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PIDE's GUIDE TO POLICY & RESEARCH

Pollution and Climate Change

Pakistan Institute of Development Economics (PIDE)

Islamabad

PIDE P&R

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VOLUME III – ISSUE II



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PIDE Policy & Research is a guide to policy making and research. Each issue focuses on a particular theme, but also provides a general insight into the Pakistani economy, identifies key areas of concern for policy makers, and suggests policy action. The publication offers a quick orbit of the country's economy and is a hands on and precise go to document for the policy maker, businessperson, academic, researcher, or student who seeks to remain updated and informed. This issue is themed around pollution and climate change of Pakistan. We welcome contributions from within PIDE as well as from any external contributors.

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The views expressed by the contributors do not reflect the official perspectives of PIDE.

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Welcome to PIDE

The Pakistan Institute of Development Economics was established at Karachi in 1957 and in 1964 accorded the status of an autonomous research organization by the Government of Pakistan. It is devoted to theoretical and empirical research in Development Economics in general and on Pakistan-related economic issues in particular. In addition to providing a firm academic basis to economic policy-making, its research also provides a window through which the outside world can view the nature and direction of economic research in Pakistan. Other social sciences, such as demography and anthropology and interdisciplinary studies increasingly define the widening scope of research that must be undertaken for proper economic policy and development to have sound underpinnings. Over the past 61 years PIDE has earned an international reputation and recognition for its research. Our faculty is rich and our advisory committee consists of world renowned economists such as Nobel Laureate Robert A. Mundell.

PIDE is located at the Quaid-i-Azam University Campus in Islamabad, the capital of Pakistan. The campus rests against the backdrop of the Margalla hills on the Potohar Plateau, within a short distance of the remains of Taxila, which once housed the world's oldest university. Archaeological remains discovered in this area show that it has been a center of civilization for some 5,000 years. The Institute, neighbor to several other academic outfits situated in this historic and scenic part of the green foothills of the great South Asian mountain ranges, is the hub of economic and social science research in this part of the world.

In November 2006, PIDE was granted the degree awarding status and hence our top priority now is to provide quality education which is affordable but of world class standard in this region along with a truly stimulating learning environment.

The advice of PIDE's International Advisory Board is also sought on various aspects of the Institute's academic activities. This Board comprises outstanding scholars (including Nobel Laureates) in the fields of Economics, Demography and Anthropology.





AT DE CS

Post COVID-19 Lockdown & Air Quality Analysis in Most Polluted Cities of the Globe

Yahya Khan and Abedullah¹

The Post - Industrial revolution has promulgated the environment as a key subject of international agreement and policies. In this epoch of globalization world has agreed on the new development path that environment is a key enabler for green and more - Inclusive growth. Every year the countries across the globe come on the common platform of conference of Parties to promote the strategic vision of green, clean and resilient World for All.

Due to excessive use of natural resources instead of preservation, and by releasing the pollutants instead of absorption we have long been setting ourselves ready for disaster to come. The horrible destruction of nature equilibrium in the name of development has drawn nature's ire and virus appeared as a sort of retribution. Severe acute respiratory syndrome Corona Virus is not new in this world but evolved and repeated in its severe form of COVID-19 since its emergence in 2003. The Corona virus has enforced the entire nations into lockdown mode, terrified citizens and enforced even the diehard laissez faire economy of United States to take quick measures that can be described as communism. The Virus is putting the global economy into tailspin and is the deathblow for capitalist economy. Many countries were seen heading towards unprecedented recession. The agility, scalability and automation were described as the new words of this era.

Environment Scenario of Post COVID-19

The COVID-19 lockdown that have irked billions and economic activities were grind to a halt appeared as a sort of blessing for the environment as people spend less time in vehicles, offices, factories and more bounded to home. The citizens of India have observed the scenic beauty of Himalayas for the first time which was hide by air pollution for 30 years. The governments have imposed stringent lockdown to contain the spread of corona virus through restricted mobility and modern life is in pause as millions of people are cooped up inside the doors. As economic activities is grind to a halt, so environmental quality Index is expected to follow the downward trend in major polluted cities across the globe. In this study we have identified forty cities that were declared the worst polluted cities by World Health Organization. Since after lockdown was imposed, all these cities have recorded unprecedented fall in air pollution. This study is intended to compare the air quality index before and after lockdown based on microscopic particulate matter known as PM 2.5. This pollutant is smaller than 2.5 micrometers in size, but highly dangerous as it can lodge deep into the lungs and pass into other organs and the bloodstream, causing serious health risks. To meet this objective, five worst polluted cities out of forty that shows downward trend in air pollution such as

Anyang, Hotan, Tashkent, Beijing and Karachi is shown graphically.

A graph ahead shows fall in air pollution as the single greatest positive effect of Lock down on environment using PM2.5 ($\mu\text{g}/\text{m}^3$) concentration data over 40 days before and after lockdown. The government of republic of China enforced the nation into strict lockdown on 23rd January and Anyang, Beijing and Hotan cities have experienced decline in PM2.5 ($\mu\text{g}/\text{m}^3$) concentration by 26%, 14% and 23% in the early 20 days of lockdown. The possible reason of significant reduction may be that there was no need of educating people about the importance of social distance and limited mobility because the 2003 SARS Pandemic remained in living memory for most people. Secondly government has tightened restrictions on villages and residential compounds, and were not allowing people to enter or leave their home without relevant authorization. At the same time Chinese government have introduced new rules by allowing the vehicles on alternate day depending on their number plates which has contributed toward reduction in air pollution level.

The Karachi city have shown dramatic decline of 24% in PM2.5 ($\mu\text{g}/\text{m}^3$) concentration, once the government imposed stringent lockdown on 13th march, 2020. Due to significant decline in air pollution, the Karachi city has been placed among the moderate polluters as its Particulate matter concentration fall in the range of 12.1- 35.4 $\mu\text{g}/\text{m}^3$. The National forum for environment and health (NFEH) reported that with public transportation completely halted and limited industrial activity, Karachi's air pollution problem had been eased for the time being.

The Uzbekistan Capital Tashkent saw a decline by 21% in PM2.5 ($\mu\text{g}/\text{m}^3$) concentration in the early two weeks of lockdown started on 24th march 2020. At the beginning of Lockdown government has isolated one lac

¹Yahya Khan and Abedullah are respectively, ex-graduate student and Chief of Research at PIDE

people at home and started issuing certificates for Personal vehicles to reduce unnecessary mobility which has not only reduced the number of infected Persons but also improved the air quality.

Major Outcomes and Suggestions

1. As the COVID-19 lock down is a sort of blessing for the environment, but it will have disrupted the environmental diplomacy with

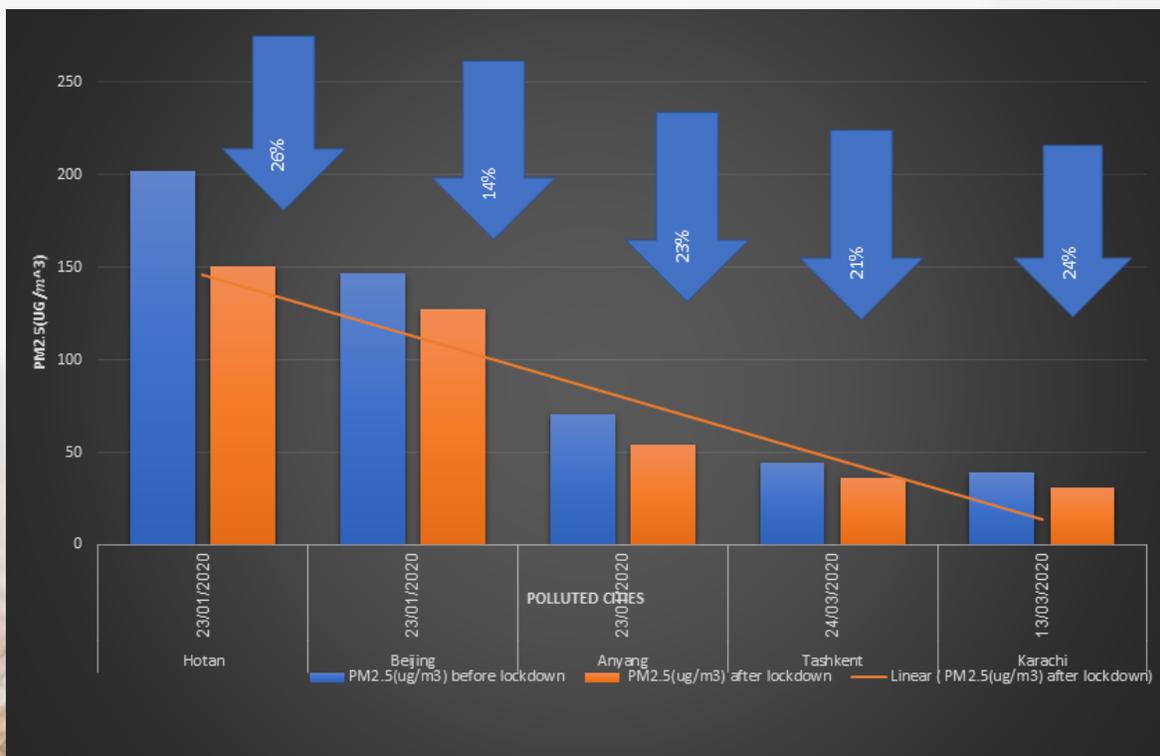
future effects in the form of reduced Investment in green technologies.

2. Due to outbreak of Corona Virus most of the developing Countries will enter into recession which will shift the attention of Policy makers from environment sustainability project towards economic sustainability Projects.

3. As this benefits to environment is blessing for a short period of time and once lockdown is withdrawn and economic activities re-emerge, the issue of global warming will

again put the challenges to the world. This requires proper re-assessment of our needs for industrial and transportation activities in a socially sustainable manner.

4. The present situation thought us the lesson about the importance of environmental laws, rules and regulation for promoting environmental Sustainability.



Smog

The fifth season in Pakistan

Farah Naz and Abedullah¹

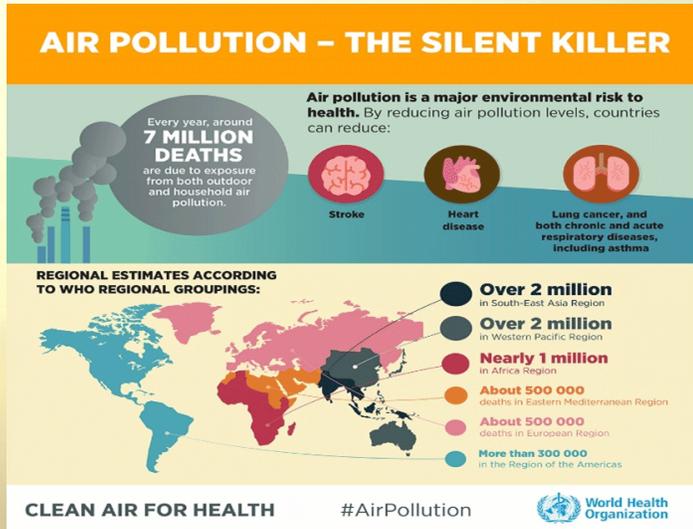


Figure 1. Environmental pollution a sources of health risk²

Smog (smoke+fog) is becoming a fifth season in Pakistan especially in Lahore and its surroundings. Its intensity increases since last few winters. Smog greatly reduces the visibility, slow down the daily activity, increased the probability of accidents and may lead to flight cancellations. The readings of Air quality index (AQI) helps in understanding the severity of smog Table 1.

AQI	Air pollution level
0-50	Good
51-100	Moderate
101-150	Unhealthy for sensitive groups
151-200	Unhealthy
201-300	Very unhealthy
300+	Hazardous

Table 1. AQI limits and pollution measurements

Air pollution kills approximately 7 million people worldwide every year, of which 4.2 million deaths are due to exposure to ambient air pollution and rest are due to household exposure to smoke from dirty cook stoves and fuels (Figure 1). WHO data shows that 9 out of 10 people breathe air that exceeds WHO guideline limits containing high levels of pollutants, with low- and middle-income countries suffering from the highest exposures.

Smog is composed mainly of tropospheric ozone (O₃); primary particulate matter (PM) such as pollen and dust; and secondary particulate matter (PM) such as Sulphur oxides, volatile organic compounds, nitrogen oxides (NO_x) and ammonia gas. The prominent causes of smog include regular pollution with fossil fuel burning with lack of pollution control technology in our vehicles, power production, and in industrial sector. Among other sources of pollution includes, burning of municipal and industrial waste, bricks kilns which again use dirty fuel such as rubber tyres, **burning of crop** residue and dust from construction sites such building new roads and buildings. Generally, people know the key causes of smog but the big question mark is who will control it and how to control it? And what are the steps being taken by relevant authority (if any) in order to manage and lesson it.

In Pakistan the Ministry of climate change (MOCC) is

¹Farah Naz and Abedullah are respectively Ph.D. Scholar and Chief of Research at PIDE

²<https://www.euro.who.int/en/health-topics/environment-and-health/air-quality/news/news/2018/5/over-half-a-million-premature-deaths-annually-in-the-european-region-attributable-to-household-and-ambient-air-pollution/infographic-air-pollution-the-silent-killer>

concerned with climate changes at federal level while in Punjab there is “Environment Protection Department” responsible for these changes. MOCC established “Smog Control Room” in Lahore in order to monitor the health hazards associated with smog in various regions of Punjab. The room is also supposed to maintain check on AQI in Punjab especially Lahore.

At the end of 2019 there were certain announcements by prime minister of Pakistan for the possible control of smog, “Govt. announced that till the end of year 2020 Euro5 fuel would be imported while the recent fuel would be converted into Euro4. 90% pollutants could be reduced by such steps. Oil refineries to be given three years to improve and adopt modern technologies. Furthermore, negotiations are underway with electric vehicles manufacturers. The govt. would import machinery worth Rs. 30 billion to help control the stubble burning issue, moreover the govt. will convince owners of kilns to adopt modern zigzag technology. 60,000 kanal area of land had been identified for urban forestry in Lahore. To have an effective strategy, there should be monitoring centers to keep a check on the air quality, he said, Lahore had two such centers and now their number would be increased to 30 which would help give accurate data” - PM Imran Khan, November 2019

But there is yet lot to do in actual terms, in Lahore the range of AQI for the second week of November 2021 ranges from 221-337 which in intensity is from “very unhealthy to hazardous” requiring a health emergency management because it may affect people at large scale (AQI, 2021). In December 2021, according to the AQI, Lahore has been ranked first in the list of polluted cities with reading as highest as 453 which is termed as extremely toxic, also the PM2.5 crosses 300 µg/m³ which is ranked as hazardous (AQI, 2021). The poor air quality has serious health effects, aggravating the lung and heart diseases and causing respiratory effects in general population. Table 2 is projecting unhealthy air in Lahore for the month of January 2022 with three sets of readings each after 10 days.

Table 2: Reading of AQI and PM_{2.5} Lahore | Source: AQI (2022)

Date of reading	AQI	PM _{2.5}
2 nd January 2022	279 (very unhealthy)	229.2 µg/m ³ (very unhealthy)
12 th January 2022	276 (very unhealthy)	226.1 µg/m ³ (very unhealthy)
22 th January 2022	160 (unhealthy)	72.4 µg/m ³ (unhealthy)

There is a need to fight this environmental issue for the safer future. The relevant bodies need to actively handle the smog weather before its arrival and also there is a need to create awareness in the general public because usually people misunderstand smog as “fog. Solutions provided by WHO which are adopted by various countries in order to combat air pollution includes:

1. Investment in energy-efficient power generation
2. Improving domestic, industry and municipal waste management
3. Reducing agricultural waste incineration, forest fires and certain agro-forestry activities
4. Making greener and more compact cities with energy-efficient buildings
5. Providing universal access to clean, affordable fuels and technologies for cooking, heating and lighting
6. Building safe and affordable public transport systems and cycle-friendly network

Additionally, there are also certain artificial yet technical measures to contest smog which are:

1. Gas to liquid technology in fuel which is more environment friendly
2. Usage of hydrogen fuels additive which can reduce the emission of pollutants
3. Usage of photo-catalytic materials which can remove the pollutants from air in the presence of sunlight
4. Air purification like smog free towers which can suck the pollutants from air and emit the clean air in the atmosphere (first such tower was installed in the Rotterdam, and the inventor claimed that the single tower can clean the 3.5 million cubic meters of the air per day) [Usman et al. 2019]

Usman M. Aamir HM. Naz Iqbal HF. Arshad HA (2019) New Techniques for the Prevention Control of Smog and Air Pollution in Pakistan”. *Environment Pollution and Climate Change*, 2(4), 166
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A Smart Shift from Private Cars to Public Transport Can Help to Reduce Smog/Air Pollution in Pakistan

Abedullah

The term “smog” was used first time in 1950 and described it as combination of smoke and fog in London. Now it refers to a mixture of smoke (pollutants made up mostly of ground level ozone) and mist. Exhaust cloud is the dirty air contaminated with chemical emitting from different anthropogenic activities and it is characterized as the blend of the gasses with residue and water vapors. Air pollution has emerged as a serious environmental threat in the South Asia. According to WHO (2016), world’s top most 20 polluted cities are located in Asia, among them three are located in Pakistan. Since 2016, dense smog blankets the city of Lahore, the capital of Punjab during months of October to December is becoming a serious problem.

Natural phenomenon and anthropogenic activities are two major sources of air pollution. Natural phenomenon is beyond our control but pollution from anthropogenic activities can be managed/minimized by adopting clean production practices. Air quality in Pakistan is deteriorating at a faster rate due to unprecedented increase in motor vehicles, residue of agriculture and solid waste burning, and use of fossil fuels for power generation (Murtaza et al., 2018). A large body of literature has explored the relation of CO2 emission with energy production (Butt et al. 2021; Boqiang and Yousaf, 2019; Anwar et al. 2017) but the relation of air pollution with transport sector has rarely explored. Hence, the objective of this article is to analyze the increasing demand of transport and to identify the possible interventions to minimize its pollution.

Contingent upon the modern pollution, winter exhaust cloud is primarily made from particulate matter (PM), Sulphur dioxide, nitrogen oxides (NOx), and volatile organic compounds (VOCs) (USEPA, 2021). The PM2.5 is referred to particulate matter that is 2.5 micrometers which is less than one-tenth the diameter of a human hair. Particulate matter ranging in size between PM10 and PM2.5 is invisible killer in the air as they can easily pass through nose and can penetrate into lungs tissues (Li et al. 2017). The



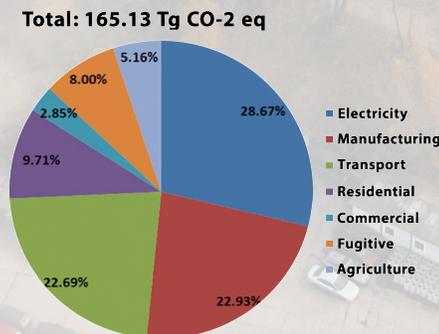
incomplete combustion of fossil fuels is the major source of these pollutants (Usman et al; 2019). Although, burning of wood or coal is also a source of black carbon but it is more prominent from the fumes released by vehicles.

The intensity of smallest particulate matter (PM2.5) in Pakistan reached to 65.81 ug/m³ in 2019 and put the country into the 'unhealthy' ratings category because reading between 55.5 to 150.4 ug/m³ of PM2.5 is referred to as unhealthy environment (AQI, 2021). Poor air quality increases respiratory ailments like asthma and bronchitis, heightens the risk of life-threatening conditions like cancer, and burdens our health care system with substantial medical costs.

CO2 Emissions by Sector

The combustion of fossil fuels releases a wide array of harmful pollutants and oxidizes the carbon in the fuel which emits in terms of CO2 (IPCC 1997). Anwar et al. (2017), concluded that production of electricity is emitting highest percentage (28.67%) of CO2, followed by industrial sector (22.93%) and transport sector (22.69%), implying that transport is the third largest contributor in the environment pollution (Figure 1). It is important to note that emissions from coal, oil, and natural gas activities are also considered in all sectors. A total amount of 149.73 Tg were emitted as CO2, 14.78 Tg CO2eq as CH4, and 0.62 Tg CO2eq as N2O (Anwar et al. 2017).

Figure 1. Distribution of emission by sector



Source: Anwar et al. (2017)

Poor Public Transport Infrastructure and Demand for Cars

Rapid economic and population growth and social revolution soaring the demand for means of traveling. Developing economies like Pakistan fails to invest on public transport infrastructure to expand transport facilities to meet the increasing demand and public has no choice except to buy own cars for mobility, even though it is an expensive option. Thus, with the increase in population pressure, the demand for alternative mode of transport (Motor car, taxis, Devan, pickup, jeep, and station wagons) start to upsurge. The first metro-bus system was launched in 2013 in Lahore, followed by Rawalpindi-Islamabad in 2015. First orange line metro train in Pakistan was officially inaugurated on 20th October 2020 and it is expected to carry 250,000 passengers every day. But it is not sufficient to meet the increasing demand of mobility in mega cities of Pakistan and therefore, number of cars are continuously increasing. We have divided all type of vehicles used in Pakistan into three categories, i.e mcy/scooter (bike), light commercial vehicles (LCV) , and heavy commercial vehicles (HCV) . The number of vehicles of different types has increased in the range of 928% (motor cycles/scooter) in 2000-01 to 64% in heavy commercial vehicle (HCV) in (2019-20), implying that government failed to provide a successful transport system independently or with the collaboration of private sector to accommodate the increasing population pressure (Figure 2). This lead to increase the gap between demand and supply. Hence, people has no choice except to purchase their own transport to commute from one place to another place. The highest increase is observed in case of bikes followed by LCV (725%) during the last 20 years. Bike and LCV is owned by the people belongs to middle and high income group, respectively. The increase in HCV remained comparatively low because neither government take the responsibility to fill the increasing demand of travelling

by publicly owned buses or train nor with the collaboration of private sector. In addition to this, government also fails to provide sufficient infrastructure to attract the investment of private sector (local or foreign). However, government facilitate the high income group by providing credit line to buy privately owned vehicle or to improve the rented car facilities by ignoring its impact on the environment. The drastic increase in number of bikes and cars over the last two decades has not only lead to increase the environmental pollution over time due to increasing combustion of fossil fuels (Figure 3) but expansion of roads to facilitate these additional vehicles also occupied the land of pedestrians and cyclists. The average car that uses petrol produces an CO2 equivalent of 180 gram/kilometer while average passenger vehicle (bus) release CO2 equivalent of 650 gram/kilometer (BBC future, 2020). This implies that if in each car 4 persons are riding which is rare in Pakistan. Hence, under the assumption if two persons are travelling in a car, then one bus with 80-100 passengers can replace about 40 cars while each bus is polluting equal to 3.6 cars only. This implies that a bus can reduce CO2 equivalent of 6.5kg/kilometer. Hence, in our car dominated cities a large potential exists to cut down the carbon footprints in our daily commute. Further, it is estimated that one car takes the space of about 100 pedestrians when you consider the space to facilities that must be kept free in front and back. In that space 15-20 bicycles can be operated. A bus with about 80-100 passengers takes the space of about 3 cars only while it can replace about 25-30 cars. Most major cities of world have begun to price the use of cars to curtail its use (Haque, 2019) but it is not getting popular in Pakistan yet. The policy of car parking fee may help to limit the use of cars in Pakistan under the condition that alternative options are made available to commute from one place to another place.

Fossil Fuel Consumption

The consumption of fossil fuels in power production (electricity) has declined

Figure 2. The distribution of number of vehicles on the road

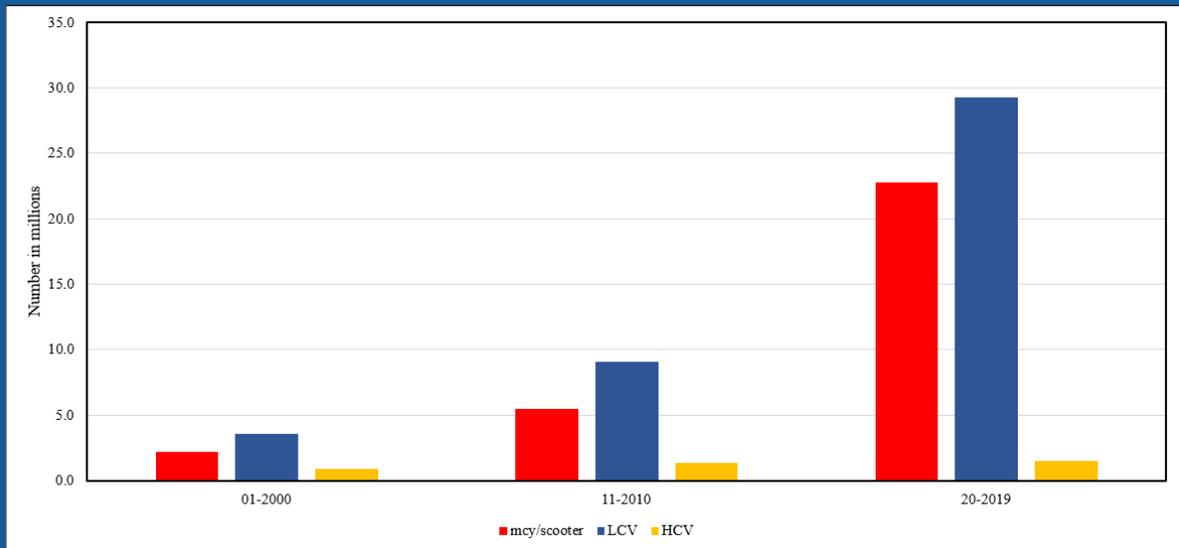
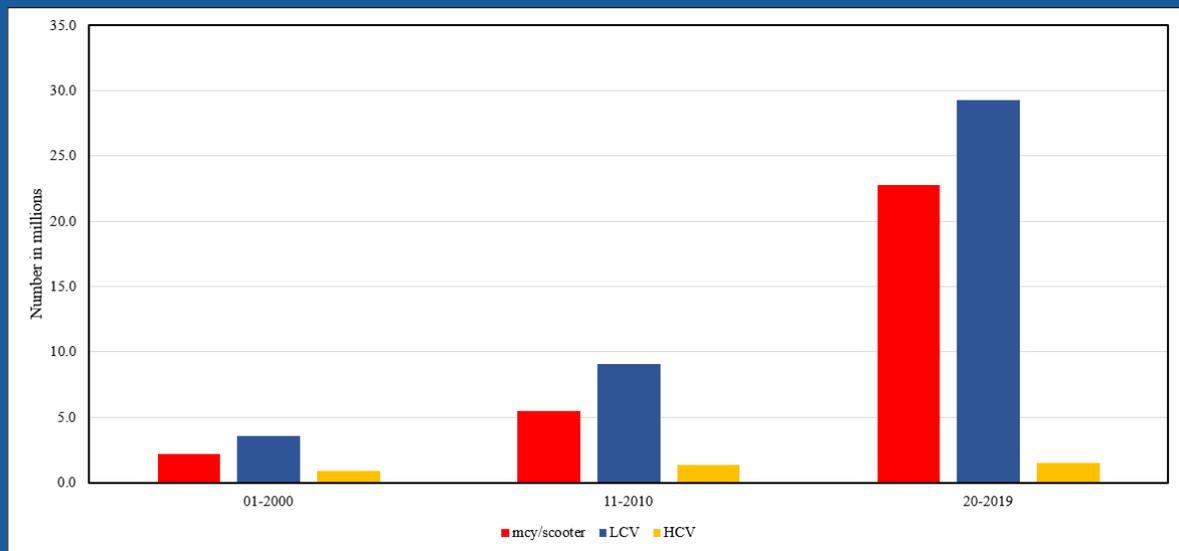


Figure 2. The distribution of number of vehicles on the road

from 6.5 million tons in 2000-01 to 1.5 million tons in 2019-20, indicating a 77% decline over the last 20 years. The similar declining trend of fossil fuel consumption is observed at the household level (90%), agriculture (95%) and industry (37%), demonstrating that anthropogenic activities are deploying cleaner sources of energy except power plants where use of coal has increased over time. In contrast, the use of fossil fuels has dramatically increased about 80% (from 8.2 million tons to 14.7 million tons) in transport industry over the last twenty years (Figure 3). This is an alarming situation for the environment and thus, policy measures need to put in place to revert the increasing trend of fossil fuel use in the transportation sector.

Figure 3. The consumption of fossil fuels by sector

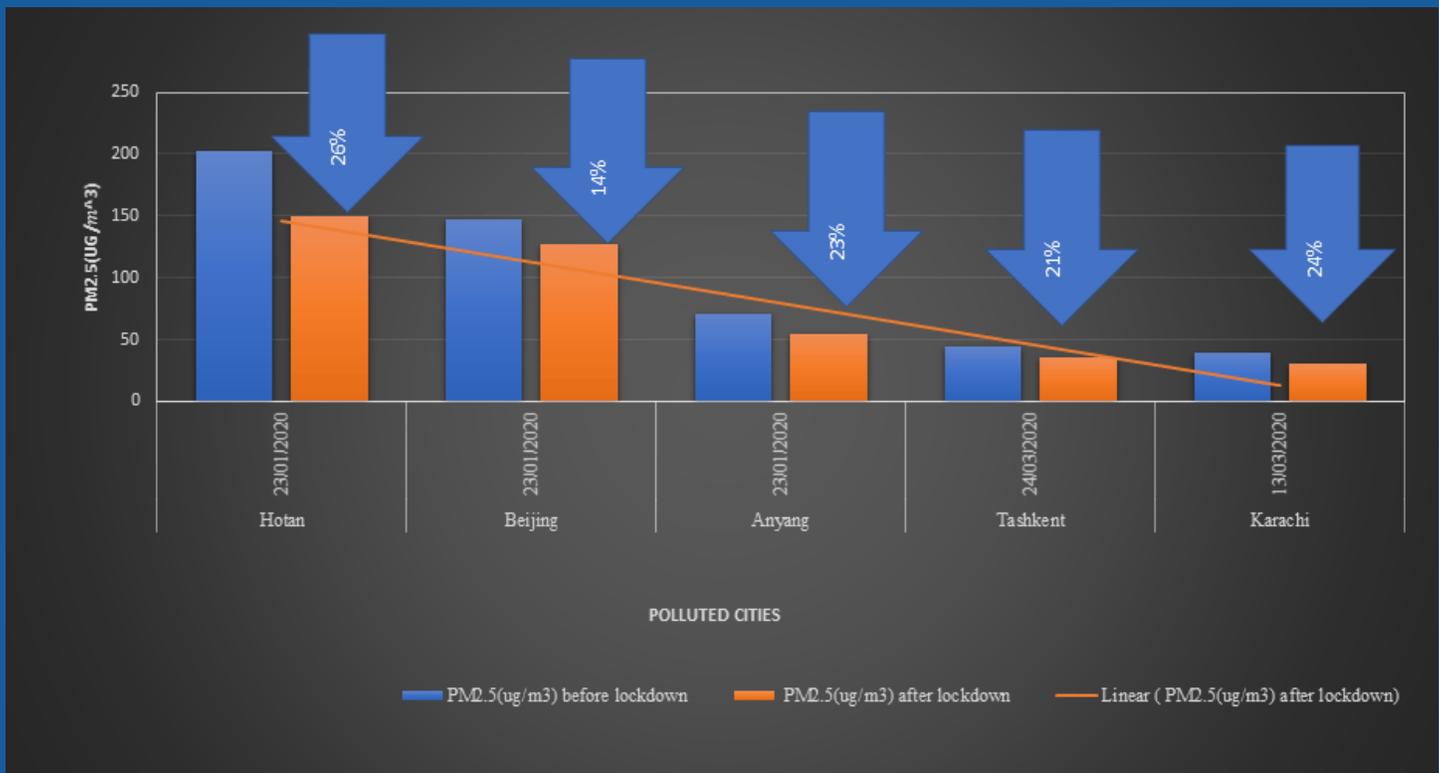


Data source: GoP (2020-2021)

Environment Scenario of Post COVID-19

The COVID-19 lockdown that have irked billions and economic activities were grind to a halt appeared as a sort of blessing for the environment as people spend less time in vehicles, offices, factories and more bounded to home. As economic activities slowdown in all major polluted cities of the world, these cities have recorded unprecedented fall in air pollution. A comparison in five worst polluted cities of the world (Hotan, Beijing, Anyang, Tashkent and Karachi) indicates a downward trend in air pollution Figure (4).

Figure 4. Pollution trends before and after lockdown due COVID-19



Source: Real Time Air Quality Index (2020)

The above graph shows fall in air pollution as the single greatest positive effect of Lock down on environment using PM_{2.5} (ug/m³) concentration data over 40 days before and after lockdown. The government of republic of China enforced the nation into strict lockdown on 23rd January 2019 and Anyang, Beijing and Hotan cities have experienced decline in PM_{2.5} (ug/m³) concentration by 26%, 14% and 23% in the early 20 days of lockdown. Because Chinese government have introduced new rules of car use by allowing the vehicles on alternate day depending on their number plates which has contributed toward reduction in air pollution level.

The Karachi city also have shown dramatic decline of 24% in PM_{2.5} (ug/m³) concentration, once the government imposed stringent lockdown on 13th march, 2020. Due to significant decline in air pollution, the Karachi city has been placed among the moderate polluters as its Particulate matter concentration fall in the range of 12.1- 35.4 ug/m³ after lockdown. The National forum for environment and health (NFEH) reported that with minimum public and private transport on the roads and limited industrial activity, Karachi's air pollution problem had been eased for the time being. All these evidence supports that transportation is one of the major factor contributing towards environmental pollution. Only improved public transport facilities with the extended network can help to minimize the use of private cars.

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Climate Change & Water Scarcity

Ghulam Nabi

The globe is experiencing an atmospheric change as the accumulations of greenhouse gases (GHGs), resultantly increasing global temperature and threatening biodiversity loss, disruption in biogeochemical cycles, food insecurity, water scarcity, migration, loss of forest cover and many others. The main reason for climate change is the anthropogenic activities; increasing concentration of greenhouse gases (GHGs) in the atmosphere which interferes with the climate system. Figure 1 shows the share of emissions that comes from different sectors, the anthropogenic activities produces 55.46 percent of total global emission (Xi-Liu and Qing-Xian, 2018) while 44.54 percent is produced naturally.²

The growing global emission has put huge pressure on natural resources and their carrying capacity and results in degradation of natural resources and increasing pollution. Water scarcity became as a great threat to human survival. In a hypothetical world without water, human civilization cannot survive for more than 3 days. On a globe that is 71% covered with water, a mere 1% of the water remains at human's disposal. Yet surprisingly, water is one of the most taken for granted and undervalued resources on earth.

Putting this in perspective, the water issue in Pakistan is also very intricate and multifaceted and listed among the water scare country. Pakistan once was a well-water endowed country with more than 5200 cubic meters per capita at the time of independence, now its availability is less than 1000 cubic meters per capita. This decline is more than 400 percent, and there will be an absolute water scarcity in Pakistan by 2025.

Figure - 2 shows the relationship between water availability and population. Figure shows, Pakistan's water availability per capita is constantly decreasing, with only 32 countries having less water per person than Pakistan whereas its population is ranked as the fifth most populous country in the world. While population growth had been one of the biggest drivers behind the stressed waterscape of Pakistan, rapid urbanization, climate change will put further pressure on our water resources and push the country towards absolute water scarcity. According to the Sustainable Development Goal (SDGs) 6.4.2 report (2017), Pakistan is categorized as an extremely high water stress country and the ratio of water supply is 102.5 percent. Water stress is going to increase further due to growing demand, mainly coming from the rising population, rapid urbanization, the adverse impact of climate

Figure 1: : Global GHG Emission

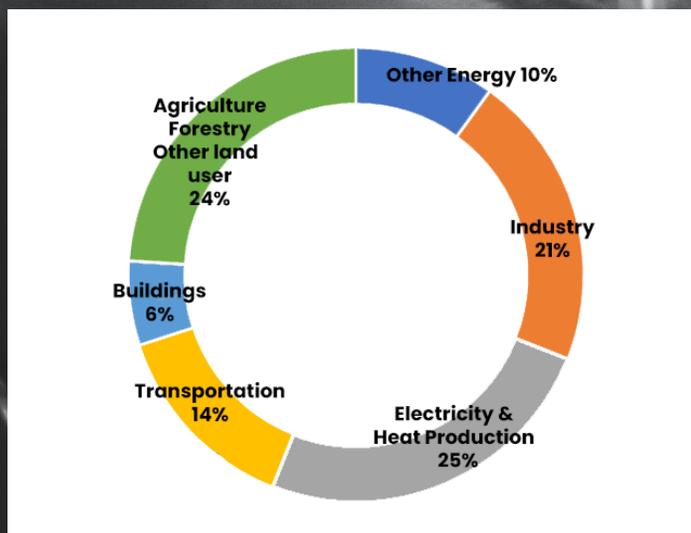
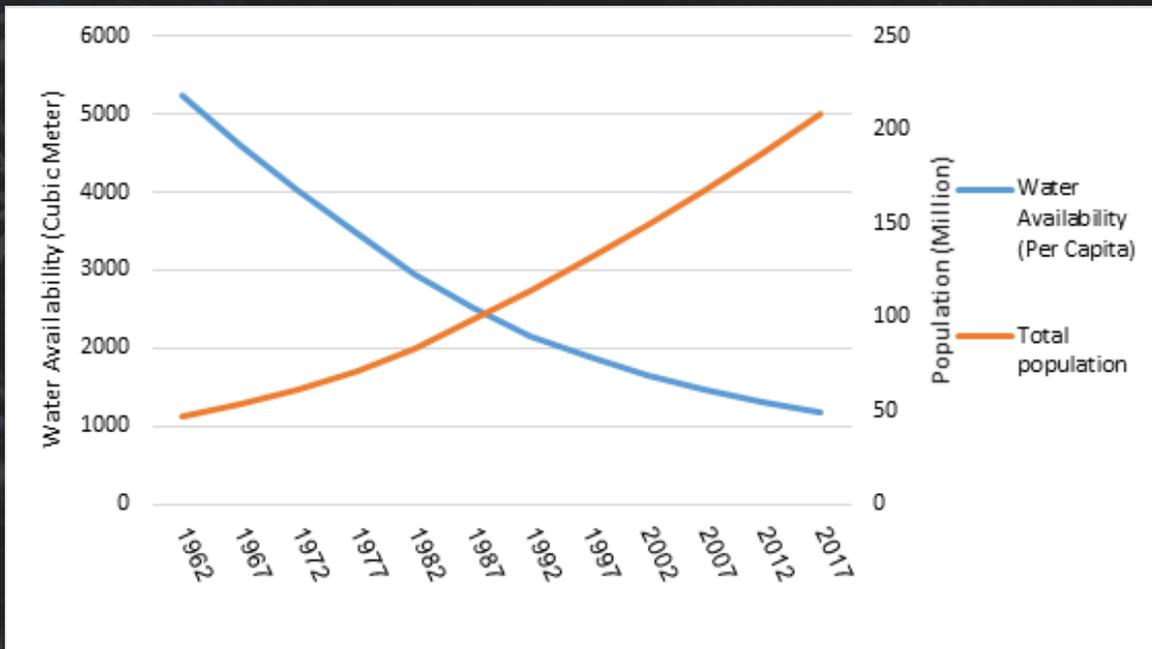


Figure 1. Environmental pollution a sources of health risk²

change, and the continuing degradation of water quality. This pressure will push the country very close to the threshold for absolute water scarcity.

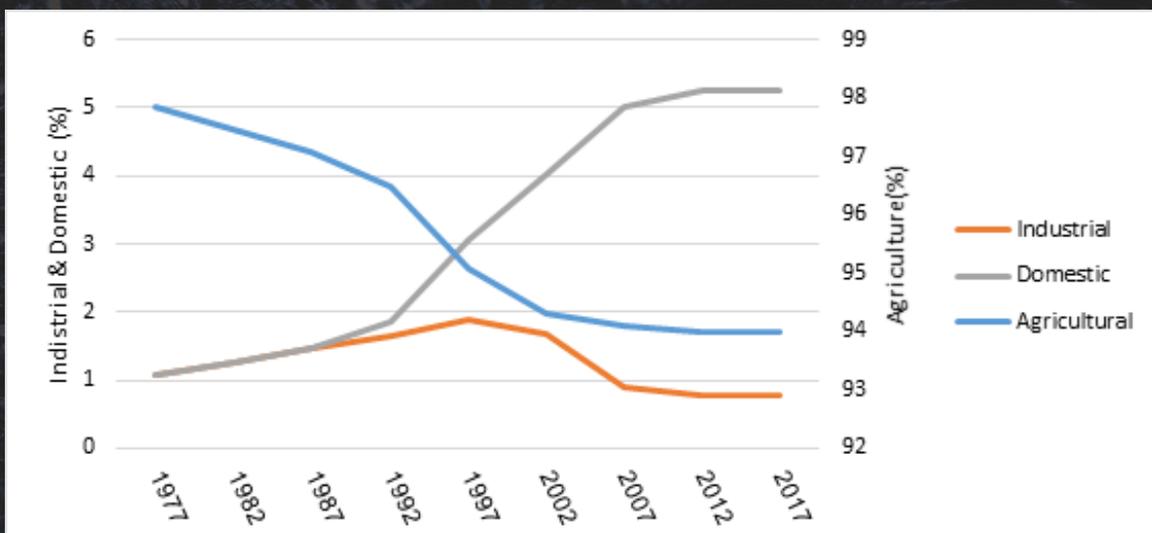
Figure 2: Per Capita Water Availability and Population



Source: Aqua Stats

Pakistan’s surface and groundwater use is heavily dominated by agriculture – four major crops (wheat, rice, sugarcane, and cotton) consumed nearly 80% of the water to generate only 5 % of GDP . On the other hand, Only 32 countries have less water per person than Pakistan; across these countries, the average per capita GDP is 10-folds than ours. The economic cost to Pakistan from poor water sanitation, floods, and droughts are conservatively estimated to be 4 % of GDP which is around \$12-14 billion. The economic cost to Pakistan from poor water sanitation, floods, and droughts are conservatively estimated to be 4 % of GDP which is around \$12-14 billion. Figure – 3 shows the sector-wise water consumption, the agriculture sector is consuming a huge quantity of water yearly, statistics show the agriculture sector has withdrawal around 94 percent of total water while the domestic sector and industrial sector consumed only 5.2 percent 0.76 percent respectively.

Figure 3: Water Consumption (Sector wise)



Source: Aqua Stats

Virtual water trade is another dimension that problematizes the country's water strategy of investing its limited water on a handful of crops. Pakistan's water productivity is less than \$1 per cubic meter whereas the global water productivity is around \$17. Table – 1 shows the water use efficiency for agriculture, industrial, and service sectors for Pakistan. The total water use efficiency is \$51.6/cubic meter which indicates that the water use efficiency for the agriculture sector is very low while it consumes more than 90 percent of total withdrawal water. However, the trend shows a little improvement from \$0.19/cubic meter to \$0.30/ cubic meter water use efficiency from 2002 to 2017, this may be due to the transition toward the high-value crops. The industrial sector is also showing a significant improvement in water use efficiency from \$6.01 to \$34.35 per cubic meter. Likewise, the service sector shows a little improvement in water use efficiency.

Table 1: Water Use Efficiency, (U \$/Cubic Meter)

	1997	2002	2007	2012	2017
Agriculture	n/a	0.19	0.22	0.25	0.30
Industrial	6.01	7.92	23.51	31.84	34.35
Services	13.52	11.49	12.22	13.00	16.94

Source: Aqua Stats

Along with many factors, unsustainable irrigation practice is the major reason for water scarcity in Pakistan while agriculture is already consuming a huge quantity of water. On top of this, Pakistan is also exporting water intense agricultural commodities like rice and imports low delta produces

The limited water resource is just but one aspect whereas water governance is another side of the story. Water governance at multiple levels is in severe need of scholarly focus. Scholars certainly need to address some of the different governance issues such as low Abiana charges, assessment, and collection but also discuss issues involved in the participation of farmers and other marginal groups, equitable water distribution at tail reaches of the canals and watercourses, groundwater governance and electric subsidies, interprovincial conflicts and transboundary issues.

Bringing in the economic perspective, water in Pakistan is a highly underpriced commodity and the cost of recovery is very poor which results in highly inefficient use of water. The prevailing cost recovery through water charges (Abiana) is able to meet only a fraction of the O&M cost of the irrigation infrastructure. The best way forward was for the country to develop and implement water governance protocols in the country and established a water economics and food nexus. The immediate efforts are required to build:

1. There should be a water accounting, audit, and water accountability system. (A portal should be created for the water and glaciers, storage, rivers flow for data accessibility)
2. Charge for the use and penalty of misuse of water.
3. Improvement infrastructure and technology introduction.
4. Major efforts are required in agriculture by using current institutions (WAPDA, IRSA, GCISE, PCRWR, PMD, and Universities) such as agriculture extension by employing scientific research and new knowledge to agricultural practices through farmer education.

¹ National REDD+ Strategy and its Implementation Framework <https://www.redd-pakistan.org/wp-content/uploads/2015/08/REDD-Strategy-V1.1.pdf>

² Natural Emission involve: Forest Fire, Ocean, Wetland, Permafrost, Volcano and Mud Volcano

³ CEECC-PIDE: Activity Report (2019) on "Water and Sustainability in Pakistan" funded by The Asia Foundation-

⁴ Report: Pakistan Council of Research in Water Resource (PCRWR) and United Nations Development Program (UNDP)

⁵ FAO and UN-Water. 2018. Progress on level of water stress: Global baseline for SDG ^{6.4.2}: Level of water stress: freshwater withdrawal as a proportion of available freshwater resources

⁶ Wheat, Ricem Sugarcane and Cotton produced 4.45 percent of GDP Source: http://www.finance.gov.pk/survey/chapters_18/02-Agriculture.pdf

Green Finance

An Islamic Way to Rescue the Nature

Ahmad Fraz

Interest is prohibited in Islamic finance and forbidden to generate money by money. According to Islamic rules money itself has no value and is just a way to define the value in Sharia's law. Furthermore, risk is being shared in business activities by market participants. The key issue in Islamic finance is to guarantee the wealth increase by productive activities. The element of speculation and gambling which uncertainty "Gharar" is forbidden in Islamic finance. The uncertainty can be avoided by using equity principle. To invest in non-ethical industry like alcohol, tobacco and adult entertainment is prohibited in Islamic finance.

Islam demands comprehensive development of an economy and emphasizes social welfare. Its teachings stress translating shariah principles into practice and integrate them into individual and collective human life. The investments which are beneficial to the society are encouraged by Islamic finance. The concept of the maqasid al sharia supports the principle of serving the public interest of maximizing benefit and reducing harm to the society. Therefore, firms have a dual objective of generating economic gains along with a positive impact on society. There is a strong nexus between Islamic finance and green finance.

In Shariah, there is an emphasis on conservation, preservation, and responsible use of resources. There is a discouragement for excessiveness, and wastefulness in the use of resources. The realization of the value of the environment even if it is in no one's private ownership is vital for fostering a culture of care and responsibility towards the environment. The steps towards preserving and conserving the climate are fundamental to promote environmental sustainability. The first step in this dimension recognition of climate as an asset endowment by Allah and its use responsible use.

The financing of green projects or firms is a challenging issue. The acceptability and growth in green finance require work in two domains i.e. creating a conducive environment for mobilizing capital for financing climate-friendly projects and/or firms and developing environment-friendly innovative financial instruments. The conducive environment means the development of a green finance ecosystem involving stakeholders that encourage the green businesses

through regulatory frameworks and ensure the availability of financial instruments along with financing and an advisory mechanism.

"Islamic finance shares similar underlying principles as that of sustainable finance, i.e. financial stability and economic growth, poverty alleviation and wealth distribution, financial and social inclusion as well as environmental preservation. This has therefore allowed for Islamic finance to capitalize on these similarities to become a natural vehicle to propagate the elements of green finance."

Figure 1 illustrates that CO2 emissions per person increased which suggests that there is a direct relationship between the GHG emissions and population. In case of India, CO2 emissions per capita increased from 1.0 to 1.8 metric tonnes per capita between 2000 and 2016. India is more vulnerable in South Asia. Pakistan and Sri Lanka are ranked second and third. The figure also presents the CO2 emission in Nepal and Afghanistan which indicate that these countries are facing a lower level of environmental and climatic issues. In general, procedural difficulties and the lack of awareness about how to safeguard the environment are major factors that may inflate the risks associated with environmental problems among countries located in the South Asian region as they pertain to CO2 emissions.

A green finance ecosystem may be composed of four major stakeholders including green finance promoters, green finance providers, green ecosystem coordinators, and ultimate users of green finance. Each of these parties may play a well-defined role in the conception, implementation, and financing of the whole scheme. The promoters may include governments, international agencies, and organizations. The green finance providers may be financial institutions in general and Islamic financial institutions in particular. Islamic green finance may include grants and investments. The creation of social finance ecosystems requires coordination between the green finance promoters and green finance providers and users. In addition, product development centers, and advisory firms, are necessary to create and maintain sustainable ecosystems. This will help to provide a framework, guidelines, and best practices to achieve the desired objectives.

Advances in green finance are attracting global attention for finding alternative ways to finance socially responsible

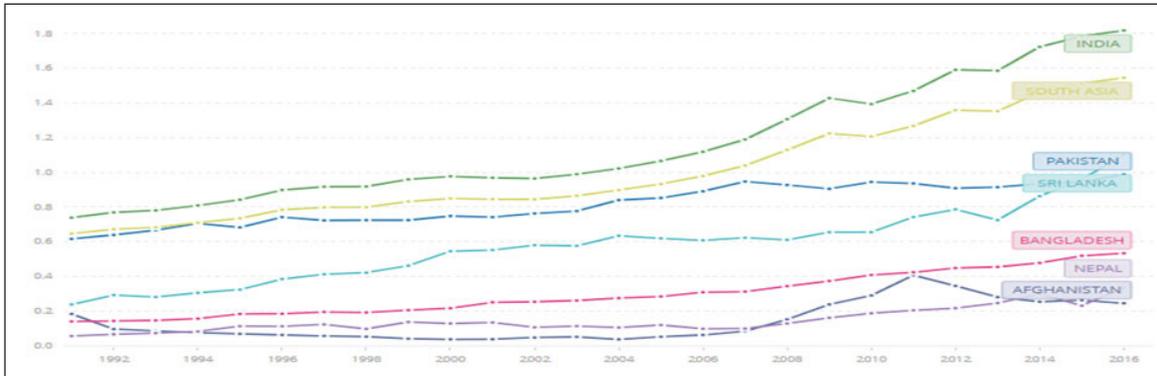
¹ Tan Sri Dato' Seri Ranjit Ajit Singh, Chairman, Securities Commission Malaysia
² <https://data.worldbank.org/indicator/EN.ATM.CO2E.KT?locations=8S>



businesses and creating value in the society and Islamic Finance is not an exception. Green Sukuk is the first step in this direction. Green Sukuk are asset-based financial instruments structured to provide funding for renewable energy and environment-friendly projects and helps in achieving sustainable development goals. Although the advancement of Green Sukuk is a positive step its small market size poses

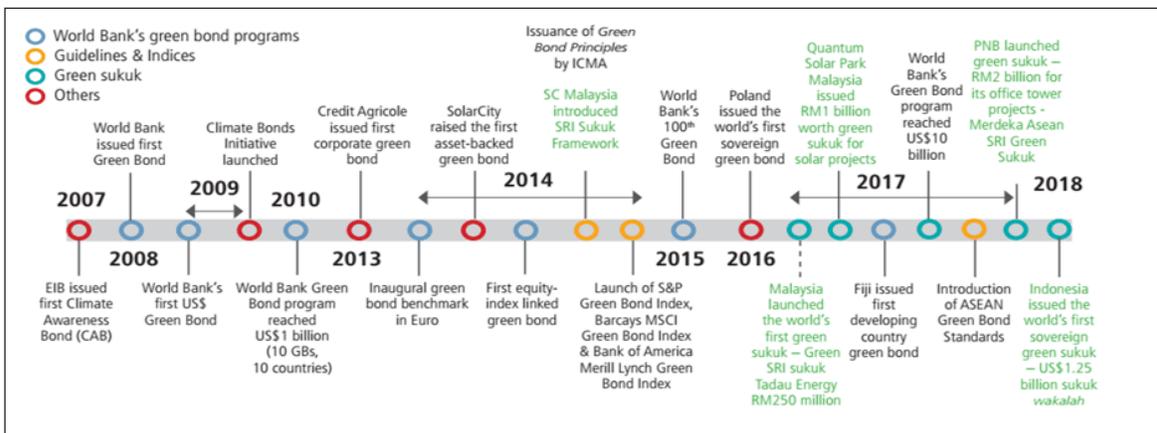
numerous challenges. It is interesting that green equity is still missing which should be an integral part of sustainable climate finance. The green equity may be a differentiating point for new firms and the existing firms may issue tracker stocks with the shariah-compliant green specification. The green bonds globally witnessed an upward curve between 2013 and 2017. The issuance amount in 2017 was at US\$155.5

Figure 1: Country-wise Position of CO2 Emissions (Metric Tonnes Per Capita) in South



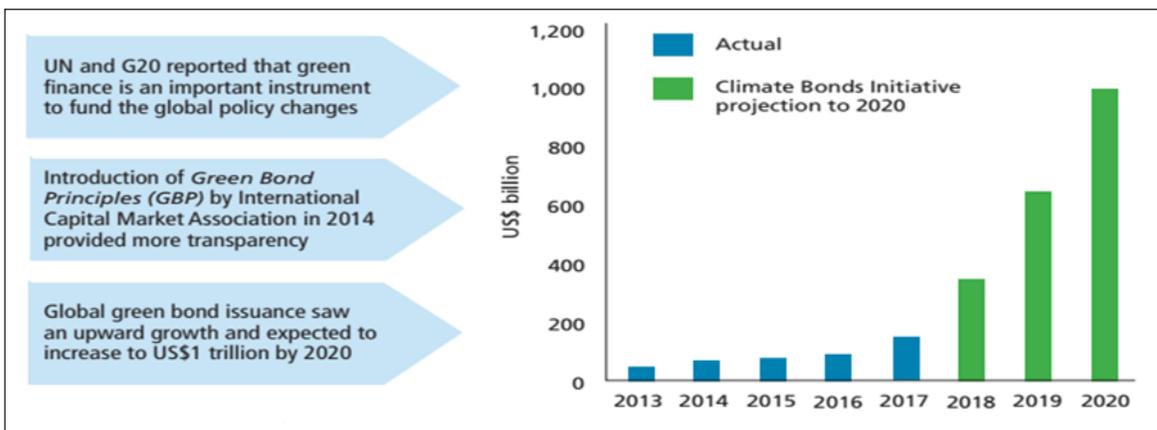
Source: World Bank, "Data Indicators," 2

Figure 2: Evolution of the Green Bond and Sukuk Market



Source: INCEIF and SC

Figure 3: Upward Trajectory of Green Bond Issuance Globally



Source: Climate Bonds Initiative

Corporate Accountability: A Conduit to Combat Climate Change

Anjeela Khurram

Scientists attribute the main cause of prevalent climate conditions to human activities. Since 1950, the global warming trend is ascribed to anthropogenic expansion of greenhouse effect. Anthropogenic or human induced warming signifies the component of that warming, which is attributable to human activities. The onset of industrial era has adversely changed the natural pattern of climate. For example, the carbon dioxide level over the last 400,000 years has remained below 300 ppm and this has skyrocketed from 1950's to present (Figure 1).

Figure 1 shows that contrast that before the industrial revolution, the climate changes were natural, but onward the current climate change is largely anthropogenic.

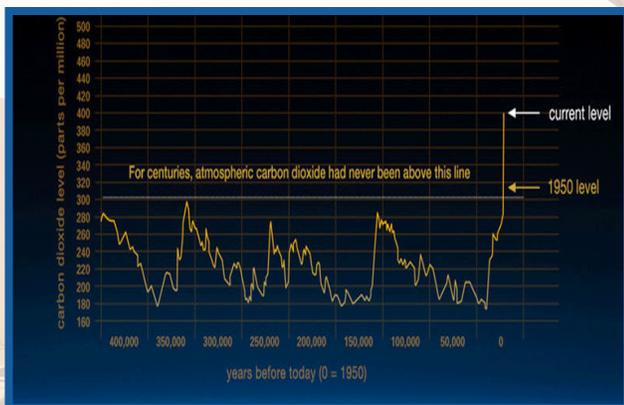


Figure 1:
Change in CO₂ levels in pre and post-industrial times

In the anthropogenic era, the CO₂ level has increased from 280 parts per million to about 417 parts per million, since 1950. As a result, the global temperature has increased up to 1.5 °C above pre-industrial level, which has adverse impacts on the environment. This situation needs immediate attention. To tackle global warming, the need is to know which sectors are contributing the most to it. Among many, the corporate operations are the main root cause of pollution and global warming. The routine operations of corporate sectors like transportation, manufacturing,

construction, agricultural and some others are emitting pollutants into the environment (Figure 2). The burning of fossil fuels, industrial activities and transportation are the main causes of greenhouse gases (GHG) concentrations, pollutant wastes and heat production and the subsequent global warming. The global warming, thus, results into glacier retreat, extreme weather, rise in sea-level, increase in land and ocean temperatures, lengthen frost-free season, changes in precipitation patterns, more droughts, heat waves, strong and intense hurricanes etc. The climate change has severe impacts on land and marine ecosystems. To curb this evil, there is a dire need on the part of companies to address the impacts of corporate activities on climate change by taking various proactive measures. Realizing this need, companies have thus made corporate accountability a governance mechanism to show their performance in non-financial areas such as social responsibility and sustainability.

Therefore, companies are positioning themselves as the steward of nature, in terms of climate change. The legal and societal expectations that companies should play their role to eliminate or reduce factors causing climate change are making companies more accountable. Likewise, there has been a significant increase in litigations to introduce a binding requirement to hold companies responsible for the impacts of climate change. Such litigations provide real opportunities for corporate accountability. These litigations introduce regulatory oversights for businesses and a liability mechanism for companies. Therefore, the legislations by coupling due diligence obligations with various other modes of accountability have the potential to ensure corporate accountability for climate change. Thus, the regulatory systems can be instrumentalized for climate purposes. The growing desire for corporate climate accountability is manifested in the fact that the litigations have included environmental, social and governance (ESG) requirements

and accountability mechanisms to entail legal implications for companies. The ESG criteria are benchmarks set by related authorities for company's operations to attract socially conscious investors. This is well evident in the current legislative developments targeting to ensure that companies should consider the impacts of their externalities on environment.

In order to comply with the environmental laws, the corporates accountability can ensure that companies are taking certain measures to play their part to reduce their externalities. The corporate governance mechanism should set some benchmarks to enhance the major stakeholders' accountability. Shareholders of companies, being vital investors can ensure compliance with climate regulations. Similarly, the companies should stop practicing the tactics of Greenwashing to give the impression of eco-friendly vision. The regulatory authorities can track compliance or violations of laws by tracking the impacts of the corporate operations on environment and can execute prosecution in case of violations. The companies can play their part to tackle the climate crisis by switching to efficient renewable and clean energy sources, by conserving water resources through efficient water management, by increasing recycling to prevent waste accumulation and by monitoring the GHG emissions on daily basis. Likewise, the companies can develop mitigation and adaptation measures to manage impacts of their operations on climate change. Besides, the companies can adopt power management options, and can help developing markets for sustainable technologies and eco-friendly products and services. The corporate accountability is a mechanism set in companies to ensure that companies should comply with all applicable federal and state regulations concerning environment, energy and human rights to eliminate or reduce the causes of climate change.

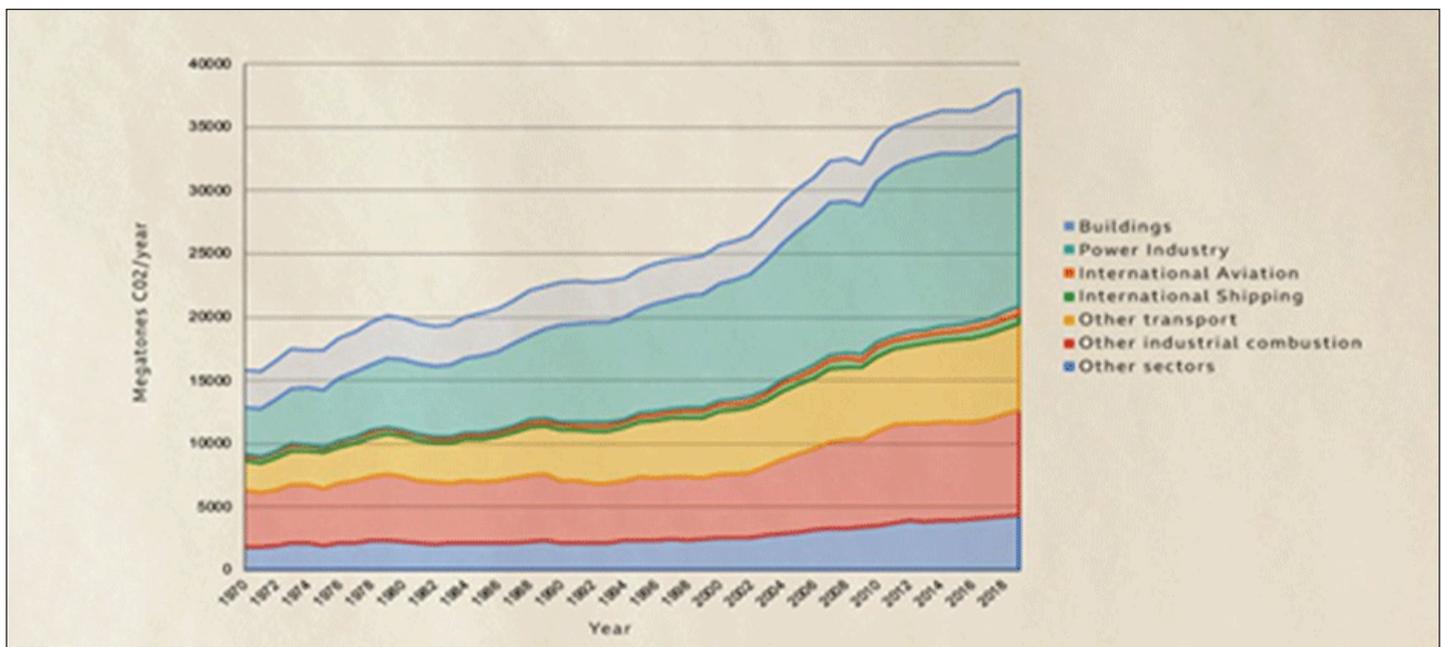


Figure 2: Sector wise Emission of CO2

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