Chapter 1

Introduction

Since the creation of Pakistan, border security has remained a pivotal point for the national security discourse. It has been a matter of serious concern for policymakers due to continuous problems originating from eastern and western borders. As a result, the mainstream national security discourse started considering the security issues link to the territorial borders of the country as immediate threats to the country. The overwhelming wave of traditional security issues rooted in the security of border encircled the whole national security mechanism of the country. Thus, National security discourse is often regarded as a pivotal point of state's policy, which marginalized the broader notion of human security. The intellectual community from different parts of the world observed the unending rivalry between India and Pakistan became the fundamental reason behind Pakistan's main stream national security discourse, initially, the partition of subcontinent, and British colonial retreat from South Asia laid the foundation of India-Pakistan multi layered conflict. A persistent revolution of various points of disagreements between New Delhi and Islamabad further intensified the regional security environment of South Asia. In response to the unavoidable Indian hostility against Pakistan, its policy makers were compelled to exclusively emphasize the security of its autonomous position in the region. Additionally, Indian quest for undermining the sovereign status of Pakistan resulted in different border conflicts and multiple points of disagreement with Pakistan which further forced Islamabad to enhance its border security against India. Indian quest for harmonizing its domestic region fundamentally hampered Pakistan position in the region. The pursuit of dominating the regional politics led New Delhi to adopt an anti-neighborhood policy. The genesis of Indian anti neighborhood policy is rooted in Indian strategic thinking. The fundamentals of Indian strategic thinking instructed New Delhi to adopt an aggressive model of foreign relations with the neighboring countries where Pakistan became the prime victim of Indian regional aggression.

While keeping in view, the India-centric South Asian security environment, Pakistan decided to secure its territorial integrity and politically autonomous status in the regional

politics. The regional security compulsions created by India pushed Pakistan towards specific security discourse revolving around Indian opposition to the creation of Pakistan.

The aggressive Indian behavior resulted in three wars with Pakistan (1948, 1965, and 1971) which makes it evident that policymakers were rational in focusing the broader concept of security. The continuous emergence of border threats jeopardizes Pakistan's territorial sovereignty and Indian opposition to Islamabad's position in the South Asian politics. The further designs of Indian antipathy towards Pakistan framed various challenges in the international community threatened Pakistan's role in the extra regional affairs. In this way, the combination of regional and extra regional challenges mainly created by New Delhi augmented the Indian hostility with Pakistan in reaction to Indian persistently growing anti-Pakistani behavior pushed the government of Pakistan (GOP) under different political administrations to exclusively focus on traditional security threats.

Pakistan's focus on traditional security marginalized nontraditional security of Pakistan. In today's algorithmic world the National Security agenda of sovereign states has gone beyond the traditional state centric approach. After the end of the cold war, the security approach has been widened by amalgamation of threats to people of the state. While the sphere of traditional security concerns is quite precise, threat emanated from military means, no similar concurrence exists in the context of non-traditional security. Broadly, non-traditional threat is perceived as: "Challenges to the survival and well-being of peoples and states that arise primarily out of non-military sources, such as climate change, cross-border environmental degradation and resource depletion, infectious diseases, natural disasters, irregular migration, food shortages, people smuggling, drug trafficking, and other forms of transnational crime".[1]

Presently, the focus has been shifted towards wide range of existing non-traditional security threats emanating from social, economic and environmental stressors. The environmental challenges are impacting globally. In Pakistan, environmental security has been neglected for a very long time. However, now the shift has been mainly towards the existing Non-traditional security threats, i.e., Climate change, water security and others.

[1]Iqbal khalid, "*Pakistan's traditional and non-traditional challenges*", Academia.edu.

In this aspect, the National Climate Change Policy (NCCP) of 2012 is significant to mention here. It is amid the growing risk of future natural hazards due to climate change and provides a detailed picture of vulnerabilities faced by individuals, sectors, eco-regions and socio-economic classes. In 2017, the major authority on Environmental issues, the Climate Change division was upgraded to a full fledge ministry. Since then, many acknowledgeable steps have been taken in this regard. The quest for maintaining massive plantation in Pakistan by the incumbent government remains at top. Millions of plants have been planted already, growing in numbers day by day.

For a quite long times, the issues such as industrial effluents, air pollution, lack of proper waste management, deforestation, loss of biodiversity, desertification, natural disasters and climate change have engulfed the country.[2] The current ruling party in Pakistan, Tehreek-e-Insaaf, (PTI) known for its moderate and long-term visions, gave appropriate importance to environmental challenges. During their first tenure in Khyber Pakhtunkhwa (2013-2018), the government started a million trees plantation drive to recover the lost forest area of KP, suffered from huge tree lose due to many domestic factors. In this aspect, provincial government in Sindh has also planted millions of mangroves in coastal areas of Sindh which is also a good initiative.[3] The up gradation of Climate Change division into full fledge ministry in 2017 shows that whole state is concerned about environmental challenges. However, much more needs to be done as environmental challenges are not just cause by deforestation, the problem has several factors, complexly integrated into one and another.

The International Environmental Conference in Paris or the Paris Treaty (2015) agreed on a global framework to avoid dangerous climate change by containing the global warming to below 2°C and do more efforts to limit it to 1.5°C.[4] It also aims to strengthen countries' ability to deal with the impacts of climate change and support them in their efforts. The Paris Agreement is the first-ever universal, legally binding global climate change agreement, adopted at the Paris climate conference (COP21) in December 2015.

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[2] , *National Environment Policy 2005*, (Ministry of Environment, Government of Pakistan, 2005).

[3] "2 billion mangroves planted along Sindh's coastal areas," *Dawn*, July 21, 2020, Accessed December 2, 2020, https://www.dawn.com/news/1570201.

[4] "Paris Agreement," n.d., https://ec.europa.eu/clima/policies/international/negotiations/paris_en.

Recent environmental challenges are actually becoming a matter of national security for many states due to their geography. Environmental security is a combination of two concepts, environment and security. Normally much opposite in general meaning, the merger of these two concepts results in a broader concept of nontraditional security. Nontraditional security in environmental paradigms is a much broader agenda. The repercussions of environmental threats are devastating. Nevertheless, the parliament of Pakistan has adopted United Nations Sustainable development goals (SDGs) as development agenda for 2030 which will enhance the importance of environmental challenges and to find ways to curb them.

1.1 Statement of the Problem:

In the transforming scope of national security of sovereign states, non-traditional challenges have become more direct and immediate threat to the national security of the Pakistan. In the backdrop, the pillars of national security are impacted by the Non-Traditional Security threats. Consequently, the state is facing challenges in economic, political and social domains.

1.2 Objectives of the Study:

1. To highlight the relation between environment and national security.
2. To explore the various dimensions of environment challenges impacting non-conventional nature of Pakistan's security.
3. To highlight the consequences of Nontraditional threats on socio-economic and political fabric of Pakistan.
4. To identify the counter measures taken by Pakistan mainly on policy formulation and its appropriate implementation, while proposing possible solutions to mitigate the threats.

1.3 Literature Review:

The literature on understudy topic is available but scattered. However, the relevant literature has been collected through liable sources and detail of the literature is as follows:

Pakistan's national security discourse largely consists of traditional means of security or defense capabilities of the state where as the nontraditional security threats have not been often highlighted in Pakistan's national agenda. However, recently some steps for preserving the environment have been taken by the government which is one of the major NTS threat presently. In the international political arena, Environment has been one of the most discussed topics recently and it is one of the most critical issue as well since the developed states are working to sort out how to preserve the environment or global climate changes which are getting sharp and sudden with severe weather pattern changes that are affecting the global environment as well as economy. Much has been written on nontraditional security threats specifically the environment internationally as well as in Pakistan which is a good sign since better late than never is a good act.

In his article published online at Daily Times "The exceptional discourse of security in Pakistan" Zahid Mehmood Zahid discusses the security discourse of Pakistan from historical point of view. He first explains the insecurity of Pakistani policy makers from Indian and Afghan threats which resulted in formulation of such security discourse.[5] Zahid further describes that the security threats to the newly formed state were the driving force behind the creation of such discourse which placed its favored the military in allocation of power among institutes as the survival of the country was at stake due to the aggressive behavior of India. Later on, writer elaborate the security discourse and its mechanism in details for a state and its implementations. Mahmood says that a security state or condition of a security emergency disturbs the balance of power, budget allocations in national structure which results in compromise on other national needs as no one can ignore the security threats. Writer concludes his work by stating that a revised national security discourse is a major need of time and the state or the political

[5] Zahid Mehmood, "The exceptional discourse of security in Pakistan," *Daily Times*, March 5, 2018, accessed August 26, 2021, https://dailytimes.com.pk/210393/exceptional-discourse-security-pakistan/.

government needs to bring back things to normalization else this situation will lead to more anarchy and agitation in the society.

In his article "Non-Traditional Security Threats in Pakistan "published on The Balochistan Express, Dr. Hussain Era expressed his views regarding nontraditional security threats for Pakistan.[6] In Pakistan the normal perception of security is taken in traditional means for security as for hard power, military and border security, however in his article, the writer also focused on natural disasters, food and water shortages, climate change, global warming, IDP's etc. The writer wrote that the new nontraditional security threats are a serious concern for states because they are not within state or national problems, they are transnational in nature, they are universal and they are going to affect all if necessary, measures are not taken as soon as possible.

In his online work titled "Deconstructing National Security Discourse in Pakistan" in International Policy Digest, Shah Muhammad states that present security discourse of Pakistan. According to him, security has always remained a top policy for the government due to various factors.[7] He then discusses that idea of security has evolved over time and currently, the interpretation of security has changed a lot as it not only covers the border or territorial security, rather it has explored new dimensions such as economic security, energy security, food security, energy, cyber security but the policy makers in Pakistan are still attached to the old idea of security which is the defense sector and hence there is a compromise on human security elements. He comments that present definition of national security is much more than the traditional security and in case of Pakistan, issues like political instability, economic crisis, and social fault lines are deeply related with national security. Muhammad discusses that although significant progress was done in military operations against terrorist outfits, but these were just the short term steps needed to overcome these issues, and in the long run, a significant number of population, specifically youth due to socio-economic problems remains fragile and weak

[6] Dr Hussain Ara, "Non-Traditional Security Threats in Pakistan," *Daily Balochistan Express*, June 13, 2018, accessed December 15, 2020, https://www.bexpress.com.pk/2018/07/non-traditional-security-threats-in-pakistan/)

[7] Shah Muhammad, "Deconstructing National Security Discourse in Pakistan," *International Policy Digest*, April 30, 2021, accessed July 20, 2021, https://intpolicydigest.org/the-platform/deconstructing-national-security-discourse-in-pakistan/.

target by them and Pakistan needs a long term strategy to counter the nontraditional security challenges and should not just stick to old patterns of security but also to deconstruct the national security discourse which needs immediate alteration. He concludes his work by stating that Pakistan needs to broaden its interpretation of national security and needs to look for evolving dimension of security which focuses on human security as well and current patterns of security cannot sustain the national security in the current era where 5th generation warfare can easily manipulate populations therefore a national policy is needed to counter the NTS in Pakistan.

In his work "Changing security paradigm?" published online at Dawn in April 2021, Muhammad Amir Rana talks about recent development between India-Pakistan regarding the peace process in which he mentions Pakistan's Army chief statement in which he suggest that Pakistan and India should bury the past and move forward for greater good.[8] The writer discuses that recent governments, particularly since 2008, are trying to develop a new national security policy which consists a shift from geostrategic to geo-economic dimensions and also to include nontraditional security threats along with human security in the national security policy or discourse to be precise. Many drafts who cover many elements of national security, internal and external have already been submitted to the government in this regard which have gone a step forward while adding the mega project of China's One Belt One Road initiative. Amir mentions that Pakistan's primary security threat is its eastern neighbor, India, primarily because of Kashmir issue therefore it is required to defuse tensions with India and bring peace to region and there have been many ups and down in the relations with India and many examples in the past are present but leadership is important in this regard. However, Amir further adds that Pakistan's geopolitical position in the region makes it a victim of international politics in the region where its relations with United States and Middle East went through different phases and India exploited them brilliantly. In addition, he said that discussion on national security discourse should be done openly on public forms and not only remain a matter reaming to a limited number of people or oligarchy. Finally, Amir makes a conclusion that to combats its internal and external challenges, Pakistan needs strong

[8] Muhammad A. Rana, "Changing security paradigm?," *Dawn*, April 4, 2021, accessed August 25, 2021, https://www.dawn.com/news/1616292.

economy and good relations with the international community especially with the regional states. He further adds to his notion that Pakistan needs to focus more on its economic progress, observing everything with the traditional security mindset would only empower the elites who are only concerned for more benefits from present situation which isn't in the greater interest of the state which needs immediate economic reforms and stability. Finally, he mentions China Pakistan Economic Corridor (CPEC) that it is a good opportunity for transforming the economy of Pakistan.

Barry Buzan has written a lot on Post-Cold War security threats and concepts. He emphasizes on NTS more than the traditional ones in the current global scenario as the time, the era, even the millennium has changed, and the challenges or issues which haven't been primary focused by states have turn into full fledge, must dealt challenges which are hard to coup with. In his article "Rethinking security after Cold War" Buzan expresses his views in light of the collapse of Soviet Union.[9] Buzan explains that when Soviet Union collapsed, it wasn't only the collapse of Soviet Union, it actually also took down whole military-political agenda which dominated the World politics since the end of World War. Buzan also explains that two new threats for national security gained prominence after the end of Cold War which were economy and environment. Introduction of these two into dynamics of security attracted the traditional security school of thought because Soviet Union did hold huge weaponry but it was not able to save itself from fall since the economy collapsed and eventually resulted in dissolution of Soviet Union. Buzan's work has been done in a broad way on NTS challenges in the wake of post-cold war security implications for states. In his book" People, States and Fear: An Agenda for International Security Studies in the Post-cold War Era" he describes fundamentals for security such as political, military, economic and shared environmental landscapes and how they shape the relations between states.[10] He repeats the argument about security that it is one of primary lens for states look at their

[9] Barry Buzan, "Rethinking Security after the Cold War by Barry Buzan - A Summary," Clueless Political Scientist, December 4, 2018, Accesed October 15, 2020, https://cluelesspoliticalscientist.wordpress.com/2017/04/13/rethinking-security-after-the-cold-war-by-barry-buzan-a-summary/)

[10] Barry Buzan, *People, States and Fear: An Agenda for International Security Studies in the Post-Cold War Era* (Colchester: ECPR Press, 2016))

international relations, it helps us understand the international scenario and fears states have from each other and how power politics affects them. He also analyzed how five perspectives of security such as political, military, economic, societal, and environment bring changes into a state. The securitization theory by Buzan comprehensively explains the NTS for the state. In the aftermath of collapse of Soviet Union, the security dynamics of a state or even regions were modified and the NTS means of security were evaluated as the traditional security failed to secure Soviet Union from dissolution. It is proven that economic status of a state may be contained to one state of a particular region, that won't be having effects on its neighboring states in a broader way unless spilled but the environmental effects are independent from that, as environment is a transnational commodity, there are no border restrictions for it, its effect will reach equally far with the event or procedure conduct no matter if it's good or bad, this is why the concept of nuclear winter was given that incase of nuclear war, the consequences would not be contained to a state, they would eventually become a global problem. Secondly, the way of life for people heavily depends on Climate conditions around them, they cannot ignore this fact, if the climate reaches the level where it won't remain suitable for living, excessive surge in temperature, and it would simply mean a catastrophe for the planet.

In article " Environmental Security in Pakistan — Are There Grounds for Optimism?" By Shaheen Rafi Khan, the author focuses on discusses different aspects of environmental security in Post-Cold War era.[11] The writer writes about the steps taken by Bush administration which became aware of environmental threats and placed sustainability and environmental security of planet on national agenda. Rafi suggested a model for Pakistan's NWFP (currently Khyber Pakhtunkhwa) that political and institutional reforms are a vital need else they will result in deforestation, water scarcity, pollution and eventually effecting lives of citizens of the province. Rafi also explains the different terms such as economic security, food security, health security, personal, community and political security which are vital need of humans for survival and if they are not maintained by the state, the traditional security means might not be enough to maintain

[11]Shaheen Rafi Khan, "Environmental Security in Pakistan — Are There Grounds for Optimism?" *Working Paper Series # 63 2001*, n.d)

peace. He highlights the different factors which effects the environment such as Water Pollution, Air Pollution, Solid Waste Management, Deforestation, and Agricultural Land Degradation etc. Rafi also wrote a case study of Kala Bagh's dam controversy. The writer suggests that environmental security is actually subset of human security and it will directly affect all human activities if the environment is affected and therefore the sustainability of environment must be focus of the government.

An article "Deterrence: A Security Strategy against Non-Traditional Security, Threats to Pakistan" by Farzana Zaheer Syed and Saba Javed discusses different nontraditional security threats to Pakistan such as terrorism, cyber threats, human security, energy crises and water security and has marked them not lesser than traditional border security threats for Pakistan.[12] They divide the threat scenarios for Pakistan into two types, first are marked as Important Scenarios internal threats such as political, economic and social order stability and second is Hazardous Scenario which discusses the environmental factor for national stability and security. Writers state that these challenges are hurdles for national development of Pakistan.

K. N. Adhikari explains the water distribution mechanism of South Asia in his article "Conflict and Cooperation on South Asian Water Resources" published in IPRI journal XIV (2014) in a brief manner. He discusses different case studies such as Bangladesh-India, India-Nepal and Pakistan-India in terms of water distribution. The author writes that one common and largest state in terms of size and population, India is trying to manipulate other states to acquire maximum water from resources, even from other states due shares. Adhikari believes that asymmetric power state relations in South Asia have resulted in some treaties which are beneficial in unilateral way for India such as the Koshi agreement (1954) between India and Nepal is way more beneficial to India, than Nepal and has been severely criticized in Nepal because of the terms, conditions and future projectiles. Author believes IWT is a comprehensive work on water distribution mechanism between Pakistan and India but it also became possible due to involvement of World Bank and Britain indirectly, and such overarching treaty which is equally

[12]Farzana Zaheer Syed and Saba Javed, "Deterrence: A Security Strategy against Non Traditional Security Threats to Pakistan," *International Journal of Social Sciences and Management* Vol. 4, no. 4 (2017): pp. 267-274, https://doi.org/DOI: 10.3126/ijssm.v4i4.18503)

beneficial to both states, doesn't exist in other cases. However, since long time, due to increasing needs and population, India is also trying to violate IWT and Pakistan has raised some serious concerns regarding the violations. Author suggested that Pakistan should also formulate a framework with Afghanistan over River Kabul, which is a major western tributary of Indus to avoid any future dispute. Adhikari recommends a well-designed framework for distribution of water resources in greater South Asia for the betterment of population and smooth progress.

Maria Syed in her article "Need for a Paradigm Shift in Security: Adopting Human Security in Pakistan" published in IPRI journal (Summer 2014) has worked significantly on describing NTS challenges for Pakistan. She suggests that for a very long time, perhaps since inception of Pakistan, more emphasized has been done on traditional security of state, military means to be specific, and this negligence in human security or nontraditional security now creating implications for state and are causing hindrances in its progress. Syed has first described traditional security and later on described the areas of NTS challenges such as socio-economic, food, environmental, health and energy security. Writer believes that it's the right time redefine the security orientation of Pakistan as the defined sectors are one of the basic needs of human beings, and yet, they haven't been given due importance due to lack of resources and a further delay would only cause more agitation and massively hit the fault lines in national security structure which has already started due to continuous crisis situation. The emphasis on human security would directly boost up all other sectors of the state as economic strength is the fundamental element of state power. If it increases in justifiable portion, the resource diversion would automatically enhance in a direct proportion to every sector, whether military, education, or health.

Michael Kugelman analyzed the situation of Pakistan under his work "Urbanization in Pakistan: causes and consequences" published by Norwegian Peace Building Resource Center in January 2013, in detail manner which has some alarming facts and figure. First, he reports that Pakistan's One-Third population is now urban, a ratio which was One-Fourth hardly three decades ago, he further estimates that by 2025, the figure is likely to be 50%. It must be mentioned here that Pakistan already has one of the highest urban

ratios in world, it currently ranks at number 10 in term of urban population which is approximately 80 million.[13] This situation is certainly not a good sign for cities, who are already facing several problems and becoming less livable gradually due to increasing pressure of population and resource depletion. Kugelman further discusses that this migration is due to lack of basic facilities, job opportunities and some social problems which haven't been controlled by the government. Kugelman recommends that government needs to this rapid urbanization seriously and must not neglect the drivers of this process because they would create problem in long term as well. He suggests that Pakistan must do appropriate measures for sustainable urbanization challenge. The Policy makers will have to look into the matter deeply, critically to maintain balances between urban and rural populations, industrial growth, basic needs of people, while also not diminish the value of agricultural sector, which has dominated the economy for years.

A brief analysis has been done in article "Human Security and Energy Security, A Case Study of Pakistan" by Muhammad Asif and Naila Saleh published by Institute of Policy Studies, Islamabad. Firstly, the authors reference the UN declaration of 2012 as that year was dedicated to "Sustainable Energy for All" goal. Later on, they discuss the situation of sustainable energy in Pakistan which is not so encouraging at all. Writers have expressed serious concerns regarding the power generation procedure in Pakistan which is mostly thermal, that is one of the largest sources of GHGs and Air Pollution in country. The authors also revealed that the current energy sector, which highly consists on thermal power generation is also not cost effective at all increasing expenditures of households and industrial production. In general, the writers recommend that the current energy sector does not portray a good picture according to the environmental or economical point of view simultaneously, and demands immediate reforms for a sustainable environmental and energy production.

Major Alex Osborn in his work "The 'Clash of Civilizations' Thesis as a Tool for Explaining Conflicts in the Contemporary World" published in Defense Studies journal (2005) has deeply studied the potential of different resources that might cause future

[13] "Urban Population - Pakistan," World Bank Open Data, accessed December 12, 2020, https://data.worldbank.org/indicator/SP.URB.TOTL?locations=PK&year_high_desc=true.

conflicts, and among them, water is listed on top.[14] He hasn't even neglected the chance of a full fledge war because of water, however, he explains that water would become primary source of conflict along with various factors due to depletion of freshwater sources in many states, which are already present in rare quantity in nature, less than One percent of total water resources. Osborn also predicts that competition for resources would increase, specifically the nonrenewable resources in future, as their depletion has accelerated in rapid manner due to increasing population and industrial demand, this is simple economics, and increasing population would result in increasing demand. World's population is likely to surpass nine billion in next 50 years. This increase in population possesses some severe impacts on environmental mechanics such as the degradation of farmland and forests, depletion of freshwater sources and fisheries, and it is highly expected that all this will eventually cause harmful environmental effects such as global warming, weather pattern change, which would simply enhance problems for states in the future. In the past, the war was for resources, and even in future, its possibility would increase no matter if its oil, or water. It is global acknowledge fact that competition for scarce resources is fundamental pillar of foreign policies, Oil or gas politics, and water would gradually gain value. This is where water has a potential of becoming source of armed conflict between Pakistan and India, two of the largest states in terms of population, and due to Indian behavior of unilateralism, and continues violation of Indus water treaty, there is strong possibility of war which should be avoided at every cost.

A very précised work has been done on Pakistan's nontraditional security challenges in "The crisis of water shortage and pollution in Pakistan: risk to public health, biodiversity, and ecosystem" by authors Ghulam Nabi, Murad Ali, Suliman Khan &Sunjeet Kumar. The editorial shows a comprehensive picture of Pakistan's current NTS and also suggest some possible solutions. Authors write that Pakistan is ranked third in states facing water shortage according to the International Monetary Fund (IMF). They have also written that PCRWR, state's premier body on water resources, in 2018 has stated that by 2025, very short amount or nearly no clean water will be available for drinking in Pakistan which will have adverse effects on socio-economic and ecological system of the country. The

[14] Alex Osborn, "The 'Clash of Civilizations' Thesis as a Tool for Explaining Conflicts in the Contemporary World," *Defense Studies* 5, no. 3 (July 2005): xx, doi:10.1080/14702430500492849.

authors have also covered another very important area, the contamination of water of in Pakistan which is not encouraging at all. According to WHO, the water distribution structure in Pakistan is old, outdated and has completed its tenure. Pipelines are rusted, damaged from many places which allows the sewerage water mixed up with fresh water, this water is not treated and supplied to home and commercial consumers which is resulting in severe diseases like cancer, restrictive pulmonary disease, gangrene, neurological impairments, cardiovascular problems, skin infections, diabetes, mellitus, and problems in endocrine glands, immunity, liver, kidney, and bladder, this is putting public health at large risk. Various research reports have revealed that approximately 60 million people are at large risk due to drinking arsenic contaminated water, which can be called as the largest mass poisoning in human history. Last but not least water pollution is responsible for approximately Thirty percent of all diseases and 30% of deaths. This situation is causing serious socio-economic and environmental hazards and, in the future, the situation is likely to go intense. In the context explained, Authors have suggested several solutions to the crisis state of water and environmental issues in Pakistan such as Sound National Water Policy, switching to bottled drinking water which might look expensive, but in the long run, is completely worth it, building dams, small or big, must construct them as soon as possible, Reforestation, Proper implementation of trans-boundary water frameworks, Installation of low-cost water filters and sea water utilization, saving glaciers and conservation of lakes.

According to a declassified report by United States Department of State subject "Domestic Policy Council meeting on protocol to control Ozone-Depleting Chemical" published in March, 2015 by National Security Archive (NSA), originally created in June, 1987 by Richard E. Benedick reveals some facts regarding United States position on Environment under United Nations Environment Program (UNEP) in 1980's. It is shown that by 1987, UNEP was fully aware of the environmental hazards caused by Ozone depletion and the elements which were causing it and it discussed this matter with countries highly involved such as United States. The report shows that the central point of agenda was the reduction of emissions by scientific, economic and technological assessment but the reluctance existed due to the lack of commitment for execution by other parties included in the meeting program of subject mentioned earlier usually known

as “wait and watch policy”.[15] The report explains how corporate sector magnified environmental issues under the lens of financial incentives although it realizes the sensitivity of the issue on the basis of cost-benefit analysis and looked for way to attain powerful market incentives for development of safer substitutes.

A declassified report named “Shell and Exxon's secret 1980s climate change warnings” published by The Guardian in September 2018 by Benjamin Franta reveals one of the most shocking, yet pragmatic facts regarding climate change and global warming which were predicted by the internal researchers of the oil giants. According to the news story, it shows that large oil companies like Shell and Exxon knew about the catastrophic implications of enormous emissions of GHG by combustion of fossil fuels on the environment by 1980’s, long way before the environmental debate became mainstream and focus of public interest. Their researchers assessed the potentials of combustion of fossil fuels in such amount and actually predicted all the present environmental challenges world is facing now such as temperature surge, rise in sea levels and ecological calamities.[16] Shell’s assessment actually forecasted sea-level rise, one meter to be specific and known as the issue of rising seas today, and calculated that warming could also result in melting of the Ice sheet in the West Antarctic ocean, resulting in a worldwide rise in sea level of “five to six meters” Which would be sufficient for catastrophic consequences for all low-lying states. Shell’s assessments were so subtle that they even predicted destructive floods and search for the need of fresh water resources. Although the assessment carried out by Exxon estimated that quantity of Carbon Dioxide ($CO_{2)}$ would be doubled by 2060, as compared to the pre-industrial age level, it was Shell whose estimates were much accurate in this regard who calculated that CO_2 would be doubled by 2030, much earlier than Exxon’s estimates. Although the corporate giants knew about the expected situation, yet they were reluctant to make their conclusions public due to heavy financial interest in oil markets. The argument looks quite valid that

[15] Richard E. Benedick, *Domestic Policy Council meeting on protocol to control Ozone-Depleting Chemical*, (Washington DC, United States: United States Department of State, 2015), https://nsarchive2.gwu.edu/NSAEBB/NSAEBB536-Reagan-Bush-Recognized-Need-for-US-Leadership-on-Climate-Change-in-1980s/documents/Document%206.pdf.

[16] Benjamin Franta, "Shell and Exxon's secret 1980s climate change warnings," *The Guardian*, September 19, 2018, accessed December 15, 2020. Shell and Exxon's secret 1980s climate change warnings | Climate crisis | The Guardian

the company's executives must have hid the frightening results of assessments from the governments which would have created complications for them and actually prevented governments from formulating environmentally friendly energy policies.

In a series of unpublished documents/reports came from Clinton administration of 1993 under the name "The Clinton White House and Climate Change: The Struggle to Restore U.S. Leadership" edited by Robert A. Wampler, made public in December 2015 by NSA, George Town University, does a comparison of the challenges faced by Obama's administration on environment which resemble with the ones Clinton's administration faced about 2 decades back.[17]Robert writes that US government aims faced a setback by the disputes over emissions of GHGs, role of developed and developing states over environmental policies. White House during Clinton's era was determined to restore USA's status of protecting the environment globally, however due to huge collision of interests of several international, domestic and procedural factors which blew down the hopes of government to attain its agenda on environmental politics. As shown from document one of the series, the point in the debate isn't that increase in emission of GHGs would have adverse effects on environment, rather the argument revolves around the implication and intensity of it on certain areas or regions of the world which would vary, furthermore it also recommends or shows concerns over that fact that even just to reduce the environmental degradation as of then, dramatic reduction of 60% in emissions of GHGs would be immediately required. 60% decrease in the current emission means to immediately cease major portion of production or industrial activity which literally looked impossible to be implemented. Then from document 16 regarding the tactics and effective implementation of Kyoto protocol reveals that Clinton administration was not ready to present stage 1 agreement to the Senate until the conclusion on stage 2 agreement from all parties. This situation clears that there were various factors which were hammering Clinton administration efforts for American position on environmental politics, as the largest economy in the world, it was inevitable that America had to begin

[17] Robert A. Wampler, *The Clinton White House and Climate Change: The Struggle to Restore U.S. Leadership*, (Washington D.C, USA: The National Security Archive, Georgetown University, 2015), Accessed December 25, 2020, https://nsarchive2.gwu.edu/NSAEBB/NSAEBB537-Clinton-White-House-Frustrated-in-Attempts-to-Forge-US-Global-Leadership-on-Climate-Change-in-1990s/.

the reform from home on a large scale to convince the other states like China and India to advance on the steps for preserving environment.

In an interview with Amanpour and Company, Jane Goodall explains the relation between Covid-19 and wild life. She describes how cutting down the forests by the corporate sector has disturbed the natural world. Forests are home to numerous animal species and birds, cutting down forest and making their area smaller has resulted in different animals getting close more close resulting in disturbing the natural order, moreover some animals have to take shelter to suburbs of cities or villages which becomes a gateway for viruses and bacteria to spread faster. Goodall says that putting too much into meat market and surpassing the species barriers makes ideal situation for rapid spread of viruses as covid-19 did. In her blunt responses, Goodall expressed mix emotions of sadness and anger regarding the inhuman treatment of animals and said that humans have brought this (Covid-19) upon them, not the nature, rather they disturbed the natural order which backfired the pandemic. Furthermore, she claims that people knew about it, and many people kept showing concerns about it but the corporate world was too busy doing business, making profits but it was for the short term and they neglected about future of the planet, which has cost heavily.

During an interview with Valerie Hickey at WB's headquarters in Washington D.C, regarding environmental pollution, Peter Thomson, currently UNSG's Special Envoy for the Ocean, expressed some serious concerns, threats and challenges to the ocean and explained how oceans have impact upon human lives. According to him, more than 60% of sewage water is dumped into environment untreated which directly effects the marine life, on the land and later on seas as well, furthermore, he added that ocean isn't big enough to digest everything which is thrown into it, rather, it has limited capacity and one of the biggest threat for ocean marine life is plastics, the micro plastics are broken pieces which becomes food of marine population, stating that it can be said that we are now eating plastics and fish hunting in seas also has limits for its populations, this isn't an endless opportunity for the hunters. Thomson stated that a brief time would be required for reverting the decline of oceans. He suggested that suitable aqua sustainable policies should be adopted for diminish the effects of climate change.

Dr. Attiq-ur-Rehman in his article "Understanding the Concept of National Security" explains the concept of national security in a brief and precise manner. According to Rehman, national security is a center point of state's policy, internally and externally as the primary concern for any state, small or large in size is its survival. Rehman explains that historically the concept of national security is interpreted as military means, however over a long course of time, specifically in post-Cold War era, the interpretation of national security has also been defined in NTS such as economy, energy and environmental securities are now considered a compulsory element of national security. Expressing his views about Pakistan, the writer deduces the national security dynamics of Pakistan linked heavily into the its past, the rivalry with its hostile neighbor, India since the partition of British India in 1947.Rehman explains that India remained a central point of Pakistan's foreign policy and most of its international decisions, policy executions, evolve around the possible outcomes for Pakistan in lens of India. Rehman in his final words remains pragmatic by looking at the current scenario for Pakistan as traditional inadequate security paradigm needs a shift as the threats of the past aren't the only threats remaining for state, rather, new threats have emerged in twenty first century which have changed the security arena for international system. A new balanced security policy for state is required now which must possess brief are for both traditional and NTS challenges.

Apart from this, this area has slightly lacked scholarly attention, but still much work has been done by different authors from other parts of the world such as Javaid Afzal, Akiko Nakagawa, and Asif Shuja Khan in their book Cleaning Pakistan's Air, Policy Options to Address the Cost of Outdoor Air Pollution, or in book The Hindu Kush Himalaya Assessment Mountains, Climate Change, Sustainability and People by Philippus Wester, Arabinda Mishra and Aditi Mukherji where they have evaluated the impacts of global warming on the Himalayan icecap.

1.5 Research Gap

There are many gaps in the existing knowledge based on the link between the environment and national security. Furthermore, there isn't any prominent national debate on nontraditional security threats for Pakistan and the work remain theoretical or

academic in general. Environmental degradation is the catalyst for conflict between and within states. Thereby, the basic methodological and conceptual issues appear to the relation. The study further fills the gap of the theoretical foundation to critically analyze and establish the link of environment-security nexus, through the lens of Securitization theory and add into the non-conventional security discourse of Pakistan.

1.5 Hypothesis

Existing environmental threats are affecting the main mechanism of national security of Pakistan. The growing nontraditional security threats in the form of environmental challenges exclusively need the appropriate responses of national security strategy of Pakistan.

The national security of a state is dependent on several factors including the nontraditional security threats where the environmental challenges stand above all for Pakistan. In this situation, the national security of Pakistan becomes a dependent variable in the study on the emerging wave of environmental challenges which is an independent variable. The study seeks to reevaluate the relation between independence and dependent variable while considering the impacts of environmental challenges on Pakistan's national security strategy.

Environmental challenges have gained significant magnitude in recent years and are requiring the immediate need to address them in unprecedented circumstances. As the environmental challenges are not limited to a region but global, therefor their transnational effects are also not limited and this has heavily hammered the environmental situation in Pakistan which is ranked among the top states who have been witnessing the consequences of an overwhelming wave of environmental threats.

1.6 Research Questions

Q1. What is the relation between environmental threats and national security of Pakistan?

Q2. Why do climate change and water scarcity seeks attention as a top nontraditional security threat?

Q3. How environmental challenges have been impacting Pakistan's socio-economic security?

1.7 Theoretical Framework

The theoretical foundation of this study can be best explained by Barry Buzan and Ole Waever "securitization theory". The end of Cold War resulted in wider agenda for security paradigms for states rather than traditional means. It sparked a debate over ideas of security in IR between 'narrowers' and 'wideners'. The narrowers were concerned with the security of the state and focused on analyzing the military stability. However, on the other hand, wideners sought to in-corporate other types of threats that were not military in nature but affects people rather than states. This expanded the security agenda by including concepts such as Environmental security, human security and regional security, together with ideas of culture and identity.

A significant contribution to the debate regarding the meaning of security has been made by the Copenhagen School. In mid-1990s through the formulation of securitization theory, the security agenda was advanced with an outcome of a special social process or "speech act" rather than an objective condition.

In the backdrop, 'Securitization' theory consists of two main pillars;

a) Identification of existential threats (mainly focusing on the NTS threats),

b) Take on emergency action i.e., effective counter measures.

In accordance with securitization theory, Pakistan has taken meaningful steps to securitize the environment but still facing multi-dimensional challenges to deal with them. Therefore, the theory of securitization is best fitted theory to this research. As per

the theory, an issue becomes securitized when an audience or referent object collectively agrees on the nature of the threat and supports taking extraordinary measures. In this regard, to understand the catastrophic environmental implications by the referent objects (all the stakeholders of the state e.g., Population, government institutions, Military institutions, NGOs etc.) of this risk sector is significant, to work collectively and mitigate its future threats. In order to protect huge outcomes of these threats on the main pillars of national security of Pakistan, government need to identify such threats, take actions accordingly and make effective strategies to mitigate their long-term impacts on economy, politics and society of Pakistan. Public awareness is also necessary to cope up these problems.

Moreover, the research focuses on incorporating the NTS threats in the environmental paradigm for the national security discourse, the securitization theory explains it thoroughly that national security policy is formulated upon the identification of existing threats to national security which are generally present in national security scenarios but haven't been addressed by the state, and the response priority level is low, upon perceiving the level of threat, priority shifts from a low level of addressing to a high level by the policymakers or all the major stakeholders of a state as the environmental issues have shifted its area of focus from government issue to public debate as environmental challenges effects everyone. According to the theory, the factor or threat which gains a dangerous level gradually becomes a security concern for state.

The securitization theory explains Pakistan’s current NTS challenges comprehensively as it not only addresses and point the NTS threats in the environmental paradigm, but also it aligns with the current situation as governmental responses to the environmental challenges have gained significant momentum such as the engagement of legislative bodies in the environmental protection framework of the country parallel to initiating various environmental awareness campaigns at the societal level. Although the national security strategies are addressing the NTS challenges such as environmental challenges, cyber security, and energy security but adequate attention is not given, probably because of financial constraints due to heavy military expenditures, and thus, the state needs to divert resources from traditional to nontraditional threats or if not possible, to increase

resources to maintain an equilibrium between traditional and nontraditional threats so they can be eliminated. The NTS have gained significant magnitude recently which is resulting in severe problems for the government. Increasing population, unplanned urbanization, excessive migration to cities are constantly putting urban areas under huge pressure which is creating economic, environmental, and social issues and also diminishing standard of living in cities, therefore the government needs to give adequate attention to environmental challenges so the hindrances could be removed for the progress of the state.

1.8 Research Methodology

For appropriate and well-defined presentation of the information and data acquired from different sources to conduct this research, Deductive approach (top-down approach) is utilized. This is descriptive and exploratory research. Research is qualitative, however, quantitative data has been used on various parts to explain points and validate arguments. The study tends to explore the effective policies Pakistan can have in the long run to incorporation nontraditional security challenges into security discourse which is required to eliminate the environmental challenges i.e., to mitigate the negative impacts of climate change and water shortage. This research work has utilized video interviews, government documents as well as declassified documents, official statements of the international leaders, relevant stakeholders and governmental authorities, both state and interstate for primary source data. The secondary sources such as articles, journals, newspaper readings and various websites have been used as secondary data tool. In contrast to purely relying on content analysis as a suitable tool of data collection, this research is primarily a desk research which accessed the available data addressing the content related to environmental challengers posing threat to national security of Pakistan.

1.9 Significance and Novelty of the Study

Nontraditional security threats or Human security are not primarily focused in Pakistan and the focus of policymakers remains on traditional security/ military threats. The scope of national security was widened with the inclusion of economic security, food security, water security, health security, and environmental security etc. These NTS

threats are adverse challenges for states to maintain their internal stability. Pakistan is a large population state of more than 200 million. Most of this population is connected with agriculture. Increasing population which would require more food, housing, jobs and water needs. With decreasing water reservoirs, rapidly changing climate would create shortage of per capita water supply, food shortage and eventually socio-economic security issues. The need to protect environment with structural development is essential because the environmental effects.

The sustainable development goals for a state are mandatory with development program. Pakistan lacks behind in structural development and industrialization. Thereby, it needs to cope up with these challenges, mainly climate change issues and water crisis that affects the national security policies and find a viable solution in a reasonable time frame to find a rightful place in modern world.

1.10 Delimitations

The research would primarily cover the nontraditional security threats for Pakistan in environmental paradigm, mainly Climate Change, Global Warming, Water Scarcity, and partially others on small scale and what makes environmental challenges important to be brought into national security discourse of Pakistan. It would relate the out coming of environmental dangers and their implications on socio-economic and political fabric of Pakistan. However, the research work would not cover the aspect of military or defense security entirely, the hydro politics between Pakistan and neighboring states since that might result in diversion of the original topic, but references for justifying an argument would be used as nontraditional security threats in environmental paradigm are directly related to socio-economic security of Pakistan.

1.11 Organizational Structure Chapters Outline

Chapter 1

Chapter 1 consists of the introduction, statement of the problem, objectives of the study, research questions, literature review, research gap, core argument, theoretical framework, research methodology, the significance of the study, delimitations, and organization of the study.

Chapter2

It explores environmental issues mainly climate change should be considered as a top nontraditional security threat as the threat are non-military. However, their impacts are far beyond the socio-economic fabric of Pakistan.

Chapter 3

It discusses the issue of water scarcity in Pakistan. The chapter focuses on the major aspects of water shortage and its socio-economic and environmental implications for the country.

Chapter 4

The chapter consists of the incumbent government's efforts for countering environmental challenges. It holds a comprehensive analysis of countermeasures to curb the impacts of NTS threats in the environmental paradigm and possible solutions for the future. In addition, the chapter is divided in two parts for addressing main issues independently, first addresses the climate change and global warming in Pakistan, whereas the second part focuses water scarcity issue and its possible solutions.

Key Terms;

Non-Traditional Security, Territorial security, Human Security, Food Security, Transnational Conflicts, Water Scarcity, Environmental Degradation, Deforestation, Over Population, Population Explosion, Rising Seas, Energy Security.

Chapter 2

Understanding the Relation between Environmental Threats and National Security of Pakistan

The hostile and tragic nature of post-partition events of 1947 laid the foundation of Pakistan's early security discourse which was primarily military and the focus of the policymakers remained on securing the borders, majorly eastern and having an uncertain situation on western fronts. As an infant fragile state with no basic structure and several administrational and financial issues along with a threat of survival, the focus on human security remained relatively low and emphasize on enhancing defense capabilities remained largely in practice.[18] The situation could have got better if the geopolitics of the region gotten stabilized after sometimes but unfortunately, that never happened and Pakistan had to compromise in the area of human security with the defense sector due to financial constraints. A long compromise on investing in human capital resulted in stagnated economic progress and advancement for moving the state from a developing one to a developed one and created a huge vacuum between state and human security. This rise of nontraditional security challenges in the past decades has worsened the situation, as the state currently not only has to counter the traditional security issues, but also has to cope with nontraditional challenges such as population explosion, job, food, energy, social, and political security, cyber warfare, environmental challenges which are becoming more and more severe and becoming a great concern putting adverse effects on the security of states. In addition, the environmental dimension to security is clear. When concerns about environment become part of low politics, they lose their sense of political importance and urgency. The cross-boundary character of most challenges to environment makes it difficult to fits into the state-centric ideology of security problems. However, by securitizing environmental issues and making them as a part of high politics, made it easy to handle them and seen them as immediate and urgent and required a quick response at top political level,[19] while such theme become the part of discussion for much heightened attention.

[18] Mehmood, "The exceptional discourse of security in Pakistan,"

[19]Nina Graeger, "Environmental security?" *Journal of Peace Research* 33, no. 1 (1996): 109-116

The precedents of some events show clearly that how some inter-state environmental issues became the part of comprehensive security. In this aspect, some potential issue may transform into the matter of security. However, it may not be happened from the external threat but internal. It can also be presented in such a way that it creates perception of security issue;[20] For instance, the incident of Chernobyl RBMK reactor meltdown in 1986. The incident grabbed the attention nationally and internationally in few days, as this catastrophic event caused death of hundreds and thousands of people. As the area of Ukraine and Belarus was wide as of 2600km and was contaminated due to which cancer toll was intensified even after many years of the reactor meltdown and caused several deaths. Until now the area is proved as highly radio-active area. As in 2006, Mikhail Gorbachve wrote that "Chernobyl was perhaps, the true reason of collapse of Soviet Union".[21]

The transnational characteristic of environmental degradation upholds its link in international security as well. The inter-state conflicts add vulnerability to the state internally, which have its repercussions at regional or global level. Mobilization of varies institutions in countering environmental-induced security threats is necessary.

There are two Dimensions to Understand the Broader Relation between Environment and Security Are As Follows

a) The ecosystem is important element for the sustainable livelihood of the population. Therefore, certain environmental changes, like, pollution, depletion of natural resources, climate change and natural disasters can pose acute threats to security. These challenges increase an individual vulnerability.

b) The direct relationship between transnational conflicts and environment. Those conflict which can outbreak of violent conflicts. For example, water issues between India and Pakistan, South China Sea politics between India, US and China, US war against Iraq over the oil etc. It all led to the extreme conflicts over the resources. This may increase the risk factor for any society or country.

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[20] Niloy Ranjan Biswas. "Is the environment a security threat? Environmental security beyond securitization." *International Affairs Review* 20, no. 1 (2011): 1-22.

[21] Mark J. Stern, "How a Nuclear Catastrophe Undermined an Entire Empire," Slate Magazine, last modified January 25, 2013, accessed August 10, 2021 https://slate.com/technology/2013/01/chernobyl-and-the-fall-of-the-soviet-union-gorbachevs-glasnost-allowed-the-nuclear-catastrophe-to-undermine-the-ussr.html.

Presently, Pakistanis a vulnerable state due to global environmental challenges and the irony is that Pakistan has not contributed much in global warming but is suffering specifically due to increasing temperatures, and water scarcity. Agriculture has an essential relation with environmental conditions of an area. If the environmental conditions are not suitable, the production would fall drastically. Being an agrarian society, where a large portion of population is directly or indirectly integrated into agriculture activity, is not just a matter of economy. It is a matter of national stability since agriculture production has not just a matter in economic field, it directly effects the food security of state which is necessary for social stability of any state. A state may survive without having large industrial complexes but without agriculture production, it would not have enough endurance to progress and fulfill domestic demands. Pakistan already lacks modern industrial facilities to compensate the fall of agriculture production. Therefore, the consequences would be catastrophic. Another important aspect in this regard is the intense weather condition that would increase the burden on national grid or natural resources, for example, gas or timber which would put pressure already decreasing forest areas, which means that environmental problems can later on turn into a concern of energy security for the state. Furthermore, Pakistan produces most of its electricity via thermal methods that is much expensive than hydro power generation. It results in increased production and cost of products. It also decreases the comparative advantage of exporter in the international market, adding more to worsen the situation is that thermal combustion also causes carbon emissions into the atmosphere. The biggest GHGs in Pakistan are produced by its energy sector, another critical factor for environmental degradation. Therefore, environmental threats are dangerously impacting the socio-economic structure of Pakistan.

2.1 Factors and Impacts of Climate Change on Security Discourse of Pakistan

Climate Change is not a new phenomenon, rather it is an old debate. However, it has come into highlights because of the unprecedented consequences the world is witnessing. It generally refers to large scale increase in global temperature, change in weather patterns due to increased industrial activity and emission of GHGs due to combustion of fossil fuels into atmosphere. According to researches, the process of

industrialization triggered the climate change in the 18th century as before, there was not much industrial activity and majority of societies were agrarian.[22] Although the process of Global Warming started in the 18th century, it accelerated after the end of WWII. The increased industrial activity after 1950's has disturbed the natural system or weather patterns like never before and this has resulted in extreme weather, changing weather patterns, oceans warming up, heat waves, resulting in melting of ice, no matter if they are the global icecaps or polar regions, it has effected in severe way.[23] This situation has changed the dimension of environmental politics from state centered approach to public centered. People are becoming more concerned regarding the climate changes happening around the world and the Paris Treaty was a substantial beginning to that. Since the environmental effects are transnational, therefore, their effects are felt throughout the globe. Pakistan has not contributed much to Climate change or global warming because of relatively less industrial activity as compare to its population size due to state being an agriculture society. However, it has two bog factors in terms of population and major industrial states, i.e., China and India.[24] Therefore, it has now become mandatory to look for all possible factors that have caused the Climate Change in Pakistan, internal or external, because in the end, they are impacting Pakistan and would become a matter of national stability in near future.

2.1.1 Surge in Temperature

Increase in global temperature is a serious concern for everyone these days. It has been estimated that temperature is increasing rapidly than ever recorded, and it is creating devastating effects. The trend or pattern of rising temperature varies from region to region, but it is happening with increasing intensity every year and its implications for

[22] Steven Phipps et al., "The Industrial Revolution Kick-started Global Warming Much Earlier than We Realised," The Conversation, last modified August 24, 2016, Accessed November 13, 2020, https://theconversation.com/the-industrial-revolution-kick-started-global-warming-much-earlier-than-we-realised-64301.

[23] Hunt, J.D., Nascimento, A., Diuana, F.A. *et al.* Cooling down the world oceans and the earth by enhancing the North Atlantic Ocean current. *SN Appl. Sci.***2,** 15 (2020). https://doi.org/10.1007/s42452-019-1755-y

[24] Syed M. Abubakar, "Pakistan 5th Most Vulnerable Country to Climate Change, Reveals German watch Report," DAWN.COM, last modified January 16, 2020, Accessed Dec 20, 2020, https://www.dawn.com/news/1520402.

Pakistan are more severe than majority of states, and is also suffering from impacts, and global warming or rise in temperature is one of the major impacts of climate change which Pakistan is facing recently, resulting in difficulties for many areas such as food, medical, infrastructure and energy. Although, Pakistan witnesses all four seasons in a year, but the recent shift in climate patterns has actually created a polarization between Summers and Winters, with Summers increasing or extending more and more with intense climate causing increased difficulties in some areas who are already considered historically hot, other problem is that Pakistan already receives less average rainfall annually than global average, that rainfall number has also decreased significantly, furthermore, it has been observed that Pakistan is also facing the problem of heatwaves which creates more difficulty for general population and government since several heat waves have been proven fatal and causes the economic activity to slow down. Then winters, usually considered a sign of relief are getting shorter or partial rather than getting their full potential, with cold waves but not entirely as they used to be 20 years ago. Undoubtedly, their intensity has increased but duration has diminished marginally. Two or three decades ago, Winter used to arrive by the end of September in most of the country and stayed till Mid-April, but as of now, its stay is getting short, it can also be called a winter wave, not full fledge season. Sometimes, even in December or February or March, it looks like a summer day. Also, another problem which has risen from past decade is the number of rainfalls in winters significantly decreased, this weather condition is known as dry winters, which results in seasonal diseases and infections, fog and smog, but it also decreases the water supply for domestic use, hydel power generation, and national water storage as the water flow in rivers is already slow. The decrease in hydro electric supply to national grid creates difficulties for home and industrial clients even in winters where the production of electricity should be surplus normally. It is a fact that demand for gas increases in winters, which also often leads to shortage and gas load shedding, again directly affecting the home and commercial clients. Pakistan has already faced many problems due to its energy crisis and the increasing temperature or intense weather, no matter if its summers or winters, would also increase the problems, economically and socially.

2.1.2 Change in Weather Patterns

In the early 2000s, a new field of climatic science research emerged that started to explore the human fingerprint on extreme weather or natural disasters, such as floods, heat waves, droughts and storms.[25] The changing weather patterns are actually a result of humans themselves, increased used of fuels causing excess flow of CO2 into atmosphere, natural resources, deforestation, unplanned urbanization, is affecting the weather in such a way that probably history has never witnessed. Since the end of WW2, when the economic dominance became a major focus of major powers, it always was, but acquiring or developing weapons remain consistent, the globalized economic activity increased rapidly, at the end of world war 2 in or in 1950 to be exact figures recording date, the global GDP was 4 trillion US$, but just by a spin of time of 5 years, it reached 5.4 trillion and by the end of 1990, it hit 27.53 trillion, So in a time spawn of just 40 years, it grew around 7 times, all of this was not possible without excessive increased use of natural resources, and it happened in every sector, specially natural resources like oil, often called the black gold or blood for economy now a day, natural gas, deforestation for industrial use and housing, rapid urbanization for fast grow in population, which was 2.5 billion in 1950, and by 1990, it reached 5.281 billion. All this resulted in an enormous negative impact on environmental systems and excessive burden on natural resources.

2.1.3 Irregular weather conditions

It has been observed in Pakistan recently, that summer is getting hotter and prolong, whereas winters are getting intense but their duration is getting shorter and it often feels like a cold wave in some areas rather than a season. Another important factor that shouldn't be neglected here is that although there is some rainfall in summers, winters remains dry for most of the time with very little rainfall. Average rainfall in Pakistan is 25.03 mm from 1901 until 2015, reaching an all-time high of 170.66 mm in August of 1916 and a record low of 0.15 mm in December 2014.[26] As of 2014 by data

[25] "How Climate Change Affects Extreme Weather around the World," Carbon Brief, last modified April 21, 2020, accessed December 26, 2020 https://www.carbonbrief.org/mapped-how-climate-change-affects-extreme-weather-around-the-world.

[26] "Pakistan Average Precipitation | 1901-2015 Data," TRADING ECONOMICS, accessed September 29, 2020, https://tradingeconomics.com/pakistan/precipitation.

collected of more than 186 states, Pakistan ranks at 144 on average precipitation index.[27] Since Pakistan receives relatively less rainfall every year, this problem is also causing shortage of water. Another problem is that these dry winters creates environmental diseases. They also cause smog which causes disturbance in cycle of life, humans and plants as well. Recent reports reveal that air quality or US AQI in Lahore is 168 which is extremely alarming and it gets worst in winters, and these are just reports from Lahore, the situation in other cities is also the same. Media reports revealed that due to the construction of Orange line train project in Lahore,[28] more than 600 trees were cut down and many petitions were also filed in Lahore high court regarding this issue by environmental agencies.[29] In November 2020, Faisalabad, Lahore surpassed Delhi as most polluted cities.[30] Furthermore, Dry winter add more problems for government when they produce heavy fog or smog in many areas of the country. The issue of Smog is getting severe and severe every year, causing environmental pollution, specifically air pollution and health issues for public which increases the burdens on already overburdened national health system.

2.1.4 Less Average Rainfall

Rain is the purest source of natural water for all living things because it has a higher level of nutrients and is considered best for drinking, it also is a large source of water for natural reservoirs and they play very important role in filling lakes and dams. Rain also cleans the atmosphere, eliminating dust and hazardous elements from the air which makes it better for breathing. In generalized means, a decent amount of rainfall is very healthy for humans in all ways, however, in case of Pakistan, it receives relatively less rainfall than the world's average every year, which means that acquiring water from the rain and also for cleaning environment, which is being polluted and is dried up, is not up to the marks which is required according to Pakistan's geography. This makes the

[27] "Countries Ranked by Average Precipitation in Depth (mm Per Year)," IndexMundi - Country Facts, accessed October 29, 2020, https://www.indexmundi.com/facts/indicators/AG.LND.PRCP.MM/rankings.

[28] Khalid Hasnain, "City to Lose 620 Trees for Orange Line Train," DAWN.COM, last modified June 26, 2015, accessed October 29, 2020 https://www.dawn.com/news/1190468.

[29]"LHC Stays OLMT Transmission Lines Work," The Express Tribune, last modified February 17, 2020, accessed October 29, 2020, https://tribune.com.pk/story/2158927/1-lhc-stays-olmt-transmission-lines-work.

[30]Xari Jalil, "Faisalabad, Lahore Surpass Delhi As Most Polluted Cities," DAWN.COM, last modified November 14, 2020, accessed November 29, 2020 https://www.dawn.com/news/1590269/faisalabad-lahore-surpass-delhi-as-most-polluted-cities.

climate situation even worst for Pakistani people, first they have to live in a dry climate which caused many health issues, 2nd, many areas are highly dependent on rain water which makes life harder for them since there is no water supply mechanism, 3rd, rain water also helps fill national water reservoir and feed crops, all these facts present a very well-defined picture of Pakistan's atmosphere. Pakistan averaged 25.03 mm from 1901 until 2015, reaching an all-time high of 170.66 mm in August of 1916 and a record low of 0.15 mm in December of 2014. Many environmentalists blame the forest or environmental authorities for this situation, having very strong arguments, such as excessive cutting of trees in urban population for project development, completely ignoring the environmental consequences, or for the expansion of cities which also results the same, as in case of Karachi and Islamabad. Then, it comes unplanned or uncalculated deforestation having severe impacts for atmosphere. Another important issue is of using agriculture land for commercial purposes or selling it for housing societies. Trees play very important role in keeping the temperature calm and cool, they keep the environment clean, it has been scientifically proven that region with trees attract heavy rainfall than those who don't have tree plantation or forest. Trees act as interceptors, catching falling rain, which then evaporates causing rain precipitation elsewhere, a process known as evapotranspiration, by better understanding this process, we may, one day, be able to strategically plant trees that will bring rain to regions that need it most.[31]

2.1.5 Deforestation

Forests are an essential element of a stable environmental systems. They absorb CO2, produces oxygen, hence decreasing the effects of greenhouse gases. They play an important role in keeping the temperature calm and cool and refreshing air, forests provide watershed protection, they prevent soil erosion, attracts rain, thus, forest are necessary for any eco system to function properly.[32] They provide lumber for industry.

[31] Kate Evans, "Make It Rain: Planting Forests Could Help Drought-stricken Regions," CIFOR Forests News, last modified July 23, 2012, accessed November 15, 2020, https://forestsnews.cifor.org/10316/make-it-rain-planting-forests-to-help-drought-stricken-regions?fnl=en

[32] "The Importance of Forests," WWF Conserves Our Planet, accessed November 29, 2020, https://wwf.panda.org/discover/our_focus/forests_practice/importance_forests/.

Furthermore, they are home to numerous wildlife species and birds, they also provide various herbals for medicines and they are huge attraction for tourists as well. To be explained in a précised manner, Forest is necessary for any state and that is why according to environmental standards, any state must have at least 25% of its entire area, covered with forest. Looking at their importance, forests are a necessary asset for any state, but unfortunately, in case of Pakistan, it is one of the most little forested country in the world. It actually comes on 21st in ranking of least area covered by forest for a state by just an area of 2.02%.[33] This is the first fact, the alarming fact or situation is that even this area is diminishing gradually due to many domestic factors. According to a report, Pakistan almost loses 27,000 hectares of natural forest area every year.[34]

There are four primary reasons are mentioned below for deforestation in Pakistan:

I. Illegal timber harvesting.
II. Fuel needs.
III. Urbanization.
IV. Forest fires

According to World Bank data reports, area covered by forest in Pakistan in 1990 was around 3.278%,[35] it is reduced to 1.84% in 2016. In the duration of 26 years, Pakistan had lost more than 40% of its forest area.[36] This is a very strong argument for the environmentalist that one of the primary reasons of devastating climate changes in Pakistan are result of unplanned forest cutting by illegal or not sustainable ways. Forests are not only habitats for wildlife, they are essential for maintaining eco systems, keeping environment fresh and air clean, but what makes them essential for a state or any area is

[33] Jessica Dillinger, "Countries with The Lowest Forested Area in the World," World Atlas, last modified December 14, 2015, Accessed October 15, 2020, https://www.worldatlas.com/articles/the-smallest-forests-in-the-world.html.
[34] Rahat Jabeen, "The Green Emergency: Deforestation in Pakistan," World Bank Blogs, last modified May 22, 2019, Accessed October 15, 2020, https://blogs.worldbank.org/endpovertyinsouthasia/green-emergency-deforestation-pakistan.
[35] "Forest Area (Percent of Land Area)," World Bank | Data, accessed November 29, 2020, https://data.worldbank.org/indicator/AG.LND.FRST.ZS.
[36] "Pakistan - Forest Area (Percent of Land Area) - 1990-2016 Data," TRADING ECONOMICS, accessed November 29, 2020, https://tradingeconomics.com/pakistan/forest-area-percent-of-land-area-wb-data.html.

that they also absorb harmful GHGs that damage the climate or harm it, this is the most important function trees do which is a dire need of Pakistan at the moment. According to WWF, the tropical forests alone have a stored of quarter of a trillion tons of carbon is in above and below ground biomass.[37] Forests provide clean water for drinking and other domestic needs. They protecting watersheds and reducing or slowing the amount of erosion and chemicals that reach waterways. They are defense shields against land sliding, provide food and herbals for medicines. They also act as a buffer in natural disasters like flood and rainfalls. Last but not least, they provide habitat to more than half of the world's land-based species which is needed for biodiversity. Forests are huge attraction for tourist as their presence beautiful scenic landscapes. By keeping air clean, they also act as a shield against diseases which are caused by air pollution. If we look at the mentioned benefits, it generates a clear picture that presence of forest in essential, perhaps vital for maintaining a sustainable environment friendly system for any state, specially, a large state like Pakistan which has every kind of climate and geography. Pakistan is certainly, in need of a green emergency program to protect its climate system, which must begin with preservation of forests. Another factor which cannot be neglected in this case of excessive forest cutting in Pakistan is the presence of wide gap between production and consumption of wood. In 1993, the consumption of wood was 29.5 million cubic meters whereas in the year 2018 it is projected to go up by 52.6 million cubic meters. At present, Pakistan is producing only 14 million cubic meters of wood. By 2020, it is estimated to reach 50 million cubic meter of wood in order to meet the demands of the people. This wide gap between production and consumption of wood is one de facto reason of deforestation in Pakistan.[38] Another important problem which occurs every year are forest fires, which not only causes life loss of wildlife and people, but also hammers the government ambitions to increase the area covered by forest. According to a media statement given by Secretary of Ministry of Climate Change Hassan Nasir, the incidents of forest fire have cost a loss of over 1.2 million trees in Pakistan's northwest Khyber Pakhtunkhwa province during the financial year ranging

[37]WWF, "The Importance of Forests,".

[38] Asif Saeed, "The Underlying Causes of Deforestation and Forest Degradation in Pakistan," World Forestry Congress | Food and Agriculture Organization of the United Nations, last modified 2003, https://www.fao.org/3/XII/0983-B1.htm.

from July 2018 to June 2019. He also said that said the forest department does not have modern equipment in to prevent the spread of fire which is the main reason resulted in death of 13 people of the forest department while trying to extinguish the fire.[39] The rapid increase in population in both areas, urban and rural areas would increase the dependence for needs on Pakistan's forests putting them in more venerable position, as forest fulfil many needs of people and industry, growing needs of increasing population would simply worsen the situation if not contained properly.

2.1.6 Heat Waves: An Immense Risk to Public Health

Climate change has affected the globe in various ways, it is not unidirectional, and rather the impacts of climate change are multilayered. They may take time to take place, but they also last longer and take a very long time to be cured. Recently, a very important issue that has occurred on various occasions in Pakistan are heat waves, these heat waves have caused life losses of 100's of people in Pakistan, specifically in Southern Pakistan, where series of heat waves struck in 2015 and caused around 2000 deaths, from heat strokes and dehydration. After this situation, the Meteorological Department,[40] issues early heat wave warnings to avoid any unusual situation so lives can be saved.[41] UN experts have warned that a 1.1-degree Celsius increase in the global temperature would continue to cause such calamities. The temperature in Karachi hit peaked since 1979 causing an emergency situation in city.[42] This has not only remained a matter of concern for Pakistan, but for the world as well, Experts have predicted that future heatwaves will have a more intense pattern and cause more damage. A similar heat wave struck Europe in July 2019 reaching all-time high-temperature records in Belgium, Germany, Luxembourg, the Netherlands, and the United Kingdom and causing more than

[39]Yan , "Forest Fires Destroy 1.2 Million Trees Last Year in NW Pakistan - Xinhua | English.news.cn," Xinhua Net, last modified August 30, 2019, Accessed October 8, 2020, https://www.xinhuanet.com/english/2019-07/30/c_138267966.htm.

[40] Qazi Hassan, "Karachi to Experience Heatwave for Next 6-8 Days: Met Office," DAWN.COM, last modified October 11, 2020, Accessed November 1, 2020, https://www.dawn.com/news/1584480/karachi-to-experience-heatwave-for-next-6-8-days-met-office.

[41]Anwar Iqbal, "Rising Temperatures Continue to Cause Heatwaves: UN," DAWN.COM, last modified October 13, 2020, Accessed October 20, 2020, https://www.dawn.com/news/1584747.

"Pakistan Heatwave: Death Toll Crosses 800 People in Sindh," BBC News, last modified June 26, 2015, https://www.bbc.com/news/world-asia-33236067.

800 deaths in France along with thousands of animals. Increasing global warming is causing this and put people in panic. Europe, known for its moderate and cool temperature has seen a succession of heatwaves in 2003, 2010, 2015, 2017 and 2019.[43] Paris conference on environment in 2015 was a result of facing consequences of climate change in Europe, to strengthen the response of industrial states to curb the climate change by keeping a control over global temperature rise in this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.[44] If the rise in global temperature is not restrained, perhaps very soon, this planet would become inhabitable for every living thing. Although Pakistan contributes less than 1% to global warming, it is one of the highly effected country. In this aspect, the government should also be aware of all the global developments on environmental policies and act accordingly.

2.1.7 Rapid and Unplanned Urbanization

Rapid and unplanned Urbanization is perhaps the biggest challenge and threat to Pakistan's environmental system. The process of urbanization is necessary for economic activity of any state but the issue lies in its planning and management. If the process of development in unplanned, neglecting various factors such as size of area, resources, facilities, then process of urbanization can turn into a serious headache. Looking at Karachi's case study, where booming construction activity has heavily damaged the environment and caused several other problems like traffic jams, water shortage, energy deficiency, increased crime rates has really affected the progress of city. Pakistan is one of the most urbanized countries in world, and most urbanized in South Asia since more than 1/3 of population is city dwellers, and more than 50% population lives in towns of 5000 or more.[45] There might be many factors of the increase of urban live hood of population, however this isn't the case here, the case is how this rapid urbanization is

[43] Alec Fenn, "What Has Caused Europe's Heatwave?" CGTN, last modified August 8, 2020, Accessed November 11, 2020, https://newseu.cgtn.com/news/2020-08-08/What-has-caused-Europe-s-heatwave--SLw1mnNUkw/index.html.

[44] "The Paris Agreement," UNFCCC, accessed November 29, 2020, https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement.

[45] Jason Burke, "The Critical Changes Transforming Pakistan," The Guardian, last modified December 2, 2017, Accessed November 25, 2020, https://www.theguardian.com/world/2008/aug/17/pakistan.

effecting the environment of Pakistan, although the process of urbanization results in boosted economic activity, the question here remains if the activity is sustainable for environment or not, and if it's not, what would be consequences of it. The answer is, no, it's not. The current process of urbanization is at the cost of forests, green areas of the suburbs, or rural areas of the cities. This means that cities are extending without even proper planning, sustainable structure is the next thing, one of most prominent examples is city of Karachi, which population has exceeded 14.91 million people according to census of 2017, and kind of funny thing is that people of Karachi reject these stats, they claim that population has crossed over 20 million. Even for a moment, if we consider the first figure of 14.91 million right, we can clearly see that current metropolitan structure of Karachi was certainly not planned well, it was based on temporary basis, or no up to living standards of a full fledge metropolitan were followed during this procedure.[46] This has cost the living standards of Karachi and the environmental situation has worsen over the course of years due to excessive population, industrial pollution. Furthermore, there is no open green area left in the city except luxury clubs. There are many other big cities such as Lahore, Faisalabad, Islamabad, Rawalpindi, Gujranwala, Sialkot, Gujrat, Jhelum, and Sargodha whose population are rapidly increasing due to migration. Although the population of Islamabad is not increasing rapidly, it must be mentioned here that surrounding areas of Islamabad or rural Islamabad, about 20 years ago, who were once habitat to wild life, have now become large towns which means that most of the ecological system there, is destroyed. When the process of urbanization takes place, wherever, the safety of environment is always considered, unfortunately in a state like Pakistan, where many political economy hindrances are present , often called governing the ungovernable, it becomes difficult for moderate environmental authorities to implement sustainable environmental policies or often, the environmentalist have to consult Judiciary for help as it happened in case of construction of a cricket stadium in

[46] Michael Kugelman, "Pakistan's Urbanization: 'A Challenge of Great Proportions'," DW.COM, last modified December 31, 2014, Accessed October 30, 2020, https://www.dw.com/en/pakistans-urbanization-a-challenge-of-great-proportions/a-18163731.

Islamabad, Shakarparian National Park which is a protected wild life reserve.[47] However, there are rare cases like these. The effects of war against terror also have adverse effects on cities as people from the terrorism or operational areas have migrated to cities in large numbers including the capital, Islamabad. This has placed more pressure on urban populations and structure.[48] It is very important for the government to look at sustainable environmental goals to preserve environment, only buildings or roads cannot make city livable, it's also the nature, which is essential for a moderate atmosphere of the cities.[49]

2.1.8 Water Borne Diseases

Global warming results increase the process of water evaporation on large basis, which means that water stored in open places doesn't tends to last long if rain doesn't occur. This often results in shortage of water as Pakistan already receives less rainfall annually. Other issue is shortage of water supply to general population. Very small portion of Pakistan's population has access to clean water, rest is dependent on unhealthy means which causes water borne diseases. According to a research report published in Science Advances journal, heavy quantity of arsenic has been found in different samples of around 1,200 groundwater quality tests conducted from the country.[50] Before going further, it must be mentioned here that what actually is arsenic? Arsenic is a semi-metallic element found all over the world in varying concentrations. Humans usually come into contact with it because it leaches into groundwater from rocks and sediments. The consequences of drinking arsenic containment water are leading to a variety of chronic health diseases, including skin disorders, cancers of the lung, bladder and cardiovascular issues, and this isn't just the end of the story. Different researches have

[47] Zulfiqar Baig, "Cricket Stadium on the Cards in Federal Capital," The Express Tribune, last modified April 10, 2019, Accessed October 30, 2020, https://tribune.com.pk/story/1947897/cricket-stadium-cards-federal-capital.

[48] Ayesha Siddiqa, "Urbanisation in Pakistan and Its Consequences," The Express Tribune, last modified November 21, 2012, Accessed November 9, 2020, https://tribune.com.pk/story/469260/urbanisation-in-pakistan-and-its-consequences.

[49] "Sustainable Urbanization," UNDP, last modified May 8, 2019, Accessed November 1, 2020, https://www.pk.undp.org/content/pakistan/en/home/library/development_policy/dap-vol5-iss4-sustainable-urbanization.html.

[50] Matt McGrath, "'Alarmingly High' Levels of Arsenic in Pakistan's Ground Water," BBC News, last modified August 23, 2017, Accessed November 1, 2020, https://www.bbc.com/news/science-environment-41002005.

revealed that only around 20% of the Pakistani population has access to clean water resources, the rest 80% is dependent or forced to use unsafe drinking water due to the scarcity of safe and healthy drinking water sources.[51] This water eventually causes water borne diseases such as typhoid, intestinal worms, diarrhea, different infections, and gastroenteritis. Infant deaths caused by polluted water in Pakistan are 60% according to International Union on Conservation of Nature (IUCN) report, which is the highest ratio in Asia. Gradually, the problem becomes the same, these all problems burden the already overburdened, financially constrained health system of Pakistan causing increased expenditure on national treasure.[52]

2.1.9 Conversion of Agriculture Area for Commercial Use

Pakistan is an agriculture state, with majority of men power, or the most men power as compare to other sectors is engaged with it, same goes for production and societal pattern, Pakistan is an agrarian society. This means that whole state is heavily engaged in agriculture sector, directly, or indirectly. Recently, it was revealed or lately noticed that huge cultivable land or area was being sold to commercial sectors or being converted for commercial activities, which in simple terms means that cultivable area was decreasing time by time. As mentioned earlier, Pakistan's urbanization rate is highest in South Asia, which means that those areas which used to be rural or rural areas of an urban city, are being converted into urban live hood or housing schemes. The problem isn't with urbanization in this case but problem is once the area is converted into commercial or urbanized area, it results in two situations.

I. The agriculture production from that area ceases.
II. The land which used to be environment friendly, in some or most of the time of a year, becomes less or completely non beneficial for environment, perhaps it may even cause harm due to commercial activity, so the area which used to serve environment in a positive way, stops to do so.

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[51] Muhammad K. Daud et al., "Drinking Water Quality Status and Contamination in Pakistan," *BioMed Research International* 2017 (n.d.), xx, https://doi.org/10.1155/2017/7908183.

[52] "Water-borne Diseases Break out in Pakistan after Floods," Gandhara, last modified September 1, 2020, Accessed November 8, 2020, https://gandhara.rferl.org/a/water-borne-diseases-break-out-in-pakistan-after-floods/30815353.html.

These two factors forced the government to take measures which eventually imposed a sanction upon selling of agriculture land for commercial uses.[53]

2.1.10 Conservation of wildlife

Presence of wild life has significant importance in ecological system. As shown from the term, wildlife refers to the animal or fish species living in the forest areas or water bodies independently from any human intervention in terms of feeding or cross activities rather maintain their own natural ecological order except if any emergency situation such as floods, draughts or forest fire occurs to rescue the animals. Wildlife conservation can be explained as the method of protecting animal species and their habitats, which means to protect both, the animals and their habitat, usually, forests or suburbs of cities, villages etc.[54] The importance for presence of wildlife in forests or even human habitats generally helps two ways which are mentioned below.

- Maintaining Biodiversity
- Human dependence for food

2.1.10.1 Biodiversity

Biodiversity is one of major factor for sustainable ecological system. Reduction or increased in one animal species disturbs the whole eco system and the natural food chain, and leads to the threat of other species. It can be explained as if there aren't any carnivores left in nature, it will rapidly increase the population of herbivores which would require more and more pastures and water needs since there is a natural order maintained, leading them to explore new areas to fulfil their needs and would later on result in going to human populations or suburbs, creating social and economic disorder or threats as wild animals can destroy or damage properties or crops on large scales. Same goes for opposite direction for carnivores, if the presence of preys in wildlife has diminished

[53] "PM Imposes Ban on Use of Agricultural Land for Housing Schemes," Dunya News, last modified March 1, 2019, Accessed November 8, 2020, https://dunyanews.tv/en/Pakistan/480684-PM-imposes-ban-use-agricultural-land-housing-schemes.

[54] Ragnhild, "Importance of Wildlife Conservation | what is It? Why? How?" Globalteer, last modified March 11, 2020, Accessed November 5, 2020, https://www.globalteer.org/importance-of-wildlife-conservation/.

significantly that it cannot fulfil the decent food chain order would force the carnivores for hunting in other territories and human populations are easy targets in such scenarios because the presence of pet animals attract them, and also weak targets such as children or old people, this is why maintain the ecological order is mandatory for healthy environment. The population explosion has many circumstances and unplanned rapid urbanization has added more to worsen the situation. It has also caused the ecological disorder. For example, in case of Karachi, it wouldn't be easy to believe that Karachi was once home to strong wildlife species, but it is true. The city's outskirts had served as a habitat for several rare birds and animals, including leopards and deer until 1960s, which also indicates that presence of food for carnivores was also available in abundant manner.[55] The last Chinkara deer, also known as gazelles and can be found in India, Pakistan and Iran, were also spotted in the remits of Karachi in 1994. According to environmentalist, the unplanned urbanization has also hit hard on population of urban human friendly birds such as house sparrow, doves and parrots in the recent two decades and they have been replaced by other bird species such as kites, crows, and mynas. It also shows the air quality of the city. The inadvertent urbanization has gradually destroyed the natural habitat, eventually leading to extinction of several birds, reptiles, and animals like leopard, deer, hedgehog, snakes, and others in Karachi however situation in other big cities like Lahore, Faisalabad, Rawalpindi Islamabad, Peshawar and Quetta is relatively better as they still have "marginalized areas" to protect their wildlife to a certain extent. It might not be as satisfactory as it should be but still relatively better than Karachi. Islamabad has two national wildlife parks Margallas and Shakarparian. Environmental degradation, illegal trade and climate changes are among the most dangerous challenges faced by wildlife in Pakistan, because of this problem, wildlife species have also been affected. Another greater threat for wildlife in Pakistan is deforestation, loss of habitat

[55] Amir Latif, "Pakistan's Karachi in Danger of Losing Wildlife," Anadolu Ajansı, last modified September 29, 2019, Accessed November 10, 2020, https://www.aa.com.tr/en/asia-pacific/pakistans-karachi-in-danger-of-losing-wildlife/1629258.

and over-hunting of some rare, near to extinct animals. Animal species like Markhor, Chakor, Indus river dolphins and many others in Pakistan are near extinction.[56]

2.1.11 Air Pollution

Another very dangerous factor which has prominent presence in Pakistan is of air pollution that is damaging the environment and human lives in many ways. Air pollution is the presence of substances in the atmosphere that are harmful to the health of humans and other living beings, or cause damage to the climate or to materials.[57] Usually, there are two sizes of particulate matters that are used to analyze air quality,[58] fine particles with a diameter of less than 2.5 µm or PM 2.5 and coarse particles with a diameter of less than 10 µm or PM10. PM 2.5 particles are more concerning due to their small size which allows them to travel deeper into the human body while breathing or even just staying in that environment. Air pollution is a severe type of pollution because it is directly present in the atmosphere of the area, making its victims vulnerable to its effects. Air pollution causes several diseases, it can even lead to a person's death. In the Long-term health effects from air pollution include heart disease, lung cancer, and respiratory diseases such as emphysema. Air pollution can also cause long-term damage to people's nerves, brain, kidneys, liver, and other organs, which leads to breathing problems, chronic diseases, increased hospitalization, and premature mortality.[59] Air Pollution in Pakistani cities is at its worst, according to updated Air quality index, Multan, Lahore, Faisalabad, Islamabad, Peshawar, Rawalpindi, Gujranwala, Karachi, are among the most air polluted cities of Pakistan.[60] The mentioned cities includes all the major metropolitans of Pakistan which clears the picture how much negligence has been done in this regard. Air pollution isn't only dangerous for living things, in the long run, it damages the environment as well, air, itself is a component of environment, and this is why air pollution directly effects it.

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[56] UROOJ KHAN, "What Happened to the Wildlife?" Pakistan Today, last modified May 31, 2017, Accessed November 12, 2020, https://www.pakistantoday.com.pk/2017/05/31/what-happened-to-the-wildlife/.

[57] "Air Pollution, Definition.

[58] "Pakistan: Air Pollution," IAMAT, accessed November 29, 2020, https://www.iamat.org/country/pakistan/risk/air-pollution.

[59] "Air Pollution," National Geographic Society, last modified October 9, 2012, Accessed November 30, 2020,https://www.nationalgeographic.org/encyclopedia/air-pollution/.

[60] "Pakistan Air Quality Index," IQAir, accessed November 29, 2020, https://www.iqair.com/us/pakistan.

There are many problems, which in the mid or long run are causing environmental issues. Firstly, it's the global warming, which is one of the most worrying effects for scientists and environmentalists.[61] Air pollution causes global warming and its effects on Pakistan environment have been observed closely, since in recent years, Pakistan's temperature is gradually rising, Summer is getting longer and longer where winters are getting shorter with very less rainfall. Eventually global warming results in negative climate change, when the temperature of the planet increases, there is a disturbance in the usual climatic cycles, accelerating the changes of these cycles in unnatural way. Due to climate change, ice in poles is melting, and this is leading to rising sea levels.

One of the most discussed topics in terms of air pollution is the smog effect, the smog effect or beret effect happens when there is a kind of dark fog concentrated over the cities and fields. That fog is a load of pollutants and can be of 2 types, sulphureous smog and photochemical smog, both dangerous and harmful to health. Both types of smog are a consequence of industrial and urban action. Many major cities of Pakistan, prominently Lahore and its surrounding areas, Islamabad/Rawalpindi, Karachi witness heavy smog effect during winters causing disturbance in daily routine of life.

Many advanced countries have taken appropriate measures to counter the smog effect, however in a developing state like Pakistan, not much treatment protocols have been adopted in this regard. Another important thing which cannot be neglected in case of Pakistan is that air pollution results in climate change and smog all damage the Earth surface. Contaminated water and gases seep into the earth, changing the composition of soils. That directly affects agriculture, the most important national economic activity, changing crop cycles and the composition of the food we all eat. Air pollution not only makes it difficult for the humans to breath in, but also for wild life and birds. As the unplanned and not sustainable ways are adopted for urbanization, animals and birds are forced to seek food in environments unknown to them. Deforestation acts as catalyst results damaging the ecosystems and habitats. Air pollution also causes Respiratory health problems that are probably one of the most obvious and worrying effects for

[61] "10 Serious Effects of Air Pollution on the Environment," Tecam Group, last modified April 29, 2019, Accessed November 30, 2020, https://www.tecamgroup.com/effects-air-pollution-environment/.

human beings. Pollutants can cause respiratory illnesses and allergies ranging from coughs to asthma, cancer. Inhalation of toxic agents directly affects the lungs and other organs that make up the respiratory system. It also results in cardiovascular disorders. The emission CFC's damages the ozone layer. This is because there is a high concentration of chlorofluorocarbons that alter the thickness of the ozone layer. CFCs are released using aerosols, industrial refrigerants. Air pollution also results in skin damage. Many of the chemical intolerances directly affect people's skin. However, one of the worst damages caused is skin cancer. That disease in many cases develops from the direct incidence of ultraviolet light rays on the skin. The ozone layer acts as a filter for those rays. A thinner ozone layer diminishes the effectiveness of the filter which is very harmful to humans. Rain in a week or once a month can decrease air-pollution, however air pollution itself results in decreasing rainfall and snowfall.[62]

2.1.12 Melting of the Icecap in the North

Most of the fresh water resources present on surface of earth are in form of ice glaciers, out of range for direct use to some extent but in the long run, they are very effective since they are origin of many rivers, keeping the climate cool and moderate in those areas attracting tourism and good summer spots. In this regard, Pakistan is quite lucky that it has almost has greater number of ice glaciers than anywhere on planet except the Polar Regions.[63] Often known as the icecap, it is origin of many rivers in the region therefor it can be said that for millenniums Ice glaciers in the Karakoram and Himalayas have served the people, but now they are at huge risk due to global warming which has accelerated the process of ice melting, endangering people's lives and future water supply potential. Pakistan's north consist of several mountain ranges such as Himalayas, the Hindu Kush and the Karakoram ranges which has more than 7000 glaciers. From the last 50 years, the proper monetization of glaciers began which showed that many glaciers are melting and shrinking. Around 3,000 glaciers have formed unstable lakes and at least 30

[62] "Air Pollution Can Prevent Rainfall," ScienceDaily, last modified March 14, 2000, Accessed December 10, 2020, https://www.sciencedaily.com/releases/2000/03/000314065455.htm.

[63] Tim Craig, "Pakistan has more glaciers than almost anywhere on Earth. But they are at risk," The Washington Post, last modified August 11, 2016, Accessed December 2, 2020, https://www.washingtonpost.com/world/asia_pacific/pakistan-has-more-glaciers-than-almost-anywhere-on-earth-but-they-are-at-risk/2016/08/11/7a6b4cd4-4882-11e6-8dac-0c6e4accc5b1_story.html.

are at risk of bursting, which can be proved catastrophic if they trigger ice avalanches and flash floods as one happened Gyari sector near Siachen glacier when a gigantic ice avalanche hit Pakistan Army military base resulting in death of 129 soldiers and 11 civilians.[64] People of these regions are in fear because already due to ice bursts, land sliding and glacial floods.[65] Some regional factors causing the acceleration glacier melt, specifically the toxic smog that chokes South Asia through the winter. It is largely caused by less rainfall, vehicle emissions, farmers burning crop stubble, brick kilns that emit dirty black smoke. Acceleration in glacier melt would temporarily increase the flow of water in rivers, but in the long run, it is harmful for environmental stability of areas they are located in. Furthermore, in a broader perspective, the decrease in flow of rivers will directly affect the water supply which has already diminished due to global warming.

2.1.13 Ecological Disorder

The loss of biodiversity is one of the key challenges, currently the world is facing. Humans are directly dependent on biological diversity of nature that includes various elements like plants or forests, fresh water resources, marine life and species living in and around the natural habitats.[66] Any disturbance in these elements directly effects the natural pattern means it would react in a negative manner, as we are currently witnessing the surge in temperature, rains are decreasing or occurring in unusual manner, intense weather conditions. All these outcomes are result of humanistic hammering effects on natural resources which is causing the natural disorder. This is true that humans are most valued on Earth but this doesn't legalize them to do everything in unaccountable way, rather there always are some factors which should be considered, should have been considered in past because they are showing their results now which are not encouraging at all. Although the loss of biodiversity has happened all over the world, but in Pakistan, due to population explosion, it has happened in a more severe manner, for example, a

[64] "Pakistani Troops Dig for 135 Missing in Avalanche," Khaleej Times, last modified April 7, 2012, Accessed November 9, 2020, https://www.khaleejtimes.com/article/20120407/ARTICLE/304079932/1028.
[65]Diaa Hadid, "'Maybe It Will Destroy everything': Pakistan's Melting Glaciers Cause Alarm," NPR.org, last modified November 21, 2019, Accessed November 13, 2020, https://www.npr.org/2019/11/21/779412377/maybe-it-will-destroy-everything-pakistan-s-melting-glaciers-cause-alarm.
[66] Tauseef K. Babar and Muhammad Saleem, "Loss of Biodiversity," DAWN.COM, last modified October 21, 2013, Accessed October 29, 2020, https://www.dawn.com/news/1050733.

country must have a covered area of 25% with forests for moderate environment, but Pakistan hardly has 5% of it and it is also diminishing due to unplanned urbanization, fuel needs and mafia operating on large scale, specifically in KPK and northern Pakistan. Then fresh water resources, which are depleting rapidly, which is also a serious matter of concern for an agriculture economy, even the present water resources are polluted, effecting the marine life, this is also resulting in soil erosion and degradation of precious agriculture land. More, Agriculture land is being converted to commercial projects and housing schemes which has been banned recently. So over all, they are numerous factors which are affecting the biodiversity in Pakistan which would have long lasting effects on the states. Sustainable development in answer to most of the solution and Pakistan should look to it before it's too late.

A panel of environmental and forestry experts took part in webinar urged the government to take measures to maintain biodiversity because absence can have devastating effects on human population and till, they realize, it would already be too late. The experts warned that loss of biodiversity can result in pandemics and disasters which are not affordable at all for the state, already facing many crises.[67]

[67]Afshan S. Khan, "Loss of Biodiversity to Increase Pandemics, Disasters," The News International, last modified May 24, 2020, Accessed November 20, 2020, https://www.thenews.com.pk/print/662992-loss-of-biodiversity-to-increase-pandemics-disasters.

Chapter 3

Water Scarcity and Its Implications on Socio-Economic Security

Water, since the beginning of human civilizations, has been an integral part of human lives. The early civilizations such as Nile, Tigris or Indus can be geographically identified that they started near water bodies. Although more than 70% of Earth's mass is covered by water bodies, more than 97% of it is consisted of sea water, often known as salt water. IT cannot be directly used by humans and agriculture purposes which make fresh water resources very limited in availability. According to estimation, about 69 percent of Earth's freshwater are in the form of ice in glaciers and Polar Regions and the rest 30 percent of Earth's fresh water is under the surface in the form of groundwater. That leaves only about 1 percent of Earth's fresh water as readily available for human use.[68] This indicates that around 1/5th of the world's population lives in areas where on average, each person receives less than 1,000 cubic meters (35,315 cubic feet) of water a year which is international standard of water scarcity. This shortage of water affects people's life in many ways, such as clean, usable water, economic development and geopolitics of different areas which adds more importance of Fresh water resources on Earth. Furthermore, water is not only needed for human or agriculture requirements, majority of sources of energy and electricity require water in their production processes: the extraction of raw materials, cooling in thermal processes, in cleaning processes, cultivation of crops for biofuels, and powering turbines to generate hydroelectricity. It is estimated that Global energy consumption will increase by about 50% between now and 2035 due to population growth and increasing economic activity.[69] According to an estimate, freshwater demand will increase up to 50 percent by 2050. This increase in water use will put further strain on Earth's limited freshwater supplies and make access to fresh water even more important. Also, the presence of water is one of the most essential and important elements for a stable ecological system. Therefore, politics over it cannot

[68] National Geographic Society, "Freshwater Resources," National Geographic Society, last modified June 28, 2019, Accessed November 14, 2020, https://www.nationalgeographic.org/article/freshwater-resources/.

[69] , *Global water resources under increasing pressure from rapidly growing demands and climate change*, (Italy: World Water Assessment Programme | United Nations, n.d), http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/WWDR4%20Background%20Briefing%20Note_ENG.pdf.

be neglected. In present world, where literally every state is facing several issues already, the rapid decrease in fresh water sources in a contrast to increasing population would inevitably increase the importance of water in international political arena. Water scarcity is often not given the due importance according to nature of issue, yet it heavily effects a government's ability to provide and manage access of water for maintaining political, economic, and social stability. Climate change has brought some severe effects for many states and Pakistan is one of the top states which has been affected by it. Environmental challenges have created many circumstances for Pakistan maintaining a stable supply of water to its large population throughout the year is becoming a challenge after the effects of Climate change or Global Warming for the government. As explained, no human civilization can survive without water. It is said that "wine is for drinking, but water is fighting for".[70] Since ancient times, securing the water resources or water security has remained source of conflict and power, even today, water can be used as a political weapon. As witnessed in many cases such as when Syria tried to control The Headwater Diversion Plan (Jordan River) to pressurize Israel however, due to on time intelligence reports, Israel conducted airstrikes in Syrian territory to destroy it,[71] which explains how critical a situation can get if state's survival is at stake as it can even force a state to use military means. Sea of Galilee or Galilee Lake is the largest source of water for Israel. Another potential conflict study is of India Pakistan, due to increasing water needs and rivalry with Pakistan simultaneously, is continuously constructing dams on rivers which were awarded to Pakistan according to Indus Water treaty. Pakistan not only require water for its population, rather it also requires it for agriculture needs which is backbone of this area's economy since ancient times. This factor made Britain constructed one of the largest irrigation systems in the world due to agricultural potential of the area and thus, state's economy is also based on this pattern since old ages. A large portion of Pakistan's population which consist of large figure 220 million is linked with agriculture. The presented scenario signifies the importance of water for Pakistan which cannot be neglected as it would put Pakistan's social and economic stability in jeopardy. Hydro

[70]"Whiskey is for drinking, water is for fighting," accessed December 16, 2020, https://www.usbr.gov/lc/phoenix/AZ100/1950/whiskey_drinking_water_fighting.html.

[71]*The Jordon Waters Report*, (Central Intelligence Agency, 2002), https://www.cia.gov/library/readingroom/docs/DOC_0000850997.pdf.

politics with India isn't the only factor in creating water scarcity in Pakistan, there are many other factors as well which are causing water scarcity in Pakistan and will lead to several harmful consequences.

- Some major factors causing Water Scarcity in Pakistan.
  I. Population Explosion
  II. Climate Change and Global Warming
  III. Industrial Pollution
  IV. Insufficient Water Reservoirs
  V. Melting of Icecap
  VI. Hydro Politics with India And Afghanistan
  VII. Water Pollution

3.1 Population Explosion

Increasing population has always been a concern for governments. It is also considered one of the major reasons for shortages and increase for demand in world for many commodities and same goes for water scarcity in the world, which is a very vital natural element for human survival as population is increasing where as fresh water resources are decreasing, it simply makes a sum that allocation of per capita water would automatically decrease. An argument supported by Malthusian Theory of Population to support this approach is that population grow in 2, 4, 8 proportions and resources or income grow at the rate of 2, 3, 4. If the resources are not renewable, the situation becomes more worsen. This led to a flash point of Malthusian catastrophe. Therefore, governments always remain very concerned about population statistics and keeping it in a control has been a major priority, primarily for the developed states as only then the statecraft can be conducted swiftly. Population control results in more effective administration, adequate distribution of resources, increased employment opportunities, sustainable development and infrastructure which help in high living standards for the population. If the population exceeds the state's economic or resource capacity, this causes severe consequences for state, first it causes political problems among different groups, increased natural resource consumption, distribution of income becomes uneven, which means per capita incomes decreases, standards of living go down, whereas waste

production and environmental degradation are accelerated. Such situation is catastrophic for states and it can actually lead to collapse of a state as the world witnessed the collapse of Soviet Union in 1990's. At the beginning of 20th century, world population was approximately 1.6 billion[72], which grew to 2.58billion in 1951 and growth rate was 1.88%[73] which was eventually contained to 1.3% by 2000 and 1% according to latest figures. At the time of independence of British India, there was huge mass migration of about 14 million people between India and Pakistan which resulted in refugee crisis,[74] later on the demise of Muhammad Ali Jinnah resulted in a power tussle between politicians causing several administrative issues, Kashmir War in 1948 and many other factors delayed the conduct of population census which is an essential need for future planning. Eventually, population census was conducted in 1951 which gave the figure of 75 million for both wings (Eastern and Western) of Pakistan since both parts were geographically separated. According to 1951 census, Pakistan total population was 75 million, in which West Pakistan consisted of 33.7 million and East Pakistan (now Bangladesh) consisted of 42 million people. In the past 40 years, the population growth rate of Pakistan has remained 3%/year which is considered the red zone in population growth rates, it declined a bit but has remained a constant of 2.1% as of recent census in 2018 which is still very horrifying for the government as the population has already reached 220 million. This situation is often called Population explosion in academics.[75] As mentioned earlier, the increase in population directly effects the pressure and consumption of natural resources such as water, a very essential natural resource for survival of any living thing has also became a matter of concern globally, although more than 71% of Earth is covered with water bodies, but only less than 1%of the world's total sources consist of fresh water which is drinkable by living things,[76] rest is salt water.

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[72] "World Population Growth," Our World in Data, accessed December 16, 2020, https://ourworldindata.org/world-population-growth.

[73] "World Population by Year," Worldometer - Real Time World Statistics, accessed December 16, 2020, https://www.worldometers.info/world-population/world-population-by-year/.

[74]Population Redistribution and Development in South Asia. Springer Science & Business Media. 2012. p.6.

[75] "Population Explosion," Www.dictionary.com, accessed December 18, 2020, https://www.dictionary.com/browse/population-explosion.

[76] "Freshwater Systems," World Wildlife Fund, accessed December 18, 2020, https://www.worldwildlife.org/industries/freshwater-systems.

Pakistan is one of the 36 states which are currently categorized as water stressed and it is predicted that if emergency steps are not taken,[77] Pakistan would become a water scarce state by 2025 and the most stressed in the region by 2040.[78] Pakistan touched the water stressed line in 1990 and is currently ranked at number 14 in World Resources Institute's list of states that are facing extremely high baseline water stress.[79] Where water reservoirs capacities are no sufficient enough to store extra water, which results in more than 80% of the natural water supply discharging into sea on average every yearly basis. This scenario also means that narrow gap between supply and demand makes Pakistan vulnerable to emergency situations like droughts or increased water withdrawals. According to the IMF, Pakistan's per capita annual water availability is 1,017 cubic meters which hardly passes the scarcity threshold of 1,000 cubic meters. Back in 2009, Pakistan's water availability was about 1,500 cubic meters which shows that water sources have decreased significantly over the course of 10 years. Population explosion would gradually worsen the situation in a state, which already has many disputes regarding distribution of water among provinces.

3.2 Climate Change and Global Warming

Climate change and global warming are undoubtedly the one of most widely discussed topic these days. No matter if it is the international politics or academics, it has been widely discussed due to the sensitivity of the issue. The world has not noticed such sharp climate change in history or perhaps the recorded history where it has literally affected every domain of life. Areas which used to have cool weather have been struck with heat waves on various occasions,[80] and those areas which used to receive rainfall as a rare case as it would be justified to say, once in a blue moon, are receiving excessive

[77] Joshua Meribole, "The Water Crisis in Pakistan," WorldWater& Solar Technologies, accessed December 18, 2020, https://www.worldwatersolar.com/the-water-crisis-in-pakistan/.

[78] Shah M. Baloch, "Water Crisis: Why is Pakistan Running Dry?," DW.COM, accessed December 18, 2020, https://www.dw.com/en/water-crisis-why-is-pakistan-running-dry/a-44110280.

[79]Rutger W. Hofste, Paul Rieg, and Leah Schleifer, "17 Countries, Home to One-Quarter of the World's Population, Face Extremely High Water Stress," World Resources Institute, last modified August 6, 2019, Accessed November 9, 2020, https://www.wri.org/blog/2019/08/17-countries-home-one-quarter-world-population-face-extremely-high-water-stress.

[80] Alec Fenn, "What Has Caused Europe's Heatwave?" CGTN, last modified August 8, 2020, Accessed November 10, 2020, https://newseu.cgtn.com/news/2020-08-08/What-has-caused-Europe-s-heatwave--SLw1mnNUkw/index.html.

rainfalls.[81] Scientists have observed that this situation is not halting, it's increasing continuously. Scientist have also predicted that if global warming is not controlled within limited time, temperature could rise up to 10 degrees Fahrenheit by the end of this century.[82]

The world is also experiencing increased agricultural constraints resulting from the expanding population and associated trends of urbanization and industrialization. Globally, population growth, dwindling land resources, energy requirements, environmental constraints, and water scarcity are impacting simultaneously and unlike ever before, without an existing spare capacity to exploit. Commentators increasingly refer to resource scarcity as a "precondition" for and likely source of future conflict. Scarcity, which can be defined as a diminishing resource and/or growing pressure on the supply available from an increase in demand, could arise from a depleted or degraded resource, which could result from population growth or greater per capita consumption, or through the unequal distribution of the resource.24 These circumstances, which are increasingly evident across the range of global resource issues, impact upon each of the three key areas of individual,

3.3 Industrial Pollution

Industrial utilization of fresh water resources in Pakistan is only 2 to 3%, but the factor which is concerning is that industrial waste is one of the largest contributors of water pollution in the country. In Pakistan, there are no proper factory safety standards, waste disposal procedures, and even if there are, they are not properly followed or policies are not properly implemented. Industrial waste is usually dumped into sewerage lines, water streams or even directly into the rivers. Industrial units lack proper waste water treatment facilities and hence, they cause a large substantial amount of water pollution in Pakistan. According to figures, approximately 20 large and 80 small industrial estates do not possess industrial waste dump treatment faculties and they simply throw it into water

[81]Ashwani Kumar, "Here's the Reason behind UAE's Record-breaking Rainfall," Khaleej Times, last modified January 14, 2020, Accessed December 25, 2020, https://www.khaleejtimes.com/news/weather/heres-the-reason-behind-uaes-record-breaking-rainfall-.

[82] Amanda MacMillan, "Global Warming," NRDC, accessed December 18, 2020, https://www.nrdc.org/stories/global-warming-101#warming.

bodies. Total waste water discharge is split 70% to 30% between municipal and industrial sources, while pollution load is 50% each. Estimated wastewater discharges in the sea are 2-3 million cubic meters (MCM) per day, of which 0.50-0.75 MCM per day is from industrial sources. This situation has worsened the water scarcity factor in Pakistan as many of the rivers such as Chenab, Ravi and Sutlej are already completely contaminated. Although the utilizations rights of Ravi and Sutlej are awarded to India under Indus Water Treaty,[83] but the area or small stream is still active, which means that when excessive water is released by India, the flow of rivers becomes active and all the waste which has been thrown into Ravi or Sutlej, gets mixed up into water and puts hazardous effects for humans, crops and fish population. Same situation occurred in Rawal Dam, Islamabad, when CDA (Capital Development Authority) discovered that water of the reservoir has been highly contaminated.[84] These tests were conducted after a large number of fish, about 14,000 Silver Cods, were found dead in dam. Such large number of fish suddenly turned dead, raised concerns for authorities which ordered immediate inquiry on incident, and later on it was revealed that there are many housing societies, more than 50 throwing or dumping sewage waste into fresh water streams of Rawal Lake which resulted in such sad incident.[85] It was also revealed that Dam does not possess a water treatment plant although it requires at least four. If this is the situation of Federal Capital, often known as the status symbol for higher standards of living, it won't be much hard to imagine what problems would the rest of country be facing and how much this situation is harming Pakistan in all means, health, environmental and economic since large financial resources are required for treatment of waste water. In the present situation, 10% of total river kilometers are affected by pollution which, lakes, ponds are not included, this is a severe situation which needs to be addressed soon since Pakistan already lacks enough rainfall which significantly effects the quantity of fresh water reservoir and in a time where fresh water resources are decreasing rapidly, it's not only

[83] "Indus Waters Treaty," Encyclopedia Britannica, accessed December 18, 2020, https://www.britannica.com/event/Indus-Waters-Treaty.

[84] CDA finds high levels of 'waste contamination' in Rawal Dam, Kashif Abbasi Updated 19 Jul 2017, Accessed November 9, 2020, https://www.dawn.com/news/1346246

[85] Muhammad Anis, "Rural Areas Dumping Sewage in Streams of Rawal Lake, NA told," The News International, last modified March 16, 2018, Accessed November 15, 2020, https://www.thenews.com.pk/print/292945-rural-areas-dumping-sewage-in-streams-of-rawal-lake-na-told.

the duty of government, but the whole nation, to play our role effectively to address this issue accordingly.

3.4 Insufficient Water Reservoirs

One of most common property of water along with some other natural resources is that it cannot be reproduced or it's not renewable. It can only be reproduced via natural ecological system method which is rain which Pakistan already lacks sufficiently as it ranks on below world's average rainfall index. This argument would amaze many as they consider water a normal commodity, abundantly available in nature, but this isn't the case as on whole planet, only less than 1% of the total water bodies consist of fresh water. Hence, effective and judicious utilization with saving/storage of water is the only way to make the water flow/quantity last longer with storing capacity, else it will simply be discharged into sea and would become unusable, it would help the marine life to some extent, but not in a way it would beneficial for humans and land inhabitants. One major characteristic of water is that it keeps flowing, slowly or fast, depending on its path, it keeps moving. If it stays for a longer period of time, it creates many problems and eventually becomes unusable. There are two types of fresh water reservoirs.

- Natural Reservoirs which are rivers, lakes, ponds, wetlands, and aquifers or oceans.
- Artificial water reservoirs, which include lakes created behind dams, artificial wetlands, and flood-spreading sites.[86]

Artificial water reservoirs are one of most effective way of storing water for difficult times since they are controlled and can be managed according to need. The flow of water does not remain the same throughout the year, it varies from time to time, and season to season. Sometimes, the amount of water exceeds the need and sometimes it falls down drastically hence the humans cannot depend entirely upon availability of water naturally, they have to manage or store this quantity at their own and thus artificial water reservoirs are constructed to store excessive water which is a very common practice globally. Large,

[86] Peter Bobrowsky and Brian Marker, s.v. "Reservoirs," in *Encyclopedia of Engineering Geology* (Basingstoke: Springer, 2018).

medium or small-scale dams, lakes are constructed which store the water, and supply it accordingly needs. IRSA. Unfortunately, Pakistan hasn't been able to construct sufficient water storage facilities which creates difficulty for the governments every year, as water demand is rising where as its supply is falling, or even if not falling, it's not stable throughout the year. Pakistan's geography is truly God gifted but a gift cannot be helping if one doesn't have capability to use it. The origin of most of the Pakistani rivers under IWT (Indus Water Treaty) is in Northern Himalayan Ice cap.

Last time, when any major water reservoir was constructed dates back to 1960's in Ayub Khan's era, Tarbela on Indus and Mangla on Jhelum. After that, there hasn't been any significant large-scale dam construction which was eagerly the need of time and this has cost Pakistan too much, Tarbela and Mangla are still operational but their water storing capacity is falling due to surface area is filling with soil. As there hasn't been any major construction of dam, it results in loss of huge amount of water every year, according to report, Pakistan only has capacity to store 10 to 20% of water every year, rest is discharged in Arabian Sea. If only Pakistan had enough water storage capacity, it would have proven beneficial in various ways, first, water would have been available throughout the year for agriculture and domestic needs. Secondly, electricity generation via Hydel power method is a source of cheap electricity, a long-desired need for people and industries. Increased fisheries, availability of fish to increase food supply. Hydroelectric power generation is not only cheap, but also environment friendly, so it will be beneficial in both ways. A national consensus is a vital need of time on construction of water reservoirs else it will put national stability in jeopardy. We witnessed how a mega construction project of Kala Bagh's dam was politicized due to absurd arguments and construction work was ceased. Currently, government has initiated work on construction of Diamir Basha dam in Gilgit Baltistan but it will take much longer time and cost if compared to Kala Bagh, which was much more feasible since the area is a natural dam site. The construction of water reservoirs is undoubtedly the biggest need of time and it is only way to avoid the inevitable crisis which is soon about to hit Pakistan in the most severe manner.

3.5 Melting of Glaciers

Pakistan has several mountain ranges in its geography, some of them such as Karakoram and Himalayas are one of the highest in the world. These mountains not only maintain ecological system which is necessary for wild life or biodiversity, but also contribute to national economy in various ways. According to various studies, Pakistan has estimated of having around discovered 7,253 glaciers, including 543 in the Chitral Valley alone, it is often stated that Pakistan has more glaciers than anywhere on Earth except the Polar Regions. These glaciers are rich source of water supply to rivers that account for about 75 percent of the stored-water supply in the country of at least 220 million. But this isn't the end of the story, the present climate change has also affected the glaciers of Pakistan, which has increased the melting of its glaciers, for the time, it would result in increased or excessive water supply, but once the glacier is completely wiped out, it will be a huge blow to national water reservoirs. With increasing population, every drop of water should be given value, and these are, technically, mountains of frozen water which is a vital substance for life there for the melting of glaciers should be considered a serious issue and must not be neglected because time is running short. The climate change is actually "eating away Himalayan glaciers at a dramatic rate" and there have been many glaciers outburst reported recently. These outbursts are not only causing flood threats but also put more than 7 million people at risk and the economic loses are on the other hand. Many of the glaciers in the regions are melting rapidly which are also endangering the life of the residents and many have already melting drastically. If managed properly and environmental threat countered accordingly, Pakistan can well manage the environmental challenges and turn them into boosting economic activity in its North since Glaciers can turn out to be a very attractive tourist spot and North of Pakistan has huge tourism potential already, the point is to capitalize this situation and properly handle the challenges else it will be more of a trouble than blessing for the state and its people. Earlier, Chairman NDMA warned that Gilgit Baltistan has started to receive more rainfall, received One third of more snowfall than normal over the winter, which would increase the chance of flood risks.

3.6 Hydro politics with India and Afghanistan

South Asia, particularly Pakistan is currently facing severe impacts of water scarcity that would fuel dangerous tensions with its neighbors that will have repercussions for regional stability. The national security implications of rising water shortage, caused by increasing population, agriculture demands, hydroelectric power generation, and climate instability will be felt all over the region. Division of Subcontinent was done in such a manner which left behind some severe issues who still needs attention today such as Kashmir issue, the unsolved partition agenda. Partition resulted in many issues between Pakistan and India. The horrible stories of division explained by migrant still hunt many people who witnessed the situation themselves. Since the beginning, Indian attitude towards Pakistan was very hostile because the Indian or Congress's leadership was against the partition of British India and thus, Indian leadership didn't spare any chance to harm Pakistan. No matter they were border disputes, allocation of assets, bloodshed, Kashmir issue, or justified division of water reservoirs. Strategic experts believe that Red Cliff award deliberately gave edge to India in many areas such as border markings or land routes to Kashmir via Gurdaspur, and control of important water headwork which were used to control flow of water to the areas presently known as Pakistan. India immediately started using it as a political tool to pressurize Pakistan and it did it in most effective way possible. After creation of Pakistan, India blocked the water flow to Pakistani rivers. Pakistan not only has large population, it is also agrarian society, to fulfil both needs, Water is an essential element, and no matter if it's for drinking, domestic uses or agriculture, it is vital. Therefor water is not only a need of humans, it was and still is a matter of social and economic survival. To solve this issue, in 1959, Indus water treaty was signed between Pakistan and India by attribution of World Bank. A framework was designed in which usage rights of Eastern rivers were awarded to India (Ravi, Beas and Sutlej) whereas western rivers were awarded to Pakistan (Indus, Chenab, and Jhelum). Indus water treaty is often known as most comprehensive framework of division of water resources in transnational water bodies. The distribution of water resources between both states has raised issues for governments because of significant increase in population of both states, India's population in 1960 was 450.5 million whereas Pakistan's was 44.99 million, currently India's population has

hit gigantic figure of 1.353 billion (2018) and same case for Pakistan who also has reached a huge figure of 212.2 million as of 2018. The trends show that they will continue to grow as India Pakistan has population growth rate of 1.4% and 2% annually. If we calculate the size of population from past and present, Indian population grew around 3 times and Pakistan more than 4.5 times which shows that water needs for both states must have increased but the supply of water has decreased. Indian government, by looking at its future needs has constructed numerous dams to store more and more water, Pakistan also has done some work but very less if compared to India. Due to increasing water needs, India also started construction of dams and barrages on Western Rivers which were awarded to Pakistan according to Indus water treaty. This act resulted in decreased water supply for Pakistan and flow of River Chenab was heavily affected. Afghanistan by facilitation India has also started construction of dam on Kabul River, an important western tributary of Indus, which flows from Afghanistan into Pakistan which will also decrease the flow of Indus. Experts believe that India is using water as a political tool to pressurize Pakistan. No matter if it is done for political agenda or dire needs by Indian government, Pakistan needs to address this issue quickly with its neighbors as it is a matter of national security else this situation might lead to an armed conflict between two states as Pakistan already is very close to scarcity standard of 1,000 cubic meters by just surpassing it with 1017, which was 2172 in 1990, in just in a time phase of 30 years, it has diminished more than half and it may even fall down to 860 cubic meters quickly if appropriate measures are not taken to resolve this.

3.7 Water Pollution

Water pollution does not only affect the quality of water, it makes it infectious causing diseases, and sometimes even not usable at all which suggests that if there is prominent reduction in water pollution, it can directly increase availability of water for the state as water is already present, but it cannot be used due to its quality. According to various reports in Pakistan, only 20% of the population has access to clean water and rest 80% is forced to drink contaminated water, primarily by sewerage and secondarily by fertilizer, pesticides, and industrial effluents because no proper SOPs are being followed

for disposal of wastes.[87] The report also revealed that this intense level of contamination is resulting in serious viral infections and is responsible for approximately 80% of all the diseases and 30% of deaths in the country. The water distribution structures in state are old and out dated, furthermore, dried out pipelines are perfect incubation center for viral bacteria and viruses, even a single E. coli bacterium can multiply into trillions in just a week and such pipes are used for the water supply without any treatment. Drinking or even using such polluted water does not only result in the death of several people, but also cause bone and teeth diseases, diarrhea, dysentery, typhoid, hepatitis, cancer, and other waterborne diseases which are cause of over 2 million diseases worldwide every year. IMF has ranked Pakistan on third in list of states facing severe water shortage. According to statement by PCRWR, Pakistan won't be having enough clean water or to some extent, not clean water at all for the general population by 2025. Such statement coming from the national authority on water should be alarming enough to look for all the possible measures which indicates the nature of sensitiveness of the issue for the state. According to a report, In Pakistan, approximately 60 million people are at risk of being affected by high concentrations of arsenic in drinking water, this would be the largest mass poisoning in history.[88] Arsenic numerous numbers of diseases such as cancer, restrictive pulmonary disease, skin lesions, cardiovascular problems, diabetes mellitus, gangrene, neurological impairments, and problems in endocrine glands, immunity, liver, kidney, and bladder. It can even cause severe socio-economic hazards. Unfortunately, still, no epidemiological data of arsenic poisoning, alternate drinking water, and health interventions are available to the people at risk. Therefor the issue of water pollution needs to be addressed as soon as possible.

[87]The crisis of water shortage and pollution in Pakistan: risk to public health, biodiversity, and ecosystem, https://link.springer.com/article/10.1007/s11356-019-04483-w

[88]Guglielmi G (2017) Arsenic in drinking water threatens up to 60 million in Pakistan. Science. http://www.sciencemag.org/news/2017/08/arsenic-drinking-water-threatens-60-million-pakistan.

Chapter 4

Governmental Efforts and Possible Solutions to Counter the Environmental Challenges

One of the earliest efforts by the GOP in terms of sustaining environmental protection was done in 1997 by establishing Pakistan Environmental Protection Agency (EPA). It regulates the environmental laws passed by the parliament and is a federal executive agency, which means it has authority to exercise without following regular procedural protocol and currently is attached with Ministry of Climate Change to provide technical assistance to the ministry.[89] Although EPA is not a cabinet-based department but the Director General is normally granted a cabinet rank for smooth flow of operations and it also has its provincial wings for better administration. Then one of the major developments in this regard is of National Environmental Policy by GOP in 2005 which aims to protect, conserve, and revert Pakistan's environmental structure to improve living standards of citizen with sustainable development.[90] By having some primary objectives of environmental considerations in developing projects, policy making and making public aware regarding environmental challenges. Another important initiative taken by present ruling party during its first provincial tenure was the massive tree plantation drive in the province which was aimed to recover lost forest area due to various domestic factors and later on to enlarge the tree plantation project to whole country.[91]The campaign is internationally acknowledge in terms of battling global warming. [92]The policy of adaptation by GOP is gradually gaining momentum in environmental paradigm and is progressing well as it is also integrated in its MDGs. Then establishment of a Global Change Impact Studies Centre (GCISC), which will cover areas of climate, health, water,

[89] "Introduction to the agency," Pak-EPA, accessed March 3, 2021, https://www.environment.gov.pk/.

[90] , *National Environmental Policy (2005)*, (Ministry of Environment, Government of Pakistan, 2005), http://www.mocc.gov.pk/PolicyDetail/ZWQ3YTg5MDgtOTc0MC00ZjViLWJlM2ItNzM3OGM3MTUwMGZk.

[91] Rosamond Hutt, "Pakistan Has Planted over a Billion Trees," World Economic Forum, last modified July 2, 2018, https://www.weforum.org/agenda/2018/07/pakistan-s-billion-tree-tsunami-is-astonishing/.

[92] Alastair Jamieson, "Pakistan plans to plant 10 billion trees to fight climate change," *NBCNEWS*, August 5, 2018, Accessed November 5, 2020,, https://www.nbcnews.com/news/world/pakistan-plans-plant-10-billion-trees-fight-climate-change-n897216.

energy, food security by the parliament is another important step executed by the government in 2013.[93] One of major development governmental efforts is up gradation of Climate Change division into a full ministry in 2017. Federal government initiated a test case of banning plastic bags in the capital city Islamabad from 14th August, 2019 and become one of the latest states to adopt this step.[94] This law is enforced properly and fines are imposed on shopkeepers regularly regardless of the size of their business.[95] This has resulted in majority of the major businesses stopped using plastic bags. The steps to counter environmental degradation are not only limited to Federal government but also initiated by provincial government of People's Party in Sindh which also started a massive mangroves plantation drive in coastal areas.[96] The government of Sindh aims to develop the province on sustainable methods without harming the environment for future generations.[97] Prime Minister Imran Khan also announced that Pakistan will gradually move out power generation by coal and aims to develop sustainable energy resources in December, 2020.[98] Where as in most recent development, State Minister for Climate Change Zarate Gull announced of establishment of 23 Miyawaki forest in Islamabad, the federal capital.[99] Many plantation drives have also been launched by institutions independently which indicates that good progress is been done in this regard however much more substantial efforts are still required.

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[93] "Global Change Impact Studies Centre," Global Change Impact Studies Centre, accessed March 4, 2021, https://www.gcisc.org.pk/About_us.php.

[94]Dia Hadid, "Pakistan Tests A Plastic Bag Ban In Islamabad," NPR.org, last modified August 6, 2019, https://www.npr.org/2019/08/06/748163832/pakistan-tests-a-plastic-bag-ban-in-islamabad

[95] Staff Report, "Shopkeepers Fined for Using Polythene Bags," The Nation, last modified March 3, 2021, Accessed November 15, 2020, https://nation.com.pk/03-Mar-2021/shopkeepers-fined-for-using-polythene-bags.

[96] "2 billion mangroves planted along Sindh's coastal areas," *Dawn*, July 21, 2020, Accessed November 20, 2020, https://www.dawn.com/news/1570201.

[97] "Sindh Forest department, Vision," SINDH FOREST, accessed March 5, 2021, https://sindhforests.gov.pk/page-vision.

[98] Sana Jamal, "Pakistan moves towards coal-free future with focus on clean energy," *The Gulf News*, December 16, 2020, Accessed November 24, 2020, https://gulfnews.com/world/asia/pakistan/pakistan-moves-towards-coal-free-future-with-focus-on-clean-energy-1.75900265.

[99] APP, "23 Miyawaki Forests to Be Established in Capital: State Minister," DAWN.COM, last modified March 4, 2021, Accessed November 29, 2020, https://www.dawn.com/news/1610507/23-miyawaki-forests-to-be-established-in-capital-state-minister.

4.1 Way Forward to Mitigate Huge Repercussions of Emerging NTS Challenges (Climate Change and Water Scarcity)

Pakistan has not contributed much to Climate Change but unfortunately is one of most victimized state by it. Therefore, it becomes significant for government and people of Pakistan to take actions. Climate Changes have various factors, and every factor needs to be addressed in an equitable manner, because it has its contribution in the larger problem. It is a famous saying that problem is not the problem, but the attitude towards the problem is. Therefore, in this regard, the most appropriate attitude or approach to curb environmental challenges for Pakistan is adaptability. Adaptability as an approach means to adjust a person, organization or even a state according changing trends, innovation, destabilization, industry patterns, and so on.[100] Perhaps Darwin was very much right in his approach when he said that only those species would survive who will have the ability to adapt the necessary changes, not the strongest ones, neither the intelligent ones. In contemporary times, adaption is a very important approach when one needs to adjust in society, whether they are fashion, technology or other trends. The people who are not open to change, face many difficulties and in most of the cases, left behind. The environmental challenges are matter of pure adaption for the survival since people live in environment, their lives depend on environment in all means, if environmental change reaches point of no return, what would be left to live with? The current trends, methods and the way of living needs to be changed in a decent and precise manner for preserving the nature and sustainable economic activity. The good thing is that Pakistan's government is showing level best commitments in this regard and has recently achieved UN Climate Action SGD-13. Pakistan is giving high priority on environmental projects, emphasizing on tree plantation, biodiversity conservation and investment in clean energy projects.[101] However, much more needs to be done in this regard. The changes needed to

[100] Anne C. Willkomm, "4 Ways to Boost Your Adaptability Skills," Goodwin College of Professional Studies, last modified September 18, 2019, Accessed November 3, 2020, https://drexel.edu/goodwin/professional-studies-blog/overview/2019/September/4-ways-to-boost-your-adaptability-skills/.

[101] Sana Jamal, "Pakistan Achieves UN Climate Action Goal 10 Years Ahead of Deadline," Gulf News, last modified July 13, 2020, Accessed November 4, 2020, https://gulfnews.com/world/asia/pakistan/pakistan-achieves-un-climate-action-goal-10-years-ahead-of-deadline-1.72574154.

be adapted in various areas and policies which are mentioned below which should be implemented on priority basis.

- Sustainable Development Environmental Policy for Pakistan
- Switching to Environment Friendly Power Generation
- Mass Transit System (MTS)
- Factory Safety Standards
- Recyclable Products and Banning of Plastic Bags
- Waste to Energy Mechanisms
- Introduce Electric Trains
- Forestation
- Promoting Hybrid Cars in domestic
- Use of Bicycle
- Fuel Efficient and Environment Friendly Automobile Technology
- Strict Rules Regarding Environmental Standards of Vehicles
- Plantation Campaigns and Gardening
- Preservation of Wild Life Species

4.2 Sustainable Development Environmental Policy

Sustainable development means to develop human goals by considering all the negatives and positive impacts on environment or natural systems, and eradicate all the negatives in it for preserving the nature. In other means development while not effecting nature in a harmful way. Sustainable environmental policy is a need of time because of the current situation of the country, which is not only facing a single but multiple environmental threat that can be proven catastrophic eventually for the state. Pakistan is blessed with many natural gifts. Therefore, it is our national duty to help preserve them and to work more since environmental is not bounded by the borders. It has a trans-border issue, if Pakistan is facing an environmental issue. It would not remain in Pakistan, but would affect the area on the other side of border as well. This is one of the key arguments of Barry Buzan in securitization theory as well that environmental issues are regional, not state level. Thereby, integrated future development policy, especially

urbanization or any mega project must be created while considering all its environmental aspects. If it is badly affecting the environment, alternatives must be taken or compensations must be done so it remains environment friendly, since environment belongs to everyone, not a single person, or organization, even a state but to all.

4.3 Switching to Environment Friendly and Renewable Energy Production

According to a report published in 2013, Pakistan emitted 342 million metric tons of CO2 in 2012, with the energy sector contributing 46 percent to overall emissions, this statement or figure is quite amazing and worrying simultaneously as it clears one fact that energy sector is one of the main reasons of devastating climate change in Pakistan,[102] Report also mentioned that greenhouse gas emissions increased by 87 percent from 1990 - 2012, primarily due to of increase activity in energy and agriculture sector. It is a global acknowledge fact that excessive combustion of fossil fuels emits high quality of carbon pollution which is the biggest driving force behind climate change in the world and decreasing its emission to the environment is bigger challenge. Presently, Pakistan's total power generation capacity is 35,735 MW by June 2020.[103] Out of which, 16 percent is generated from furnace oil, 27 percent from Hydel sources, 12 percent from natural gas, LNG (26 percent), coal (9 percent), renewable (solar and wind 5 percent) and nuclear (5 per cent) are the principal sources, Which means that only 37 percent of total production output is non thermal (except for nuclear power plants which are also environment friendly) which is environment friendly and rest isn't. Thermal electricity production is not only harmful to environment, it is pretty expensive as compare to hydel sources as well, with several other factors making it difficult such as regular supply, payments to oil and gas companies. Because of high-cost production of thermal electricity, government has to sell it on higher rates with combining aggregate, which makes it worst for cost price of industry which is already suffering and cannot produce a good competition in international market from other states. The high cost of production and unstable supply of

[102] "Greenhouse Gas Emissions Factsheet: Pakistan," Climate links, US Aid, last modified June 2016, https://www.climatelinks.org/resources/greenhouse-gas-emissions-factsheet-pakistan.

[103] National Electric Power Regulatory Authority, Pakistan, *The State of Industry Report 2020*, (NEPRA, 2020), https://nepra.org.pk/publications/State%20of%20Industry%20Reports/State%20of%20Industry%20Report%202020.pdf.

power resources made or forced many industrialists to shift their industry from Pakistan to other states which further caused economic decline and unemployment in Pakistan. Therefore, it is certainly a vital of need of time to switch to hydro or other environment friendly electricity generation systems, they take long time to establish, but also have long term benefits as compare to thermal production of electricity. Some of the environment friendly systems are mentioned below.

4.3.1 Hydro Power Generation

Pakistan has enormous potential of producing hydroelectricity because of its geographical features. Its current power generation capacity is 38,719 GW as of 30th June 2020, out of which only 27% is generated from hydel power, and 10% (5% each) from renewable (solar and wind) and nuclear power plants. Rest of the electricity needs are fulfilled from thermal power generation which are not only much costly, highly dependent on fuel prices, increases the import oil bill, and the supply is also are not ecofriendly, contributing high number of carbons into atmosphere. Many feasibility reports have revealed that the true hydro power generation potential of Pakistan is around 60,000 MW out of which only 7,320 MW has been developed,[104] which means that Pakistan can actually fulfill all of its electric power needs from hydel power which is economical, environment friendly, is available throughout the year, if proper water reservoirs are constructed.

4.3.2 Wind Energy

Wind energy is one of most environment friendly form of renewable energy generation tool that is being used throughout the world in areas wherever wind flow is strong and stable, the strong flow of causes the turbines to move which eventually results in converting mechanical energy into electricity generation. Historically, it is revealed that first practical wind power turbine machines, windmills and the wind pump were invented in the area which currently comprises of Afghanistan, Iran and Pakistan by the

[104] "COUNTRY profile Pakistan," International Hydropower Association, last modified November 2020, Accessed December 5, 2020, https://www.hydropower.org/country-profiles/pakistan.

9th century.[105] As for now, Pakistan generates around 6% of the total electricity production though wind energy. Wind power capacity in Pakistan is 1,237 MW. Coastal areas are often considered best for wind power generation because of strong wind flow and Pakistan has a coastline of about 990 km.[106] the government is planning to increase the share of renewable energy into the national grid and has initiated several projects and working of feasibility reports to look for potential wind power areas. According to a survey conducted by The Pakistan Meteorological Department in 2013 entitled "Wind Power Potential Survey of Coastal Areas of Pakistan", Ministry of Science & Technology provided funded this project. Often named Wind corridors are those specific areas which are economically feasible for establishment of wind farms. The Gharo Jhimpir wind corridor in Sindh was identified as the most lucrative site for wind power plants with an electricity power potential of 43000 MW on a covered area of 9700 km^2.[107]Wind Energy, to some extent is independent in power generation, which can help to provide electricity in remote areas of Sindh and Balochistan which can help eradicate many infrastructure problems there.

4.3.3 Solar Energy

Solar power is another very effective natural renewable way of creating electricity from sun light. In this procedure, the heat energy from sunlight is absorbed by solar panels using photovoltaic (PV) or indirectly using concentrated solar power, or a combination of both. Concentrated solar power systems use lenses or mirrors and solar tracking systems to focus a large area of sunlight into a small beam. Photovoltaic cells eventually convert light into an electric current using the photovoltaic effect. Best thing about solar power is that this can also be used as independent unit by home or commercial users by installing the equipment, just like wind power technology. Pakistan

[105]Lucas, Adam (2006), Wind, Water, Work: Ancient and Medieval Milling Technology, Brill Publishers, p. 65

[106] Ministry of Climate Change, Government of Pakistan, *A Handbook on Pakistan's Coastal and Marine Resources* (Karachi: Daccan Printers (Pvt) Ltd., 2016),

[107] "Guidelines for Environmental Assessment of Wind Farms in the Gharo Wind Corridor- Pakistan," Alternative Energy Development Board, United Nations Development Programme, accessed November 27, 2020, https://www.aedb.org/index.php/component/judownload/root/2-wind/15-guidelines-for-environmental-assessment-of-wind-farms-in-the-gharo-wind-corridor-pakistan?Itemid=101.

has one of the highest values of insulation in the world due to its geography resulting in eight to nine hours of daily powerful sun exposure which results clear and bright sunshine every day.[108] This is ideal climatic conditions for solar power generation. However, due to expensive adoption technology or equipment's, Pakistan hasn't been able to utilize the true potential of solar energy which is present in country. Government has initiated several solar power projects in country Pakistani Kashmir, Punjab, Sindh and Balochistan. Projects are under development by the International Renewable Energy Agency, the Japan International Cooperation Agency, Chinese companies, and Pakistani private sector energy companies. Punjab government constructed Quaid-e-Azam Solar Power Park (QASP) in the Cholistan Desert, Punjab, with a 1 GW capacity, one of its kinds in the country. A plant of this size would be enough to power around 320,000 homes. Pakistan is aiming to add approximately 10 GW of renewable capacity by 2030 in addition to replace 5% diesel with biodiesel by 2015 and 10% by 2025.[109]

4.3.4 Nuclear Power Plants

Nuclear power plants are one exception in generating power by process of combustion which is relatively much environment friendly as compare to other thermal electricity generation processes. Around 435 nuclear power plants are being operated in world presently which generates about 345,000 MW of electricity in 32 states, which is about one-sixth of world's electricity supply.[110] Pakistan welcomed United States Atoms for Peace Program in 1953 and by 1956, Pakistan Atomic Energy Commission (PAEC) was established. Currently, Pakistan does not have a big nuclear power program as compare to other nuclear states, its capacity is 1355 MW and projects of 2300 MW are under construction with help from China.[111] Nuclear power reactors do not produce direct CO2 emissions into the environment, unlike other thermal or thermal power plants. Also,

[108] "Solar Power in Pakistan,"

[109] Reena S. Khan, "New Pakistani Energy Plan Aims for 30% Renewable Generation by 2030," Institute for Energy Economics & Financial Analysis, last modified August 10, 2020, Accessed November 20, 2020, https://ieefa.org/new-pakistani-energy-plan-aims-for-30-renewable-generation-by-2030/.

[110] "Nuclear Fission Energy," last modified August 9, 2000, Accessed November 21, 2020, https://www2.lbl.gov/abc/wallchart/chapters/14/1.html.

[111] "Nuclear Power in Pakistan - World Nuclear Association," World Nuclear Association - World Nuclear Association, last modified February 2020, Accessed November 22, 2020, https://www.world-nuclear.org/information-library/country-profiles/countries-o-s/pakistan.aspx.

nuclear reactors do not produce air pollution or CO2 while operating. However, the processes for mining and refining uranium ore and making reactor fuel all require large amounts of energy.[112]

Some advantages that make nuclear power plants environment friendly are as follow:

- One of the most low-carbon energy sources.
- It is necessary to look for low carbon emission energy sources like nuclear power which are vital for a positive response to climate change and greenhouse gas emissions.

Nuclear power plants are reliable and cost-effective because of high energy yield of Uranium. 1 gram of uranium 235 can produce energy up to same amount of energy produced by 3 tons of coal or about 600 gallons of fuel oil.[113]

4.4 Mass Transit System (MTS)

Mass transit systems or pubic transports systems can bring a massive effect on environment of an area that can both be negative or positive. If the public transport system is modernized, environment friendly, it will result in healthy environmental and economic activities since a modern transport bus or train can help move hundreds of people with ease without putting excessive pressure on roads. It results in less fuel combustion by private vehicles, less traffic on road with prevents unnecessary traffic jams which also causes waste of fuel and causes psychological problems on people though. If 100 people are moving in a bus or 200 in train from one place to another, it means that there are least 50 to 100 less vehicles on road. It puts less pressure on road and their infrastructures as well. Mass transit systems are considered essential for every large developed metropolitan city, most developed cities in the world adopted public transportation systems especially subway trains in early developmental stages because building such systems in a full established city is very difficult. Unfortunately, in Pakistan such systems were not introduced from the start due to several reasons, there

[112] "Nuclear Power and the Environment," U.S. Energy Information Administration (EIA), last modified January 15, 2020, https://www.eia.gov/energyexplained/nuclear/nuclear-power-and-the-environment.php.
[113] "Nuclear Fission Energy,".

used to be circular railway network in Karachi, but it has been dysfunctional since 1999. Modern mass transit systems in Pakistan were initiated by PML-N government, the first project was Lahore Metro bus service which became operational in 2013, Peak daily ridership was 178,850 and the average daily ridership through the first half of 2014 was at 149,228 with a monthly average peak of 159,222 with a track range of 27km, which means that only in area of Lahore, more than 54 million people travel via this service, which puts relatively less pressure on roads.[114] Second project in Rawalpindi-Islamabad became operation in 2015 which has daily ridership of around 80,000 to 100,000.[115] Length of track is 22.5 km, it touches one end of Rawalpindi, Saddar to Pak Secretariat in Islamabad. An extension was also initiated which will link this track to New Islamabad international Air Port which will decrease traffic on roads linking Motorway and Peshawar road in twin cities which often witness heavy traffic. Same projects have been developed in Multan and Peshawar, recently Orange Line train project has also become operational in Lahore, however business hub of the country, Karachi is in dire need of mass transit project, largest city of Pakistan in terms of area and population both, a city with population of 14.9 million lacks any basic modern transport system and has recently been called the worst in the world.[116] Same old models that used to run on roads in 1980's or 1970's perhaps are still running on roads that are not only harmful for environment, but also a matter of public safety concerns because of their fitness conditions. In a generalized manner, Modern mass transit environment systems would be established in all major cities, in Karachi, on high priority basis, and if already established, should be continued, even if the government has to bear some burden like financial assistant, because in the long run, they return significantly to environment and such projects are considered public welfare projects all around the world. It is often said

[114] Shahid Saeed, "Why We Need More Metro Buses," DAWN.COM, last modified November 6, 2014, Accessed November 9, 2020, https://www.dawn.com/news/1142688.

[115] Danish Hussain, "Punjab Went 'halfsies' on Cost, but Not on Revenue," The Express Tribune, last modified April 17, 2016, Accessed November 15, 2020, https://tribune.com.pk/story/1086838/metro-bias-service-punjab-went-halfsies-on-cost-but-not-on-revenue.

[116] Faseeh Mangi, "The World's Worst Public Transport System Attempts to Modernize," Bloomberg, last modified November 2, 2020, Accessed November 20, 2020, https://www.bloomberg.com/news/features/2020-11-02/pakistan-s-megacity-tries-to-modernize.

that you are not stuck in traffic, you are the part of traffic there for establishment of such systems is a need of time, and for the city of Karachi, a dire need.

4.5 Environmental Safety Standards for Industrial Units

Industrial units are one of the largest contributing factors of pollution. Their waste materials and air pollution are a large source of pollution in the environment but at the same time, production units are necessary to keep the cycle of economic activities of a state going on because in the end, the GDP matters the most in today's world but it shouldn't be at the cost of nature and environmental sustainability. Many environmental summits including the Paris conference on climate change in 2015 has emphasized the importance of controlling the waste materials emitting from factories because they use heavy machinery and large industrial units which discharges several gases into the environment, whether in shape of gases or solids to be reduced or minimized maximally, also to be discharged in environmentally friendly way so they don't cause damage to nature. Pakistan lacks many factory safety and environmental laws for protection, or even if the laws are present, they are not implemented properly.[117] The chemicals discharged from the factories is usually released into surrounded areas, sewerage or water bodies directly endangering human and wild life.[118] Therefore, the implementation of factory safety and environment friendly standards is to be ensured at any cost by the respective authorities for a sustainable environment friendly economic activity.

4.6 Recycling and Banning of Plastic Shopping Bags

Recycling means to utilize things or materials for optimum use or eventually otherwise they go to waste and become a burden on environment. In order to save natural resources and the energy that it used to extract and transform natural resources into finished products.[119] It is necessary that recycling should be promoted and those materials which are one time useable should be discourage at maximum extents. Recycling is one

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[117] Ajmal M. Mehdi, "Industrial Pollution in Pakistan," The Nation, last modified January 6, 2019, Accessed November 5, 2020, https://nation.com.pk/07-Jan-2019/industrial-pollution-in-pakistan.

[118] Wajid Rehman et al., "Heavy metal pollution assessment in various industries of Pakistan," *Environmental Geology* 55, no. 2 (2007): xx, doi:10.1007/s00254-007-0980-7.

[119] Cole Rosengren and Rina Li, "What Does 'recycling' Actually Mean?" Waste Dive, last modified April 3, 2019, https://www.wastedive.com/news/what-does-recycling-actually-mean/551905/.

of the best things we can do easily for nature and it won't require much effort, just a commitment that we will try our level best not to pollute environment and try to recycle all the products that can be used again easily. To have a positive impact on the world in which we live, recycling is important for all, natural environment and humans. One of most harmful material which is causing problems is plastic shopping bags, they should be banned immediately, alternatives should be taken early before imposing absolute ban on them as they are causing serious pollution and even causing soil issues, since they are not dissolvable, they remain in soil which eventually destroys it. It is estimated that Pakistan uses 55 billion bags a year that are gradually dispatched into environment which is increasing pollution but also ends up clogging sewerage systems and rivers.[120] Government decided to ban plastic bags and Islamabad became the first test case where shopping bags were banned from the 14th August, 2019 and heavy fine policies were imposed.[121] The strategy worked for a while, but since no alternatives were early introduced, eventually, the ban was unofficially lifted, however it worked for large retail stores or shops, who started using reusable paper or environment friendly material shopping bags. Again, the problem isn't formulating a policy, problem lies in strict implementation, plastics shopping bags have now been used for several years, perhaps, more than 2 decades in such a way that they have become part of our life styles, it will take some time to mold our attitude and to become normal to use fabric or other types of bags. If the policy is gradually introduced in whole country, it will certainly take some time to be effective, but in the long run it will help a lot to save environment.

4.7 Waste to Energy Mechanisms

Pakistan current population is estimated at around 220 million people, it makes it ranked 5th by terms of population in world. It also results in huge quantity of garbage which has been created daily in the country. Government of Pakistan estimates that

[120]Dia Hadid, "Pakistan Tests a Plastic Bag Ban in Islamabad," NPR.org, last modified August 6, 2019, Accessed November 15, 2020, https://www.npr.org/2019/08/06/748163832/pakistan-tests-a-plastic-bag-ban-in-islamabad.

[121] Pamela Constable, "Pakistan moves to ban single-use plastic bags: 'The health of 200 million people is at stake'," The Washington Post, last modified August 12, 2019, Accessed November 10, 2020, https://www.washingtonpost.com/world/asia_pacific/pakistan-moves-to-ban-single-use-plastic-bags-the-health-of-200-million-people-is-at-stake/2019/08/12/6c7641ca-bc23-11e9-b873-63ace636af08_story.html.

approximately 87,000 tons of solid waste/day and more than 20 million/year is generated in country and its quantity is increasing at about 2%/year due to increasing population and economic activity. Most of this waste comes from urban population. Solid waste management has been a big problem for the government since no proper sop's have been followed and usually the garbage is dumped into surrounding areas of cities, burned, or it makes its way by water, in simple, no proper policy has been formulated in Pakistan for solid waste management, which has already become a matter of environmental and health concern for general population. Solid waste management is one of core issues since the population and economic activities are increasing and the garbage generation is a process which cannot be stopped immediately, rather there are some measures required to restrain it and utilize it effectively which decreases its harmful effects on environment. It is often said that the problem is not the problem, but attitude is. For example, Karachi, the biggest city of Pakistan has a population of approximately 24 million. Figures show that on a daily basis, about 12,000 tons of solid waste is generated in Karachi alone, the bad side is that forty percent of that garbage can be found on the city streets. This mismanagement in waste dumping is not causing environmental problems in Karachi but also is causing spread of infections and diseases.[122] New York City produces more than two times of garbage as compare to Karachi, around 26000 ton, but waste management structure in NYC is much more effective than Karachi and this is why NYC doesn't face much problems in this regard as Karachi is facing presently.[123] Waste management is not a simple process, rather it requires structural planning and execution, and in this aspect, Singapore has surpassed most of the major cities of the world. Singapore's growing population and economy size contributed rapidly to increase its size of solid waste, from 1,260 tons a day in 1970's to a peak of 8,559 tons a day in 2016 but Singapore's government has handled this situation in such a marvelous way that this is often called Singapore waste management or Energy model. The process of solid waste management in Singapore initiates from homes and businesses, after collection of solid waste,

[122]Wardah Sabir et al., "A Study of Solid Waste Management in Karachi City," *Journal of Education & Social Sciences* 4, no. 2 (2016): xx, doi:10.20547/jess0421604205.

[123] Steven Cohen, "Waste Management Practices in New York City, Hong Kong and Beijing," The Sustainable City, last modified 2017, Accessed November 9, 2020, http://www.columbia.edu/~sc32/documents/ALEP%20Waste%20Managent%20FINAL.pdf.

recyclables are sorted and retrieved for processing to prolong the lifespan of recyclable materials. The solid waste that is left is then collected and sent to the various waste to energy conversion plants for incineration. Incineration reduces the volume of solid waste by about 90% and produces steam that is not harmful for environment, but actually beneficial.[124] Pakistan is in urgent need of such models since the quantity of waste produced here is enough to generate electricity and at the same time, to pollute its cities, lakes and rivers, later on, the Arabian Sea. A report revealed that approximately 500 million gallons of untreated sewage water is being dumped into the Arabian Sea with an addition of 12 tons of garbage on a daily basis. This has drastically decreased the marine life population by 40% in Arabian Sea of Pakistan's territorial waters.[125] It has also decreased the quality of marine life in the sea, many people after having a look at this report said that they are not willing to eat fish from sea again which is logical since fish living in such polluted water can cause several diseases. A problem can become an opportunity or blessing if handled accordingly, it's just a matter of approach towards and Pakistan must need a vigilant approach and work must be done on emergency basis.

4.8 Electric Trains

The annual ridership of Pakistan railways is approximately reached 70 million passengers a year of 2018-2019.[126] Freight rail traffic is not included in this figure, which even makes the actual number of travels, trains do in a year much more. On the one side of picture, such huge rail traffic is really good which indicates the improvement in railways services and also good for economic activities, on the other side, there are some concerns which are economic and environmental. Railways traffic in Pakistan is powered by diesel-electric engines, however, only diesel is being used to run the engines and

[124] "Solid Waste Management Infrastructure," National Environmental Agency of Singapore, accessed November 28, 2020, https://www.nea.gov.sg/our-services/waste-management/3r-programmes-and-resources/waste-management-infrastructure/solid-waste-management-infrastructure.

[125] "PMSA DG Reveals Dumping Untreated Sewage Caused 40pc Drop in Marine Population," Pakistan Today | Dedicated to Telling the News Like It is, last modified October 18, 2017, Accessed November 15, 2020, https://www.pakistantoday.com.pk/2017/10/18/pmsa-dg-reveals-dumping-untreated-sewage-caused-40pc-drop-in-marine-population.

[126] Naeem Qureshi, "Pakistan Railways Achieves Record Income in 2018-19," International Railway Journal, last modified August 20, 2019, Accessed November 15, 2020, https://www.railjournal.com/financial/pakistan-railways-achieves-record-income-in-2018-19/.

electronic locomotives are rarely used or just for small routes. Such huge rail traffic means huge emission of carbon into the environment which acts as a catalyst for environmental degradation process in the country. This situation can be improved in a better way by the use of electric locomotives. An electric locomotive is a locomotive powered by electricity from overhead electric transmission lines.[127] The major advantage of Electric locomotives is that as comparison to Diesel locomotives, they usually cost 20% less, their maintenance is also less around 25-35% lower, and one of the core benefits is that they save the fuel cost of up to 50%.[128] Fuel prices have been created severe problems for railway sector in Pakistan, and by switching to electric system, it can overcome this issue. Electronic locomotives are a bit sophisticated, need proper infrastructure but in the long run, they are worth it because they are healthy for both economy and environment. British government has decided that it will complete switch to electric train by 2040.[129] Same steps or planning are underway in many states and many states already have electric trains operational on large scale. Pakistan railways introduced electric locomotives in 2009 by making Lahore-Khanewal track with a length of 286 operational however due to some domestic issues, the service was suspended in 2010.[130] In the current climate change scenario, it would be necessary for government to look for all the possible measures and if the technology is beneficial both ways, economic and environmental, it should be acquired as soon as possible. Railways are public welfare transport systems in whole world, running electric trains would definitely result in fare decrease which will also attract more people to travel via railways, which will also decrease pressure on road travel eventually resulting in more environment friendly approach.

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[127] *Encyclopedia Britannica* "Electric Locomotive," accessed December 25, 2020, https://www.britannica.com/technology/electric-locomotive.

[128] Richard Nunno, "Electrification of U.S. Railways: Pie in the Sky, or Realistic Goal?" Environmental and Energy Study Institute, last modified May 30, 2018, Accessed November 11, 2020, https://www.eesi.org/articles/view/electrification-of-u.s.-railways-pie-in-the-sky-or-realistic-goal.

[129] "What Are the Pros and Cons of Rail Electrification?" Shropshire Star, last modified October 17, 2018, Accessed November 11, 2020, https://www.shropshirestar.com/news/uk-news/2018/10/17/what-are-the-pros-and-cons-of-electrification-on-the-rail-network/.

[130] Shahram Haq, "Pakistan Railways: Electrical Locomotives Wrapped Up," The Express Tribune, last modified February 28, 2011 Accessed November 11, 2020, https://tribune.com.pk/story/124828/pakistan-railways-electrical-locomotives-wrapped-up.

4.9 Forestation

Forest contributes to environment in various effective ways, they produce large amount of oxygen and absorb CO2 which keeps the temperature moderate and cool, attract rains, they are also home to countless species of wild life, and many other advantages that makes them essential for humans and eco systems. Although Pakistan's total area is 881,913 km which makes it 33th in the world, but when it comes to area of forest, Pakistan is a poor country with only less than 6% of its total area is covered by forest,[131] which should be at least 12% according to UN standards and 25% for ideal environmental conditions.[132] The alarming fact is that too is diminishing at the rate of 2% annually due to rapid urbanization, illegal excessive harvesting of trees for human and industrial needs, resulting in wiping out thousands of hectares of forest land every year. Due to such circumstances and increasing environmental concerns, Pakistan Tehreek Insaaf (PTI), a political party in Pakistan when had provincial government in KPK during 2013-2018 term, started a project of afforestation known as The Billion Tree Tsunami in the province. Although not actual numbers of trees by the project name were planted during this activity,[133] more than 100 million trees and added an area of 350,000 hectares of trees both by planting and natural regeneration to the province which has been facing a rapid decline in forest regions due to many factors to compensate the loss and to fight global warming. After coming into power in 2018, Pakistani Prime Minister announced that it would expand his billion-tree project to all over the country to fight the effects of global warming which has made Pakistan 5th most effected country. The steps by government encouraged the general public and NGO's to contribute their share to fight global warming and climate change since environment belongs to all, and many plantation drives have taken place since then.[134] It is also important to control the events of forest fire which cause heavy loses every year, and due to massive losses occurred during the year 2018-2019, Secretary MCC Hassan Nasir told media that to control the

[131] "Forests," WWF Pakistan, accessed November 28, 2020, https://www.wwfpak.org/our_work_/forests/.

[132] Rosamond Hutt, "Pakistan Has Planted over a Billion Trees," World Economic Forum, last modified July 2, 2018, Accessed November 10, 2020, https://www.weforum.org/agenda/2018/07/pakistan-s-billion-tree-tsunami-is-astonishing/.

[133] Hutt, "Pakistan Has Planted over a Billion Trees,"

[134] "One Million Trees: Plant a Tree and Plant Hope in Pakistan," Caritas, last modified May 19, 2020, Accessed November 20, 2020, https://www.caritas.org/2020/05/one-million-trees/.

fire incidents, the forest department has framed standard operating procedures and decided to ban fireworks, campfires and any other activity that increases risks of forest fires.[135] Lack of modern equipment for fire extinguishing is also a major problem and forest guards usually have to look for external sources in case of fire emergency.

4.10 Promoting Hybrid Vehicles

Carbon emission into the atmosphere is one of the primary reasons for global warming, and what else can be more carbon producing than automobiles running on fuels such as gasoline, diesel or gas (CNG). Auto Mobiles are one of the largest contributors of carbons into the environment, and increasing human population is just making the scenario worst but this is also a proven reality that without automobiles, human life would become very difficult. It's true that not all cars are fuel efficient and environment friendly simultaneously and for that many different technologies have been introduced that are environment friendly and efficient at same time but Hybrid car technology, probably, surpasses them all.[136] A hybrid car is one that uses more than one means of power generation that means combining a petrol, diesel or electric battery system to power the engine. The main advantage of a hybrid cars or technology is that they are not entirely dependent on fuel, but at the same time, they have alternative energy sources to keep the car running, which means it is much more environment friendly than any other automobile technology. Some major advantages of Hybrid Cars are as follows:

4.10.1 Higher Mileage

Hybrid cars produce much more mileage or fuel efficiency than any other standard car technology present in market. For example, if a car of 1300 or 1500cc produces 13-15 in city, and 15-18 on highway, the fuel consumption of hybrid would be 15-20 in city and approximately 22-23+ on highways. Another major advantage of hybrid car is that under

[135]Yan , "Forest Fires Destroy 1.2 Mln Trees Last Year in NW Pakistan"

[136] Claire Evans, "What is a Hybrid Car and Should You Buy One?," What Car?, last modified February 1, 2018, Accessed December 1, 2020, https://www.whatcar.com/news/what-is-a-hybrid-car-and-should-you-buy-one/n1290.

speed limit of 50 or 60, they are entirely driven on battery synergy combination,[137] which means that if a car is parked on, or moving slowly in traffic jam, which is a very common problem in Pakistan and other developing states, even developed some states, fuel consumption is very low, or literally zero which help produce much economic fuel consumption.

4.10.2 Reduced fuel dependence

Hybrid cars are very less fuel dependent are very less fuel dependent, again because of the synergy drive technology, so if you want to are low on fuel, due to electronic management system, you won't always be needing to fill your tank.

4.10.3 Economic Price Tag

It’s true that hybrid cars are relatively expensive than 20% to 30% expensive than traditional gasoline powered cars, but in the long run, they are completely worth it.

4.10.4 Environmental Friendly

One of the most important factor or quality which is making people go for hybrid cars is that they have more efficient gas mileage than conventional gasoline-powered vehicles, and at the same time, they are relatively much more environmentally friendly, and they emit very less carbons to the environment.[138] The electric motor and the gasoline engine, when working together reduce fuel consumption, conserving it in traffic jams.

Currently, Hybrid vehicles are not being produced in Pakistan, they are imported which makes them pretty expensive as compare to locally assembled cars, so if the government is sincere in environment friendly policies. It must give incentives to automobile manufactures and encourage them the produce hybrid vehicles because eventually they are going to bring benefit to huge oil import bill, and environment.

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[137] "Toyota Hybrid: How Does It Work?" Toyota UK, last modified August 5, 2020, https://blog.toyota.co.uk/how-does-toyota-hybrid-work.

[138] Rinkesh , "Advantages and Disadvantages of Using Hybrid Cars," Conserve Energy Future, last modified June 26, 2020, https://www.conserve-energy-future.com/advantages-and-disadvantages-of-hybrid-cars.php.

4.11 Use of Bicycles

Cycling is a very healthy exercise, as a matter of fact it is a low impact exercise for people of all ages and also very effective for human body.[139] It decreases the chance of diseases such as stroke, heart attack, some cancers, depression, and diabetes. It keeps a person healthy and active. It is also a cheap method of transport since only cycle and physical energy is needed from moving one place to another with no tension of fuel which makes it too environment friendly than any other means of transportation specifically when it comes to reach short distance destinations. Encouraging people to use bicycles can be a very good and healthy imitative. 2 or 3 decades earlier, a large number of people in Pakistan used to ride bicycles to reach their destination, and young children's biggest wish was to have a cycle to so they can move from one place to another, specially going to school daily. However, trend decreased due to various socio-economic factors. The major reason why cycling should be encouraged that it is not only environment friendly, but also lessens the burden on economy of a state, even in developed states such as Belgium and Switzerland, 48 percent of the population uses cycles.[140] In Japan, the number reaches 57 percent, and highest number is for Finland, where it is 60 percent of whole population. The Netherlands holds the record as the nation for most bicycles per capita. Even world's largest country in term of population, China has a cycle ridership of 37.2 percent of its population, that is enormous figure of more than 500 million people, more importantly, all these states are much advanced and developed than Pakistan, therefore Pakistan, as a nation, should also adopt the habit of bicycling which will be better for environment, health and economy.

4.12 Fuel Efficient and Environmentally Friendly Automobile Technology

Auto sector is one of major contributors of emission of GHGs into environment. Auto mobile sector is not only one of the highest consumers of oil, not only in Pakistan, but throughout the world. Because of heavy fuel consumption, it results in heavy emission of

[139] "Cycling - Health Benefits," Better Health Channel, last modified 2013, Accessed November 12, 2020, https://www.betterhealth.vic.gov.au/health/healthyliving/cycling-health-benefits.

[140] "Why We Need to Encourage Cycling Everywhere," World Economic Forum, accessed November 28, 2020, https://www.weforum.org/agenda/2015/02/why-we-need-to-encourage-cycling-everywhere/.

CO2which is harmful gas for environment and increased presence of it leads to global warming.[141] Recently, many technologies have been developed which are environment friendly such as hybrid synergy, or Euro 2 in auto sector which are much environment friendly and also are fuel efficient at the same time. New upgrades of petrol and diesel have also been introduced such as euro-V for better fuel performance. Pakistan's government recently announced of upgrading its fuel variants in markets which is a very good step and by 2021.[142] All the fuel types available in market will be upgraded to Euro-V standards. Disadvantages of low-quality fuel or old fuel combustion technologies are that they not only caused environmental pollution but also cause countless issues in vehicles.[143] Diesel engines in the country have been most affected due to low quality fuel. Modern auto mobile engines are made in compliance with Euro3, Euro4 and Euro5 standard fuel and these engines do not work properly without substandard fuel. Substandard fuel also caused many technical difficulties for car owner as well as call manufactures that they had to send a letter to OGRA (Oil and Gas regulatory Authority) showing concerns over low quality fuel.[144] Therefore environment friendly auto mobile technologies, no matter by engine or fuel type must be introduced, made available in market because they are not only necessary for environment but for economy as well.

4.13 Strict Monitoring Regarding Environmental Standards of Vehicles

Oil is known as blood in industrial and mechanical operations and Transport is one basic mechanical sector which is one of the largest consumers of hydrocarbons in the world, and thus, it also makes it one of the largest contributors of greenhouse gases to

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[141] "Combustion of Fuels - Products and Effects of Combustion - GCSE Chemistry (Single Science) Revision - Other - BBC Bitesize," BBC Bitesize, accessed October 28, 2020, https://www.bbc.co.uk/bitesize/guides/zx6sdmn/revision/1.

[142] Fawad Yousafzai, "PSO Upgrades Pakistan's Fuel Standard," The Nation, last modified August 19, 2020, Accessed November 7, 2020, https://nation.com.pk/19-Aug-2020/pso-upgrades-pakistan-s-fuel-standard

[143]Sulman Ali, "Great News! Pakistan to Upgrade Petrol, Diesel Quality," PakWheels Blog, last modified June 24, 2020, Accessed November 12, 2020, https://www.pakwheels.com/blog/great-news-pakistan-to-upgrade-petrol-diesel-quality/.

[144] "Car Assemblers Facing Technical Problems Due to Substandard Fuel: PAMA," Profit by Pakistan Today, last modified November 16, 2017, Accessed November 20, 2020, https://profit.pakistantoday.com.pk/2017/11/16/car-assemblers-facing-technical-problems-due-to-substandard-fuel-pama/.

environment. Transport sector, which primarily involves road, rail, air and marine transportation, accounted for over 24% of global CO2 emissions in 2016.[145] It is expected that it will grow at a faster rate than any other sector, posing a major challenge to efforts in line with the Paris Agreement and other global goals for environmental sustainability. Emission of greenhouse gases from the transport sector are a major reason to climate change, about 14% of annual emissions (including non-CO2 gases) and around a quarter of CO2 emissions from burning fossil fuels. What is even more concerning is that in a time when global emissions immediately need to go down because much damage has already been done, transport emissions are on the rise, therefore improvement in automobile technology is a genuine need of time. Transport or automobile sector is a key contributor to the national GDP of Pakistan with a figure of 13.7% and 05% of employment rate.[146] However, in means of looking at it from environmental point of view, the progress isn't hopeful due to various factors, such as old engine technologies, low quality fuel, and road infrastructure to be precise. It is projected that during the time period of 2012-2030, greenhouse emissions are like to rise by 128%. They are expected to hit 80.7 MtCO2e in 2030 which was 35.4n in 2012. Road Passenger Vehicles and Road Freight Vehicles are the major contributor of gas emissions while and Aviation and railway sector literally has a very small part in it. What needs to be done in this regard is the implementation of strict vehicle manufacturing rules, that everyone vehicle, which will be produced in Pakistan, will be according to environmental standard or else it will not be allowed to sale in market. Government should also give incentives to companies who introduce Hybrid Technology locally which is probably the best in environmental concerns. Vehicle safety and maintenance standards should also be a top priority and all those vehicles which are causing harmful emissions to climate should be brought under standards, heavy transport vehicles to be specific that are still using very old technology and also cause road damage. If the government is serious in efforts to handle climate

[145] Shiying Wang and Mengpin Ge, "Everything You Need to Know About the Fastest-Growing Source of Global Emissions: Transport," World Resources Institute, last modified May 5, 2020, Accessed November 17, 2020,https://www.wri.org/blog/2019/10/everything-you-need-know-about-fastest-growing-source-global-emissions-transport.

[146] "Greenhouse Gas Mitigation Options for Pakistan: Transport Sector," n.d. http://www.ccrd.edu.pk/files/Transport_LCS%20Factsheet.pdf.

change and global warming, it must look at all these factors since all these contribute to cause a greater problem.

4.14 Plantation Campaigns and Gardening

Gardening is the practice of growing ornamental plants for increasing the beauty of home as well as cultivating vegetables and fruits plants for home use since ancient ages. Gardening is equally beneficial for environment as tree plantation, practice can be different, but effects are same. It is also a very healthy activity. Even small gardens can create huge difference if a large number of people start it. Having a large area for gardening is not necessarily at all, and even a small area can play it role if one wants to help Earth and play its role in a decent manner.[147]

4.15 Preservation of Wild Life species

Pakistan is home to countless wildlife species of animals, birds and fish and many of them are facing threats of extinction such as Snow leopard, Markhor and Indus dolphin being the prominent ones with many others. The conservation in Pakistan refers to practice of preserving, guarding, or protecting, biodiversity, environment, and natural resources of Pakistan.[148] National Conservation Strategy of 1993 was a major landmark of start of conservation of natural resources and wildlife in Pakistan. According to International Union for Conservation of Nature (IUCN), there are 157 protected areas in Pakistan which include various National Parks, Game reserves, protected wetlands etc. Many manmade forests like Changa Manga, Kamalia plantation and Chichawatni plantation have been planted to serve the purpose of conserving forests. Many forest areas in the country have been declared national parks which means no construction or hunting activity can be practiced there. However, urbanization has also hit hard there and the protected areas or parks have been affected by deforestation, illegal hunting of animals, forest fires and increasing urban development activity in surrounding areas national parks. An example is of 27 years old, LohiBher Wildlife Park in Rawalpindi,

[147] "Sustainable Gardening and Its Importance in Our Lives," HuffPost, last modified December 6, 2017, Accessed November 9, 2020, https://www.huffpost.com/entry/sustainable-gardening-and_b_9880140.
[148] Zara Khan, "Inside the World of Wildlife Conservation in Pakistan," Mashable Pakistan, last modified January 25, 2020, Accessed November 9, 2020, https://pk.mashable.com/science/401/inside-the-world-of-wildlife-conservation-in-pakistan.

once known for a leisure facility on the border of Rawalpindi and Islamabad now rarely is visited by visitors due to its despair condition.[149] The park was established on 687 acres of forest land in 1992, along the Islamabad Expressway. It had all the essentials required for a wildlife park but currently its look is devastated by the housing societies constructed around it and therefore original look of such parks should be restored.

[149] Aamir Yasin, "The Forgotten LohiBher Wildlife Park," DAWN.COM, last modified August 4, 2019, https://www.dawn.com/news/1497963/the-forgotten-lohi-bher-wildlife-park.

Steps Needed to Overcome Water Scarcity

I. Construction of Dams
II. Public Awareness Regarding Usage of Water
III. Deal with India And Afghanistan
IV. High Efficiency Watering Techniques
V. Sea Water Utilization
VI. Modernization of Irrigation System
VII. Water Pollution
VIII. Storage of Rainwater

4.16 Construction of Dams

Dams are most effective and fundamental way of storing excessive water for dry seasons or when rivers have relatively less flow of water, in such times, dams help maintain proper supply of water for home, agriculture and hydropower generation. Dams hold enormous space to store water for needy time or seasons of slow water flow in rivers which is a common problem in Pakistan. Sometimes rivers have so much excessive water that it can actually cause floods which is a normal practice in Pakistan, causing heavy financial and life loss every second year and sometimes, they are literally dried up. This situation results in several difficulties for state, according to reports, many states have water storage capacity of up to 130 days, whereas Pakistan only possesses capacity of hardly 36 days.[150] This means that if there is any unusual situation such as drought, there wouldn't be any water available to fulfil its needs only depending on rain which already falls much less than it used to be. Secondly, an alarming point is that Pakistan only produces around 40% of its electricity from Hydropower whereas it has potential of generating 100% from it, even much more than, exceeding the total demand projectile for future. It must be mentioned here that most of the remaining electricity needs are fulfilled by thermal production which is not only much expensive, but also emits significant number of carbons in the atmosphere. Reports show that energy sector is one of the

[150] Israr Khan, "Pakistan Has Capacity to Store Water for 36 Days," The News International: Latest News Breaking, Pakistan News, last modified September 7, 2018, Accessed November 20, 2020, https://www.thenews.com.pk/print/364943-pakistan-has-capacity-to-store-water-for-36-days.

highest contributors of greenhouse gases in the Pakistan. Thirdly, Pakistan does not have sufficient water storage capacity to store all the water available in a year, it can only store up to 25% of the total water supply, rest goes to sea which means it is wasted and true potential of that water cannot be capitalized completely as Pakistan already suffers from water shortage and very often, disputes keep rising between provinces. The excessive water can also be diverted to those areas which have agriculture land do not have sufficient water resources for cultivation, in this way, water can be capitalized in its optimized way which will help in increasing economic activity. This is why the construction of dams, no matter small or large, depending on geography, as much as feasible is a dire need of time as only that can maintain continuous water supply throughout the year for needs and storing it for difficult times. Too much time has already been wasted and it cannot be wasted anymore because this issue needs to be addressed as quickly as possible. The construction of dam not only helps in storing water, it also helps in increasing cheap electricity generation, maintaining ecological systems, increase economic activities, in this regard, fisheries and increased agriculture area or production are to be pointed.

4.17 Public Awareness Regarding Usage of Water

Public awareness regarding the judicious use of water and environmental protection is a vital need of time because protecting the environment is not only duty of government, its national duty for all and only government cannot do everything in this regard. Population plays a decisive role in such matters when their contribution to a cause has large impacts on the outcome. Therefor public awareness regarding the issue of climate change and water scarcity should be on maximum scale. Public awareness campaigns should be conducted on regular basis in educational institutions and children should be the target audience because they are enthusiastic and can play their role very effectively. Secondly, if children or young students are made awareness of the consequences and inform about their duties and what they can do in this regard, it will have long time effects. Children can adopt habits of gardening, planting trees, prevent wastage of water. Such measures look might look small but if done collectively, they can have significant effects on environmental health.

4.18 Use of Effective Diplomacy with India and Afghanistan

Water is an inevitable source of conflict, not only intra state, but inter states since many states share transnational water boundaries and fresh water resources are decreasing rapidly. Many reports and researches have predicted or estimated that water would be source of conflict and it might lead to a full-scale armed conflict. Pakistan also share transnational rivers with its neighbors, India, Afghanistan and relations with these states are tensed. Pakistan has a very comprehensive framework of water distribution in shape of Indus Water Treaty with India in which usage rights of Eastern Rivers (Ravi, Sutlej, and Beas) and Western Rivers (Indus, Jhelum, Chenab) are awarded to Pakistan.[151] IWT is often regarded as one of the most effective water sharing mechanism in the world, it has survived two wars (1965,1971) and a few border conflicts or standoffs (1998, Kargil, 2001 Border standoff) but due to increasing demand of water in both states, the treaty looks in jeopardy. It has been reported that India is using Pakistan's share of water by constructing dams (Baghliar) and Barrages (Wuler) on Pakistani rivers which would put Pakistan's agriculture production at huge risk since water is essential element, not only for live hood but also for economic activities and sustainable eco system and a state like Pakistan, which is agriculture and large part of society is directly or indirectly engaged with it, would certainly put economic stability in peril. Although, India often claims that it is constructing dams or barrages for its tremendous population and has no intention of using water as a political tool, but even this argument is a two-edge sword, Firstly, India has no legality of using Pakistan's share of water according to IWT, second, even if India uses water for its population without any political intentions, it would still affect Pakistan in destructive ways. Last but not least, Pakistan is a lower riparian state, and according to International Law on Water, no upper riparian state can have storage or divergent rights over river without the consent of lower riparian state and despite Pakistan claims, India hasn't stopped constructions. There are several conventions on this scenario which justifies Pakistan position or claims on this issue.[152] The issue of

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[151] , *The Indus Waters Treaty 1960 Treaty Signed by the Government of India, the Government of Pakistan, and the International Bank for Reconstruction and Development*, (United Nations, 1961), https://treaties.un.org/doc/Publication/UNTs/Volume%20419/volume-419-I-6032-English.pdf.

[152] Fahim Zaman, "International Law on Water Rights," DAWN, last modified October 31, 2016, Accessed November 5, 2020, https://www.dawn.com/news/1293406.

Kashmir is much more complex than it seems. Most of the rivers which flow to India and Pakistan have their origins in Kashmir or they pass through as in case of Indus who has its origin in Tibet, China. This is why both states, Pakistan and India, even after 70 years, do not show any flexibility over Kashmir. Therefor Pakistan should take all necessary steps to handle this situation vigilantly and stop India from using Pakistan's share of water and constructions for controlling transnational water bodies as it is now necessary for Pakistan to use all legal and diplomatic means to force India in this regard. Then it comes the case of Afghanistan which has a large flow area of river Kabul, one of major western tributary of Indus Flows into Pakistan, there has not been any constructions on River Kabul yet by Afghanistan, but they are proposing plans of constructing dam on river Kabul with help from India, this also strengthens the argument that India is planning to use water as a political tool. In both discussed cases, Pakistan is the lower riparian state and Pakistan has much stronger legal position in this situation. It is responsibility of Pakistan's government to do diplomacy and create a framework with Afghanistan so no further dispute rises to fuel more tensions and increase also to regional cooperation which is certainly required.

4.19 High Efficient Watering Techniques

According to several studies, it has been proved that agriculture sector uses more than 70% of fresh water resources annually making it the largest consumer of fresh water resources around the globe.[153] It means that efficiency in crop watering techniques can result in huge water saving which is a great need of time since fresh water sources are depleting rapidly. Pakistan's economy is highly dependent on agriculture. Land and climate of Pakistan a very suitable for agriculture activities and to grow good quality crops, however, improvement of yield and quality of crops to according to international standards remains a matter of concern which not only reduces the cost but also the production scale, in the contrast, ever increasing demand for food of quality for increasing population create more and more pressure on the agro-ecosystem. Agriculture sector employs approximately 43% of labor force in Pakistan and its contribution to

[153] "Freshwater Resources," National Geographic Society, last modified June 28, 2019, Accessed December 15, 2020, https://www.nationalgeographic.org/article/freshwater-resources/.

national GDP is approximately 19.5% and if the spinoff products are included, it is much more than that. Total cultivable area in Pakistan is 22.12 million hectares and out of that area, 19.23 million hectares are irrigated through several sources such as canals, canal tube wells, rainfall and wells. It makes Pakistan a large agrarian land state which is beneficial and dangerous simultaneously. Beneficial in way that if this land is capitalized effectively, it can result in enormous agriculture production which helps the state in all means, dangerous in such way that if not managed properly, it results in difficult outcomes, for examples, if accurate estimates for some crops such as wheat or cotton are collected, they may result in socio-economic crisis for the country. Secondly, such large area means it will require large road structure for transportation and most importantly water resources which are recently proving to be a major source of intra-province and inter-province disputes. The uncertainly and limited water availability at important growth stages of the crops creates fear in farmers which then tend to apply too much water to the crops which also causes negative effects on production. Therefor effective and judicious use of water is necessary which can only be made possible by adopting High Efficiency Irrigation Systems whose outputs are scientifically proven for optimum agriculture production and minimum water usage. Availability of water resources is reducing drastically therefor is an essential need of time to adopt HEIs for increased performance with judicious and effective use of water. Introduction of HEIs and facilitation to farmers would not only save precious inputs like water & fertilizer, but they can enhance productivity and quality requirement which are the essential need of the day. Thus, HEIs brings valuable contribution to address the issue of water scarcity.[154] There are various techniques used in high efficiency irrigations systems, some of them are mentioned below.

4.19.1 Bench Terraces

Bench terraces are measures used on inclined land with relatively deep soils to retain water and control erosion. Bench terraces are reinforced by retaining banks of soil

[154] Muhammad Adnan, "Adaptation of Modern Irrigation Method amid Water Shortage," Technology Times, last modified July 3, 2020, Accessed November 18, 2020, https://www.technologytimes.pk/2020/07/03/adaptation-of-different-irrigation-method-by-farmer-in-current-shortage-of-water/.

or stone on the forward edges. This practice is typical for rice-based cropping systems since rice is one of the most water need based crop. It has following benefits

- Control's soil and water runoff and erosion.
- The speed of water running down the slope is greatly reduced.
- Improves soil productivity over the long run.

4.19.2 Micro/Drip Irrigation

In this technique, low volume of water is applied at low pressure and with high frequency. Time ranges from 1 to 4 days. The system consists on network of pipes operated at low pressure. At pre-determined spacing exits are provided for the release water generally known as emitters. Since water is applied so close to the plants that it reaches only the area of the soil necessary to feed the roots Micro / Drip Irrigation, unlike other traditional methods, it prevents the moisturizing of whole soil profile resulting in saving in water leaching and evaporation. By adopting this method, about 40 to 60% of water can be saved which makes this technique completely worth it in terms of efficiency, money and water saving.

4.19.3 Sprinkler Irrigation

It is similar to natural rainfall. Water is scattered into the air and irrigate entire soil surface through spray heads so that it breaks up into small water drops spreading over the ground. Sprinkler's irrigation method provides efficient coverage for small to large areas and are suitable for wide range of crops and are adaptable to nearly all type of soils because they are available in a wide range of discharge capacity. They are designed to ensure maximum water saving, affordability which makes them advantageous in the both long and short runs at favorable cost economically.

Government can initiate awareness, education programs or courses for farmers with sizable land holding and tube wells to adoption modern irrigation method and technology because of its simplicity and availability. It can also finance them since one of the major issues in adopting such techniques is lack of financial sources. Switching from flood

irrigation system to sprinklers and drip irrigation systems helps the agricultural sector to save a tremendous amount of water every year. When combined with better soil management practices, it will definitely be cost effective in the long run and these systems can significantly reduce water usage which is vital need of time.

4.20 Sea Water Utilization /Desalination

Rising water demands and decreasing fresh water sources have started to become a severe problem presently, and the Climate Change has just acted in catalyst way to fuel up the issue. It is true that water bodies cover more than 70% of the world's whole area, however, most of this area consists of seas or oceans which consists of salty water, making more than 97% of the available water not suitable for drinking or bio use.[155] In the time, where fresh water resources and population are going in complete opposite direction, it has become necessary to look for alternatives to fulfil water needs. One of those alternatives is utilization of sea water after the process of Desalination.[156] In this process, Sea water is purified from salt and other minerals which make it suitable for human consumption or agriculture use. The by-product of the desalination process is brine. Desalination and recycled wastewater are two methods which do not depend on acquiring water from the rainfall which means it can be produced without depending on weather. The method of Desalination is very common in those states which lacks fresh water sources or which have costal lines and providing water to port cities or coastal areas is not cost effective. These states mostly include the Middle Eastern and North African states such as Saudi Arabia, UAE and Kuwait. This method is also effectively used on ships, submarines and small islands or island states. A report has stated a fact that there are currently more than 15,000 desalination plants operation worldwide who produces approximately 95 million m3/day of desalinated water for human use, out of which 48% is produced in the Middle Eastern and North Africa region.[157] Due to energy

[155] "Freshwater Resources,"

[156] Manish Thimmaraju, DivyaSreepada, and Gummadi S. Babu, "Desalination of Water," IntechOpen - Open Science Open Minds | IntechOpen, last modified September 19, 2018, Accessed December 5, 2020, https://www.intechopen.com/books/desalination-and-water-treatment/desalination-of-water.

[157] "The State of Desalination and Brine Production: A Global Outlook," ScienceDirect.com | Science, Health and Medical Journals, Full Text Articles and Books, accessed November 29, 2020, https://www.sciencedirect.com/science/article/abs/pii/S0048969718349167.

use, desalination is an expensive method of acquiring water however when the fresh water resources are decreasing rapidly, this method is still very cost effective in terms of utility. Pakistan is also facing water scarcity and its financial hub, Karachi is heavily affected by it due to enormous population and industrial needs. In this situation, the process of Desalination can help in solving the issue of water supply, particularly if the water supplied is for drinking purposes which will also ensure the judicious use of water. Another developing port city of Pakistan, Gwadar, Balochistan, which is planned to become a mega port city in the medium term (2030) and long-term (2050) scenarios also lacks access to fresh water for local population and to overcome the needs, a water desalination plant has been made operational which is also seen as a solution for Balochistan's old water shortage problem.[158] Currently, the plant is providing clean drinking water to 4000 household in Gwadar therefor it is needed to use all available methods to overcome the issue of water scarcity.

4.21 Modernization of Water Distribution Networks

Irrigation systems are a vital part of agriculture systems, often considered backbone in many areas. Pakistan has one of the largest irrigation systems in the world which is known as the Indus Basin Irrigation System (IBIS). IBIS comprises of six major rivers that are Indus, Jhelum, Chenab, Ravi, Sutlej and Kabul, and their catchments, however after Indus Water Treat (IWT), now the major rivers are Indus, Jhelum, Chenab and Kabul.[159] It has three major storage reservoirs, 19 barrages, 12 inter-river link canals, 40 major canal commands and over 120,000 watercourses. The Indus River has a total average annual flow of 146 Million Acre Feet (MAF), of which only 106 MAF of water is diverted to canals. This system was constructed during the British Colonial era to increase the agriculture output of the region since the soil had high standards which is required for high yield. After the partition, those areas particularly, Punjab in this regard, became part of Pakistan which had high agriculture production and proper irrigation system. Every system requires changes and modernization according to need of time and

[158] Zahra K. Durrani, "Gwadar Port Desalination Plants: Avoiding Past Trends," Centre for Strategic and Contemporary Research, last modified July 24, 2019, https://cscr.pk/explore/themes/energy-environment/gwadar-port-desalination-plants-avoiding-past-trends/.

[159] Ministry of Planning Development & Special Initiatives, *Chapter 20, Water. 11thFive Year Plan*, (Government of Pakistan, 2018), https://www.pc.gov.pk/uploads/plans/Ch20-Water1.pdf.

for updated performance. Undoubtedly the irrigation system in Pakistan is one of the finest, but as of now, it is mostly out dated which is not only causing water logging and salinity, over-exploitation of fresh groundwater, low efficiency in effective use, insufficient cost recovery for government. These problems are only part of the larger problem which results in inadequate distribution of water resources which causes interprovincial clashes, primarily between Punjab and Sindh, the agriculture power houses of the state. Pakistan's irrigation system requires overhauling in this regard and one major step needed is construction of canal borders or slopes, which at the moment of many canals are made up of raw material or not properly constructed, which not only causes wastage of water, increase in annual expenses of cleansing of canals which disturbs water supply schedule. Raw slops also are harmful for precious agriculture land. This issue must be solved as soon as possible because unnecessary discharge of water not only causes wastage, it eventually results in shortage of water which isn't affordable at any cost in present era.[160]

4.22 Eradication of Water Pollution

Increase in population, rapid urbanization, industrial and agriculture activities have resulted in numerous environmental problem and water pollution is one of prominent one. Water pollution is not only a matter of public health, it also results in decreasing supply of safe water standards for publics which means water available also becomes hazardous, or in other words, useless. Pakistan currently ranks at 80 on index of 122 states regarding water drinking standards and many water drinking standards parameters, set by WHO are frequently violated.[161] According to various reports, only 20% of the whole population has access to safe drinking water and the remaining 80% has to rely on unsafe sources of water for drinking due to the scarcity of healthy drinking

[160] A. R. Ghumman et al., "Modeling for Various Design Options of a Canal System," *Water Resources Management* 26, no. 8 (2012): xx, doi:10.1007/s11269-012-0022-4.

[161]Azizullah, Azizullah, Muhammad Nasir Khan Khattak, Peter Richter, and Donat-Peter Häder. "Water Pollution in Pakistan and Its Impact on Public Health — A Review." *Environment International* 37, no. 2 (2011): 479–97. doi:10.1016/j.envint.2010.10.007.

water sources.[162] Major cities, industrial units lacks solid or chemical waste management mechanism which means that waste is dumped into sewerage lines which is later on discharged into drinking water system supplies which not only reduces the useable water resources since it is being contaminated but also cause waterborne diseases that constitute about 80% of all diseases and are responsible for 33% of deaths.[163] Therefor it is necessary for maintaining and implementing of strict SOPs regarding disposal of wastes, no matter if its generated from general population, industries or agricultural waste should be managed properly and must not be dumped into water line even if they are sewage because it doesn't only harm humans, later on, it has adverse effects on marine life.

4.23 Rain Water Harvesting

The sharp reduction of fresh water resources is increasing worldwide and the demand supply gap is increasing day by day and due to climate change or global warming, the trend is expected to rise in upcoming year. Increasing population and industrial activities have put enormous pressure on fresh water resources of all kind, no matter if they are rivers, lakes, ponds, aquifers, they have posed a serious stress on water resources and they are depleting in a rapid manner which is alarming and urban areas are most affected one in present situation since they do not have independent water resources and ground water level is falling sharply. There are various theories and predictions that water will be primary source of upcoming conflicts.[164] This situation has forced the experts and environmentalist to think out of the box to resolve the issue of water scarcity and some have come with a very meaningful conclusion that is to utilize rain water. Rain water is one of the purest forms of fresh water. This method is often called the Rainwater

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[162] Nabi, G., Ali, M., Khan, S. *et al.* The crisis of water shortage and pollution in Pakistan: risk to public health, biodiversity, and ecosystem. *Environ Sci Pollut Res***26,** 10443–10445 (2019). https://doi.org/10.1007/s11356-019-04483-w

[163] M. K. Daud, Muhammad Nafees, Shafaqat Ali, Muhammad Rizwan, Raees Ahmad Bajwa, Muhammad Bilal Shakoor, Muhammad Umair Arshad, Shahzad Ali Shahid Chatha, Farah Deeba, Waheed Murad, Ijaz Malook, Shui Jin Zhu, "Drinking Water Quality Status and Contamination in Pakistan", *BioMed Research International*, vol. 2017, Article ID 7908183, 18 pages, 2017. https://doi.org/10.1155/2017/7908183

[164] JOHN F. KERRY et al., *AVOIDING WATER WARS: WATER SCARCITY AND CENTRAL ASIA'S GROWING IMPORTANCE FOR STABILITY IN AFGHANISTAN AND PAKISTAN*, (Washington, D.C: U.S. Government Printing Office, 2011), https://www.foreign.senate.gov/publications/download/s-prt-112-10-avoiding-water-wars-water-scarcity-and-centrals-asias-growing-importance-for-stability-in-afghanistan-and-pakistan.

harvesting method (RWH) in which Rainwater is collected from a roof-like surface and redirected to a tank, cistern, deep pit (well, shaft, or borehole), aquifer, or a reservoir with percolation, not simply allowing it to run off. RWH has been practice since ancient times and it is an effective method to conserve water and to solve the problem of water scarcity since the stored water can be used for many days depending on the need. RWH projects have not been initiated on large scale by the government lately, the first project was started in the capital city, Islamabad at Faisal Mosque.[165] Pakistan Tehreek-e-Insaaf (PTI), a political party, has done many efforts for environmental preservation, in this regard. During its first tenure in the provincial government of Khyber Pakhtunkhwa (KP), they initiated the Billion tree tsunami project which was acknowledge internationally.[166] Usually when it rains out of routine, it literally causes flood every time in urban areas of the country, and yet, country is also suffering from water scarcity, recently, provincial government of Punjab has started an underground rainwater storage system which will have capacity to store up to 1.4 million gallons of water.[167] Lahore Development Authority (LDA) started this project in area of Lawrence Road which often suffers from flooding during heavy rainfall. Such projects would help significantly in overcoming the water scarcity in the city therefor it is suggested that such projects should be made operational in all major urban cities since it's not only cost effective way to store water but also helps prevent crisis situation in cities during rainfall or monsoon seasons as Karachi did in August 2020.[168]

[165] Brett Walton, "Pakistan Installs Country's First Urban Rainwater Harvesting System," Circle of Blue, last modified January 19, 2016, Accessed November 15, 2020, https://www.circleofblue.org/2010/south-asia/pakistan-installs-countrys-first-urban-rainwater-harvesting-system/.

[166] Hutt, "Pakistan Has Planted over a Billion Trees,".

[167] Sana Jamal, "Lahore Sets Up First Underground Rainwater Storage System," Gulf News, last modified July 20, 2020, Accessed November 5, 2020, https://gulfnews.com/world/asia/pakistan/lahore-sets-up-first-underground-rainwater-storage-system-1.72655677.

[168]Arif Hassan, "Urban Flooding: The Case of Karachi," International Institute for Environment and Development, last modified October 27, 2020, Accessed November 27, 2020, https://www.iied.org/urban-flooding-case-karachi.

CONCLUSION AND RECOMMENDATIONS

Conclusion

The historical security discourse of Pakistan has remained on territorial security for a very brief time or in an excessive manner which has adversely effected human security paradigm. Nontraditional means of security haven't been focused lately, much due to the financial constraints where the external security or border security threats remain a key element in national policy-making, and hence a large part of the resources is spent on traditional security threats or military muscle.

The argument presented in research is certainly not questioning the presence of traditional security threats as focusing on them has many valid reasons by considering the geopolitics of the region, rather the work focuses that why nontraditional security threats haven't been given adequate presentation in the national security discourse and particularly the environmental challenges, which have already gained a robust magnitude, hammering the socio-economic structure of Pakistan severely and have already cost too much damage in property and lives.

The problem of climate change gradually gained unprecedented momentum in a negative manner since the 1950's, due to factors such as population explosion, deforestation and industrial activity boost. The excessive emission of chlorofluoro carbons boosted the process of global warming and climate change which hammered the weather patterns in adverse manner. Since environment is a transnational element, the supranational effects even have implications for those states who haven't even contributing to climate change. The worsening climate situation concerned international actors and environmental challenges were considered a real threat for the planet. Another alarming factor for Pakistan in this regard is that it has 2 large population industrial states as neighbors which means that Pakistan also have to even effects of climate change produced by them and this is also going to create problems. What makes the situation worst for Pakistan is that it is not only victim of traditional security challenges, but presently it is also facing nontraditional security challenges which are making the situation difficult for state. Pakistan is a large state with the 5th largest population in the world but the investment in

human capital has remained relatively low which has affected its standard of livings for the majority of population and is highly reflected in its HDI.

Findings

1. The present security discourse of Pakistan heavily relies or is constructed on traditional means of security which are primarily military.
2. The pattern of security discourse was adopted since the early days of the infant state due to its rivalry with India and later on by the geo-politics of the region which has remained active for most of the historical discourse due to great power's strategic rivalry.
3. Pakistan current security discourse primarily focuses on state's or territorial security which has marginalized human security whereas, in the present era, an equilibrium is maintained between human and state security and some states primarily focuses on human security since it covers multiple factors such as food, health, education, energy, environmental and economic security, etc.
4. Pakistan's national security discourse is dependent upon various domestic and international factors and its geopolitical position makes it an important state in the international political arena majority of situations, which means that it cannot simply detach itself from international politics and when it comes to geopolitics, having significant military muscle is always a consideration.
5. Alteration of national security discourse requires an open public debate on various forms whereas presently the national security policy has remained a subject to very few offices.
6. Pakistan requires strong economy and good relations with international community to combat internal and external challenges.
7. Having a large population is an asset and a liability at the same time for any state. If the population is skilled, well trained, it can become an effective driving force for economic muscle else it becomes a large burden on the economy and environment, and society, therefore, empowering the population with special consideration to its youth should be done on a priority basis which currently consists a large portion of the population else this is just going to act as population bomb.

8. Water scarcity issue is going to raise political agitation which already exists whose resources are constantly depleting in Pakistan, and with a large population, continuously rising, the situation is not look encouraging at all and would result in domestic conflicts.
9. Marginalizing the human security has resulted in a large vacuum and created adverse implications for the socio-economic development of state which is clearly reflected in the human development index and Pakistan currently ranks much behind in this area and even those states who were once behind Pakistan in development have leaped way ahead of Pakistan.
10. A precise interpretation of present situation suggests that the current security discourse of Pakistan cannot be continued and should be deconstructed or revised in a comprehensive manner where an equilibrium should be created between traditional and nontraditional security challenges.
11. Emergence of nontraditional security challenges such as population explosion, water scarcity, economic, food, energy, health security, unemployment, brain drain, cyber security, climate change, global warming, environmental degradation, water scarcity, rapid and unplanned urbanization has placed Pakistan progress and security on stake.
12. Presently, Environmental challenges are a one of top nontraditional security threat to national security of Pakistan which have already done significant damage in recent years, primarily last 2 decades, continuously striking in different ways causing damage.
13. Furthermore, in the current era where nontraditional security issues are constantly rising, environmental challenges stand above all for Pakistan as environmental conditions have undeniable relation with agriculture and the pattern of Pakistan's economy which heavily relies on agriculture production, environmental issues can have serious adverse implications on Pakistan's socio-economic structure.
14. Finally, the research work finds that it's the right time to incorporate nontraditional security threats into national security discourse of Pakistan and environmental emergency is needed to curb the effects of environmental degradation which are adversely affecting the state and causing extra burden on national treasury.

Recommendations

1. As the present situation of the country demands where economic progress is at a halt position and no substantial advancement is present, it is a dire need of time to deconstruct the national security discourse adjust it according to the modern requirement of the state craft.
2. The present economic conditions needs improvements and cannot be carried out any further. In the current era, the present politics revolves around economic relations more than ever therefore Pakistan needs both long and short-term policies for enhancing economic capabilities to improve the human security sector as well as incorporating nontraditional security threats into main stream security mechanisms as the present definition of national security has considerably broaden its dimensions.
3. Environmental security which is one of the core elements of human security, should be given adequate attention as the situation requires attention on emergency basis. It must be mentioned here that environmental impacts have proportional impacts on Pakistan's socio-economic structure as it is heavily dependent on its agriculture sector which is also one of the largest contributors to GDP, and a large portion of the workforce directly and indirectly is integrated with the agriculture business, which means that any harmful environmental change would have adverse effect on its output for Pakistan.
4. Nontraditional security threats such as population explosion, environmental degradation, water scarcity, economic, food, energy, health security, unemployment, brain drain, cyber security, climate change, global warming, water scarcity, rapid and unplanned urbanization are some of the major challenges in to security of Pakistan, therefore a national policy should be made and adopted as soon as possible to address these issues.
5. Present government is making acknowledgeable progress on the environmental challenges however it also needs to address the other NTS issues adequately as it still falls far behind the other states and situation isn't even encouraging if compared to other regional countries. Therefore, the government needs to take serious and pragmatic steps on emerging footings in order to ensure a prosperous and peaceful future for the nation to come.

6. The government of Pakistan needs a comprehensive, precise framework to combat environmental challenges and to revert the existing implications which have various elements and driving forces that are deeply rooted in socio-economic structure of the country.
7. The government needs structural reforms and needs to focus various areas with a major focus on energy-producing mechanism which is dominantly thermal and results in heavy emission of carbons into the atmosphere causing environmental degradation.
8. The auto mobile sector in the country needs to bring technological innovations which it is already using in developed states and there is immediate need of assembling hybrid vehicles locally which are much environment friendly than conventional vehicles.
9. An important area which needs immediate regulation is the real estate sector. It's true that this sector contributes to national economy but its relentless speed by utilizing precious agriculture land and cutting off vast forest areas and suburbs of cities is heavily damaging the eco system of cities. The growth of real estate sector must be sustainable rather than at the cost of eco systems.
10. Deforestation should be banned completely or replica policies must be immediately with zero tolerance that is the least government can do easily and government already has a significant progress on tree plantation drives which is beneficial and must be acknowledged.
11. Pakistan is facing severe water scarcity, therefore government needs initiate a comprehensive national water dialogue and policy regarding construction of dams, dealing with India and Afghanistan on water sharing mechanisms. It also needs to promote public awareness regarding usage of water.
12. Large portion of fresh water sources is utilized by agriculture sector, therefore Innovative irrigation techniques should also be introduced since agriculture accounts for approximately 65% of fresh water resources therefore the use of fresh water must be marginalized and wasting of fresh water must be stopped by taking appropriate measures. High efficiency watering techniques not only save water but increase agriculture output.

13. Some modern techniques to utilize or acquiring water which are being practiced on large scale abroad should be introduced in the country such as sea water utilization and rain water harvesting can also help government to overcome water scarcity.
14. Finally, an all-inclusive integrated policy response is required to incorporate the nontraditional security challenges into national security discourse and address the environmental perils and their effects on the national security of Pakistan which is the main aim of this research. A deconstruction or reconstruction of national security discourse needs to be done in a precise manner and human security should be included in it to combat the nontraditional security threats as well as to boost the socio-economic progress of the country.

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