduction are linked as water-related risks which must be handled with great care. Lastly it identifies alternative economic trajectories for identification on where intervention can lead to a more water-secure future.

Akhter, M (2017) expounds upon water security, its causes, its effects and the various factors that affect it in the Indus Basin in his work. Water security anywhere in the world is considered to be the physical decline of supply per capita. Apart from this, the factors that also affect the physical decline of water supply are political, economic and the actual supply of water from a water body.There is observed an interaction between the structural and absolute scarcity of water affected by historical and geographical location of the Indus Basin and especially in the region of Pakistan and India.

Mirzaei, A & Zibaei, M. (2021) in this article have identified the interlinked connection of climate change with water resources at the basin level. Water scarcity and increasing droughts are leading to conflicts among the users of water. The writers have given a WEAP (water evaluating and planning) model which covers all dimensions in a state from socio-economic, hydrologic, agronomic and behavioural systems. Iran was used as a case study and it was extracted that suitable adaptive strategies could restore the water crisis and mitigate the effects of climate change.

Literature review of this research consists of articles, reports, studies obtained from print as well as from online sources. They are all taken from relevant academic journals, articles, institutional publications, books etc. The literature selected consists of data relevant to the research questions and objectives.

CHAPTER II

HYDRO-MANAGEMENT AND NON-TRADITIONAL SECURITY: AN INTERDISCIPLINARY ANALYSIS WITHIN THE FRAMEWORK OF INTERNATIONAL RELATIONS

INTRODUCTION

Water is an essential part of human survival and well-being. It not only supports human life but also many different industries and economies and also holds an essential position in agriculture. It helps regulate the climate and has a critical role in the preservation of biodiversity and maintaining the ecological balance. With such an essential position in this world, water has to be managed so that it keeps on benefitting us. As the study of water became a wider subject, it automatically also came under the domain of social sciences.

The natural resources are of two types: non-renewable and renewable. In the early times, non-renewable resources such as coal, oil, and gas were the main focal point. Their study was based on demand/ supply, their availability, and the distribution pattern. As the main focus were non-renewable, the renewable resources such as water, wind, solar, etc. were not considered critical of depletion. The focus of the study was mainly on coal, oil, etc as they were the main proponents for energy sources. But the scholarly study failed to recognize that if one source of non-renewable energy depletes there is still another one on standby. But if water resources are depleted, life on earth will cease to exist. Hence, it is impossible to deny the necessity of water for life. In order to properly study this resource, academics needed to do more than just play intellectual games; they also needed to be sympathetic to the demands of the public from a political, cultural, religious, and scientific perspective.

According to some estimates, the oceans and seas span more than 70% of the planet. Just 3% of this is fresh water, and the rest of 97% is saline water. Of that freshwater, icecaps and glaciers account for 68.7%, while groundwater makes up the remaining 30.1%. Out of all surface water bodies, Lakes constitute 87%, swamps 11%, and rivers 2%. As a result, less than 1% of fresh

water is usable for human consumption in rivers and lakes as shown in the figure 1 (Ohlsson, 1995).

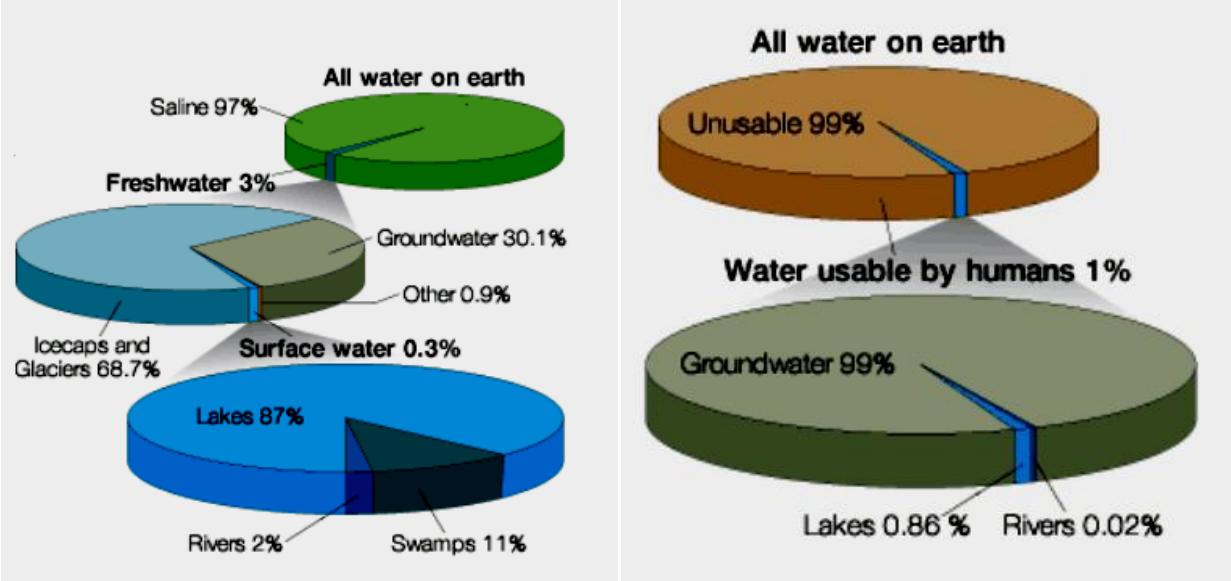

Figure 1 Pacific Water Organization, Retrieved in 2023

The demand of water is also increasing as the population is growing and the consumption patterns are changing including agriculture and other industries. If the demands are not met and the water is not managed properly, tensions will arise. Different ways have been adopted to meet the water demand and to manage it such as irrigation but due to new lands, water logging and other problems, irrigation is not a lucrative option. Water from icebergs is also being used to manage and meet the water requirements. The military, during the Gulf War and Falklands War, used iceberg for water needs.

Another means of attaining water is Sea Water which is utilized after desalinating it. Over 7,500 units worldwide are desalinating water at the moment. However, this technique is usually employed in gulf countries such as Saudi Arabia because the production costs are equal to one-tenth of the total water demand. The other countries which employ this technique are dry areas of Australia, and Spain (Ohlsson, 1995).

Soon, international relations studies and more precisely the conflict studies attention were focused on water. The water is a resource which is shared between people, states and within a state. It was soon observed that water scarcity or depletion is going to impact the states and lead

to conflicts over water (intra state and interstate). This led to security studies broadening its definition and including environment study under its domain. Hence the research on all environmental issues including water scarcity, ozone depletion, deforestation, global warming, etc. became international concern as it now hindered the security and peace of the world. Water in security discourse has a major role now.

2.1 CONCEPT OF SECURITY IN INTERNATIONAL RELATIONS

The concept of security has existed since the human lives on earth begin. In the early time security was only identified with military or state security. The need to secure your area or borders of your region became the top most priority. Especially after the Treaty of Westphalia came into existence, state-security overtook all other forms of security. Security only meant to protect your state from the enemy. Although the idea of enemy was changing as new types of warfare generations were being introduce but the concept of security was still only associated with the protection of state.

The idea of security was that the better and larger military with advanced technological equipments you have, more secure your state would be from internal and external threats. But the concept of security saw two major shifts, the first was seen after World War II and the second was seen after the downfall of USSR (1991). New states were being introduced during this period and so did the age of globalization. Globalization introduced the concept of security into other spheres. And as the world started to interact more and more, new ideas and concepts were being added to the existing concept of security. International Relations had a serious ecological blindness problem up to the late 1960s and until the emergence of the Environmental Movement. The study and practice of international relations would have keep on going if environment resources were infinite but sadly that is not the case. The situation changed, mainly when it was realized that the environment/ nature is not resilient. The study on the environment shows that the world's natural resources are depleting and are finite. As nature is directly related to the security of humans, this made security studies include the environment in its discourse.

2.1.1 TRADITIONAL SECURITY

The concept of security is analysed in multiple ways, some analysts describe it as vague to something which is all pervading. According to Rowland Maddock (1996), a threat which is

perceived by the whole society is a security threat. In a traditional sense, protection from the armed attacks of the enemy or the other state is the main concept of security. Stephan Walt is one of the realists in International Relations. He has described security as:

"The study of the threat, use, and control of military force" (Walt, 1991)

This definition shows that the traditional theoretical frameworks of International Relations only revolved around power, conflict and peace. Realism, Idealism and Structuralism are the main three schools of thoughts through which we see the world in different lenses (Viotti & Kauppi, 1993). These three schools of thoughts have specific actors, a predefined structure and a narrow topic agenda. These points show a stark contrast from the environmental issues and as to why the analysts of International Relations were not able to understand the evolving discourse.

During the Cold War, the security discipline got diverted, and strategic studies gained more prominence. Security of the state was viewed through the link between military means and political ends. As a result, the risks coming from outside were studied, and national interests served as the motivation for the state. The field of security revolved around the discourse of arms race, war, deterrence and disarmament. The concept of security was not being challenged in this disciple and was moving between the same actors, structure and agenda.

Soon, the Copenhagen School including Barry Buzan, Ole Weaver and others gave a boost which was needed in the security studies. They broadened the concept of security by breaking it from political, social, economic and environmental confines. According to Buzan (1991), the definition of security has a different meaning in each school of thought in International Relations. Where the realists believe that security is derived from power and the idealists believe it is a consequence of peace. But Buzan believes that the concept of security is situated between peace and power. He argued:

"…the concept of security is, in itself, a more versatile, penetrating and useful way to approach the study of international relations than either power or peace" (Buzan, 1991)

Thus, broadening the definition of security from the state security where the political actors were the main players. The environmental issues do not see any conceptual, state or institutional boundaries, and are equal for all. This is why the environmental problem (and thus, water) needs more response from international actors. For peaceful existence in the world ecological health

must be a key component. This is why, the concept and definition of security (individual and collective), has acquired a broader definition and included the Non-Traditional Security elements. From traditional elements (military and political components) to including the non-traditional security elements (economic, social and environmental), the security problem has broadened its spectrum (Ullman, 1983).

2.1.2 NON-TRADITIONAL SECURITY

The non-traditional security measures go far beyond the conventional ones, such as war or military. In contrast to traditional security, where the state is the primary focus, non-traditional security centers on the individual. It also covers other issues including poverty, environment, natural disasters, and other things like hunger, water, food, and energy. When an individual, a community, or the entire human race is engaged, human security becomes the primary objective. The protection of each person from non-military means becomes the main objective.

The idea of "human security" was first officially defined in the Human Development Report in 1994, released by the UNDP (United Nations Development Programme). Mahbub ul-Haq, former finance minister of Pakistan and consultant for the UNDP, has been closely linked with this notion since its inception. He wrote an article ‘New Imperatives of Human Security’ in 994 which laid the theoretical groundwork for human security and facilitated its widespread acceptance. Haq asserts that human security prioritises individual security over that of nation-states (Haq, 1994).

Non-Traditional security includes issues which are global in nature. Not one or two, but every individual will be affected from its negative impact. These issues include water scarcity, floods, droughts, environmental degradation, food security, human displacement, climate change, diseases, transnational crimes, etc. The threats which were originated from non-military sources have been defined as non-traditional security threats by Mely Caballero-Anthony. Human Security holds a major part of non-traditional security as humans are at the centre of non-traditional security. Where in traditional security state security was the main component, in non-traditional security humans hold the major position. The above mentioned issues majorly affect the human life.



Figure 2: Components of Non-Traditional Security, (Emmers, 2006)

In an essay on 'redefining security', Richard H. Ullman has argued for the involvement of issues which are outside of the scope of military in the concept of security. He defined security as something which hinders and threatens the quality of life of all humans of the earth. This threat can happen drastically or is happening over a period of time. It narrows the policy options of a state or other non-governmental entities of a country (Ullman, 1983). Global warming and climate change are one of the biggest threats to human life currently. These topics have been highlighted numerous times and on different platforms such as 2019 UNGA (General Assembly of the United Nations).

Slowly other domains such as political, economic, societal and environmental have become a part of security. Buzan defined all three and gave an explanation on how each domain has security as its main part. Political security focuses on states and governments and the organizational structure. On the other hand, economic security, focuses on financial stability, recources, etc. The societal security has our traditions, customs, languages and all the things which makes up a society in a protective circle. Environmental security was defined as the maintenance and protection of the ecosystem. Myers (1993) called environmental security as the

'ultimate security', proving the point that the security of the environment or natural resources is of ultimate importance.

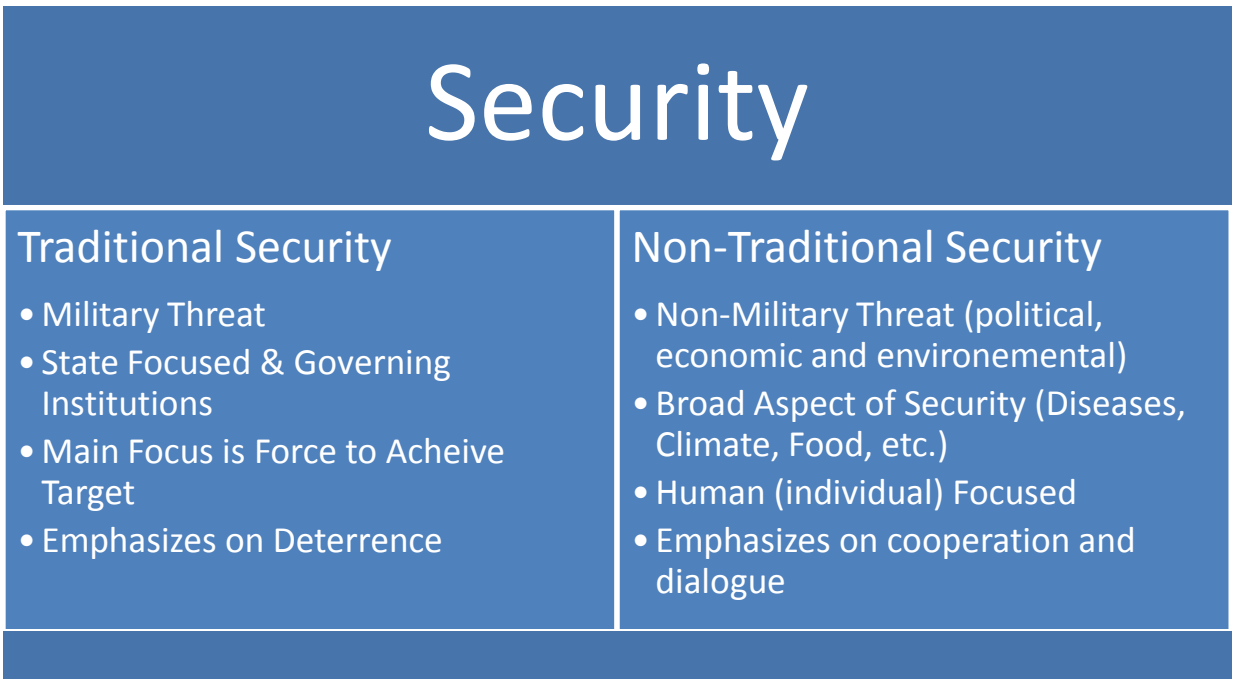

Figure 3: Difference between Traditional & Non-Traditional Security, (Emmers, 2006)

2.2 WATER IN SECURITY DISCOURSE

The increased interest in the environmental security discourse followed up with increased importance and focus on water security. People's lives, political security of a state and the looming water conflict between states, forced water into the domain of security studies. Water was affecting each domain of security including economic, social, political and environment. After entering the security domain, water was being seen as a natural resource with the power to cause strain between states as well as within states (Thapliyal, 2011). As the water has multiple sources, there is a certain starting point of each of these water sources. When it comes to transnational water sources, the upper riparian states or regions have a dominant position as they are in control of the water heads. The lower riparian region or state is in one way or another at mercy of upper riparian state. For the states not to abuse the water flow, international laws and agreements have been created, which makes sure the lower riparian region is not being neglected or abused.

Water has become one of the main topics of the environmental discussion over the last 30 years. It is considered the source of all life on earth and being a multifunctional good, water, has no other known alternative. The idea of security has now included water as a major component and it also includes the water resources and concerns relating to water. The politicization (and consequent securitization) of water has been a fairly common practice, especially in regions of the world where its scarcity is the primary focus such as the Middle East and North Africa. Water is also linked to other issues such as poverty, population increase, hunger and other development issues. The way water is being managed constitutes an important part of the demand and supply of the water and the environmental security concerns of a state.

It is obvious that the water security combines state and human security concerns, and also interconnects economic and human growth. Securing enough water resources at the state level is essential to sustaining food production and supporting industry, hence ensuring the state's economic sustainability. Agriculture-based economies are particularly at risk from water scarcity; however countries that rely on hydropower are likewise more susceptible to water shocks than nations that use other energy sources (Gleick, 1993).

As important regions of the world suffer exponential rates of population increase, rising consumption patterns, degrading water sources, and the hazy effects of climate change, the restrictions on water availability and water quality are getting tighter. Some nations are currently dealing with extreme water insecurity known as "water stress" as a result of these global challenges. Because of these conditions, society must quickly adjust. However, a large number of the nations that will face the greatest water stress also lack the governance capabilities to effectively respond to the shifting supply and demand disparity. In these regions, a significant risk factor that could lead to weak states failing is likely to be water insecurity.

2.3 CONCEPT OF HYDRO-MANAGEMENT

Water resources are not merely for drinking but also serve as a foundation for economic development, higher political standards and political and social stability. But for all these points to take place, it has to be effectively managed. But current and emerging water conflicts raging between and within nations points to poor resource management. This is what made hydro-management an essential field to understand especially its demand and supply. Also fulfilling the

increasing water needs is essential especially in the states facing water problems. As more and more countries are on the verge of facing water scarcity, it will be difficult for the government to manage and provide the required water needs.

In simple words, hydro-management is a process of managing water resources to meet the demands of users while also maintaining the health of the ecosystem. This includes activities such as dam construction, irrigation, flood control, and groundwater extraction. The main goal of hydro-management is to balance the demand and supply of water which has to be done sustainably. The process must be done in a way that it doesn't cause any depletion in the resource or cause any harm to the environment.

2.3.1 DEFINITION OF HYDRO-MANAGEMENT

One definition of hydro-management comes from the World Bank, which defines it as

"The process of developing, implementing, and enforcing policies, strategies, and plans for the sustainable management of water resources."

Another definition comes from the United Nations which defines Hydro-management as:

"The integrated management of water, land, and related resources, in order to maximise economic and social welfare without compromising the sustainability of vital ecosystems." (UNDESA)

As you can see, the general idea behind all the definitions is same. Integrated water management, balanced demand and supply, increased economic and social welfare while also ensuring that the ecosystem and all resources remain sustainable for future use, is the crux of hydro-management.

2.3.2 KEY ELEMENTS OF HYDRO-MANAGEMENT

Hydro-management is a wide term which encompasses multiple activities for managing water resources. Some of the key elements included in the hydro-management are:

2.3.2.1 WATER ALLOCATION

Deciding how much water should be allocated to different users and sectors, such as agriculture, industry, domestic use, and the environment. This can involve the use of water rights systems, water allocation plans, and other tools to ensure that water is used efficiently and equitably (Wurbs, 2013).

2.3.2.2 WATER RESOURCES MANAGEMENT

Managing the supply of water from different sources, such as surface water, groundwater, and recycled water. This can include activities like dam construction, river diversions, and groundwater pumping to increase water availability (World Bank, Water Resources Management).

2.3.2.3 FLOOD CONTROL

Managing the risk of floods by building dams, levees, and other structures to protect communities and infrastructure from flood damage. Flood control also involves planning and preparedness activities to minimize the impacts of floods when they do occur (World Bank, 2020).

2.3.2.4 WATER QUALITY MANAGEMENT

Ensuring that the water supply is safe and suitable for its intended use. This can include monitoring and regulating pollutants, treating wastewater, and managing land use activities that can affect water quality.

2.3.2.5 ENVIRONMENTAL FLOW MANAGEMENT

Managing the flow of water in rivers and other waterways to ensure that the needs of aquatic ecosystems are met. This can include setting minimum flow levels, releasing water from dams and reservoirs, and managing stream flow patterns to create suitable habitat for fish and other aquatic life (UN Water).

2.3.2.6 CLIMATE CHANGE ADAPTATION

Preparing for changes in precipitation patterns and sea level rise that will result from climate change's effects on water resources. This can include building more resilient infrastructure, developing drought-resistant crops, and identifying new sources of water supply (World Bank, 2022).

Overall, hydro-management aims to balance the competing demands for water while ensuring ecological conservation and sustainable resource usage. This can be a complex and challenging task, but by taking a comprehensive and integrated approach, it is possible to meet water demand for humans and the environment.

2.3.3 IMPORTANCE OF HYDRO-MANAGEMENT

Hydro-management is important for a number of reasons. Mainly it ensures access to clean and reliable water where it is demanded. Water is used and needed in different sectors including households, agriculture, industry, and the environment. Hydro-management is essential for the regions where water scarcity is becoming a reality. The demand and supply ratio is also unbalancing due to growing population and economic development (UNESCO).

Pakistan and other parts of the world are facing high ratio or floods and droughts. The need of the hour for these nations is effective hydro-management as it will help in minimizing the impact of floods and droughts by managing the water resources in a way that reduces the risk of these events, and by planning for and responding to extreme weather events when they do occur (World Bank, 2022).

Another important thing which hydro-management helps is in protecting the environment. Poorly managed water resources can lead to environmental degradation, including loss of biodiversity, water pollution, and land degradation. Hydro-management can help to protect the environment by ensuring that water is used sustainably, by monitoring and regulating activities that can affect water quality and ecosystems. It also supports economic development by providing water for irrigation, energy production, and other uses. Food security and the welfare of the people are also linked with efficient hydro-management; this can be done by ensuring the availability of water resources.

2.3.4 HYDRO-MANAGEMENT AS A PREREQUISITE FOR DEVELOPMENT

Water infrastructure and economic development has a clear link which is quite significant when it come to economic activities of a country (WWDR, 2009). Slowly as the technology became more accessible and advanced people started to use new ways to meet their water requirements. Some of the new ways were irrigation system, large scale dams and reservoirs, cisterns and harvesting systems (WWDR, 2009). In the early years the hydrological cycle was precise and provided minimal rain, but as population grew, so did the demand for more food. This led to increase in water storing and distributing the water mainly for the food production (Hunt, 2004).

Planners and decision-makers realized the importance of building a sufficient water infrastructure as populations and economies grew in order to ensure the survival and advancement of the nation. US Inland Waterways former secretary, William McGee said that in order to have cost savings and economic growth, proper management of water and advanced technology is required. this will also increase the energy production and help in navigation in river (McGee, 2010). McGee's visionary understanding of the importance of managing water resources as a tool for fostering national economic development lays the groundwork for prioritising water for national security.

World Bank economists David Grey and Claudia Sadoff (2007) assert that governments can be classified as industrialised or underdeveloped based on their capacity to build institutions and infrastructure to manage their water resources. According to Grey and Sadoff, water institutions and infrastructure serve as both a cornerstone for water security and a catalyst for growth.

2.4 HYDRO-MANAGEMENT AND NON-TRADITIONAL SECURITY UNDER INTERNATIONAL RELATIONS

The world is being plagued with population growth, climate change, environmental hasp hazards and multiple other environmental problems. Not just one country but rather all regions are affected by it but some more than the others. This is especially true for South Asia, Africa and the Middle East which are being termed as the water scarce regions. As population growth, the cost of industrialization, and the demands of agriculture have increased water consumption, it is now putting pressure on nations to claim a larger share. This idea of claiming might lead to water conflicts within and between the states.

There are multiple other non-traditional security threats which are putting water supply in danger. Droughts and floods due to climate change have become quite an important element. This can be seen in multiple parts of the world. For example Aral Sea Basin is shared by almost seven states (Five Central Asian states, Afghanistan and Iran). These countries are being threatened by water scarcity as the Aral Sea is shrinking and drying up. According to the experts is intensifying because of poor water and land management. Many countries of Asia cultivate cotton, which requires intensive water but because of water pollution from the agrochemicals, the cultivation is being affected. This is also leading to inter-state conflicts as the transboundary

water sources is affecting states sovereignty, territory and in case of water, the riparian rights (Elhance, 1997).

As the water usage and demand is increasing, states responsibility of providing and supplying the water is also increasing. Mostly a state controls the demand and supply of water and as the river water also comes under their control, so does its discourse. Water resources are also transboundary which means they don't have a certain demarcation they cross the borders of two or more nations. This way it becomes water sharing sources and brings in the international actors to discuss hydro-management and the resources.

Water crisis has become an important topic in international debate. In 1977, the United Nations Water Conference held in Argentina proposed the idea to prepare the world for the upcoming water crisis as it is global in nature. Then in 1992 International Conference on Water and Environment drafted an action plan which overlooked new ideas for sustainability in the water sector. The plan was submitted to United Nations Conference on Environment and Development (UNCED). United Nations has been trying their best to increase the discourse and actions revolving around water crisis. They have formulated Agenda 21 in which it gives a detailed action plan related to all issues of water and while also keeping the resource sustainable for future use (Dolatyar, et al, 2000).

The way water resources are managed within and between the countries provide an adequate playground. Mismanagement of water has been termed as the main reason for the increase in water scarcity. For the states to overcome non-traditional security issues, people or state actors involved must come together for hydro-management. The Indian Prime Minister Manmohan Singh, while listing water as the one of the seven pillars of development, stated that the involvement of people or general public is important to meet the challenges of natural disasters especially in the field of hydro-management (Singh, 2004).

2.5 HYDRO-POLITICS IN A NON-TRADITIONAL SECURITY PARADIGM

Generally hydro-management problems have been related to unequal distribution and inequality in the system. But Mahendra P. Lama (1997) has identified that the politics of the region plays a

critical role in managing the transboundary water bodies especially when nationalistic tendencies are involved. So is the case with water issues in the state, political rivalry has influenced the hydro-management crisis. Politics surrounding water disputes are frequently influenced by factors such as population size, economic development, availability of sufficient water, and social organizations.

The extent to which water has contributed to violent conflict between states as well as served as a forum for discussion and collaboration has been the subject of extensive inquiry. The two most well-known, though frequently at odds, points of view on water politics are those of Peter Gleick and Aaron Wolf. Water has not been the explicit target of war between states in more than 4000 years, according to research by Gleick and his colleagues at the Pacific Institute (Gleick, 1993; Wolf, 1999). However, water has occasionally played a role in riparian state disputes that have led to military engagement between states. In the Middle East, protection of water sources has created a conflict like dynamic between Israel, Jordan, Palestine and Syria (Klare, 2002).

Additionally, water has been used as a weapon of war or as a target of conflict (Gleick, 1993). Water infrastructure such as dams and irrigation systems have been targeted by the enemy forces during major wars such as World War II, Korean War, Vietnam War and others (Gleick, 1993). A country suffers severe consequences when its water infrastructure is destroyed, including the risk of flooding, power outages, and deteriorated water quality, all of which can be used to effectively suppress opposition forces. These instances support the claim that, even when governments haven't engaged in direct conflict over it, water has played a significant role in interstate conflict.

The choice to use and distribute water, whether it comes from rivers, trans-boundary rivers, glaciers, or underground, belongs with the state. As a result, the person is required to follow both the state's authority and its water-use policy. Those who express opposing or alternative opinions are perceived as being on the other side of the security zone as the state assumes the dominant voice. Making laws, policies and having an organizational body is how the state controls the water access and its usage. The problem with the third-world countries is that the authoritative figure controlling water is not an expert in the field but rather a political figure. This creates hurdles in efficiently managing water in the state.

The reality on the ground is generally different than from the political plans are created. In case of transboundary agreements, the sates sometimes go in defiance and oppose the trusties or agreements. The higher authority must be aware of the ground reality before creating laws. This goes for both national and international level. The development projects for hydro-management are the need of the hour but sometimes they also get in the way of political rivalry or political instability in some cases. The politicization of hydro-management especially when it comes to bigger development projects such as dams for hydropower, water management, etc. are hampering the progress related to water sustainability.

Riparian position affects perceptions of the equity of water resource allocation and use across groups within a state, much like hydropolitics at the interstate level. For instance, the Cauvery River allocation dispute between the Indian federal states of Tamil Nadu and Karnataka has lasted for decades. The river flows will be appropriated by both states for agricultural use, and each considers the other's plans to be an infringement on their water rights. Property damage, injuries, and a handful of fatalities have resulted from the conflict between the two federal units (Kramer, 2004).

Kalabagh Dam is one of the biggest examples of politicization of a project. It is a proposed hydroelectric dam on the Indus River in Pakistan. It was proposed in 1980s but since then has been a contentious issue in Pakistani politics. The political parties and regional interests have taken a strong position (for and against) regarding the dams establishment. The debate over Kalabagh Dam is a hot topic as the ones opposing it believe that it would harm the environment while also displacing the local population and will only benefit certain regions. This debate has highlighted the broader challenges facing Pakistan's political system, including regionalism, ethnic tensions, and a lack of consensus on important policy issues.

2.6 HYDRO-MANAGEMENT IN SOUTH ASIA

Water is the second most critical issue of stability in south Asia. The fresh water crisis is preparing to emerge at a large intensity. South Asia is considers as the water stressed area where there is deficiency in the supply of water and increase in population. It is obvious that in south Asia, the demand for water is going high on the list. Water is already the contentious problem prevailing in south Asia with the exploitation of water resources. Transboundary rivers such as

Indus, Ganges and Mekong have elucidates the geography and cultural view of south Asia but over the few years, they have come under the pressure of the population growth, industrial development, increased urbanization (UNDP, 2022). The poor management and lack towards resources have led the region to extreme drought and flood condition.



Figure 4 Water Sources in South Asia | South Asia Journal

"South Asia is a water insecure region in many ways, but is not because of actual physical scarcity. Therefore, one has to look at water security and insecurity as resource management and governance problem in south Asia." (Isha Ray)

India is experiencing similar shortages like that of Pakistan. A government minister issued a warning in 1998 that the amount of freshwater available per person was decreasing as a result of fast population increase and urbanization. According to the minister, freshwater availability per person is predicted to be 1,500 cubic metres per year in 2025 as opposed to 2,200 cubic metres in 1997 and 5,300 cubic metres in 1955. Water scarcity in Asia is anticipated to get worse in the coming year (Bandyopadhyay, S. et al., 2020). Given that irrigation is already a major part of Asian agriculture and that much of the anticipated increases in food production are likely to depend on even higher levels of irrigation and irrigation efficiency, this will have a significant negative impact on food security.

Conflicts between the countries like Pakistan, India, Afghanistan and Nepal have made region the violent place to live where the states should open up space for water sharing system (The Diplomat, 2019). There is a necessity for the downstream states to look up for the negotiations and for upper stream states, it is necessary to open up their water basin for water sharing to lower riparian ones.

Hydro-management is a serious issue in South Asian states as they share multiple water bodies with each other and require water extensively. South Asia is a water-stressed region, characterized by high population density, rapid economic growth, and a complex network of transboundary water resources, which can lead to water scarcity, floods, droughts, environmental degradation, and other non-traditional security challenges.

2.7 HYDRO-MANAGEMENT IN PAKISTAN

Pakistan faces numerous political and social challenges but with these challenges Pakistan is being termed as the most water-stressed country in the world (World Bank, 2005). Pakistan has one of the largest irrigation systems in the world, and its economy is mostly dependent on agriculture. However, Pakistan faces an uncertain water future due to inefficiency and misuse, as well as anticipated climatic changes and rapid population growth, which endangers the state's ability to function and legitimacy.

When considering Pakistan's state of water security, the flaws and contradictions evident in its political, social, and economic structures become even more apparent. Water security, according to Grey and Sadoff (2007), necessitates a foundational level of institutional and infrastructure ability to prepare for and meet water requirements as well as to respond to future water-related crises. The environmental context, also referred to as the hydrologic legacy, of a nation has a significant impact on its capacity to achieve water security (Grey and Sadoff, 2007).

According to these definitional standards, Pakistan's water security is precarious. Pakistan already has difficulties meeting its present water needs due to its dry to semi-arid climate and dependence on just one main river system. Pakistan's infrastructure is also outdated and ineffective, which causes significant waste (Kamal, 2009). There is little regulation in place to stop industrial water quality degradation. Recent flooding incidents show that Pakistan's

government lacks the capacity to respond to significant water-related emergencies, leaving the populace with severe water insecurity.

Pakistan has a number of transboundary water concerns as it shares rivers with India, China, Afghanistan, and Iran in South Asia. In case of Pakistan and India, they share the Indus River which has become the cause of major issue between the two countries. The disputes are due to construction of dams and hydropower projects on the shared river basin. It raises concerns over the ecological health of Transboundary Rivers and the raising issue of riparian states.

Efforts to manage water resources in Pakistan have traditionally focused on increasing water availability for agriculture and other sectors, rather than on sustainable water management. However, there is increasing awareness of the need to adopt a more holistic approach to hydro-management in the region, which includes a focus on sustainable water use and water conservation, as well as the protection of ecosystems and the promotion of good governance.

Hydro-management in South Asia and Pakistan, therefore, involves addressing the complex web of water-related challenges that are seen in the region. This includes working to ensure equitable and sustainable access to water for all users, managing the risks associated with floods and droughts, protecting and restoring transboundary river ecosystems, addressing disputes over shared water resources, and working to address the wider non-traditional security challenges associated with water scarcity and environmental degradation.

CHAPTER III

EXPLORING THE HISTORICAL ROOTS PAKISTAN'S HYDRO-MANAGEMENT WITH FOCUS ON NON-TRADITIONAL SECURITY (1947-1990)

INTRODUCTION

Water is an essential part of human survival. But in addition to being necessary for human consumption, water holds an important position in a state's economic development. It is essential for agriculture (production of food), hydropower (production of energy), and environment (maintenance of ecosystems). These things in the world are also essential for survival of human kind as without food no human can survive.

Our planet earth consists of 29 percent of land and 71 percent of water (Spellman & Bieber, 2012). While constituting a larger chunk of this planet, its importance also increases, especially now when the disparity between water supply and demand has started posing a major threat.

Pakistan is currently experiencing a serious water deficit, while posing direct risk to the socio economic issues in the country. Ineffective water management, climate change, and a lack of political will to address the crisis have further aggravated water crisis (Baloch, 2018). Urbanization and population increase are just two of the many causes contributing to the water dilemma. The irrigation of Pakistan is also outdated and inefficient as it consumes almost 93% of total water and in process loses 60% of it during transportation and application (Imran, 2018).

India has not been of much help to Pakistan's water crisis either as it has started constructing the dams on Pakistani rivers which is diverging the water ways. This will ultimately create more problems for Pakistan and its agricultural sector. As Pakistan is an agricultural state, in case water scarcity reaches an alarming high it will have a devastating effect on the economy and create food crisis as well, further leading to conflicts within the country (Maitlo, 2019). In terms of water sharing within Pakistan, the provinces already feel that the water distribution is not equal. Balochistan and Sindh accuse Punjab of taking more than the shared amount.

In Pakistan, lack of water will hinder food production, increasing food poverty. Also, the disappearance of water, which is essential for conducting domestic business, agricultural production, and industrial processes, will halt development and have a terrible effect on society, leading to both economic and health instability. Furthermore, lack of water has the deadly potential to start or intensify a conflict, which will lead to instability in both the individual and the group (Fahim, 2011). All in all, water scarcity has been associated with mismanagement of water by the Pakistan's authority, which in turn has started to influence the non-traditional security concerns in the country.

3.1 HYDROLOGICAL ENVIRONMENT OF PAKISTAN

3.1.1 PAKISTAN'S WATER SOURCES

Pakistan has some major water sources. The two major water resources are natural and artificial (manmade). The natural resources are rainfall, ponds, lakes, streams, rivers, wells and others. The major surface water comes from rivers and rainfall that is surplus to needs for irrigation and other uses. The remaining water is held in dams and reservoirs which is a major example of artificial water source. In addition to being utilised for cultivation and providing water for daily use, the water from these dams and reservoirs is also used to generate hydroelectric power. These water sources of Pakistan provide the outflow of water to different sectors. According to PCRWR, the major water sources of Pakistan include surface water, groundwater, rainfall and glaciers.

3.1.1.1 SURFACE WATER: Surface water resources, which make up around 1400 million km of the planet's surface, cover three-quarters of it, according to a 2009 assessment by the Punjab Irrigation and Power Department. Only 30 million km^3 (or 2.20%) of our planet's surface is covered by fresh water, and precipitation is the main source of this resource. The surface water in Pakistan comes from rivers, canals, lakes, and ponds. The major rivers in Pakistan are the Indus, Jhelum, Chenab, Ravi, and Sutlej. The Indus River is the most significant source of water in Pakistan, and it is the lifeline of the country's agriculture and economy.

3.1.1.2 RAINFALL: Rainfall is a natural phenomenon and is the main source of precipitation in Pakistan. Monsoon and the western disturbances are the reason of rainfall in

Pakistan; the monsoon occurs from July to September and accounts for 70% of annual rainfall. But as Pakistan's climate and regions vary, the amount of rainfall also varies from north to south of the country. The most significant amount of rainfall is experienced in the canal command areas of KPK and Punjab provinces.

3.1.1.3 GROUNDWATER: Groundwater is an essential source of water in Pakistan, particularly in areas where surface water is scarce or inaccessible. The aquifers under the ground on the region are the main source of groundwater. The Indus Basin Aquifer System is the largest aquifer in Pakistan, and it is the source of groundwater for most of the country.

3.1.1.4 GLACIERS: Pakistan has several glaciers in the Himalayas and Karakoram ranges, which are a vital source of water for the country. As the glaciers melt (now excessive due to global warming) the water contributes to the flow in the rivers. This water source is majorly used for irrigation and hydropower in the country.

3.1.2 INDUS RIVER BASIN

River Ravi and its tributaries are the main water source in Pakistan and India. It flows roughly from north to south with some farmlands and a lot of water infrastructure like canals, dams and embankments. It's a system that transformed one of the most arid regions in the world into millions of acres of farmland. And it also helped create Pakistan's precarious relationship with water.

With an area of over 566,000 km^2, the Indus Basin spreads to almost 70% of Pakistan. The water which it gets from western rivers (Jhelum Chenab and Kabul) and eastern rivers (Ravi and Sutlej) derives the Indus Basin. The Indus Basin which rises from the Himalayan peaks moves to Sindh's low-lying regions and ends at the Arabian Sea (Yu, et al, 2013). The Indus River Basin also provides the space to the world's largest continuous irrigation system. About 150,000 km^2 of crops in Pakistan get its water from the Indus Basin Irrigation System (Ahmed, 2005). This shows that the major part of Pakistan's agriculture is interlinked to the Indus River Basin.

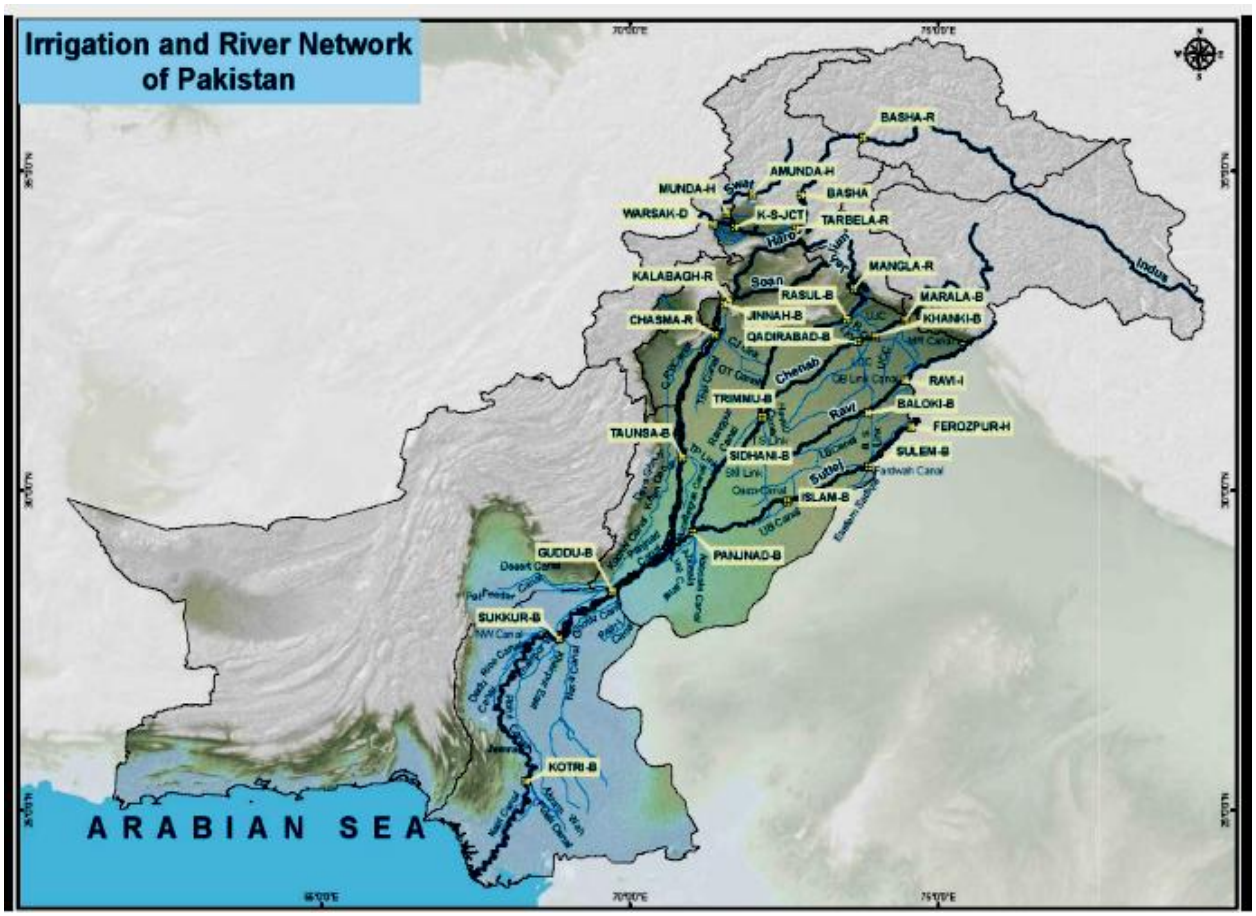

Figure 5: Irrigation and River Network of Pakistan, IRSA (Available Online: http://pakirsa.gov.pk/Home.aspx)

The environment of the delta has, however, gotten worse recently because there hasn't been a consistent minimum river flow. The area experiences extremely little precipitation on average—about 230 mm/year. The basin has a subtropical climate with annual transpiration rates of 2,112 mm (UN-Water, 2020). In the past 75 years Pakistan's population has increased fivefold while the water availability per capita is plummeting. By 2025 the region is predicted to reach absolute water scarcity. With this Pakistan also suffers from increasingly severe flooding events, each one destroying land and claiming hundreds of lives.

3.1.3 WATER CONSUMPTION BY SECTORS

A country which has abundant water resources is now being considered as water scarce. Pakistan is on its way to become the most water-stressed country in the world. Multiple reasons have been

attributed to the source which is causing the water scarcity; population growth, climate change and environmental degradation.

Majority of the water consumed in Pakistan is by the agriculture sector which is almost 69 percent. Being an agro-economy, agriculture sector will the most affected one. The second is all the other industries with 23% and lastly 8% by domestic users as shown in figure 6.

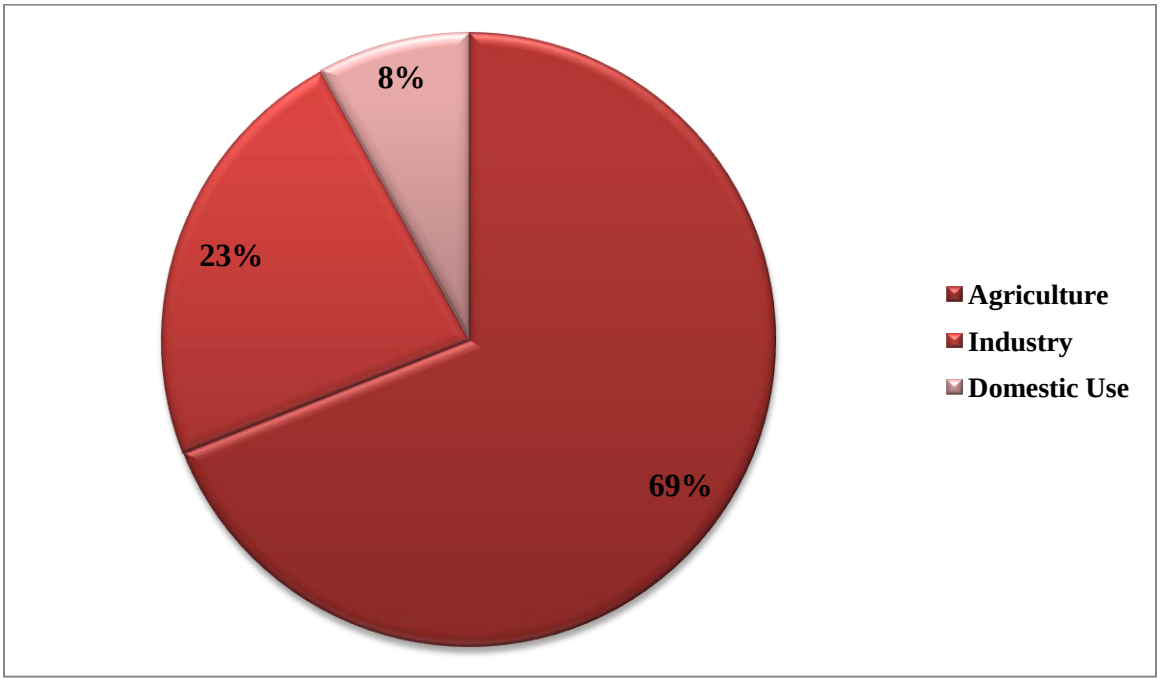

Figure 6: Water Consumption by Different Sectors in Pakistan, (Khoso, S & Ansari, A, 2015)

3.2 TRACING HYDRO-MANAGEMENT THROUGH PAKISTAN'S HISTORY

Pakistan gained independence in 1947, but the water sources in Pakistan and South Asia has forever been present. Even though a demarcation line divided the sub-continent into different countries but the water sources can't be divided but rather have to be managed expertly. The transboundary water sources still have the same route and flows from state to state.

3.2.1 INDUS VALLEY CIVILIZATION

The great rivers have played a significant influence in the development of the world's underdeveloped regions throughout the Neolithic, Copper, and Bronze Ages, which span thousands of years of human history. The magnificent Indus Valley Civilization thrived in the area where Pakistan is located. According to archaeological evidence, the great civilizations thrived and had the best chances of progressing close to the banks of the Indus, Nile, Tigris, Danube, and Ganges rivers (Karlovsky and Sabloff, 1979).

With the increase in population, humans' style of production changed from subsistence agriculture to the cultivation of cash crops thanks to the refined irrigation system. Along the banks of the Indus River, the Indus Valley Civilization (4000–3000 B.C.) thrived and created an irrigation system, according to Briscoe and Qamar (2005). According to Sohag and Mahessar (2004), the Indus River and its tributaries (Chenab, Jhelum, Ravi, Bias, and Sutlej) were instrumental in Pakistan's creation of the world's greatest irrigation system. The first canals in Pakistan date back to Feroz Shah Tughlaq's rule in the fourteenth century, and the irrigation system was created between the sixteenth and eighteenth centuries during the Mughal era. However, the British began building irrigation canals in the Indo-Pak subcontinent at the beginning of the 19th century, during the colonial era. Despite the fact that Indus-derived irrigation has been used for centuries (Karlovsky and Sabloff, 1979), Pakistan's irrigation system's physical foundation was planned and built in the 19th and 20th century during the colonial era. The irrigation system has also undergone significant physical improvements since post-partition in 1947.

3.2.2 PRE- BRITISH COLONIZATION

The modern water infrastructure that transformed the Indus river basin started with British colonization in the 1800s. Before British rule this region was largely populated by agropastoralists. They had spent centuries raising livestock and growing crops like sorghum, vegetables and rice along the river. They migrated depending on the Indus river basin fluctuations.

The region is arid and the Indus River and its tributaries are its singular source of surface water fed by snow and glacial melt starting in the spring from the mountains in the northeast and heavy seasonal monsoons in the summer. As it does today, this means the flow of the river fluctuates a

lot throughout the year roughly 84 percent of its flow occurs from around April to October while the other half of the year the river flow diminishes. So if the flooding happens, the flooding would typically spread put onto the floodplain and because it could spread out all over the flood peaks would not be that high. This would have been the case if the flow had not been changed.

Pre-colonial empires build their own irrigation system. Inundation canals that captured flood waters and allowed irrigation several miles from the river's banks. Like the river, they flowed seasonally filling up during peak water flow but were dry in the winter and crucially they followed the landscapes natural drainage patterns. This way the water still found its way back to the Indus system and the sea.

3.2.3 BRITISH COLONIZATION- 1800S

3.2.3.1 ANNEXATION OF PUNJAB (1849)

In the 1800s things began to change. Punjab was annexed by the British in 1849 and the main development on the irrigation system can be traced back from that time. The Indus basin region fell under British authority and was incorporated into their Indian empire in 1857 after a series of conflicts. Most of the Punjabis which sided with the British during 1857-1858 conflicts were acclaimed as “the martial race of India”. So for the services that they showed to the British during that time, were compensated by land in the west Punjab. The British wanted to keep them happy so that they would continue showing support to them in the future.

The British had their own strategic considerations as well while the Punjabis were content to gain the ownership rights for themselves. The British originally wanted the use the agricultural frontier in the west Punjab as a preventive measure against the Russian invasion. This scheme was the part of the Great Game of that time. Punjab was also envisioned as a major economic hub that would supply raw materials to British companies.

The strategic plan and also the fact that Punjab region was faced with ongoing famines gave way to the irrigation channels development in the 19th century. These channels were built between Ravi, Beas, Sutlej, Jhelum, and Chenab rivers. As the famines were a great threat to the lives of people and a security threat to the British, the irrigation channels became a major source for the increase on agricultural production.

3.2.3.2 DEVELOPMENT OF CANALS

After Punjab was annexed in 1849, the development of irrigation infrastructure reached its apex. The new British rulers wanted to make this region as agriculturally productive as possible. They began building a much larger network of canals (perennial canals) designed not just to capture flood season flow but to irrigate year round and to extend the river waters reach. This water would irrigate cash crops like wheat and cotton up to 100 miles from river source. The British built embankments to keep flood water from flowing past the river's banks and the key to these canal systems designs were barrages. The completion of the Lloyd Barrage in 1932 is emblematic of this change. It's now called the sukkur barrage and sits on the Indus River in the province of Sindh. This project alone created canals that irrigate around 8 million acres of land.

Nine colonies were constructed and this helped make Punjab a fertile land which once was the waste land. Given the dependency on canal waters, there would not have been a water dispute in the absence of canal colonies because the value of water would have been negligible and the possibility of diverting the flows nonexistent in the absence of the modern irrigation system.

3.2.3.3 SINDH-PUNJAB DISPUTE

The large canal system also demonstrated the increasing reliance on water supplies. For instance, Sindh opposed the construction of Bhakra Dam in the 19th century as that wold have made Sindh dependent more on Punjab. This conflict between Sindh and Punjab was only resolved by the Rao Commission in the middle of the 20th century (1941), which concluded on "equal apportionment" citing the rule that a "upper riparian can take no action that will interfere with the existing irrigation of the lower riparian." Lower riparian awareness was not unheard of on the subcontinent, according to the argument made by Sindh. It is also possible to argue that during the years leading up to the partition, people's minds may have been affected by such worries and assertions that highlighted the geographic significance of headwaters.

3.2.4 PRE-PARTITION YEARS

The partition lines created were impacted by the canal network and the Sikh sentiments during that time. The canal network had created interdependency between both nations as Punjab was considered as one during the British rule. Radcliffe also proposed that the water system in Punjab is a complex and can’t be separated so it should be a joint venture controlled by both countries after independence. But both Jinnah and Nehru rejected this idea as they believed that this will,

in future, become an issue as the water related affairs of both countries will be shared. Jinnah even retorted that he would rather see Pakistan as a desert than a fertile land because of the courtesy of Indians. This statement demonstrates that throughout the early years, territorial goals and water were not related.

This issue in future did become a major issue for both countries known as "Kashmir Issue". F. J. Fowler in 1959 stated that India's threat to Pakistan in relation to water control is real and is one of the most pressing issues in relation to Kashmir for Pakistan. He stated that the reservoirs built in the upper valley of Jhelum and Chenab can be used to store excess water flow in summer by India creating problems for Pakistan. The connection, however, became increasingly significant during the administration of President Pervez Musharraf, as India's aspiration to build river projects is becoming more prevalent.

3.2.5 PARTITION-1947

By 1947, at the end of British rule the canal system had grown into a large network that turned roughly 26 million acres of land in the basin into farmland. The Indus River and its tributaries were diverted into a vast web of canals. After Pakistan won independence the government continued the legacy left behind by the British and added more barrages and links to the canal system. 18 barrages and canal link were added in between 1960 to 1990. The system includes over 50 canals, over 80 dams, 19 barrages and two major drainage projects for agricultural waste. The whole canal system is considered the largest contiguous canal system anywhere in the world. The inter-provinvial problems related to water initially rose because the major water flow came from the rivers in Punjab Province.

3.2.5.1 RADCLIFFE LINES: THE ISSUE OF HEADWORKS

The Indus valley irrigation system has a command area of around 20,000,000 ha and an annual irrigation capacity of approximately 12,000,000 ha. The Government of India Act of 1935 devolved responsibility for water management and supply to the individual states for the first time (Wescoat et al., 2000). The Government of India Act decentralised water rights as a precursor to eventual independence from the central British government, which had previously arbitrated disputes over water irrigation. In heavily irrigated areas like Punjab and Sindh, where water rights were decentralised, issues emerged rapidly.

When Pakistan and India were hastily divided along the Radcliffe Lines in 1947, millions of people on both sides of the border migrated, throwing the region into chaos (Wescoat et al., 2000). While the British were concerned with population distribution, the allotment of Indus River water was made more difficult by the Radcliffe Lines. The Bari Doab and the Sutlej Valley Project (a key tributary for the Indus) which was initially one was cut off into two. This cost Pakistan the headworks which fell to India while the canals flow was spread in Pakistan. This gave way to problems and disputes between both countries ultimately making way for the Indus Water Treaty in 1960.

3.2.5.2 1948- INDIA-PAKISTAN WATER CONFLICT

When India cut off water supplies to several Pakistani canals at the start of the summer irrigation season in 1948, it sparked a significant water conflict. India ceased water shipments due to the uncertainty surrounding water allocation following partition and to meet the water demands. Initial discussions failed to settle the matter, and India's move resulted in the loss of water from around 5.5 percent of Pakistan's agricultural land (Miner et al., 2009). No violence broke out, but the conflicts between the provinces hinted to deeper issues and a bilateral treaty to resolve the differences between the upstream and downstream water users. Because to the tense relationship that India and Pakistan had established during the 1947 Kashmir War and the fact that it was unlikely to improve in the foreseeable future, a legally enforceable water distribution agreement was necessary to prevent a potential escalation of tensions (Wescoat et al., 2000).

3.3 HYDRO-MANAGEMENT/ HYDRO-GOVERNANCE SYSTEM IN PAKISTAN

After Pakistan was created, for a smooth hydro-management, a hydro-governance system had to be created. Through this system effective water services were to be provided regularly, monthly, seasonally, and annually through cooperative efforts of all stakeholders and the use of infrastructure, funds, and other resources (FAO, 2018). Additionally, the practice of analyzing, monitoring, and developing action plans to keep water resource in a desirable state is referred to as "hydro-management." Hydro-governance, on the other hand, is used at all levels including federal, provincial and local levels as a social, political, and administrative strategy. This strategy is utilized to manage the water resources and deliver quality water to the people (Ahmad, 2018).

According to the FAO (2018), legal frameworks, protocols and certain processes are included in the governance system. This gives a platform and access to the governing body to resolve the disputes over water resources by using those protocols and frameworks. Neef (2009), has described hydro-governance as a collection of system which regulates the policies and also overlooks the financial and monitoring frameworks. Furthermore, hydro-governance explains how regulatory politics and allocative decisions are used in relation to water security through formal and informal institutions, deciding "who gets what and how much, and who does what" in a transparent and equitable manner (Jiménez et al., 2020).

Pakistan after independence created a hydro-governance system especially for the management of water. This system includes agreements, laws, policies and institutions which overlooks all water related activities. With time new laws and policies were created which were the needs of the time.

3.4 AGREEMENTS, LAWS, AND POLICIES FOR HYDRO-MANAGEMENT IN PAKISTAN (1947-1990)

Effective management depends on excellent governance, just as efficient services do. As a result, for hydro-governance to be effective, it must be tailored to the specific geopolitical, biophysical, cultural, and political practices of the nation (FAO, 2018). Pakistan has a variety of political organizations, laws, and regulatory bodies operating at both the federal and provincial levels. It was necessary to restructure its legal system and institutions in order to manage the water of the Indus River. The 1947 partition divided the Punjab province and with the water system. Indus Water Treaty became a major step for both countries as both countries bilaterally decided the division of the Indus Water System (Briscoe, 2005).

3.4.1 ADOPTION OF 1873 BRITISH CANAL AND DRAINAGE ACT

The first act adopted by the government of Pakistan for hydro-management was the British Canal and Drainage Act of 1873. In 1967 revisions were made on this act (Bisht, 2013). The act created a legal framework for the allocation of water through a traditional system of water distribution which is known as “warabandi” (Qureshi & Ashraf, 2019). The term is divided into two words: wara (wahr) which means ‘turns’ and bandi which means ‘fixed’ (PWD, 1987). It was a fixed method for water allocation and distribution adopted by the British in which the rotation of the

water depended on the individual water use (Malhotra, 1982). This was done to protect the canals from suspended sediment and heavy silt load. According to the act, all the water resources are owned by the government and in case the irrigation water infrastructure is destroyed in any way, the government holds the right to put sanctions.

3.4.2 COUNCIL OF COMMON INTERESTS (CCI)

CCI's main role is to resolve the issues or disputes which erupt between the federation and the province. Article 155 (3) in the 1973 Constitution of Pakistan discusses this issue of power sharing. According to this article, problems involving water are sent to the Council of Common Interests (CCI) for resolution, and both the federal and provincial governments are required to abide by the Council's judgment.

3.4.3 INDUS WATER TREATY- 1960

When the disputes increased between both nations, India and Pakistan came to an important agreement over the flow of the Indus River and its tributaries via the Indus Waters Treaty (IWT), which the World Bank mediated (Basharat, 2019). The pact established a Permanent Indus Commission to arbitrate disputes and assure the treaty's conditions were implemented between both countries. The treaty also assigned and divided the rivers in which the three eastern rivers went to India (Ravi, Beas, and Sutlej) and three western rivers to Pakistan (Indus, Jhelum, and Chenab).

The IWT revolves on the dilemma of upstream river management vs downstream water demand. It was with this in mind that India and Pakistan worked to strike a balance in their interests via the IWT. Specifically, "Pakistan shall receive for unrestricted use all those waters of the Western Rivers which India is under obligation to let flow," according to Article III, Section 1 of the IWT's "Provisions Regarding Western Rivers." That's the conclusion reached by (Basharat, 2019).

The treaty's Article IV further lays out the four circumstances in which India is permitted to "interfere" with the Indus, Jhelum, and Chenab rivers: There are four main use for water: (1) residential; (2) industrial; (3) agricultural; and (4) hydroelectric power generating. As noted in the treaty, the clauses offer flexibility for interpretation in the upstream power's use of rivers for national internal reasons.

The IWT has been effective in averting significant water conflicts between India and Pakistan, as well as in providing a stable framework for the two nations to manage their shared water resources. Others have criticised the pact as being skewed towards India, which has erected multiple dams on the western rivers, harming Pakistan's water supplies (Miner et al., 2009).

From its foundation, the IWT has played an important role in establishing Pakistan's water policy. The government has prioritized infrastructure development in order to fully realize the capacity of the Indus River system, which is crucial for Pakistan's agriculture-based economy (Basharat, 2019). The treaty has also had an impact on Pakistan's policies to hydro-management, stressing the significance of international collaboration and diplomacy in resolving water issues.

In order to make up for the lost water supply from the Beas, Sutlej, and Ravi rivers (rivers allocated to India), the Indus Water Treaty mandated a substantial infrastructure development programme, including connecting canals, barrages, and extra reservoir storage. Pakistan's government received funding for the Indus Basin Development Plan (IBDP) from the World Bank and a group of "friendly countries". It contributed to the Indus irrigation system's deeper territorial and economic integration, which was aided by a greater dependence on water system engineering and planning (Basharat, 2019).

Pakistan not only has inter-water problems, but it also has to face external water problems, majorly from India. The transboundary water issues include integrated water resource management, ecosystem management, and differences in water-use habits on both sides. Contradictory interpretations of the Indus Water Treaty (IWT) provisions gave India the chance to construct water reservoirs and control structures on the rivers that Pakistan was given access to. This is now becoming a serious threat to Pakistan's water security (Mirza, 2021).

3.4.4 KALABAGH DAM PROPOSAL

The Kalabagh Dam is a planned hydroelectric project on the Indus River in Pakistan that has sparked great debate. The dam was initially suggested in the 1960s as a solution to Pakistan's expanding water and energy demands, but it has been met with considerable resistance from the provinces of Sindh and Khyber Pakhtunkhwa, who claim that it will diminish their water supply and create environmental harm (Bhatti, 2011).

Despite several feasibility studies and cost-benefit evaluations, the Kalabagh Dam project was never completed owing to political resistance and a lack of agreement across provinces. The dam debate underscores the difficulties in combining national interests with the concerns of regional governments and local populations.

3.5 MANAGEMENT AND ENVIRONMENTAL REFORMS FROM 1970s-1990s

In the 1970s, tensions in the water sector induced by economic, environmental, and institutional performance prompted the development of new paradigms for "water management." There was a rise in complaints that national investments in the water sector were not helping agriculture and the economy as planned, were hurting the environment, and weren't helping local water authorities. Broadly speaking, the national military and bureaucratic organisations that had supervised extensive water development in Bangladesh were weakened as a result of the 1972 war with India and Bangladesh's independence (Miner et al., 2009). Transformation from development to management was influenced by challenges in governance, economic performance, and environmental quality.

Measures of management included both economic efficiency and institutional capacity in addition to physical water control. Many aspects of water infrastructure, including its management, distribution, and efficiency, were considered. It shifted the conversation over water use from the federal level to the state, local, and agricultural spheres. Increased acknowledgment of hydro-management expertise and inventiveness in socially and physically marginalised regions, such as mountain villages in Northern Pakistan and katchi abadis in Karachi, mirrored and supported this idea of decentralization inside the main irrigation system (World Bank, 1990). The management and environmental reforms focused on seven substantive fields (Wescoat et al., 2000):

3.5.1 IRRIGATION ADMINISTRATION

The irrigation subsector was the first to experience the management revolution, which concentrated on the physical and socioeconomic elements of hydro-management. A USAID-funded “On-Farm Water Management” (OFWM) project in Central Punjab focused on failing water channels and inefficient irrigation techniques. One of the project's most significant

advances was the employment of creative participatory approaches, such as water users' organizations, to boost output on the agricultural sector. Early results of the OFWM Project in minimizing physical water losses via irrigation efficiency led to widespread implementation in the 1980s and 1990s. In the plains, irrigation management research has expanded beyond watercourse improvement to include equity; environmental quality; economic efficiency; and institutional and policy reforms.

The International Water Management Institute (IWMI, previously IIMI) and other bilateral and multilateral organisations hosted regional exchanges of experience and knowledge in these fields. Despite novel policy initiatives (e.g., command water management) and growing government recognition, these trends have not resulted in a significant transition from bureaucratic to participatory water management. The Aga Khan Rural Support Program (AKRSP) funded innovative programmes of local irrigation investment and management in the Northern Regions. Local adaptations to water supply instability and shortage have received attention in Balochistan.

4.5.2 PLANNING FOR GROUNDWATER MANAGEMENT AND DRAINAGE

The private sector should be allowed to handle groundwater development, according to the Revised Action Plan (RAP) for the 1980s. The SCARP transition, as it is known, was made possible as a result of this advice, which was implemented through programmes (World Bank, 1997a). Engineers and planners in Pakistan gave drainage, salinity, and waterlogging the highest priority after the construction of massive dams and canals (WAPDA, 1990). A National Drainage Plan was developed to manage regional groundwater and drainage activities (World Bank, 1997). It was noteworthy that it made an effort to treat drainage issues as "environmental" problems, highlighting the rising concern for environmental aspects of hydro-management. Physical structures included the enormous and expensive Left Bank Outfall Drain (LBOD) and a hypothetical Right Bank Outfall Drain (RBOD) (Mott MacDonald International and Hunting Technical Services, 1992). Market-based efforts and collaborative management are recent groundwater management strategies (Basharat, 2019).

4.5.3 FLOOD RISK REDUCTION

Floods in 1973 caused enormous damage and demonstrated that a single disaster might reverse years of progress. This understanding sparked the nation's first Flood probe. Prior to

independence, flood control was a provincial duty (Basharat, 2019). After 1973, the federal government attempted to coordinate provincial and national flood prevention measures via a Central Flood Committee, which was eventually replaced by a Federal Flood Commission (FFC). In contrast to the irrigation and drainage subsectors, flood risks planning has continued to focus on physical measures of flood management, as opposed to societal vulnerability and non-structural means of flood damage mitigation. Flood-control programmes in the mountainous north have increased snowmelt and runoff monitoring in the upper Indus and Jhelum basins, as well as ice-dam outburst forecasts, but have largely ignored local flood risks modifications and mitigation (Basharat, 2019).

4.5.4 WATER SUPPLY AND SANITATION IN REMOTE AREAS

Despite the International Drinking Water Supply and Sanitation Declaration (1981–1990), residential sanitation and water supply have made only modest, independent progress. Programs promoted suitable technology, participatory techniques, and local financing, operations, and maintenance. IWMI has recently focused on the connections between irrigation and health. With the exception of trial programmes by the Aga Khan Health Service, efforts to enhance rural water supply and sanitation in the Northern Regions have been doomed, inadequately organised, and underwhelming in comparison to the region's intended objectives.

4.5.5 SECTOR OF URBAN WATER SUPPLY

Urbanising cities, such as metropolitan Karachi, Islamabad-Rawalpindi, Lahore, as well as small towns in Punjab and Sindh, are experiencing major problems with water availability and quality. The World Bank and the Lahore Development Authority worked together on a project that linked upgrades to municipal water infrastructure with the preservation of the Walled City's historic heritage. Large-scale World Bank-funded water and sanitation projects were underway in Karachi throughout the 1980s, but they were halted due to financial difficulties, political unrest, and ethnic violence. In the Karachi region, the Baldia Soakpit Project and the Orangi Pilot Project are two of the most successful and well-researched community-based sanitation development programmes. The environmental and water challenges of urbanising and peri-urban areas are expected to worsen as rural-to-urban migration increases.

4.5.6 ENVIRONMENTAL ADMINISTRATION

In Pakistan, the environmental issues of water management are receiving increasing official and non-governmental attention (Basharat, 2019). The National Conservation Plan of Pakistan has detailed sections on water resources. Water and environmental preservation initiatives in the Indus delta have been initiated by the International Conservation Union (IUCN-Karachi). The Indus basin model, which was originally created for irrigation water sector analysis, has lately been extended to examine environmental elements of groundwater management as well as the prospective implications of global climate change in the Indus basin. The Northern Regions have produced one of the most robust records of environmental studies to date. The National Conservation Plan contains chapters on highland watersheds, while international symposia on Karakorum-Hindukush-Himalaya conservation include water resource research.

4.5.7 MANAGEMENT OF THE WATER SECTOR

Activities for managing the environment and water in Pakistan are still in their inception. For instance, the Command Water Management (CWM) Project made vain attempts to synchronise regional water programmes. On the other hand, the Water Sector Investment Planning Study (WSIPS) made substantial progress in bringing together federal and provincial planning initiatives. An inter-provincial water treaty was signed in 1991, nearly immediately after it was finished, in an effort to put an end to a century of struggle between the provinces upstream and downstream.

According to NESPAK and Mott MacDonald (1993), the National Drainage Programme Project has focused on environmental issues related to drainage projects. One of the most challenging integration issues is the control of the water systems. Despite an increased emphasis on farmer participation and decentralised control in planning documents (WAPDA, 1990), these concepts have received little more than lip service in field management. Large-scale irrigation systems are still run by provincial irrigation agencies and the WAPDA under a systemic institutional structure that puts engineering solutions ahead of social ones. The World Bank's proposal to reinstate the area-based approach to water management and relate it to water pricing and privatisation plans to be carried out by provincial water utilities has drawn a lot of criticism (World Bank, 1994).

3.6 HYDRO-MANAGEMENT POLICY FROM 1990-PRESENT

3.6.1 18TH AMENDMENT|CENTRALIZATION TO DECENTRALIZATION

In Pakistan, the development of the Water Policy and its framework has gone through numerous stages. Multiple national and international reports, particularly in the last three decades, called attention to the need for higher authorities to address issues with hydro-governance. The federal government, however, mostly controlled the water governance policies. The 1973 Constitution's 18th Amendment, was ratified in 2010 and this changed the country's paradigm from one of centralization to decentralization. This in turn gave the provinces more influence over policy and decision-making (Yang et al., 2014).

Water institutions and authority were split between provincial and federal administrations following the 18th Amendment. According to Gillani, Shafiq, and Ahmad (2019), environmental pollution, public health, and agriculture (connected to water) are now exclusively provincial responsibilities. According to Mustafa and Akhter (2013), each province has a distinct department in charge of irrigation, water supply, and sanitation. In contrast, water resources (surface and groundwater resources) were elevated to federal status.

3.6.2 NATIONAL WATER POLICY AND NATIONAL WATER RESOURCE MANAGEMENT PLAN (2018-2022)

In recent years, Pakistan has been dealing with a significant water crisis as a consequence of a number of causes, including climate change, rapid population growth, and insufficient management practises for water resources. The government has adopted a variety of policies and initiatives to tackle the crisis, including the National Water Policy (2018) and the National Water Resource Management Plan.

The National Water Policy (2018) places an emphasis on enhancing water management practises, increasing water storage capacity via the construction of dams and reservoirs, promoting water efficiency and conservation, and fostering more inter-provincial water cooperation. The significance of gender-sensitive policies and practises is brought to light by the policy, along with the importance of the engagement and participation of stakeholders in the administration of water resources.

In the National Water Policy (NWP) of 2018, water scarcity got high attention by the government and this policy was approved as the national need of the time. The following problems are addressed by the policy:

- Sustainable national commitment to significantly expand public and private resources for the water sector.
- This commitment should cover water conservation, water storage, water treatment, and clean drinking water.
- The development of institutional frameworks that can solve current shortcomings in project management and cost-effective maintenance on a war footing in order to restore the technical capability and efficacy of the system that made such amazing progress between 1950 and 1990.
- Promotion of environmentally friendly production and consumption practises across the entire water industry, from extraction to use.
- Improvement of the nation's available water resources through prudent and equitable use of reservoirs, conservation, and efficient use.
- Improving the efficiency of the system and decreasing non-revenue water by making the necessary investments to fulfil the needs for drinking water, handling waste water, sewage disposal, and industrial effluents.
- The expansion of hydropower to boost the proportion of renewable energy.
- With the agreement of all federating units, construction of new big dams for system augmentation, medium and small dams for local and regional applications, and smaller dams for water conservation.
- Dams are checked and repaired on a regular basis, and water should be used sustainably at every level of use.
- Wastewater should also be treated and potentially reused in the agricultural, industrial, and home sectors. (MWP, 2018)

The National Water Resource Management Plan (2019-2023), acts as a road map for the implementation of the National Water Policy and lays out targets for improving water management practises and infrastructure, will be in effect from 2019 until 2023. The policy

focuses on improving water governance, increasing water efficiency and conservation, and enhancing water storage capacity via the creation of dams and reservoirs.

3.7 POLICIES OVERVIEW

Pakistan has implemented several laws, policies, and agreements related to water management and governance over the years.

Year	**Policy and Institution**	**Provincial or Federal**
1873	Canal and Drainage Act[1]	Provincial & Federal
1945	Sindh-Punjab Agreement	Provincial
1952	Punjab Development of Damaged Areas Act	Provincial
1958	Water and Power Development Authority Act (WAPDA)	Provincial & Federal
1959	Land Reforms	Provincial & Federal
1960	Indus Water Treaty	Bilateral
1973	Council of Common Interests (CCI)	Federal
1977	Federal Flood Commission (FFC)	Federal
1982	Water Boards and Farmer Organization	Provincial
1991	Water Apportionment Accord	Inter-Provincial
1992	Indus River System Authority (IRSA)	Provincial
1993	National Environmental Quality Standards	Provincial & Federal
1997	Provincial Irrigation and Drainage Authority Acts	Provincial
1998	National Drainage Program	Provincial & Federal
2001	WAPDA Water Vision (2025)	Provincial & Federal
2005	National Environment Policy[2]	Provincial & Federal

2006	Balochistan Water Policy	Provincial
2007	Pakistan Vision 2030	Provincial & Federal
2007	National Disaster Risk Management	Provincial & Federal
2009	National Drinking Water Policy[2]	Federal
2010	18th Amendment to the Constitution of Pakistan	Federal
2011	Punjab Drinking Water Policy[2]	Provincial
2012	National Climate Change Policy	Federal
2015	KPK Drinking Water Policy[2]	Provincial
2015	Pakistan Vision 2025	Federal
2018	National Water Policy[2]	Provincial & Federal
2018	Punjab Water Policy[2]	Provincial
2020	KPK Water Act[2]	Provincial

Sources:

1. Jawad Hassan, Environmental Laws of Pakistan (Lahore: Book Biz, 2006).
2. Govt.Policies, PCRWR (https://pcrwr.gov.pk/govt-policies/)
3. Bisht, 2013
4. Mustafa and Akhter, 2013

3.8 INSTITUTIONS OVERVIEW

In Pakistan, the water related institutions are divided into provincial and federal. After the 18th amendment most of the decisions are taken by the provincial setup. Whereas the major decisions regarding the water query for the country are taken by the federal institutions. The major institutions inviolved in water governance and management include Ministry of Water Resources (MOWR), Public Health Engineering Departments (PHEDs), Tehsil Municipal Authority (TMAs), Water and Sanitation Agency (WASA), Water and Power Development Authority (WAPDA), Indus River System Authority (IRSA) and even NGOs are also responsible for water and sanitation in some cities as well as maintenance and operation.

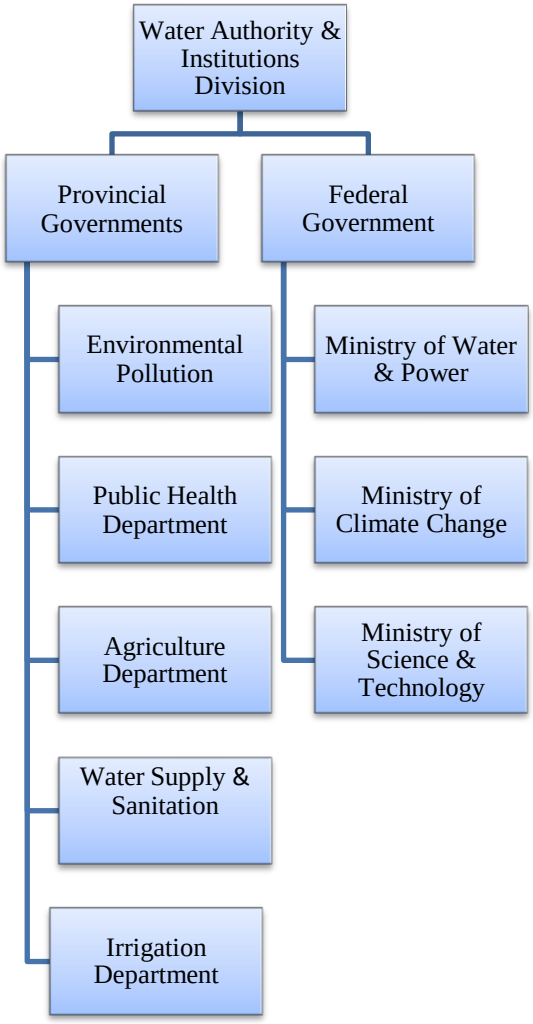

Figure 7: Institutions Related to Hydro-Management in Pakistan, Mustafa and Akhter, 2013

Pakistan's water management and administration are severely disappointing and unsatisfactory, this is due to inefficiency and structural inconsistency. Pakistan is experiencing a serious water crisis as a result of many years of managerial neglect. Institutions and policies for water management abound, but their execution is sluggish and ineffective. Most policies at the federal, provincial, and institutional levels overlap and are in conflict with one another due to a lack of technical expertise and coordination. It makes the division of duties between the federal and provincial governments unclear and confusing.

In Pakistan, the legal system for managing water is also extremely complicated. Many laws that were put into effect decades ago have never been examined or changed to reflect the passage of time or evolving needs. Political gridlock prevented the building of new reservoirs. Because of this, Pakistan cannot conserve enough water during rainy days, causing considerable freshwater to be wasted. The country has been unable to settle the internal disagreement over water allocation for the past 70 years. There isn't a simple answer to this issue. The administration must take action in parallel on various fronts.

Pakistan must make serious and persistent efforts to overcome this problem. Legislative tools that are suited for sustainable water development will be made available through effective reforms and rational decision-making procedures. Pakistan must reexamine its problems with governance and water management, and it must equip its institutions to collect data accurately and efficiently. efficient collaboration amongst all stakeholders is crucial to ensure a just distribution of water since accurate information will aid in efficient planning. In order to guarantee accuracy in the application of policies, transparency in the data gathering processes, and the absence of corruption in the irrigation water from canals, strong monitoring and evaluation systems are also urgently needed. There is no other way for Pakistan to guarantee the efficient management of this finite resource.

CHAPTER IV

TRACING THE LINK BETWEEN HISTORICAL HYDRO-MANAGEMENT POLICIES AND CURRENT WATER SCARCITY CRISIS IN PAKISTAN

INTRODUCTION

Pakistan is a South Asian nation that has borders with India, Afghanistan, Iran, and China. With nearly 220 million citizens, it is the fifth most populous nation in the world. It is known for its diverse culture, rich history, and natural resources. However, one of the most pressing issues that the country faces is the water scarcity crisis. Water scarcity is a global issue, affecting millions of people worldwide. It is defined as the lack of sufficient water resources to meet the demands of a population.

Pakistan is one of the countries that are most affected by this crisis. The country is situated in a region that is naturally arid and semi-arid, with limited rainfall and a high rate of evaporation. In recent years, Pakistan has been dealing with a serious water problem as a result of factors such as changes in climate, fast population increase, and ineffective management techniques regarding water resources. This situation has profound consequences for the country's economy, ecology, and social stability.

Pakistan's agriculture, hydropower production, and residential water supply are significantly reliant on the Indus and its tributaries. Yet, the nation is suffering a water shortage issue owing to a variety of causes such as deforestation, unsustainable farming practices, and poor irrigation infrastructure. The problem is compounded further by the fact that Pakistan and its neighboring nation, India, have been entangled in a long-running water dispute over the distribution of Indus River resources. This has heightened tensions between the two nations, with Pakistan accusing India of damming the rivers in order to deny Pakistan its legitimate share of water.

One of the causes is population expansion, since Pakistan's population has grown by over 50% over the past three decades. It has placed tremendous strain on the nation's water supplies. The groundwater is being extracted without any second thought which in turn is depleting the aquifers and declining the water quality. In Pakistan, the rivers flow is not equal which is causing asymmetrical relationship between the provinces and creating problems. The history of canal irrigation and the colonial legacy established by the British also had a significant impact on the politics of the water sector. The unequal land distribution patterns prevalent in Sindh and Punjab are evidence of the colonial heritage in modern-day Pakistan. Among these, bureaucratization and corruption in the water industry have also influenced how water resources are distributed. The army's function as well as the connections between politicians, wealthy landowners, and the water bureaucracy significantly influence water politics in Pakistan.

In this chapter we will go through all the factors which are contributing in the mismanagement of water leading to the water crisis in Pakistan and exacerbating the non-traditional security threat. Analysis of the policies will be made, which have pushed Pakistan to the line of extreme water scarcity. Pakistan’s hydro-management dilemma has serious ramifications for the country's food security, energy security, and social stability. It is critical to understand the roots of this problem. Pakistan has gone through political instability which has also affected the water policies, as new government brings new policies.

4.1 CURRENT WATER SCENARIO IN PAKISTAN

4.1.1 PAKISTAN’S WATER AVAILABILITY

Northern areas in Pakistan receive the snowfall in the winter season and the rainfall in the country is noticeably unpredictable in terms of intensity, timing, and aerial distribution. The Lower Indus Plain receives, in average less than 100 mm of rainfall and the Upper Indus Plain receives more rain, exceeding 750 mm.

Presently, Pakistan solely relies on the three western Indus tributaries of the Kabul, Jhelum, and Chenab rivers, while an agreement gave India exclusive use of the three eastern tributaries of the Indus, the Ravi, Sutlej, and Beas rivers. These eastern rivers currently carry 4.60 MAF of water

from India to Pakistan, with an extra 3.33 MAF of runoff produced in their catchments within Pakistan. The Kabul River on the other hand contributes 21 MAF to surface water.

The Indus River System receives an average annual water inflow of roughly 146 MAF, which is primarily produced from snow and glacier melting, according to IRSA data from 2013. With predicted yearly losses of 48.29 MAF, Pakistan's current water availability at various canal head works is approximately 97.71 MAF. According to the WAPDA, Pakistan is already beyond the safe yield's sustainable limit after extracting about 50 MAF from groundwater aquifers. Aquifers have been overworked and polluted, which has caused salinization and an increase in fluoride and arsenic concentrations in water, all of which are lowering the quality of agricultural areas.

According to United Nations, Pakistan would become a water scarce nation by 2025, this is an alarming situation. The water crisis of Pakistan could be understood by the fact that as Pakistan is one of the top ten countries on which climate change has had the worst impact. The water availability has dramatically reduced from 5,000m^3 to 1,050m^3 per year and is reported to decline further (Ali, 2020). This can be seen from the below given graph.

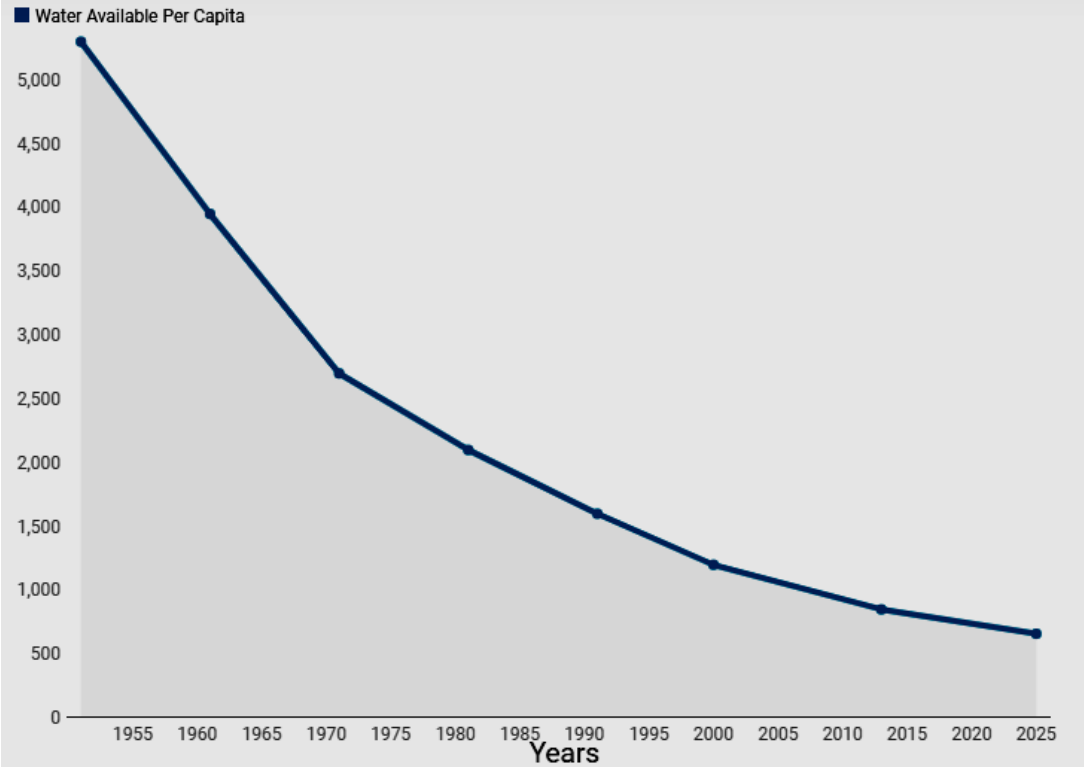

Figure 8 State of Environment Report, Retrieved in 2023

According to the World Bank report (2018) the rate of reduction will be lessened more by year 2035. Being an agrarian country, Pakistan is heavily dependent on its agriculture which is directly affected by water (Qureshi, 2011). Pakistan is currently facing serious water shortage problems and by corollary, a threat to food and energy security.

4.1.2 WATER SCARCITY LEVEL

The increasing population is also not helping Pakistan's water. Population of Pakistan is about to get 241 million by 2025 according to IMF (2018) and this will definitely affect the demand and supply ratio. The availability of water per person has steadily decreased as a result of the growth in population and the corresponding rise in water consumption. In 2015, 39% of Pakistanis resided in urban areas; by 2030, that number is predicted to rise to 47%, and by 2050, it will reach 58%. Although daily water consumption in rural areas is only about 45 litres, in urban areas it is closer to 120 litres. By 2050, water demand will increase by 15 cubic kilometres, totaling 195 cubic kilometres (Adeel, 2021).

Even after being located in a water rich area and a contiguous irrigation system. Pakistan is facing severe water problems due to a myriad of reasons, such as poor distribution, irrational water management schemes, poor town and water management planning etc. (Khoso et al., 2015). Pakistan's water sources are multiple but are still depleting. According to reports, Pakistan will reach the absolute water scarcity level by year 2025 which means that water availability will be less than $500m^3$ per year.

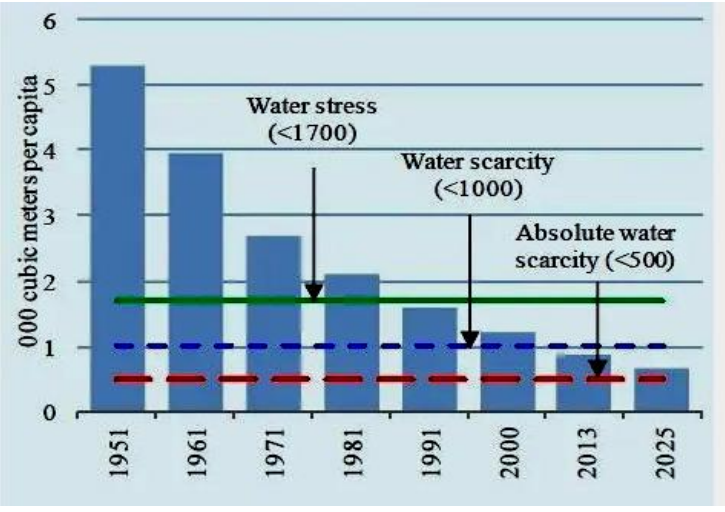

Figure 9 IPRI, 2021

The depleting water resources and the water availability in Pakistan pose the question as to what exactly is causing Pakistan's water availability to decrease so rapidly. For this Pakistan's water reduction profile is created to review the current situation of water in Pakistan.

According to standards established by Swedish hydrologist Falkenmark, nations with 1700 m3 or more of renewable freshwater per person annually have sporadic water shortages. On the other hand, nations with freshwater availability from renewable sources below this level frequently have water stress issues. The ultra-scarcity syndrome affects less than 1000 m3 of water per person per year (Biswas, 2009). Pakistan had an excess of water throughout its early decades of existence, with 5000 m3 per person each year. Pakistan currently has a water shortage of 1050 m3 per person per year.

4.2 HYDRO-MANAGEMENT POLICY EFFECT TO WATER SCARCITY CRISIS IN PAKISTAN

4.2.1 HISTORICAL FACTORS- ROLE OF BRITAIN'S POLICIES

The starting of modernized water policies in Pakistan (subcontinent) were made by the british. The British distributed land among the Punjabis for administrative and covert reasons which included a defensive strategy to stop Russia from acquiring the warm water. They started to design irrigation routes between the Jhelum, Chenab, Beas, Ravi, and Sutlej rivers in the 1860s. This irrigation route is now the largest canal system in the world.

4.2.1.1 CANAL NETWORK IN PUNJAB

The British constructed a network of canals that grew out of the rivers, with distributaries dispersed across the plains of western Punjab. In addition to facilitating immigration into this region from 1885 to 1947, the irrigation system saw an increase in the Punjab's canal-irrigated land from 3,000,000 to 14,000,000 acres. As a result, the state's involvement increased and the process of establishing canal colonies resulted in the development of a landholding within the colonies.

Additionally, land grants were made for the breeding of horses, camels, and other animals for the army. These land grants helped to make the army a desirable profession and allowed the peasants to raise their socioeconomic standing. This led to the emergence of two groups of farmers in addition to the landlords: (a) occupancy tenants, who had a legal right to occupy the property, and (b) simple tenants, who occupied land as a result of a lease agreement with their landlord. Thus, a hydraulic society was created in Punjab as a result of these developments, and the army eventually established vested interests in Punjab's land and agricultural industry. Thus, there were many powerful landowners who continued unfair land distribution practices, which to this day has had a big impact on agricultural practices and water consumption patterns in Punjab, Pakistan.

4.2.1.2 ENVIRONMENTAL DAMAGE POSED BY CANAL SYSTEM

The British crown moved farmers onto plots of farmland along the canals and destroyed the wetlands, forests and biodiversity that were there before. This wasn't just a project in physical engineering but it was social engineering too. At the end of the canal with the least water access, the British granted land to the agropastoralists. At the heads of canals with the best water access they awarded property to people who favored the British crown, often former military men, and the powerful elites. They then empowered these local elites to collect rents and taxes. It became a reward system to cultivate the native elites and keep them beholden to the empire. There is nothing unique about engineering rivers for irrigation as countries everywhere do that, for example, China, Egypt, and USA. But the scale of this region's canals sets it apart.

4.2.2 EFFECT OF HISTORICAL FACTORS ON CURRENT PAKISTAN

This degree of manipulation has transformed Pakistan. Cities appeared in the desert. The population boomed to over 200 million. Agriculture is the country's largest economic sector and employs roughly half of the country's labour force and it uses 90% of its surface and groundwater. This complete redesign of the country's water has caused some major catastrophic consequences.

These consequences are now coming forward after 150 years of their inception. As in August of 2022 an unusually heavy monsoon season flooded one third of the country and killed more than

1600 people. The low lying provinces of Sindh and Balochistan were underwater and when the water across this part of Pakistan wanted to drain back into the Indus River it couldn't find a natural path back to the river. It was blocked by the system of canals, embankments and wastewater drains built parallel to the river. The water lingered for several weeks causing disease and displacement (Dawn, 2022).

Generally, the region's most vulnerable to this type of flooding are the low lying ones without the historic wetlands and floodplains that would have absorbed the water. The embankments along the river were built to protect regions from riverine flooding. But the government and powerful landowners are known to breach these embankments on purpose. So that some land can be spared from flooding while other land gets inundated. The wide network of barrages and canals capture and disperse the river water out in a way that diminishes the water that reached the Indus delta. That means sea water can intrude back into the riverbed and groundwater destroying water sources and millions of acres of farmable land.

4.3 INDUS WATER TREATY

The 1960 Indus Water Treaty increased tensions along the rivers between Sindh and Punjab and in many ways deprived South Punjab of the eastern Rivers, which helped to create the gap between South Punjab and North Punjab. Because of the effects it had on Pakistan, the Indus Water Treaty is frequently called into doubt. Many in Pakistan, particularly the lower riparians, believe that giving India control over the eastern rivers was a grave historical error because it had a negative effect on Sindh's agricultural industry. The institutions created by the Indus Water Treaty are under a lot of pressure due to the effects of climate change and new instruments for carbon trading.

4.3.1 INDUS BASIN PROJECT

One of the main justifications for giving India the eastern rivers was Pakistan's conviction that engineering solutions could control the spatial distribution of rivers. When the Indus Basin Project was started, the Bambanwala-Ravi-Bedian-Dipalpur (BRBD) link canal served as an excellent example of how river waters could be diverted. The BRBD canal was important

because it demonstrated how easily Chenab and Ravi flows could be changed to compensate for the loss of Sutlej-Beas waters. The practice of diverting river water through provincial link canals spread, and after 60 years of operation, diversion projects have emerged as one of the primary causes of interprovincial fault lines and even transboundary waters.

4.4 INTERNAL FACTORS LEADING TO WATER CRISIS

4.4.1 BUREAUCRATIZATION OF IRRIGATION DEPARTMENTS

Bureaucratization of irrigation departments in Pakistan refers to the system of governance where the management and control of irrigation systems are centralized within bureaucratic institutions. The bureaucratization of irrigation departments has been increasingly responsible for the ineffective water distribution and management policies. This system was established during the colonial period in South Asia and has continued to be maintained by the Pakistani government since independence.

The impact of this system on water management in Pakistan has been widely debated by scholars. On one hand, some argue that the bureaucratization of irrigation departments has resulted in increased efficiency and productivity in water management. On the other hand, others argue that it has led to corruption, inefficiency, and neglect of the needs of small farmers.

One of the most significant consequences of this system is the unequal distribution of water resources, with larger and politically connected farmers receiving preferential treatment over smaller farmers. This has led to social and economic disparities in rural areas, and has also contributed to conflict over water resources. Additionally, bureaucratic hurdles and political interference have hindered the development and implementation of effective water management policies.

According to the book "Water Resources and Inter-River Basin Water Transfer" by A. Mujtaba Khan and Asghar Ali, the bureaucratization of irrigation departments in Pakistan has resulted in a lack of accountability and transparency in water management. Similarly, in the book "The Political Economy of Water and Sanitation in Pakistan" by Adnan A. Khan, it is argued that the

centralized control of irrigation departments has led to a lack of innovation and responsiveness in water management. The bureaucratization of irrigation departments in Pakistan has had significant implications for water management in the country. While some argue that it has resulted in increased efficiency, others point to the negative consequences of corruption, inequality, and neglect of small farmers (Adnan, A. 2014).

4.4.2 SOCIETAL FACTORS

One of the major social practive in Pakistan includes water theft. Water theft in Pakistan has developed into a significant problem that interferes with canal operations and the fair distribution of water. Water shortages caused by robberies by powerful individuals at the canal head frequently deprive impoverished farmers at the tail end of these canals. The theft of water reduces the amount of available water for legal users, including households, agriculture, and industry. The illegal tapping of water also damages public water supply infrastructure, leading to further water losses and damage to the distribution system.

Water wastage is also a significant contributor to water scarcity in Pakistan. Agriculture is the largest consumer of water in Pakistan, and inefficient irrigation practices lead to the wastage of a significant amount of water. This wastage can be attributed to the use of flood irrigation, which is a highly inefficient method of irrigation.

The impact of water theft and water wastage is particularly acute in areas that are already facing water scarcity, exacerbating the problem and making it even more challenging to manage. In such areas, water theft and wastage can result in the complete depletion of water resources, leading to severe social, economic, and environmental impacts.

4.4.3 NON-MAINTENANCE OF INFRASTRUCTURE

The lack of dedication to sustaining and upgrading the water infrastructure in Pakistan makes the intra-provincial water issues worse. According to the World Bank research, Pakistan's water infrastructure is deteriorating significantly as a result of the build/neglect/rebuild strategy. Although the decentralisation of water practises did little to improve the earlier chapter, water

management practises frequently reveal the undercurrents of water politics and fall short of the "vision" for an equitable distribution of water.

Chellaney in his book, “Water, Peace, and War: Confronting the Global Water Crisis" has highlighted that investing in water infrastructure and modernizing irrigation systems to improve water use efficiency and reduce wastage is really important. He also discusses on the role of technology and innovation in improving water management, such as using remote sensing to monitor water resources or developing new water treatment technologies.

4.5 NON-TRADITIONAL SECURITY FACTORS LEADING TO WATER CRISIS

4.5.1 POPULATION GROWTH

People frequently identify bettering water management and water technologies as their top priority. The constantly expanding population is one important concern that is disregarded (National Geography, August 2010).

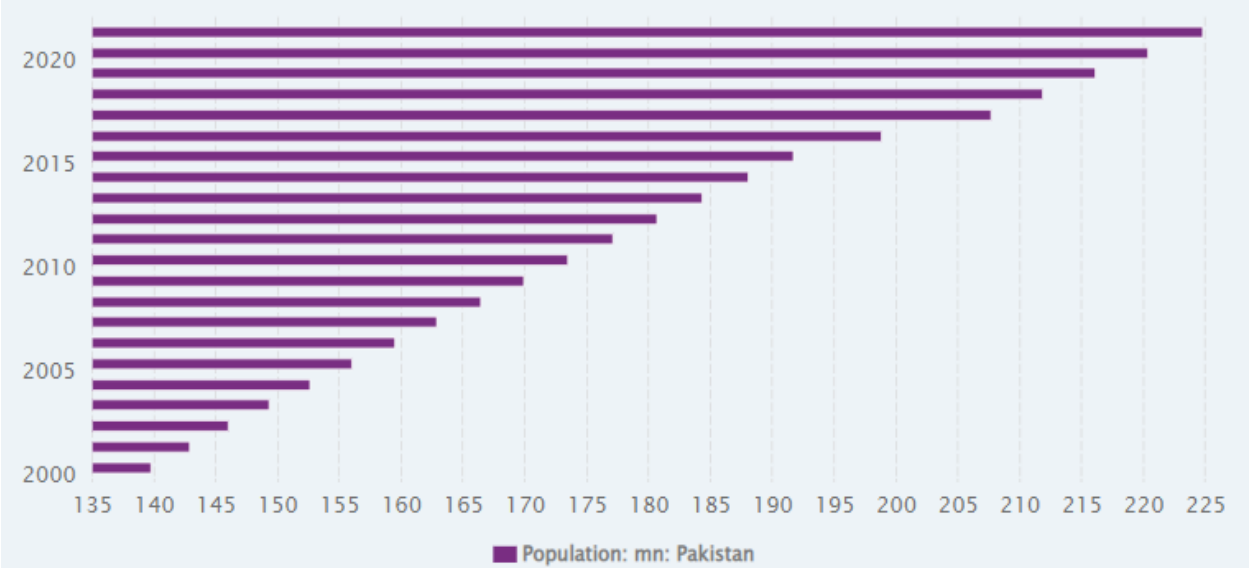

Figure 10 Population of Pakistan, CEIC (2023)

A new paper by the Pakistan Institute of Development Economics (PIDE), "Water Crisis in Pakistan: Manifestation, Causes and the Way Forward," provides some insight into the seriousness of the problem by providing sobering figures. Pakistan is ranked 14th out of 17 countries with a "extremely high water risk" due to its wasteful use of the limited water. More than 80% of the people in the nation experience "severe water scarcity."

4.5.1.1 COMPARISON OF POPULATION GROWTH AND WATER AVAILABILITY

According to a U.N. estimate, Pakistan's population is projected to reach more than 380 million people by 2050. In addition, a 191 MAF supply of water is predicted to be insufficient to meet Pakistan's 274 MAF water demand by 2025. The declining availability of land and water resources and the state of the ecosystem are threatened by population growth (Federal Bureau of Statistics, 2009). The population growth rate grew from 1.79% annually in 1951 to 3.69% in 1972–73 and then decreased to 2.4% in 1998. Despite this arguably problematic decline, the population growth rate is listed as 1.90% for 2005 in the statistics yearbook of Pakistan (2009).

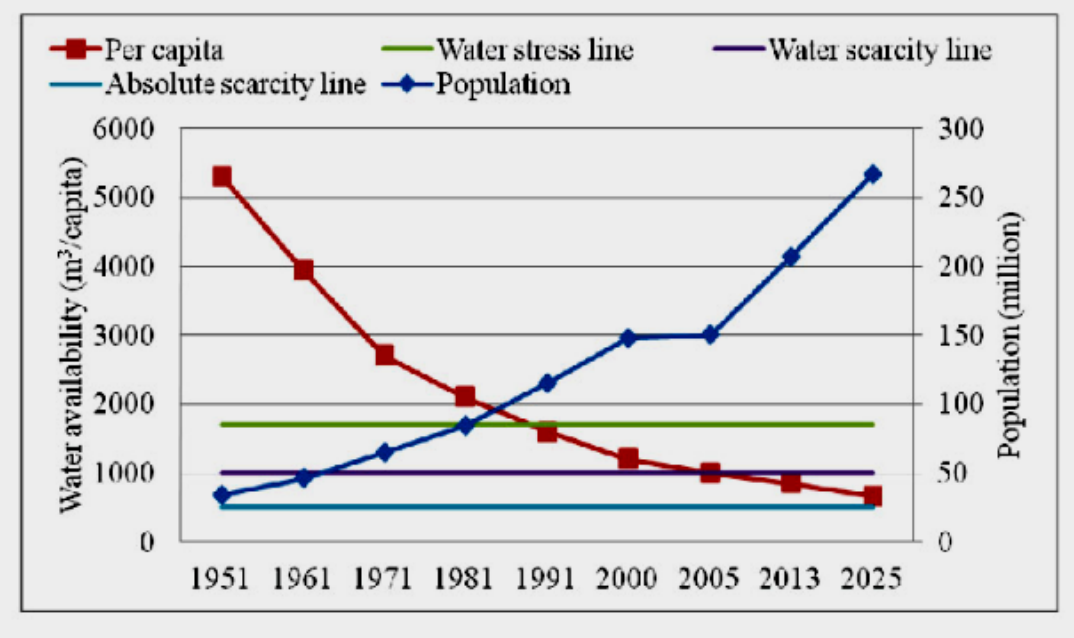

Figure 11 Population and Water Availability of Pakistan, Ashraf, M.

4.5.2 CLIMATE CHANGE

Human security, particularly in terms of health, food, and energy, would be the most important and obvious impact of climate change. It is anticipated that the increase in northern temperatures will pose a new health risk to Pakistan by exacerbating the malaria epidemic. Low winter temperatures are now limiting the mosquito season. Additionally, hotter air and water are more conducive to the reproduction of various fly species and other disease-carrying vectors, which causes an increase in infectious disease, especially in Pakistan's north.

Smog, which has been present across the whole Punjab in the winter months of January and December for the past few years, is another effect of climate change. As a result, climate change would not only have an impact on human health but also on Pakistan's total social development due to the emergence of heat-related and vector-borne diseases as well as malnutrition (Task Force on Climate Change, 2010).

4.5.3 FOOD SECURITY

In Pakistan, where agriculture and the cattle industry are the backbone of the economy, food security is a crucial aspect of water security. As mentioned before, agriculture accounts for 60% of the nation's exports and 22% of the GDP. Pakistan has a total of around 22.2 million hectares (mha) of cultivable land, of which 66% is irrigated by canal water, 22% by water from tube wells and wells, and the remaining merely depends on rainfall.

In Pakistan, 86% of the farms are owned by farmers with only five hectares or less of land this is because they lack the financial means. This in turn is harmful as the farmers especially small-scale farmers become vulberable to climate change. This in turn affects the production. Almost 38percent of agricultural land in Pakistan is suffering from environmental damage (Task Force on Climate Change, 2010). And it is predicted that climate change will increase the already worsening environmental situation in Pakistan and also affect the food production.

4.5.4 ENERGY SECURITY

Pakistan's future would see a lot of problems with energy security. The recent power riots that have swept through Pakistani cities are proof enough of this. Because hydropower makes up

30% of the total electricity generation mix, climate change would have a significant effect on energy security. The generation and distribution of electric power may be particularly vulnerable to the effects of climate change, according to a report on climate change and adaptation in the electric power sector issued by the Asian Development Bank in July 2012 (ADB, 2012):

1. If water availability is also impacted, an increase in water temperature is expected to lower generating efficiency.
2. The capacity of the generating and grid networks would be put under stress due to the decrease in output and efficiency of the generation process as well as the rise in cooling requirements of the consumers.
3. Modifications to precipitation and surface water discharge patterns, as well as an increase in the frequency and/or severity of droughts, might have a negative effect on hydropower production and limit the amount of water available for cooling thermal and nuclear power plants.
4. Extreme weather conditions, such as harsher and more frequent storms, can decrease the supply and possibly the quality of fuel (coal, oil, or gas), limit energy input, harm the infrastructure supporting generation and the grid, lower output, and jeopardise supply security.

The economic growth of the country will be affected by the energy security especially as Planning Commission of Pakistan has predicted that its demand will likely increase. As the population is increasing so is the consumption trends increasing, with this the climate change has also impacted Pakistan significantly and if proper planning is not done, Pakistan might face extreme energy shortages in the future.

4.6 INCREASING INEQUALITY WITHIN PAKISTAN (PROVINCIAL PERSPECTIVE)

Inequality is also built into the system in terms of water access. The richer you are the better positioned you are in terms of access to water. So just like British colonial rule, landowners at the head of canals today still benefit from this privilege of better water access while the people at the end of the canals suffer from the most water scarcity. A similar dynamic also plays out

among provinces. Punjab is an upstream province, meaning they get access to the river water before Sindh in the south and can use control of the barrages to direct how much water flows downstream in the Punjab.

The lower Indus delta of the river there are vast land masses which are now no longer fit for agriculture and people who have been practising particular kinds of agriculture are completely destitute. Pakistan is largely dependent on agriculture. According to estimates, Balochistan has 0.5 MAF, Khyber-Pakhtunkhwa has 2 MAF, Sindh has 3.5 MAF, and Punjab has 34 MAF. Overall, 79 percent of the total area of Punjab province is covered by fresh water, compared to 28 percent of the total area of Sindh province.

Pakistani officials have proposed building more mega dams along their rivers as a solution to water scarcity and flooding. This shows that they intend to continue the same colonial tradition of over engineering the Indus River. The colonial mindset still lingers on in post-colonial Pakistan. Which believes that the way to manage the river basin is through engineered solutions and not taking account of indigenous knowledge systems. This system was created through political, bureaucratic and uninformed decisions in many ways. This many times hinders the understanding the engineers have. For example, world bank experts suggested Pakistan to not amend the Indus water treaty. But they did and now face the consequences with Indian controlled water heads.

Water-engineering drastically increased the amount of farmable land which is now needed to feed Pakistan's vastly larger population. With Pakistan's economy reliant on agriculture, there is also the risk of an economic crisis that could have similarly severe impacts as some of these natural disasters. Building a water management system with the modest means of a developing economy that equitably provides enough water to irrigate enough land to feed people in a world that is plagued by ever more extreme weather events, seems like a task with impossible constraints. The use of engineering processes was called out by Malin Falkenmark, a Swedish Hydrologist, who called this as ‘water blindness’. According to her, the government’s liability to treat a natural resource through engineering will have major consequences (Falkenmark, 2001).

4.7 APPORTIONMENT OF WATER AMONG PROVINCES

4.7.1 PUNJAB

Punjab is the most populous province of Pakistan and also the most fertile. The main water heads of the water sources are in this province. About 68% of the nation's annual food grain production is produced in the province, which plays a leading role in agricultural production.

4.7.1.1 NORTH AND SOUTH PUNJAB DISPARITY

As one travels towards south Punjab, water availability becomes increasingly scarce. Additionally, more than 50% of the people in Punjab live in rural areas where there is a shortage of water. The Seraiki movement, which is based in South Punjab, has frequently spoken out against North Punjab and Sindh for two reasons. The Seraiki region served as the backbone of the nation's agricultural economy, although it was treated unfairly in terms of water allocation. It is sometimes asserted that the canals in the Seraiki belt are not perennial, in contrast to the majority of the canals in upper Punjab and Sindh. The Chashma Barrage's water release has also made the divisions between north and south Punjab and Sindh more obvious.

4.7.2 SINDH

Sindh is surrounded by Balochistan to the west and north, Rajasthan, India, to the east, and the Arabian Sea to the south. Its northern border is with the Punjab province's Bahawalpur state. In terms of population, Sindh is the second-largest province in Pakistan.

4.7.2.1 INTERNAL RESOURCES PROBLEM

In Sindh, intra-provincial faultlines are frequently made worse by a lack of water. For instance, it is claimed that areas in southern Sindh, primarily Thatta, Mirpurkhas, Sanghar, Khairpur, Dadu, and Badin, are experiencing water shortages. Water contamination is a significant issue as well. According to one source, the irrigation left bank canal system of the Kotri Barrage, which includes the Phulelli Canal, Pinyari, and Akram Wah, provides contaminated water to millions of residents of southern Sindh.

According to a survey, these canals receive between 20 to 25 tonnes of solid trash everyday, which comes from roughly 60% of Hyderabad city and its vicinity. Also frequently noted is the

permanent or cyclical submergence of irrigated cultivable lands in Southern Sindh due to sea intrusion. Sindh also experiences a lot of drainage issues, which are related to over watering.

4.7.2.2 INTER-PROVINCIAL ISSUE

Additionally, because of the flat topography, water courses frequently change their course. Additionally, the siltation of the distributaries in Sindh changes their course. As the last province, it consistently experiences water shortages. These have frequently taken the form of water disputes between the provinces of Punjab and Sindh, where Punjab is frequently accused of stealing water intended for Sindh. Collectives of farmers and fishermen frequently blame Punjab (Pakistan) and India for the worsening water shortages.

4.7.3 KHYBER-PAKHTUNKHWA (KPK)

Due to its location on the Iranian plateau and the Eurasian land plate, Khyber-Pakhtunkhwa (KP) is prone to earthquakes. It has a population density of 187 people per square kilometre over an area of 74,521 sq km. The province is geographically divided into two zones: the northern zone, which stretches from the Hindu Kush range to the boundaries of the Peshawar basin; and the southern zone, which stretches from Peshawar to the Derajat basin.

4.7.3.1 SOUTHERN ZONE

The southern region is desert, with scorching summers, mild winters, and little precipitation. Chitral in the north has an extremely chilly environment, while Dera Ismail Khan has a very hot climate. The largest and capital city of KP is Peshawar. The Kabul, Swat, Chitral, Panjgora, Bara, Karam, Gomal, and Zob are the province's principal rivers. So, Khyber Pakhtunkhwa is a province with plenty of water. The western branch of the Indus is known as the Kabul. Above Warsak in KP, it crosses into Pakistan and merges with the Indus above Attock Bridge in Punjab. Above the town of Mardan, the Swat connects to the Kabul. Two other Indus tributaries, the Kurram, Gomal, and Zam, join it from the west below Kalabagh. Although it rises in Afghanistan, the Kurram flows primarily through Pakistan. The western Indus tributaries measure 965.6 kilometres in length overall.

4.7.3.2 INTERNAL RESOURCES PROBLEMS

Sugarcane is the primary crop in the area. Only a small amount of agriculture is carried out for climatic reasons. The unlawful felling of trees by the timber mafia is one of KP's most important issues. The logging, which is believed to cost billions of rupees annually, frequently takes place with the tacit approval of regional and national officials. Illegal logging has resulted in soil degradation and river siltation in addition to diminishing the resources of ordinary people. Trees help control water supply to reservoirs by reducing floods and assist reduce soil erosion.

4.7.3.3 INTER-PROVINCIAL ISSUE

KPK has been a vocal opponent of the construction of the Kalabagh dam on the Indus river when it comes to inter-provincial disputes. Human displacement, water logging, salinity, and the submergence of arable land are the main causes of opposition to the dam.

4.7.4 BALOCHISTAN

Despite having 5% of the country's population, Balochistan is Pakistan's largest and most populous province, making up roughly 48% of the country's total land area. Iran borders it on the west, Afghanistan and Khyber-Pakhtunkhwa in the north, Punjab and Sindh in the east. The three primary ethnic groups in Balochistan are the Baloch, Pashtuns, and Sindhis.

4.7.4.1 RESOURCES ISSUES

The province has abundant mineral resources, and it is Sindh's main rival as a natural gas supplier. A significant portion of the province is dry and desert, and there is a persistent water deficit there. The province's elevation varies from very low (nearly sea level) in the extreme south (the Arabian Sea) to steep Kirthar, Sulaiman, and Zarghoon mountains with heights varying from 1,000 to 2,500 metres in the north.

More than 750 kilometres of shoreline may be found throughout the province. The northern highland region, the southern desert region, and the coastline zone can be considered the province's three ecological zones. There isn't much rain in this area; it ranges from 400 millimetres in the northern highlands to just 100 millimetres in the western desert.

4.7.4.2 AGRICULTURE

For survival, the Baloch economy is largely dependent on agriculture and cattle raising. 42% of the province's GDP comes from agriculture, which includes field crops, horticultural products, and vegetable production. Nearly two-thirds of the population work in agriculture and livestock rearing, which together provide support for nearly 75% of the population. Livestock-related activities generate an additional 10%. Balochistan's vast animal herd is supported by the rangeland that covers about 90% of the country.

In conclusion, looking back at the history we can deduce that Britain's water policies did not directly lead to the current water crisis in Pakistan. It is worth noting that British colonial policies did have a long-term impact on water management in the Indian subcontinent, which includes Pakistan. During the colonial period, the British built large-scale irrigation systems for agriculture, primarily to produce cash crops for export. This led to the overuse of water resources, which caused ecological damage and undermined the sustainability of traditional water management practices.

After Pakistan gained independence in 1947, the government continued to prioritize large-scale infrastructure projects, including dams and canals, to increase agricultural productivity. However, these projects often ignored the needs and rights of local communities, resulting in displacement, ecological damage, and conflicts over water resources.In recent years, the water crisis in Pakistan has worsened due to climate change-induced droughts, over-extraction of groundwater, and inadequate investment in water infrastructure. These factors have led to a shortage of water for drinking, agriculture, and industrial use, particularly in rural areas.Therefore, while British colonial policies may have contributed to a legacy of unsustainable water management practices in the region, the current water crisis in Pakistan is primarily a result of factors that have emerged in the post-independence period.

Presently, Pakistan's four provinces deal with various issues. They all disagree on how water resources are distributed amongst the provinces. The supply-demand chain for water is significantly altered as a result of how one province uses water and how that affects how the other consumes water. The increasing water needs in each of these provinces have proven

insurmountable for the IRSA. Social structures have a significant impact on how water is distributed and how it is used, which is a remnant of British colonial policies.

River proximity has been a significant factor in the emergence and fall of powerful civilizations. Sindh, on the other hand, is totally reliant on the Indus river while Punjab, an upper riparian state, is the most fortunate region in Pakistan in terms of water infrastructure and offers a favourable topography for gravity dams. Additionally, because of its flat terrain, it is frequently subject to flooding. The importance of water resources for Pakistan's many provinces is due to their blatant reliance on the agriculture industry, which also provides a living for many. One of the primary causes of intra- and interprovincial conflict over water resources is the limited supply of water and its predominate use by the agriculture sector.

CHAPTER V

EVALUATING THE EFFECTIVENESS OF CURRENT WATER MANAGEMENT POLICIES IN ADDRESSING PAKISTAN'S WATER CRISIS (1999-2022)

PART I

INTRODUCTION

As a direct consequence of excessive extraction from its native ground and surface water supplies, Pakistan is already perilously close to experiencing a catastrophic water shortage. According to a study done by the World Bank, Pakistan comes dangerously near to exhausting all of the water resources that are available to it. The bottom line is that Pakistan is dangerously close to depleting all of the surface and groundwater resources at its disposal, while it is estimated that more than 30 percent more water will be required over the next 20 years to satisfy rising demands in the agricultural, household, and industrial sectors" (World Bank, 1994). As Pakistan's ongoing economic struggles go on, the country's need for water will continue to rise in order to secure the country's continued economic viability.

Pakistan's administrative systems has included a mix of democratic and military regimes at various points in its history, all of them have contributed to Pakistan not having a clear water management policy. A lot of governments have tried to make significant progress towards the creation of a sustainable water policies but not one have been much successful.

5.1 BRIEF OVERVIEW ON PREVIOUS GOVERNMENT ROLE IN WATER MANAGEMENT

5.1.1 AYUB KHAN (1958-1969)

Ayub Khan was in power from 1958 to 1969. During his tenure, he is credited for initiating the Indus Water Treaty (IWT) in 1960. This treaty established the border between Pakistan and India along the Indus River Basin. According to the terms of the treaty, India was given three rivers in

the east (the Sutlej, the Beas, and the Ravi), whereas Pakistan was given three rivers in the west (Indus, Jhelum, and Chenab). Khan also built a number of huge dams around the nation, among of which include the Mangla Dam and the Tarbela Dam. These dams were built to enhance the country's irrigation systems and boost water storage capacity.

5.1.2 ZULFIQAR ALI BHUTTO (1971- 1977)

Bhutto supported Ayub Khan's water policy and began many new projects, including as the Chashma-Jhelum Link Canal and the Thal Canal, to extend irrigation systems and enhance water storage capacity during his presidency from 1971 to 1977. In addition to this, he formed the Water and Power Development Authority (WAPDA) in order to supervise the water and electricity resources of the nation.

PART II

5.2 PERVEZ MUSHARRAF GOVERNMENT (1999-2008)

The dictatorship of Pervez Musharraf placed a strong emphasis on improving Pakistan's water infrastructure by constructing dams, barrages, and canals for the purpose of storing and distributing water for agricultural, drinking, and energy generating purposes, respectively. The government began a number of different water-related projects, such as the Greater Thal Canal and the Left Bank Outfall Drain, in order to increase the amount of water that could be stored and to enhance drainage systems.

5.2.1 NATIONAL WATER POLICY 2002

One of the significant initiatives taken during his tenure was the National Water Policy 2002, which aimed to address water scarcity and improve the country's water management practices.

The policy emphasized the need for integrated water resources management, conservation of water resources, and improving water infrastructure. It also highlighted the importance of community participation in water management and proposed the establishment of a National Water Council to oversee the implementation of the policy.

5.2.2 NATIONAL DRAINAGE PROGRAM 2005

Another major policy initiative was the National Drainage Program, launched in 2005, which aimed to improve the drainage system in the country and reduce the incidence of flooding. The program included the construction of new drainage structures and the rehabilitation of existing ones. It also focused on the development of water storage facilities and irrigation infrastructure.

5.2.3 HYDRO-POWER PROJECTS

Musharraf's government also initiated several hydropower projects during his tenure, including the construction of the Ghazi Barotha Hydropower Project, which has a capacity of 1,450 MW and was completed in 2003. The project is one of the largest hydropower projects in the world and has helped to address Pakistan's growing energy needs.

Overall, Musharraf's policies on water management and governance aimed to improve the country's water infrastructure, promote the efficient use of water resources, and address the challenges of water scarcity and flooding. However, some critics have argued that the policies did not go far enough in addressing the root causes of these problems and that more needs to be done to ensure sustainable water management practices in the country.

Assessing the success of Pervez Musharraf's water policies in Pakistan is a complex matter, as it depends on several factors and can be viewed from different perspectives.On the one hand, the National Water Policy 2002 and the National Drainage Program were significant initiatives that aimed to improve water management and governance in the country. The policy provided a comprehensive framework for integrated water resources management and highlighted the importance of community participation and stakeholder engagement. The National Drainage Program helped to reduce the incidence of flooding and improve the drainage system in the country, which has been a long-standing problem in Pakistan.

On the other hand, Musharraf's policies were criticised for the fact that they ignored the water rights of provinces farther downstream and instead prioritised the construction of large-scale infrastructure projects above the implementation of sustainable water management practices.

5.3 PAKISTAN PEOPLE'S PARTY GOVERNMENT (2008-2013)

During their tenure, several water management policies were adopted with a focus on addressing the water scarcity and distribution challenges in the country. Some of the key policies were:

5.3.1 National Water Policy 2009

This policy aimed to address the challenges of water scarcity and management in the country. The policy focused on promoting efficient and equitable use of water resources, increasing water storage capacity, and enhancing water governance.

5.3.2 National Flood Protection Plan

This plan was developed to address the challenges of floods in the country. The plan focused on improving flood management infrastructure, enhancing flood forecasting and warning systems, and promoting community-based flood risk reduction measures.

5.3.3 Kacchi Canal Project

This project aimed to provide irrigation water to the drought-prone areas of Balochistan province. The project involved the construction of a canal system to divert water from the Pat Feeder Canal to the Kacchi Plains.

5.3.4 Rainwater Harvesting Policy

This policy aimed to promote the collection and storage of rainwater for domestic, agricultural, and industrial use. The policy focused on reducing the reliance on groundwater and increasing the availability of water for irrigation.

5.3.5 Infrastructures

During Zardari's leadership, the government initiated a number of water-related projects, including as the construction of the Gomal Zam Dam and the Satpara Dam, in order to enhance the amount of water that can be stored and to improve agricultural systems.Overall, the main focus of the water management policies adopted during the PPP era was to improve water infrastructure, increase water storage capacity, and promote efficient and sustainable use of water resources to address the water scarcity and distribution challenges in the country.

According to experts, the majority of water initiatives taken during PPP government were a failure. For instance, the National Flood Protection Plan was criticized for its inadequate implementation and insufficient funding, resulting in limited improvements in flood management infrastructure and limited reduction in flood risks.

On the other hand, the Kacchi Canal Project was considered a success, as it provided irrigation water to the drought-prone areas of Balochistan province and enhanced agricultural productivity in the region. The Rainwater Harvesting Policy was also seen as a positive step towards addressing the water scarcity challenge and promoting sustainable use of water resources.Overall, while some policies implemented during the PPP era showed positive results, others faced implementation and funding challenges, and their impacts on water-related challenges were limited.

5.4 PAKISTAN MUSLIM LEAGUE- N GOVERNMENT (2013-2017)

The first such conversations about formulating a water policy were held in 1991 while Nawaz Sharif was the prime minister of Pakistan. The nation's primary water source, the River Indus, was divided among the provinces in an equitable manner. The chief ministers of Sindh, Punjab, the North-West Frontier, and Baluchistan provinces all signed a water accord in March 1991. Plans to construct the Kalabagh, a large-capacity dam in the Punjab, were announced after that. Nevertheless, a number of political groups opposed the project, and the plans were abandoned. New policies were implemented when General Pervez Musharraf became the country's leader in October 1999.

During the time when Nawaz Sharif was in power, the production of electricity via hydropower projects like the Tarbela 4th Extension and the Neelum-Jhelum hydropower projects were a top priority. These projects have the goal of increasing Pakistan's capacity for energy production and reducing the nation's reliance on fuel imported from other countries.

The construction of the Kalabagh Dam, which had been halted because of resistance from the provinces of Sindh and Khyber Pakhtunkhwa, was one of the projects that Sharif revived. The Kalabagh Dam was intended to have a storage capability of 6.1 million acre-feet of water and a power production scope of 3,600 megawatts.

- **WATER SECURITIZATION EFFORTS BY PMLN GOVERNMENT**

The Pakistan Water Charter (PWC), which was introduced by the Pakistan Muslim League (Nawaz) [PML(N)] administration just weeks before the 2018 general election, is yet another sign of the government's effort to securitize. Again, that might have been a response to the campaign started by Pakistan Tekreek-i-Insaf (PTI), the main political opposition group. The PML-N government was charged with acting laxly in bringing up the problem of India building dams on the River Neelum that will prevent Pakistan from receiving about 10% of its fair share of water in the future, according to Chaudhary Sarwar of the PTI (Governor of Punjab during the PTI government) (Sarwar, 2018).

The government in April 2018 adopted the Water Charter, which was endorsed by the prime minister and the four chief ministers. Five people from five distinct and occasionally rival

political parties who were seeking for votes in the approaching elections signed the charter, demonstrating the extent of the securitization of the water scarcity at the time.

The state was under "a water emergency," according to the Charter. According to Abbasi et al. (2018), differences must be put aside and must work together as a nation to meet the challenge that lies ahead. It was noted that the issue of water scarcity is producing problems with food, energy, and water security. "Our per capita availability of water, which was above 5,200 m3 at the time of independence, has now dropped below the bare minimum of 1,000 m3 per head, formally designating us a water-scarce country," the report states. Water scarcity's designation as a "existential threat" to the country in the Charter's text was nonetheless a key factor in the securitization process (Abbasi et al., 2018).

On the other hand, Sharif's policies have been criticised for the fact that they put the production of electricity ahead of sustainable water management practices and ignored the concerns of provinces farther downstream.

5.5 PAKISTAN TEHREEK-E-INSAF GOVERNMENT (2018- 2022)

Since gaining office, the administration of Imran Khan has placed a significant focus on the significance of water conservation and management in the context of tackling Pakistan's water issue. The government has instigated a number of projects, one of which is the Billion Tree Tsunami project, which is designed to increase the amount of land that is covered by trees and to decrease soil erosion.

In addition, the government of Pakistan has begun construction on a number of hydroelectric projects, such as the Mohmand Dam and the Dasu Dam, in order to increase the amount of energy that can be generated. The government has made the building of the Diamer-Bhasha Dam a top priority. When finished, the dam is anticipated to have a water storage capability of 8.1 million acre-feet and to produce 4,500 megawatts of electrical power.

In addition to these infrastructure projects, the government has also launched a number of programmes aimed at increasing water efficiency and conserving water resources. Some examples of these programmes include the Prime Minister's Agricultural Emergency Program and the Clean and Green Pakistan initiative.

Despite this, Imran Khan's efforts have been criticised for a lack of public understanding and involvement, as well as for their inability to adequately address the problems of provinces located farther downstream.

5.5.1 NATIONAL WATER POLICY 2018

In April of 2018, the government of Pakistan issued its National Water Policy (NWP), which addressed Pakistan's increasing water stress and outlined an Integrated Water Resources Management plan consisting of 33 steps that the federal government must follow to avert this impending catastrophe (Saddiqa et al., 2022).

The first of its kind, an idealistic plan was released in response to the fact that Pakistan's water tensions were increasing. These measures included increasing the amount of water that could be stored in reservoirs, improving flood management, reducing pollution in order to increase the number of freshwater resources, reducing water waste by improving water efficiency and efficacy, regulating groundwater withdrawal, and strengthening and improving the capacity of water resource institutions.

Although many people have focused on the possibility that a terrorist attack or incursion along the Line of Control will cause hostilities between India and Pakistan, very little attention has been devoted to the possibility that a crisis will begin or worsen as a result of the region's increasing water shortages. This is despite the fact that many people have focused on this possibility.

The building of dams has been prioritised by the Pakistani government among all of the efforts that are stated in its NWP because it would increase water storage capacity and enhance flood control. This technique carries with it a number of advantages. Dams in Pakistan prevent floods and enhance the amount of water that is easily available by providing a location for rainwater to accumulate during the rainy season. Rainfall does not normally penetrate the soil in Pakistan because of the country's extensive agricultural history. Dams also guard against flooding downstream in the case of glacial lake outburst floods (GLOFs), which occur when natural dams holding glacial lakes rupture or melt. This kind of flooding may be prevented by building dams. It is anticipated that GLOFs would become more common as a result of the ongoing melting of the Himalayan glaciers that feed the Indus River Basin as a result of increasing temperatures. In

addition, Pakistan is able to resolve its energy crisis via the construction of dams that generate hydroelectric electricity. This is of the utmost importance for Pakistan, not only due to the fact that the country has been going through an energy crisis for decades, but also due to the fact that conventional power facilities, such as coal and nuclear, need significant quantities of water in order to work properly.

PART III

5.6 POLICIES ADOPTED AT PROVINCIAL & FEDERAL LEVEL FROM 1999- 2022

2019 saw Punjab become the first province to enact independent water legislation. The Easements Act from colonial times has been replaced by the Punjab Water Act of 2019. The act creates the Punjab Water Resources Commission, which is entrusted with conserving and allocating Punjab's water resources and guaranteeing their proper exploitation. Previously, any landowner could remove groundwater on their property without official control. As Sindh completed its own legislation in 2020, Khyber Pakhtunkhwa passed a comparable bill for the Khyber Pakhtunkhwa Water Act. These recent changes to the legislative framework may handle many potential flashpoints for conflict, but they are still in the implementation phase. However, successful implementation will probably be a roadblock.

Government	Policies / Projects Adopted	Focus Area
Pervez Musharraf (1999-2008)	• National Water Policy 2002 • Water Apportionment Accord 2002 • National Drainage Program • WAPDA Water Vision (2025) • National Environmental Policy • Pakistan Vision 2030	Address the Water Storage and Distribution Promoting efficient and equitable use of water resources, improving water infrastructure
PPP (2008-2013)	• National Disaster Risk Management • National Water Policy 2009 • 18th Amendment	Reforms in the Water Sector Centralization to Decentralization of Hydro-Management

	• National Climate Change Policy	
PMLN (2013-2018)	• National Water Policy 2018 (initiated) • National Drinking Water Policy 2018 • Diamer Bhasha Dam Project (Initiated) • Pakistan Vision 2025	Construction of dams-A solution to water crisis Put the production of electricity ahead of sustainable water management practices
PTI (2018- 2022)	• National Water Policy 2018 (Continued) • Diamer Bhasha Dam Project (Continued) • Billion Tree Tsunami	Holistic Approach to Water Management with a focus on conservation and efficiency

5.7 HAVE THE GOVERNMENTAL STEPS BEEN SUCCESSFUL IN CURBING WATER PROBLEMS?

The primary causes of Pakistan's current water issue may be broken down into two categories: accidental and operational. Situations that are linked to poor water management practises are referred to as incidental causes, while conditions that are related to political concerns (trans-boundary or provincial) and society are referred to as operational causes (poor water management). New information and tools (technology, tactics, and institutions) addressing social, economic, political, and environmental challenges in water management are necessary to meet these concerns.

5.7.1 FACING WATER RESOURCE CRISIS

Many investigations and evaluations carried out by a large number of agencies have led to the conclusion that Pakistan is now facing a water resource crisis. Because of its rapidly expanding population, Pakistan is not only dealing with a water crisis but also a threat to its food supply. Since 1951, the amount of available surface water has diminished from 5260 cubic metres per

capita to just 1000 cubic metres per capita in 2016. It is expected that this value would decrease to around 860 cubic metres by the year 2025, showing that Pakistan is shifting from a state of "water pressure" to a state of "scarce water" (Basharat, 2019). The majority of Pakistan's water woes may be attributed to ineffective management, extended dry spells, less precipitation, and pollution.

Pakistan's water resources are in a state of emergency, according to a number of studies and publications by different organisations. Pakistan is experiencing a water crisis and a threat to food security due to its fast expanding population. From 5260 cubic metres per person in 1951 to 1000 cubic metres per person in 2016, surface water availability has declined. By 2025, this amount may drop to around 860 cubic metres, indicating that Pakistan is transitioning from a situation of "water pressure" to one of "scarce water." Poor management, droughts, low rainfalls, and pollution primarily cause Pakistan’s water shortage.

5.7.2 INCREASING NON-TRADITIONAL SECURITY ISSUES

Non-Traditional Security (NTS) refers to the security challenges that arise from non-military sources such as economic, social, environmental, and political factors. In Pakistan, NTS is an important issue due to various challenges the country is facing, including natural disasters, water scarcity, food insecurity, energy crises, and terrorism.

One of the major NTS challenges in Pakistan is hydro-management. Pakistan's economy is heavily dependent on agriculture, which in turn is reliant on the country's water resources. However, Pakistan is facing a water crisis due to various factors, including population growth, climate change, and mismanagement of water resources. As a result, the country is facing issues such as water scarcity, floods, and droughts.

The country relies heavily on the Indus River system, and water scarcity has become a significant non-traditional security issue, impacting agriculture, industry, and domestic consumption. The situation has also led to conflicts between different provinces and communities over the distribution of water resources. Moreover, environmental degradation, such as deforestation, soil erosion, and air pollution, has further exacerbated the problem, threatening public health and food security.

- Water Insecurity: Lack of clean water access and water shortage, has killed hundreds to thousands of people in Pakistan each year. Almost 21 million people in Pakistan from a total population of 230 million don’t have access to clean water which leads to health problems and leads to death in many cases. Another factor which makes water shortages a major obstacle is economic development.

- Food insecurity: As mentioned earlier, water scarcity has a significant impact on agricultural productivity in Pakistan. This, in turn, affects food security in the country. A report by the United Nations Development Programme (UNDP) found that water scarcity is a major factor contributing to food insecurity in Pakistan, with over 60 percent of the population at risk of hunger and malnutrition.

- Energy insecurity: Pakistan is also heavily dependent on hydropower for electricity generation, with around 60 percent of the country's electricity coming from hydropower sources. Water scarcity, however, has led to reduced hydropower production, leading to frequent power outages and energy insecurity.

- Migration and displacement: Water scarcity can also lead to migration and displacement, particularly in rural areas where agriculture is the main source of livelihood. As crop yields decrease due to water shortages, farmers may be forced to leave their homes and migrate to urban areas in search of employment opportunities. According to the Internal Displacement Monitoring Centre, as of 2020, Pakistan had more than 1.4 million internally displaced persons (IDPs). The situation has also led to a refugee crisis, as Pakistan hosts one of the largest refugee populations in the world, including Afghan refugees who have been living in the country for decades.

- Conflict: Water scarcity can also lead to conflicts between communities, particularly in areas where water is a scarce resource. For example, in the province of Sindh, disputes over water rights have led to violent clashes between different groups.

- Public health: waterborne diseases are the major cause of death and sickness in the areas where clean water access is scarce. Health of people is sogonofocanlt affected when clean water is not provided.

In all these Non-traditional security issues, water has been a major variable. So the problem arises as State Bank of Pakistan also stated is in the overlapping of the responsibilities and the duplication of the work. Water availability is not the problem but rather hydro-management and governance (Cooper, 2018).

5.8 HYDRO-MANAGEMENT POLICIES LEADING TO INCREASE IN NON-TRADITIONAL SECURITY THREATS

Natural disasters like floods and drought are more common in Pakistan as a result of the ineffective water management system with widespread abstraction without management and enough recharging. The recent floods that caused havoc across South Asia this year brought to light how inefficient water resource management practises and a slow reaction to the disaster led to the natural calamity.

Water quality in Pakistan is apparently being significantly harmed by contamination from industrial and agricultural waste. Further aggravating the problem is massive groundwater depletion without proper management and recharge. Pakistan is now among the top ten countries most vulnerable to climate change. The use of agriculture for more than 90% of Pakistan's water resources is wasteful and inefficient. It still relies on crops like sugarcane and rice, both of which need a lot of water to grow. Significant water is lost due to improper irrigation channel maintenance.

There is a long history behind Pakistan's present water issues. The local government does nothing to address the disasters that have developed over time in Pakistan as a result of water-related problems.

5.8.1 ENVIRONMENTAL DISASTERS

In 2022, Pakistan was met with one of the worst environmental catastrophe due to which half of Pakistan went under water. This environmental disaster affected more than 33 million people and killed more than 1700 people. Not just this, this flood killed millions of animals, injured thousands of people, and also affected housing, agriculture, transportation and so much more. As a developing nation, Pakistan has moved back to years of development due to this disaster.

The flood affected almost all provinces and in this catastrophe the loss was also seen on housing, agriculture, and even livestock. Billions worth of loss is estimated for each sector including transportation and communication. This loss has moved Pakistan way back in terms of development. Sindh is the worst affected in all of the provinces and then Balochistan.

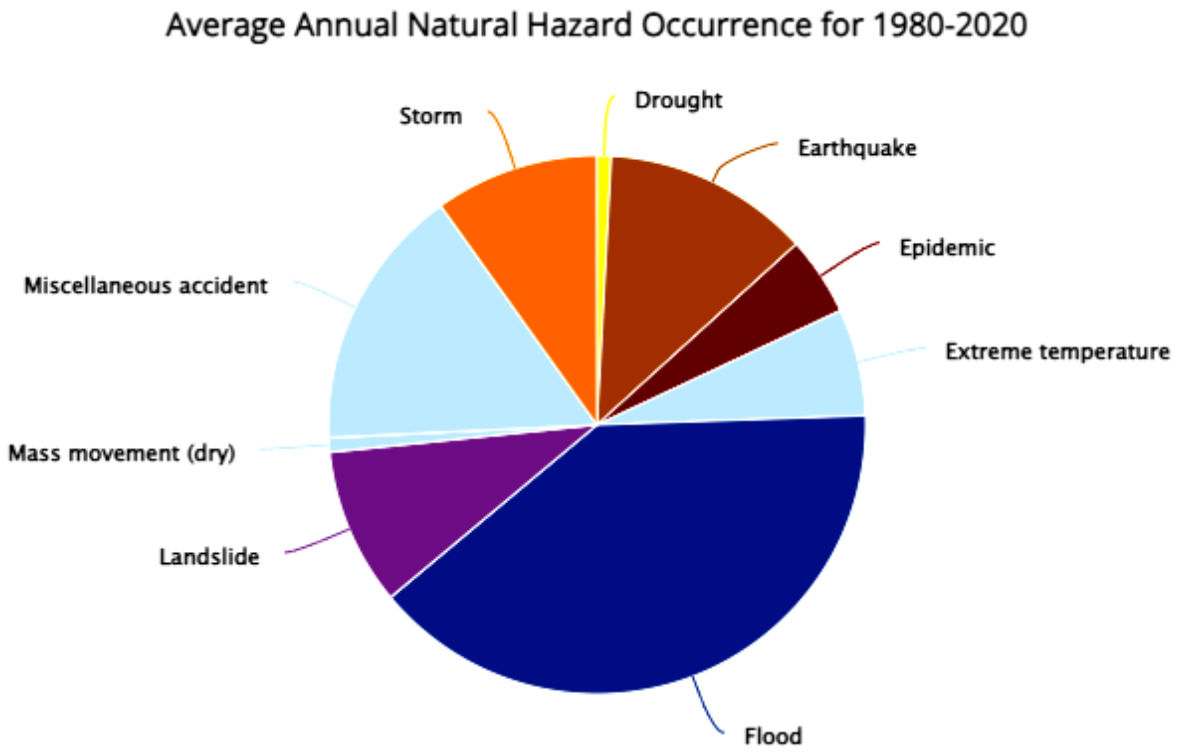

Figure 12 World Bank: Climate Change Knowledge Portal

There is a distinction between city water management even during floods. Lahore saw a 24-hour water retraction during the Pakistani floods of 2020, whereas Karachi experienced weeks of significant standing water throughout the city. The city's elites protested the city government's response to the flooding for the first time in recent memory by taking to the streets. The protests in Karachi brought to light the extent to which Pakistan's inadequate water management practices are becoming a subject of public resentment. However, the most disadvantaged people continue to be disproportionately impacted by depleted water supplies. The crisis that is currently being observed in Pakistan as a result of this year's floods is the next tragedy that Pakistan should be worried about, not next year's monsoon rains. Food instability, a public health nightmare, widespread internal migration, and food insecurity are all things that experts predict will happen.

5.8.2 CLIMATE CHALLENGES

Pakistan faces significant climate challenges. The Global Climate Risk Index for 2021, declared Pakistan among other countries as one of the most vulnerable to climate change. This came as shock because Pakistan has the lowest carbon emissions in the world. Climate challenges are increasing and with this are coming multiple problems such as high temperature, floods, droughts, health problems and others. Jacobabad, a city in Pakisan recorded the highest ever temperature of the country at 50 Celsius. After the flood, the city is under water and in need of help.

Climate resilience is slow and one of the reasons is weak governance and cooperation. Because of weak authority, it has led to increase in water mafia, increase urbanization, illegal construction, etc. To fight climate change, the PTI government led the tree tsunami initiative. Plantation of trees and concentration on tech indut=stry for renewable energy were the main aims.

The coalition government of multiple parties, after coming to power, was met with the worst flood situation. The political chaos and instability can be one of the reason that efficient planning wasn't done to meet this challenge. Although the provincial level should have worked on it beforehand, but nothing of significance was seen.

5.8.3 FOOD INSECURITY

The Food and Agriculture Organisation of the United Nations (FAO) estimates that approximately 9.4 million acres of cropland in Pakistan, including 4.8 million acres in Sindh, 2.7 million acres in Punjab, 1.2 million acres in Balochistan, and 714,000 acres in Khyber Pakhtunkhwa, were potentially inundated in August. At least 1.2 million animals have been killed, severely impacting impacted households' ability to support themselves and the availability of animal goods like milk and meat.

The floods reportedly destroyed 40% of Pakistan's cotton harvest and roughly 15% of its rice crop. The private grain reserves that many agricultural families depend on for year-round food supply were destroyed by floodwaters.The increase in inflation was already cause for concern. According to reports, starting January 2022, the cost of a kilogramme of rice has increased by around 80% in some areas of Pakistan. The World Food Programme (WFP) reported that for the

eleventh straight month, food prices had risen sharply since February 2022 in their February 2023 Pakistan Market Monitor Report.

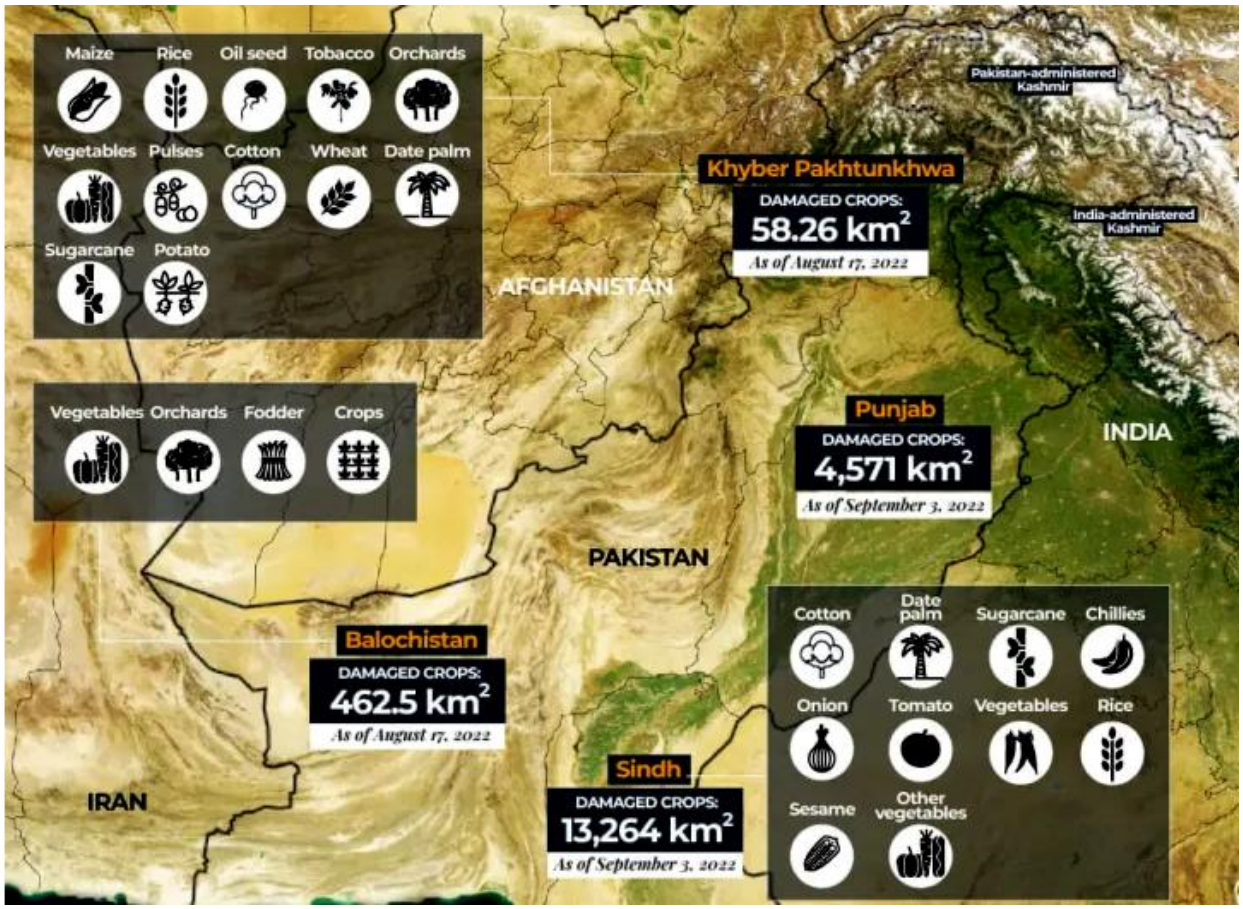

Figure 13 Flood 2020 Pakistan Affecting Agriculture, Al Jazeera, 2022

5.8.4 HEALTH INSECURITY

33 million people were impacted by the floods, and more than 1,730 people have died. The poorest and most vulnerable areas are being particularly affected. More than 8 million displaced people are now suffering a health catastrophe as a result of the flood waters remaining stagnant in many areas, which is causing the spread of water-borne and vector-borne diseases. The situation is still developing. As a result, the crisis has the potential to significantly and permanently affect people's lives and means of livelihood. Loss of household assets, rising food prices, reduced household incomes, and disease outbreaks all have an effect on the most disadvantaged individuals.

In general, these leaders' water management strategies aimed to address Pakistan's water issues by increasing water storage capacity, modernising irrigation systems, promoting water efficiency and conservation, and starting the building of hydroelectric projects. However, these initiatives have encountered a number of issues, including a constrained budget, political opposition, and a lack of public awareness and involvement.

In order to overcome Pakistan's water crisis, many governments sought to concentrate on enhancing water management and expanding water storage capacity. To increase irrigation systems, increase access to water, and conserve water resources, they started a number of water-related initiatives and policies. However, none of the previous governments were particularly successful in sustaining a successful and effective water-management strategy due to other political issues, criticisms of inadequate funding, a lack of public awareness and participation, and environmental concerns associated with some of the projects.

CHAPTER VI

TOWARDS SUSTAINABLE HYDRO-MANAGEMENT: OPTIONS AND STRATEGIES FOR PAKISTAN AND SOUTH ASIA

CONCLUSION

Hydro-management crisis in Pakistan has been a longstanding issue that has severely impacted the country's development and economic growth. The availability and management of water resources in Pakistan have been closely linked to national security and regional stability. The current crisis has been defined as a non-traditional security issue, as it threatens the livelihoods of millions of people and has the potential to trigger conflict and instability in the region.

The hydrological environment of Pakistan is characterized by the Indus River Basin, which provides the primary source of water for the country's agriculture, industry, and domestic use. However, the availability and distribution of water have been affected by climate change, population growth, and inefficient management practices. The sectoral distribution of water consumption further exacerbates the crisis, with agriculture accounting for the majority of water usage in the country.

The historical evolution of hydro-management in Pakistan has been marked by colonial legacies, partition, and nationalization policies that have shaped the current institutional and legal framework. The adoption of the 1873 British Canal and Drainage Act, the Indus Water Treaty of 1960, and the Council of Common Interests are some of the key milestones in Pakistan's hydro-management history. However, the policies and reforms implemented by successive governments have failed to address the underlying issues of water governance, infrastructure, and sustainability.

The role of government policies and leadership in hydro-management cannot be overstated. The Musharraf regime initiated several projects, including the construction of the Tarbela Dam extension and the Greater Thal Canal, to improve water storage and distribution. The Pakistan Muslim League-Nawaz (PMLN) government prioritized the construction of mega-dams, such as the Diamer-Bhasha Dam and the Kalabagh Dam, as a solution to the water crisis. The Pakistan Peoples Party (PPP) government focused on reforms in the water sector, including the creation of

the National Water Policy and the National Water Resource Management Plan. The current government of Pakistan Tehreek-e-Insaf (PTI) has emphasized the need for a holistic approach to water management, with a focus on conservation and efficiency.

Despite these efforts, the policies and reforms have not been successful in addressing the hydro-management crisis in Pakistan. The lack of political will, corruption, and bureaucratic inefficiencies have hindered the implementation and impact of these measures. The Diamer-Bhasha and Kalabagh Dam projects have faced significant opposition from environmentalists and local communities, while the National Water Policy and Management Plan have yet to be fully implemented.

As Pakistan is located in a semi-arid region, which means that it has limited freshwater resources. Moreover, the water resources are unevenly distributed across the country, with the Indus River Basin being the primary source of freshwater. This has resulted in a competition for water resources among different sectors, including agriculture, industry, and households. The mismanagement of these resources has resulted in water scarcity, particularly in the arid regions of the country.

Water scarcity, in turn, has led to an increase in non-traditional security issues in Pakistan. For example, the shortage of water has led to disputes between different provinces of Pakistan, particularly those in the Indus River Basin. These disputes have led to political tensions and even violence between different groups. Additionally, the scarcity of water has affected agriculture, which is a critical sector for Pakistan's economy. This has led to food insecurity, as well as unemployment and poverty in rural areas.

The recent floods in Pakistan have highlighted the impact of water mismanagement on non-traditional security issues. The floods were caused by heavy rainfall, which led to the overflow of rivers and canals in the country. The lack of proper water management infrastructure, such as dams and reservoirs, aggravated the situation. The floods resulted in massive damage to crops, infrastructure, and property, and left millions of people homeless. The floods also led to the spread of water-borne diseases, such as cholera and typhoid, which further exacerbated the health crisis in the country.

The hydro-management crisis in Pakistan is a non-traditional security issue that is linked to the mismanagement of water resources. The competition for water resources among different sectors, the uneven distribution of water resources, and the lack of proper water management infrastructure have resulted in water scarcity, which has led to an increase in non-traditional security issues in the country. The current flood crisis in Pakistan is a prime example of how water mismanagement can exacerbate non-traditional security issues in the country.

In conclusion, hydro-management crisis in Pakistan is a complex issue that requires a multi-dimensional approach. The government must prioritize the creation of a comprehensive and sustainable water governance framework that addresses the underlying issues of governance, infrastructure, and sustainability. The success of hydro-management policies in Pakistan will depend on political will, efficient implementation, and the involvement of all stakeholders, including civil society, the private sector, and international partners. The crisis in Pakistan also has regional implications, and South Asian countries must work together to promote regional cooperation and conflict resolution in the area of water management. The hydro-management crisis in Pakistan must be viewed as a non-traditional security issue, and proactive measures must be taken to mitigate the potential for conflict and instability in the region.

6.1 ADOPTING SUSTAINABLE MODEL FOR HYDRO-MANAGEMENT

6.1.1 INTEGRATED WATER RESOURCES MANAGEMENT | CASE STUDY: SRI LANKA

Sri Lanka has adopted several measures to manage its water resources and address its water scarcity issue. One such approach is the Integrated Water Resources Management (IWRM) model, which aims to manage water resources in a sustainable and holistic manner, considering social, economic, and environmental factors.

6.1.2 INTEGRATED WATER RESOURCE MANAGEMENT MODEL

The IWRM model is a comprehensive and participatory approach that involves the integration of various sectors and stakeholders in water resources management. The model aims to promote sustainable and equitable use of water resources by considering economic, social, and environmental factors.

The IWRM approach is based on four principles (UNEP, 2021):

1. Integrated management: This principle emphasizes the need for the integration of all water-related sectors and stakeholders in the planning, management, and decision-making processes.
2. Participation: The involvement of all stakeholders, including government agencies, non-governmental organizations, local communities, and the private sector, is essential for the success of the IWRM approach.
3. Sustainability: The IWRM approach seeks to ensure the long-term sustainability of water resources by promoting efficient use and conservation of water, preventing pollution, and protecting ecosystems.
4. Adaptive management: This principle emphasizes the need for a flexible and adaptive approach to water resources management, which can adjust to changing circumstances, such as climate change, population growth, and technological advancements.

The IWRM approach involves the participation of all stakeholders, including government agencies, non-governmental organizations, and local communities, in the management of water resources. It promotes the efficient use of water resources, encourages the use of alternative water sources such as rainwater harvesting, and seeks to minimize water pollution.

6.1.2.1 IMPLEMENTED BY SRI LANKA

The IWRM model in Sri Lanka is implemented through a national water policy framework, which sets out the principles, objectives, and strategies for the management of water resources. The policy framework is supported by legislation and regulations, including the Water Resources Board Act, the National Water Supply and Drainage Board Act, and the Environmental Protection Act.

Sri Lanka has also implemented several measures to promote the efficient use of water resources, including the construction of small-scale reservoirs, rainwater harvesting systems, and the promotion of drip irrigation in agriculture. The country has also established a system for monitoring and regulating water use to ensure sustainable use of resources.

Overall, the IWRM model in Sri Lanka is a holistic approach to water resources management that considers the social, economic, and environmental dimensions of water use. The model's success in Sri Lanka has been attributed to the participation of all stakeholders, the adoption of a long-term perspective, and the commitment of the government to sustainable water management.

6.1.2.2 IWRM MODEL: SUCCESS OR FAILURE

The Integrated Water Resources Management (IWRM) model has had some success in Sri Lanka. The adoption of the IWRM approach has led to several positive outcomes, including improved water supply and sanitation services, increased agricultural productivity, and better management of water resources.

One of the significant achievements of the IWRM approach in Sri Lanka is the improvement of water supply and sanitation services. The country has made significant progress in increasing access to safe drinking water and improving sanitation facilities. According to the World Bank, over 90% of Sri Lankan households now have access to improved water sources, and more than 80% have access to improved sanitation facilities.

1. Improved access to water and sanitation: According to the World Bank, Sri Lanka has made significant progress in increasing access to safe drinking water and improved sanitation facilities. In 2018, 93.5% of the population had access to improved water sources, and 84.3% had access to improved sanitation facilities (UNDP, 2019).

2. Increased agricultural productivity: A study conducted by the International Water Management Institute (IWMI) found that the promotion of efficient water use and irrigation technologies, such as drip irrigation, had led to higher crop yields, reduced water wastage, and improved soil fertility in Sri Lanka. The study found that drip irrigation led to an increase in rice yields by 14-23%.

3. Better management of water resources: The government of Sri Lanka has established a system for monitoring and regulating water use to ensure sustainable use of resources. According to a study published in the journal Water Resources Management, the implementation of the IWRM approach in Sri Lanka had led to improved water governance, increased stakeholder participation, and better management of water resources.

4. Reduction in water pollution: The IWRM approach in Sri Lanka has also contributed to the reduction of water pollution. The implementation of regulations and policies has led to the enforcement of pollution control measures and the reduction of water pollution from agricultural and industrial sources. According to a study published in the Journal of Environmental Management, the implementation of the IWRM approach had led to a reduction in chemical fertilizer use and pesticide pollution in water bodies.

5. Challenges and room for improvement: Despite the successes of the IWRM approach in Sri Lanka, the country still faces significant challenges related to water resources management. For example, the country experiences regular droughts and floods, which can lead to water scarcity and damage to infrastructure. Climate change is expected to exacerbate these challenges in the future, making it necessary to continue implementing the IWRM approach and developing new strategies for managing water resources in Sri Lanka.

Overall, while the IWRM approach has had some success in Sri Lanka, it is a continuous process that requires ongoing commitment and effort from all stakeholders to ensure sustainable and equitable management of water resources.

6.1.3 IWRM MODEL ADOPTED BY PAKISTAN

Pakistan, being a country facing similar water challenges, could adopt the IWRM approach. However, the success of the model would depend on several factors such as the commitment of the government, the involvement of all stakeholders, and the availability of resources. Pakistan would need to customize the IWRM approach according to its specific needs and challenges.

Pakistan could also learn from Sri Lanka's experience in developing and implementing water policies and regulations. Additionally, Pakistan could benefit from implementing innovative solutions such as drip irrigation, desalination plants, and water conservation campaigns to reduce water wastage and ensure sustainable use of water resources.

RECOMMENDATIONS

6.2.1 Increased Coordination Between Ministries And Institutions

Concerns about water security should be coordinated by the Ministry of Climate Change with all the provinces. For an efficient response, all relevant agencies and departments ought to cooperate with this ministry. Similar to how international contacts would be a crucial part of successfully implementing policy, the Ministries of Foreign Affairs and Climate Change should reduce redundancy and eliminate overlaps when necessary.

6.2.2 PROPER ENFORCEMENT OF LAWS AND POLICIES

The problems related to fair water distribution, monitoring and installation system, and the treatment plants lagged during the implementation phase of Pakistan Water Apportionment Act 1991 and even after Indus River System Authority (IRSA) were created. Concerns over unfair water theft between Punjab and Sindh have persisted throughout the years. Despite the "Council of Common Interest" (CCI) being established to address provincial complaints, problems still exist because of weak governance and implementation processes. Water distribution between each province's rural and urban areas was given to the provinces as an internal affair in the 18th Amendment to the Constitution, but ongoing water crises continue to have a negative impact on interprovincial harmony. If the situation is not addressed as a national emergency, Pakistan would be subject to the water shortages that are typically seen in Africa.

6.2.3 WATER TREATMENT PLANTS AND RECYCLING OF WATER

Pakistan urgently needs to build treatment facilities because every year, hospitals are overrun with adults and children suffering from illnesses brought on by contaminated water. Both urban and rural residents are susceptible to infectious diseases and microbes that enter the body through contaminated drinking water. Because not everyone in Pakistan can buy bottled water, the government must ensure that its people have access to clean drinking water. As is well known, Pakistan experiences its heaviest rainfall between the months of July and September, with the majority of the precipitation ending up in rivers and ponds and the remainder flooding cities and their occupants severely. To ensure public health, the government can filter pure drinking water by installing treatment plants. Similar to this, more wastewater recycling facilities are urgently needed and should be built. Wastewater treatment is essentially nonexistent in rural regions, which causes surface and groundwater pollution (Y. Ali et al., 2020). The treatment of wastewater to save clean water for drinking and the balanced supply of recycled water to other

uses like irrigation provide ever-changing difficulties that require the government's immediate attention.

6.2.4 CLIMATE EMERGENCY AND DISASTER RESPONSE MECHANISM

In the 2022. United Nations General Assembly (UNGA) sessions, Pakistan was successful at persuading world leaders of the vulnerabilities to climate hazards and the extraordinary impact in the year 2022. US President Joe Biden and UN Secretary General Antonio Guterres both personally pleaded for assistance for Pakistan to lessen suffering and hasten flood victims' rehabilitation. In order to lessen the vulnerabilities and hazards of climate change, it is advised that Pakistan prioritise climate diplomacy and begin the process of interaction with nations on a bilateral and multilateral basis.

6.2.5 CAPACITY BUILDING AND PROFESSIONAL TRAINING FOR HYDRO-MANAGEMENT AUTHORITIES

A significant interagency coordination effort is also required to reenergize the disaster response mechanism. Through capacity building and specialised training, the current framework of national and provincial disaster management authorities should be strengthened. In order to save the most lives, it is also necessary to deploy the right equipment for rescue and relief activities at critical locations. Infrastructure development in flood-affected communities should be accelerated, calling for the prompt mobilisation of crucial resources. To provide a coordinated and appropriate response that would save response time and save the most lives possible, such preparations should be made and practised annually throughout the pre-monsoon season.

6.2.6 DAMS OR EFFICIENT WATER RESOURCES MANAGEMENT

Despite the fact that dams will increase water storage during the rainy season and generate much-needed electricity, Pakistan must first focus on improving the utilisation of its existing water resources. Although irrigated agriculture consumes a significant percentage of the country's available water resources, seepage in canals results in the loss of 44.9 percent of the water that is diverted for irrigation in Pakistan. Pakistan can take action to increase water efficiency in addition to building dams by lining canals to lessen seepage, restricting the drilling of groundwater wells, and processing and reusing effluent (Saddiqa et al., 2022). These actions will lessen the country's environmental effect while assisting it in meeting its water needs. In

order to collect floodwaters during the monsoon season and restore groundwater supplies for use during the dry season, it must also include techniques like managed aquifer recharge. If these steps are adopted, as recommended in the NWP, Pakistan will be better able to withstand the depletion of its water supplies, regardless of whether it is brought on by climate change or Pakistan's neighbours.

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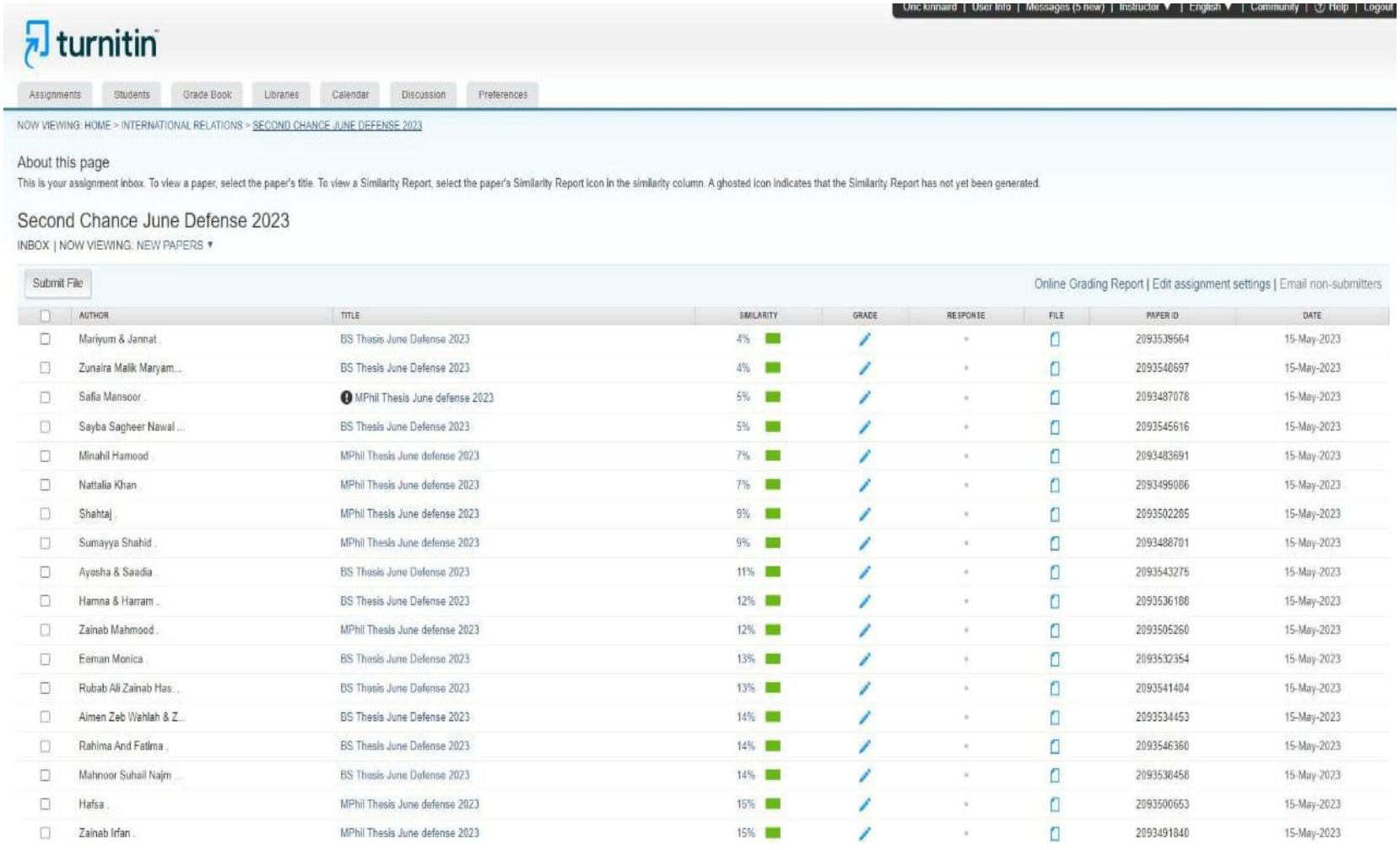

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