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Pakistan's Contribution to the Global Rise in Conventional Pollution

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Pakistan's Contribution to the Global Rise in Conventional Pollution

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Abstract

This thesis examines the impact of conventional pollutants on the environment, communities, and individuals in Pakistan. It begins by investigating the causes of conventional pollutants and exploring Pakistan's agricultural industry, domestic practices, non-renewable energy sources, and industrial practices (the brick industry, leather tanning industry, and textile industry). It then analyzes factors that continue to contribute to conventional pollution in Pakistan such as economic incentives, politics, and traditional practices within industries. The thesis then delves into measures that have already been taken by Pakistan and other organizations to decrease conventional pollutants and then suggests potential opportunities for improvement.

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Introduction

South Asia is a contributor to the rise in conventional pollution and greenhouse gas emissions worldwide. As such, examining this load of pollution and the factors that contribute to it will help countries find potential room for improvement in their industrial, domestic, and agricultural practices that could lead to the reduction of these emissions. South Asia consists of eight countries of which one will be mainly focused on this dissertation. These countries are considered to be developing countries that release a large amount of pollution. Since these developing countries are more focused on improving socioeconomic conditions, they have maintained a heavy reliance on energy uses and production that are major contributors to both conventional pollution and greenhouse gas emissions. Therefore, it is of much importance to look at South Asia when considering the environmental crisis, because they have a wide range of opportunities to reduce their carbon footprint. This change can easily be made by "investments now to slow a changing climate and enable billions to live safer, more prosperous, inclusive and sustainable lives" (World Bank 2022a).

In South Asia, Pakistan suffers severely from conventional pollution at a very high rate (World Bank 2020a). In the wake of a treacherous monsoon season starting in mid-June, Pakistan was left devastated "with more than one-third of the country reportedly submerged, housing, infrastructure, and livelihoods are negatively affected, and agricultural losses appear to be extensive" (World Bank 2020a). The contamination of water sources and other conventional pollutants caused by this severe flooding will have detrimental effects to the health of the population. While this is a period of reconstruction for the country, it is also an opportunity for Pakistan to rebuild itself in a more sustainable way that can decrease its conventional pollution and, in so doing, decrease its contributions to the current climate crisis.

Conventional pollutants in Pakistan are one of the main contributors to the ongoing environmental crisis. Conventional pollutants are contaminants released either in the air or water by industries, businesses, and households (California State University at Sacramento 2023). These pollutants can stem mechanization processes to landfill usage and even through water treatment centers. All of which have negative effects on the health and living conditions of the individuals and families living and working around these areas. In 2016, it was estimated that around every 100,000 people living in Pakistan, 176.3 of those deaths were attributed to the air pollution in those countries (World Bank 2016). In the same year, it was estimated that 19.6 of every 100,000 people living in Pakistan died from unsafe water, sanitation, and hygiene (World Bank 2016). These high mortality rates from water and air pollutants show the importance for taking action and investing in more sustainable and safe practices.

A contributor to the rise in conventional pollution is the agricultural industry's use of pesticides and fertilizers. Pesticides and fertilizers typically are crucial to agricultural production (City of Rockford 2016). However, the dangers with this practice are over fertilization and excessive pesticide usage, which are hazardous and are a serious health risk to animals and humans. This becomes especially problematic during the heavy rainfall season, which Pakistan commonly experiences during the months of July and August (Azizullah et al. 2011, 493). This runoff can contaminate water sources by either being washed into waterways or seeping through soil and contaminating underground water sources (U.S. EPA 2022b). Such contamination can have negative effects on health such as “immune suppression, hormone disruption, diminished intelligence, reproductive abnormalities and cancer” (Aktar, Sengupta, and Chowdhury 2009). It has been found that female cotton workers in southern Pakistan suffer from many health problems due to pesticide exposure. This is exacerbated by a lack of personal protective

equipment taken by many women, resulting in illnesses ranging from nausea to skin and eye injuries (Memon et al. 2019). Pesticides also have been linked to the endangerment of many species that are surrounded by this contaminated air and water. By implementing more sustainable practices and creating limits on nutrient usage in farming, individuals will be living a healthier and more sustainable life.

Within the agricultural industry, mechanization contributes to a rise in air pollution (as well as greenhouse gas emissions). Farm mechanization entails replacing human and animal labor with machines (Memon et al. 2019). Nonetheless, this new machinery and the rise in more efficient farming practices contributes to air pollution linked to many health problems including physical, behavioral, and psychological health issues (Ullah et al. 2021). Recent studies have even found that it has contributed to "11 million premature deaths in Pakistan" (Ullah et al. 2021). This is a prominent issue in Pakistan because, as a developing country, much of its revenues from production of goods is based on cotton and other agriculture products. Many workers in the agricultural industry, which makes up around 37 percent of the country's workforce, are exposed to these toxic contaminants in the air on a daily basis (World Bank 2021).

As for households, the lack of sanitary waste treatment systems contributes to the prominence of polluted wastewater in Pakistan. This is because many of the industries do not follow the regulations set by Pakistan's Environmental Protection Agency. This includes leaky pipes as well as poor water treatment and older sanitation systems typically located in urban areas (Daud et al. 2017). As a result, many of the domestic waste from households runs off into the underground water sources and streams. The health effects on individuals include typhoid

and other waterborne diseases that have caused around 60 percent of infant deaths (Daud et al. 2017).

The improper disposal of solid waste from households and industries is another major contributor to the environmental crisis in Pakistan. This is due to the lack of "waste management infrastructure" in the country (ITA 2022c). A majority of this municipal waste is either incinerated, scrapped, or dumped, which can result in higher levels of air pollution and conventional pollution (ITA 2022c). Conventional pollution comes from the improper disposal of solid waste during rainfall which results in the runoff of waste. This can lead to the contamination of water sources that disrupts wildlife and are harmful to the health of humans (U.S. EPA 2022b). Air pollution is also created through the burning of the landfill waste. Individuals who live closer to these waste sites have a higher rate of medical issues ranging from asthma to cholera and tuberculosis (Njoku, Edokpayi, and Audio 2019).

Another major contributor for conventional and air pollution are industries that include "textile, pharmaceuticals, ceramics, petrochemicals, food industries, steel, oil mills, sugar industries, fertilizer factories, and leather tanning" in Pakistan (Azizullah et al. 2011). Many of the industries contribute heavily to conventional pollution because of their use of toxic metals that generally runoff into the water. Similar to the issue seen with domestic waste systems, some industrial practices release excess waste improperly and illegally into the environment. This can also be attributed to broken or leaking pipes, as well as leakage of septic or sewage disposal systems (Azizullah et al. 2011). The inadequate system of waste disposal for many industries leads to toxic contamination of water, which can result in severe illnesses such as cancer, blood disorders, and even some neurological disorders (Azizullah et al. 2011).

Pakistan has a heavy reliance on non-renewable energy sources that contribute to conventional pollution and the global environmental crisis. Pakistan generates its energy through using “oil, gas, coal, renewable sources, nuclear, and biomass” (ITA 2022b). Of which 57 percent of their energy comes from fossil fuels and only four percent comes from non-renewable energy (ITA 2022b). However, the concern with this heavy reliance on fossil fuels is that the extraction of non-renewable energy sources does not meet the needs of the consumer, which forces them to import these fossil fuels from other countries. This reliance is especially exacerbated by the technical and financial constraints within Pakistan, which has made the price of energy expensive (Government of Pakistan 2022). However, much of the country is still reliant on fossil fuels because the government does not have the money to finance the installation of renewable energy sources. While in the short run, using non-renewable energy sources are readily available, it is not environmentally friendly and can result in detrimental health effects. Some of these health issues include neurological problems (especially for babies and young children), respiratory issues, and permanent brain damage (Kotcher, Maibach, and Choi 2019). Therefore, it is important to shift the reliance of Pakistan’s energy away from fossil fuels and more toward renewable energy.

Increasing levels of productivity leads to economic growth that can be utilized to help Pakistan increase its standard of living (World Bank 2020c). However, Pakistan’s current output of conventional pollution is preventing this opportunity from happening (Zivin and Neidell 2012). Frequently, those with lower incomes live in areas that are more exposed to pollutants because it is a cheaper option (U.S. EPA 2023). Those who live in these areas typically struggle to improve their standard of living for themselves and their children because they do not have the money and time to create an atmosphere that can provide educational and career opportunities

(Voorheis 2021). Additionally, health issues increase with higher levels of pollution which provides a barrier for many families once illnesses arise because they have to spend their earnings on health bills. This becomes especially a problem for many low-income households because treatment is scarce from poor economic and environmental conditions in the country (Ittefaq and Igbal 2018). Ultimately, this affects levels of productivity because the nutritional, educational, and physical constraints of low standards of living impose barriers to work efficiency on a daily basis (Dalton, Jimenez, and Noussair 2017).

Conventional pollution in Pakistan aggravates productivity because it increases otherwise avoidable health costs (U.S. Department of Health and Human Services 2023). Additionally, it is seen that conventional pollution in Pakistan is connected to a higher rate of birth defects which, in some cases, can affect the number of eligible workers (World Bank 2015). Ultimately, this negatively affects productivity because there are fewer people to work which means that less goods are able to be produced in a certain time frame. As a developing country, Pakistan is especially vulnerable to changes in productivity because it does not have the resources to make up for the loss in production that conventional pollution creates.

High levels of contaminated food affect the productivity of Pakistan by affecting the productivity of workers (Ahmed et al. 2016). This happens when pollutants infiltrate the ecosystems of marine wildlife and livestock through the land, air, and water. This is concerning for Pakistan because with a push towards organic and healthier foods globally, having farms and fisheries that are selling produce from polluted areas becomes less desirable. The food output also is impacted because pollution causes premature deaths for many of these animals. Much of Pakistan is reliant on the food industry to providing jobs and feed the country (Dethier 2011). As a result, an increase in health issues, such as various cancers, birth defects, and cardiovascular

diseases, can decrease the number of able-bodied workers who are available to work efficiently (Guo et al. 2019). Food insecurity therefore has been threatened by these conventional pollutants and often affects the poor to a greater extent because of their limited food options.

Global climate change exacerbates the problems of conventional pollution in Pakistan. Extreme weather conditions, which include dangerous rain storms and heat waves, lead to devastating effects on the land and air. Pakistan is particularly impacted by this because they are behind in instituting preventative measures that other countries have adopted in response to the global climate crisis. Heavy rainfall can cause excess runoff that contains pollutants picked up by storm drains and ditches (U.S. EPA 2023b). It also displaces animals and destroys building structures that pollute the land and are disruptive to productivity. Meanwhile, rising temperatures can lead to shortages in crop production, lengthen the season for wildfires, and change precipitation patterns that interrupt ecosystems. The effects of the global climate crisis disrupt many sectors that are important to Pakistan's society (U.S. Global Change Research Program 2023). This includes "human health, agriculture and food security, water supply, transportation, energy, ecosystems, and others" (U.S. Global Change Research Program 2023). As a developing country, Pakistan is especially influenced by this crisis because it does not have the resources or the money to make up for the losses that Pakistan has faced from this crisis.

Pakistan is just one of the countries in South Asia that struggles with reducing their conventional pollution. In reality, South Asia's pollution has been increasing and it is dangerous to the welfare and health of individuals living in these countries. What makes the situation even more concerning is that this region is considered to be extremely vulnerable to climate change (World Bank 2023a). With a lack of resources and money to help combat and create more sustainable practices, these countries face the threat of increased poverty levels and price

volatility (Dethier 2011). In addition, the “combined risks of extreme climate-related events, environmental degradation, and air pollution are projected to reduce Pakistan’s GDP by at least 18 to 20% by 2050” (World Bank 2022b). This is an issue that needs to be addressed because the longer countries wait to deal with this issue, the more damage they are going to have to face.

What Causes Conventional Pollution

The Agricultural Industry

To understand the severity of these challenges, it is important to assess the magnitude of the affected sectors. The agricultural industry plays an important role in Pakistan's economy and growth. In Pakistan's economy, it makes up around "43 percent of the labor force and over 20 percent of its gross domestic product" (USDA Foreign Agricultural Service 2009). During the year there are two long seasons that have very specific climate conditions, adequate for growing crops on which the country is reliant on for its own consumption and exports. From May through November, the "Kharif" season is used to grow rice, corn and cotton (USDA Foreign Agricultural Service 2009). Rice and cotton are the top exported products of Pakistan (World Integrated Trade Solution 2020). Their second agricultural season, also known as "Rabi", takes place from December through April and is important in producing wheat, barley and millet (USDA Foreign Agricultural Service 2009). Wheat makes up 45 percent of daily consumed calories and is crucial to the country's food security (USDA Foreign Agricultural Service 2009). In regard to the location of these farms, Punjab is the major region for agriculture and is considered to be one of the most polluted regions in the world (USDA Foreign Agricultural Service 2009). The improvement of the health and sustainability of the agricultural industry is necessary in the development of Pakistan.

Pesticides are commonly used in the agricultural industry in Pakistan. These chemicals contribute to conventional pollution in the ground and air to an unnecessary degree because they are overused. In the last two decades, Pakistan's consumption of pesticides has increased by 1169 percent (Rashid et al. 2022). This growth stems from the fact that many farmers are uneducated on what is the right amount of pesticides to use and are unaware of the risks that they

face through overuse (Rashid et al. 2022). As a result, it is common to see farms going above the World Health Organization's recommended standard of pesticide use.

Pesticides have been linked with a variety of health effects that are detrimental and life threatening for many individuals. One effect of pesticide overexposure is the growing rate of diabetes. It now impacts about 12.9 million individuals in Pakistan (Bahadar, Mostafalou, and Abdollahi 2014).

An overuse of pesticides above the regulated standards have become detrimental to the ecosystem as well. The excessive pesticide can be found in river ecosystems which are more vulnerable to pollution compared to the ocean (Aktar, Sengupta, and Chowdhury 2009). This has poisoned many animals living in those bodies of waters, especially the Indus River dolphins, which have become an endangered animal (Aktar, Sengupta, and Chowdhury 2009). Also, overuse of pesticides can cause a decrease in the number of microorganisms (bacteria and fungi) living in the soil (Aktar, Sengupta, and Chowdhury 2009). This can cause the soil richness to degrade because there are not as many microorganisms around to keep it healthy and full of necessary nutrients.

Fertilization is another farming technique that has contributed heavily to the rise in conventional pollution in Pakistan. As of 2020, per unit of arable land, 121.1 percent of the recommended amount of plant nutrients were used (World Bank 2020b). While this amount has decreased significantly from the 461.1 percent used in 1968 due to efforts from the Green Revolution, overfertilization is still a concern for Pakistan (World Bank 2020b). Overfertilization can contribute to conventional pollution because it releases nitrogen oxide gasses into the atmosphere. It also infiltrates the agriculture system and can become toxic to the soil and bodies of water (Good and Beatty 2011). This problem is exacerbated through an overload of farming

techniques such as plowing, which exposes the land and disturbs soil quality that leads to an increased chance of excess runoff (National Ocean Service 2023). For similar reasons to the overuse of pesticides, overfertilization stems from the lack of education that many farmers receive on the products that they are using. Additionally, a relaxed system on rules and regulations around fertilizer use is a contributing factor.

Farming activity in Pakistan is also heavily reliant on mechanization as a tool to make production more efficient. Because the agricultural sector is so important for feeding the growing Pakistani population, mechanization is needed to increase efficiency. Even during the 2021 - 2022 fiscal year, there was a growth in this industry by 4.4 percent and consumes over 40 million hectares of land (ITA 2022a). Recently, the need for agricultural machinery has been high because of this rapid growth in the industry. The agricultural machinery total revenue ended up to be around one billion dollars for equipment such as tractors, harvesters, and irrigation equipment (ITA 2022a). Mechanized farming has even become so important that the Pakistani government has reduced tariffs on imported farm machinery (ITA 2022a). However, a major problem with these machines is that they are mainly powered by fossil fuels (Guo et al. 2022).

While mechanization is a great way to increase production in a shorter time frame, it is a large contributor to the rise in air pollution in Pakistan. As of 2017, the amount of PM2.5 air pollution in Pakistan was around 58 micrograms per cubic meter (World Bank 2017). Meanwhile, in other countries, such as the United States, the standard is 12 micrograms per cubic meter (U.S. EPA 2012). This is even more important to consider because much of Pakistan’s agricultural sector is unregulated and poorly documents its emissions which is similar to the industrial sector where about one percent of the country's reports their levels of emissions (Government of Pakistan EPD 2018). With this lack of awareness and concern for pollution

outputs among Pakistanis, the country is considered to have one of the worst levels of air pollution in the South Asian region.

In addition to these agricultural processes that contribute to the rise in conventional pollution, crop burning is a farming technique frequently used by many individuals as a way to get rid of unwanted crop residue. During these periods of crop burning, “enormous quantities of leaves, grass clippings, plant stalks, vines, weeds, and twigs are burned daily” (Hashim et al. 2022). Nevertheless, burning crop residue is a way for farmers to “improve crop yields, decrease herbicide and pesticide use, and control disease, weeds, and pests” (Idaho Department of Environmental Quality 2023). However, this degrades air quality, creates smog and haze, and contributes to the longevity of heat waves (Raza et al. 2022). It also was found that households on average have an increase in their health expenditures of about $13.37 on chronic illnesses and $8.79 on non-chronic related illnesses during burning seasons (Raza et al. 2022). This is because crop burning worsens air quality and intensifies illnesses among individuals. Even though there is a growing awareness around this issue, it is still a common practice among many farms in Pakistan.

Domestic Practices

Domestic waste is also a contributor to the rise in conventional pollution. It is estimated that Pakistan generates around “49.6 million tons of solid waste a year, increasing more than 2.4 percent annually” (ITA 2022c). Most of this waste is created in urban cities that typically struggle to find proper ways of disposal due to politics, little urban planning, lack of equipment and lack of public awareness (ITA 2022c). As of now, the main routes for disposing of this waste are burning, dumping, or burying in vacant lots (ITA 2022c).

A large problem that Pakistan faces with its municipal waste is that many cities and provinces do not know where to place them. Handcarts and donkeys are the primary way of collecting waste from households and cities, which then is picked up by trucks, tractors, and trailers for secondary collection that is placed in waste sites either around or outside the city (ITA 2022c). However, there is much variation in how municipal waste is dealt with in each province. The major cities, Karachi and Lahore, have at least one landfill site and a "proper" waste management system in place (ITA 2022c). However, much solid waste is dumped outside of the city limits because of insufficient waste practices. For example, Balochistan, a province in Pakistan, has a population of over six million people and lacks any solidified waste disposal system (ITA 2022c). While there have been some moves made by cities to improve their waste system, many "plans" have been made, but they have not been executed (ITA 2022c).

Industrial Practices

Pakistan is involved in many industries that contribute to the rise in conventional pollution. Some of these industries include brick making, textiles, and leather tanning. These industries are important for the economy and are responsible for providing jobs to the labor force. However, many of these industrial practices are not up to the standards that developed countries have. This is because of many different factors, which include lack of regulations, political pressure, time and money. This section goes into more depth about what these industries are and why they are increasing the levels of conventional pollution in Pakistan.

The brick industry is a large contributor to the rise in conventional air pollution. Since the Pakistani population is continuing to increase, the rise of manufacturing bricks and the demand for them has also increased (Khan et al. 2019). The process of brick making involves using brick kilns that mostly runs on non-renewable energy sources (U.S. EPA 2022a). There are three types

of kilns that are used in Pakistan. Two of which are traditional brick kilns, one which runs on coal and the other that runs on ground rubber (Khan et al. 2019). In more recent years, the creation of the contemporary brick kiln that runs on zigzag technology that is more environmentally friendly (Khan et al. 2019). This technology differs from the traditional brick kiln because it moves the hot air in a zigzag path that improves the transfer of heat from the gasses to the bricks, which ultimately reduces black carbon by about 60 percent (Climate & Clean Air Coalition 2021). In Pakistan, brick-making is a fast-growing industry that makes up about nine percent of the world's production of bricks (Eil et al. 2020).

Pakistan's brick industry has the opportunity to improve, but it has been slow to do so. There are approximately 20,000 brick kilns that are running in Pakistan which are located in both rural and urban areas. Typically, these kilns release all types of toxic contaminants into the air such as "mercury, particulate matter, metals, and other gasses that are harmful to the health of humans and the prosperity of the environment" (U.S. EPA 2022a). While the technology for running brick kilns has advanced over the years, Pakistan is still reliant on the more traditional technology for producing bricks (Khan et al. 2019). This is because upgrading brick kilns can cost millions of dollars to construct (Khan et al. 2019). As a result, this heavy cost can be a deterring factor in the improvement of Pakistan's brick kiln industry (Khan et al. 2019; Schmidt 2013). However, it is interesting to note that the traditional brick kilns that are being used are more expensive to run, require more space, and need more energy (Khan et al. 2019, Rauf et al. 2022). With more awareness in recent years about the environmental and human health effects that traditional brick kilns have, Pakistan has very recently put in efforts to shift their reliance on kilns to be more eco-friendly (Climate & Clean Air Coalition 2021).

The leather tanning industry in Pakistan also contributes to the rise in conventional pollution. The leather industry plays a significant role in Pakistan's economy and is considered to be the second largest contributor to their GDP (USAID 2018b). In 3 major cities, Kasur, Karachi, and Sialkot, there is an estimated number of about "800 tanneries" (Syed et al. 2010). These tanneries are attributed to hiring about half a million people in Pakistan (USAID 2018b). The problem that these industries are facing is that the discharge from waste poses a serious risk to the rise of conventional pollution in the country. Similar to other industries, this industry has harmful effects on the air quality, soil quality, and the health of many individuals working within the vicinity or living near the area.

Leather tanning is reliant on chemical processing that can leak into the environment. The inputs per ton of rawhide typically uses 300 kilograms of chemicals and for one kilogram of rawhide, 30-35 liters of water are being used (USAID 2018b). This rawhide then is brought to a tannery where the final product is produced and generates air pollution and solid waste (USAID 2018b). There are three processes that the rawhide goes through before being transformed into standard leather. The first step is the pre-tanning phase that uses chemicals and water to clean the rawhide. The second step is focused on tanning the leather which dries and tans the hide, the third step takes out any extra water in the hide and makes the leather the desirable way, while adding the finishing touches to the leather (USAID 2018b). The first and second step are the processes that produce and release the most amount of pollution in both the water and air because of the use of "40 different chemicals including heavy metals, acids, and dyes" (Junaid et al. 2017).

The textile industry is also a large contributor to the rise in conventional pollution in Pakistan. The clothing and textile industry has grown more than 400 percent in the past two

decades and is considered to be the second highest greenhouse gas emitting industry in the world, following after the oil industry (Chen et al. 2021). The clothing and textile industry creates “approximately 1.2 billion tons of greenhouse gas emissions” (Chen et al. 2021). The textile industry contributes to the rise in conventional pollution because the process of manufacturing “releases many harmful chemicals, such as heavy metals and formaldehyde, into water streams and soil, as well as toxic gasses such as suspended particulate matter and sulfur dioxide to air” (Aldalbahi et al. 2021). The textile sector in Pakistan is one of the largest sectors, accounts for 40 percent of the labor force, and contributes to eight percent of the total GDP (USDA 2021). Within the manufacturing sector, the textile industry makes up about 46 percent of the industry (Kousar et al. 2022). Although the industry is declining, it is still a prevalent issue for the rise in conventional pollution in Pakistan.

There are two different types of textiles. There is the technical textile industry, that is, non-clothing, which is used more so for work and everyday use applications such as a seatbelt in a car, a fabric used to separate soil layers, or even the gauze used for medical practices. Meanwhile, conventional textiles are used to create different types of clothing. The textile industry contributes to the rise in conventional pollution because, similar to the leather tanning industry, it uses a vast amount of chemicals “which are carcinogenic” and contributes to “one-fifth of worldwide industrial water pollution” (Aldalbahi et al. 2021). A large portion of the pollution comes from the wet processes that have taken place that can infiltrate water streams and offset pH levels (Aldalbahi et al. 2021). The finishing process for creating textiles also creates pollution byproducts that contribute to the rise in conventional pollution. This includes products such as “flame-retardant, softeners, atistatic, stain-resistant, water-proof, and oil repellent” (Aldalbahi et al. 2021). Not only do these contribute to the output of pollution but it

also becomes harmful to the health of humans and aquatic organisms (Aldalbahi et al. 2021). Last but not least, similar to the mechanization seen on farms, the "loss of lubricants or spinning oil from machines can lead to an unintended discharge of harmful materials" (Aldalbahi et al. 2021). Each of these processes can lead to an increase in conventional pollution that Pakistan needs to be more aware of.

In Pakistan, the main textile processing units are located in Lahore, Karachi, and Faisalabad. Many of the units in Lahore are considered to be small and medium sized while in Karachi and Faisalabad is where they have large units for textiles (World Bank 2014). The textile industry makes up about two percent of the solid waste generated in Pakistan, being the third largest polluting industry following the brick industry and the glass industry (ITA 2022c). Additionally, the textile industry does have an influence on the availability of water, because the runoff and leakages from the factories can contaminate drinking water. For example, groundwater is considered to make up one-third of the drinking water in Pakistan. However, only 25 percent of it is able to be used by individuals because the majority of the water is contaminated by pollutants that industries such as the textile industry have released.

Renewable and Non-renewable Energy

Pakistan's energy sector is a prevailing issue that continues to contribute to the rise in conventional pollution. Power generation has been a major issue that the Pakistani government has been trying to combat. Since 2013, efforts have been made to help mitigate the steady number of blackouts each year and increase the amount of energy that is flowing through the country. However, Pakistan is still facing issues with "expensive fuel sources, a reliance on imported energy products, chronic natural gas shortages, major debt in the power sector, and aging and insufficient transmission and distribution systems" that have restrained the energy

sector from growing and becoming more environmentally friendly (ITA 2022b). As of today, Pakistan's main source of energy comes from fossil fuels and the renewable energy sector only takes up about five percent of it (ITA 2022b). This is an important issue to address because Pakistan is greatly affected by climate change. The link between climate change and greenhouse gas emissions is a lot higher than other countries, such as the United States or the UK (Zaidi 2018). However, Pakistan has even recently taken initiatives to try and help the country improve its energy issues with coal-based solutions (Zaidi 2018)

One of the main sources of energy that Pakistan is still reliant on is coal. Around 75 percent of the total amount of electricity produced in Pakistan comes from coal (Government of Pakistan 2022). While Pakistan has coal reserves located within the country - mostly in Thar, they are heavily reliant on importing coal from other countries (Government of Pakistan 2022). Coal is burned in power plants which produces steam and moves turbines to produce electricity (U.S. EIA 2022). This contributes to the rise in conventional pollution because when the coal is burned, it releases a vast amount of toxins into the air. This includes "mercury lead, sulfur dioxide, nitrogen oxides, particulates, and various other heavy metals" (Union of Concerned Scientists 2019). Therefore, it is important to regulate to make efforts to decrease the heavy reliance that Pakistan has on coal in order to help reduce the amount of conventional pollution being produced.

Why is Conventional Pollution Still a Problem?

The rise in conventional pollution in Pakistan stems from a variety of sources. This includes economic incentives for the population, political instability, as well as severe weather events.

Economic incentives

A contributing factor to the rise in conventional pollution in Pakistan is the economic incentives that influence the public sphere and the government. This can act as a deterrent for industries and government officials to adapt environmentally conscious changes to particular processes. This includes the inability of the government to pay for machines and the installation of new sustainable equipment, the profit that businesses bring to the country, as well as the risk of losing employment in certain industries.

Non-Renewable Energy

The non-renewable energy sector is a leading contributor to the rise in conventional pollution. A major issue is the increased heavy reliance on coal as a dominant energy source. Although the top Pakistan government leadership is aware of the environmental implications of using coal, they have continued to increase its usage and even promote the mining of coal in Pakistan (Nikkea Asia 2022). Coal is necessary because Pakistan is struggling to meet an increasing demand for electricity (Bhandary and Gallagher 2022). The higher demand for electricity stems from greater economic activity, a growing population, and the global transition to a more technology dependent world (Government of Pakistan 2022). In order to meet this demand, in 2010 Pakistan's government created a relationship with the Chinese government to lend money to invest in the growth of their coal fired power plant industry (BU Global Development Policy Center 2022). China being the only lender in this initiative was funding

projects because it was getting too expensive to "keep using dollars to run power plants running on expensive furnace oil and RLNG" (Nikkea Asia 2022).

The "China and Pakistan Economic Corridor" (CPEC) had been a flourishing industrial initiative up until recently. The CPEC was a part of the Belt and Road Initiative by China that fostered the growth of Pakistan by making investments in its transportation, energy, communications, and industrial sectors (BU Global Development Policy Center 2022). Chinese banks provided loans to invest in projects such as increasing the amount of coal fired power plants throughout the country. This was an especially important investment because in 1992, Pakistan located billions of tons of coal in the Thar Desert that it believed it could transform into a profitable energy source (Government of Pakistan 2002). As a way to pay back loans, Pakistan agreed to pay back debt that it owed to China and promised a high return on equity to the power generation companies. The developers in Pakistan will buy insurance through China, and the pay-back period will be reduced from five to ten years. All of these terms were leveraged as an incentive to ease investors' worries and provide a sense of security in the loans. Therefore, state-owned Chinese banks have loaned about $21.9 billion in short term loans to improve Pakistan's infrastructure, of which nine resulted in coal fired power plants (Hancock 2022). However, in more recent years, Chinese sources have stopped their investments in coal because since 2015, many of the energy projects have been at a standstill and these sources have not seen much transformation with their investments (Ebrahim 2021). While this a promising start to decreasing the amount of conventional pollution released through coal power plants, it does not ensure that reliance on coal will decline.

Much of the desire for Pakistan to continue to use non-renewable energy sources is the short-term resource availability that can meet the demand for energy. With the finding of

millions of tons of coal within the Thar desert, it was understood that there is a higher return on equity for coal-fired power plants that used locally sourced coal rather than imported coal (Bhandary and Gallagher 2022). The volatility of the Pakistani Rupee against the dollar also has another incentive for Pakistan to invest in its coal-fired power plants (Bhandary and Gallagher 2022). In regard to other sources of energy such as natural gas and more sustainable energy sources such as hydroelectric power, coal is considered to be an easier and quicker option in the short and medium term future. Coal-fired power plants are readily available and take around three to four years to create and typically retire after 50 years of operation (U.S. EIA 2021). Other energy sources are more disincentive for investors because they are more expensive, long-term projects. Hydroelectric dams, which are an investment that Pakistan has the resources to use, can take up to four to seven years to build (AQPER 2023). These dams also are very expensive to maintain. For example, "the Three Gorges dam in China is an 'environmental bane' that will cost over USD 26.45 billion over the next 10 years in environmental 'mitigation efforts'" (Ansar et al. 2014). Meanwhile, wind energy is another alternative for which Pakistan has abundant resources. However, the typical lifespan of a wind turbine is about 20 years and requires maintenance every six months to ensure that the turbines are running properly (U.S. EPA 2013). Therefore, Pakistani officials are inclined to continue the reliance on coal-fired power plants because of their efficacy and the low cost of building and maintaining.

In addition, the costs of coal-fired power plants are expensive to build but are to operate. Typically, it costs about $3,500 per kilowatt capacity to build a new coal plant and the plant's operating costs range from about "$28 per megawatt hour(MWh) to $40/MWh" (U.S. EIA 2019). Meanwhile, wind turbines on large scale wind farms can be installed for between $1,000 to $2,000 per kilowatt hour and on a large scale can be installed for $3000 per kilowatt hour

(U.S. EPA 2013). Wind sites are also heavily dependent on wind availability and the cost of electricity will depend on the amount of wind at the time (U.S. EPA 2013). On average, in the United States the cost of electricity run on wind power is about 7.9 cents per Kilowatt hour (kWh). The average cost in the United States for electricity to run on coal power is 3.2 cents per Kilowatt hour (kWh) (Greenstone and Looney 2011). However, what is a contributing factor to the reliance of electricity is the amount of financial support that other countries are providing for Pakistan to move towards a more sustainable future. Climate finance from developed countries has provided the money and opportunity for Pakistan to use more renewable-energy and decrease its conventional pollution output (USAID 2021b).

Industrial Practices (leather tanning, brick industry, textile industry)

Industrial practices are significant contributors to the rise in conventional pollution. While there have been new approaches to making these industries more sustainable, Pakistan has been slow to make improvements. This is because of the time it takes to alter the system and the economic costs associated with introducing sustainable machines and factories. Additionally, much of the population in Pakistan is reliant on industries to provide jobs.

I. *The Brick Industry*

The brick industry has stayed fairly stagnant in its manufacturing processes over the years because of its high profitability and the large investment it would take to rebuild the 20,000 brick kilns that are located all over Pakistan. However, Pakistan joined the Climate and Clean Air Coalition in 2017 with the commitment to decrease the amount of conventional pollution. The government also has set a goal of 60 percent of Pakistan's energy coming from sustainable energy sources by 2030 (ITA 2022b). As of 2021, there have been advancements towards changing the brick industry. Approximately 8,000 of the 20,000 traditional brick kilns have been

adjusted to be more sustainable (Climate & Clean Air Coalition 2021). They did this by changing the traditional brick kilns that were installed to the more contemporary zigzag brick kiln. This alteration will cost up to $45,000 per brick kiln but will have a payback time between one to three years because the traditional brick kilns operations are much more costly (Schmidt 2013).

The brick kiln industry faces limited alternatives for more sustainable fuels. Brick **k**ilns have a heavy reliance on coal, rubber, and trash as a fuel that releases a lot of pollutants into the air (US EPA 2023). These kilns need enough energy to create the heat and also meet the low release of possible air contaminants (Moedinger et al. 2013). Many of the success stories from using renewable energy sources as a fuel come from a variety of options that range from landfill gas to biogas (Moedinger et a. 2013). Since there are no established renewable energy source for brick making, Pakistan has yet to push for brick kilns that rely on renewable energy sources. However, there have been alternative suggestions for short-term opportunities to decrease the amount of pollution produced by traditional brick kilns changing the setup of the brick kilns. For example, by improving the fixed chimney kiln would focus on improving the back-process mechanization and firing processes. Even implementing a gravity settling chamber that will "reduce the speed of flue gas", an important aspect "because heavy particles cannot move with the gas stream, they are deposited in the settling chamber" (World Bank 2011). While all of these are small improvements on the brick kiln process, none focus on changing the energy source as an alternative.

II. *The Leather Tanning Industry*

The leather tanning industry is another important industry that contributes to the rise in conventional pollution. The way to decrease the amount of conventional pollution for leather

tanneries requires adjustments in each of the separate processes as mentioned earlier. The costs can deter the Pakistani government from requiring change among the 800 tanneries.

Globally, consumers of the fashion industry have been pressuring countries to provide fashion options that are environmentally friendly. Therefore, the industry in Pakistan has experienced declines in its leather exports because of the failure to make the processes more environmentally friendly (Sikander et al. 2021). There are two approaches that Pakistan can take to meet the "international environmental compliance norms" (Sikander et al. 2021). That focus on reducing, reusing, recycling, and recovery.

Leather industry executives have stated goals for their leather tanning industries but they have yet to instill them in all of their factories. So far, the industry has made efforts to reduce wastewater throughout the tanning process, as well as to install treatment plants that remove the heavy metals. However, this has only happened for the Korangi tanneries located in the Sindh province and have yet to be implemented for other tanning facilities located around the country. The Korangi treatment center construction cost about Rs 492 million which is $8.2 million (Leather International 2008). While there have been more profitable and environmentally friendly processes linked to the water management, compressed air, energy management, and steam management in the industry, it takes time and money to change the operations of the industry in all 800 tanneries.

III. *The Textile Industry*

Similar to the leather tanning industry, the textile industry has been facing external pressures to become more sustainable. Many of the polluting aspects of the textile industry are ingrained in their processes, such that the output of conventional pollution comes from multiple sources throughout the textile process. Unlike the brick kiln, which can be redesigned to make it

more sustainable, the textile industry requires changes in each of the manufacturing processes that can be difficult to achieve. In order to meet these changes, companies in the textile industry would need large investments to improve the processes. However, Pakistan is currently in an economic crisis, which makes it difficult to devote sufficient funding to upgrade the machinery and technology.

In addition to the economic crisis that Pakistan is facing, it is also facing an ongoing energy crisis that emerged two decades ago (Aftab 2014). This has had a severe impact on the textile industry because electricity shortages have made it impossible to meet the demand. Recently, textile orders have been delayed and disrupted because of the energy and economic crises, which has forced companies to cancel orders. About 100 mills have shut down, and many more are expected to follow suit in the near future (Dilawar 2022). The energy crisis has made it difficult for the textile industry to reduce their conventional pollution output because many companies are more concerned with improving their production numbers and preventing their company from being shut down, rather than making themselves more sustainable.

The Agricultural Industry

The Agricultural system in Pakistan is struggling to decrease conventional pollution because it is affected by the increasing population, lack of financial resources, high cost of production and the reliance on imported agricultural machinery.

The ongoing economic crisis has impacted the ability for the agricultural industry to move to a more sustainable way of producing. This is because farmers have to rely on exterior grants to make adjustments to their farms. While Pakistan's government is working towards implementing more sustainable practices into the agricultural industry, it is becoming more difficult to fund these projects with the current climate of the energy and economic crisis.

Therefore, much of the agricultural industry is waiting for funding from organization outside of Pakistan such as the U.S. government and World Bank to support decreasing conventional pollution.

The lack of farmers' education about sustainable practices plays a significant role in preventing the reduction of conventional pollutants. As the Green Revolution developed throughout Asia, it was common to see many farmers who own large-scale and medium-scale farms acquire the money to move towards more sustainable practices (Zulfiqar and Thapa 2017). Farmers who own small scale farms struggle to meet those levels of sustainability (Zulfiqar and Thapa 2017). However, there is a lot of pressure to become more sustainable due to the vulnerability of Pakistan's agriculture. Many small farmers are relying on information released to the public as a way to stay up to date with the latest technologies. However, Pakistan's "current extension setup often ignores marginal farmers; consequently, many smallholders remain out of the extension's reach, and the adoption of the latest agricultural technologies remains low" (Jabber et al. 2022). Additionally, even when extensions do reach these marginal farmers, the information given is more general and is not geared to the problems that plague farmers in that area (Jabber et al. 2022). As a result, not much progress is seen with many of the suggested solutions.

Pakistan, like other developing countries, is receiving investments in industries that wealthier countries have eschewed. According to the Environmental Kuznets Curve, because Pakistan has a lower GDP compared to developed countries, it is taking on tasks that countries with more money do not want to burden their population with. More recently, the climate crisis has been an important topic of discussion among countries. Many governments try to keep their conventional pollution and greenhouse gas emissions low by creating policies that limit how

much can be released by their country. The problem that developing countries encounter is that there is still a demand for certain products that have high levels of conventional pollutant outputs. Therefore, developed countries push developing countries, such as Pakistan, to manufacture and produce these products. While this does bring in a large amount of conventional pollution, developing countries are inclined to take on these projects because it has an economic benefit for them that in the long run could potentially take them out of financial instability.

Politics

Political instability plays an important role in the inability for Pakistan to adapt the industries to be more sustainable. In April 2022, the Prime Minister Imran Khan created chaos in the country, which included a series of protests after the Parliament held a vote of no confidence. Afterwards, there was a failed assassination and he was ousted from his position. Since then, he is still a prominent figure trying to claw his way back up to a position of power (Bremmer et al. 2022). This plays a toll on the political effectiveness of the government because it distracts government officials from reaching Pakistan's sustainability goals. Political instability is also a barrier to reducing the conventional pollution output because it deters government and international organizations from providing financial support (Adebayo 2022).

The political atmosphere thus affects Pakistan's sustainability efforts because many government officials are focused on short-term goals when considering reelection. As a Federal Democratic Republic with a Parliament, Pakistan's politicians are subjected to elections. However, with the current climate around the energy and economic crisis, many politicians are focusing on advocating short-term solutions to these problems rather than advocating for the health benefits of these long-term solutions. Therefore, many of those in the political sphere who

have the power to make decisions for the country are deterred from making any large-scale plans to diminish the conventional pollution that Pakistan is producing.

What Has Been Done?

There is much that needs to be done in order to achieve the goal of reducing conventional pollutants. Pakistan's sustainable development goals include deriving "60 percent of energy from renewable sources" and reducing Greenhouse Gas emissions by 20 percent by 2030 (Government of Pakistan 2021). Pakistan is rich in alternatives to non-renewable energy sources. They have the opportunity to invest in wind energy, hydroelectric power on a micro and large level, and solar energy (ITA 2022b). In order to achieve this goal, the government and private organizations within Pakistan need to allocate far more money and other resources such as improved technology, consultation on developments, and subsidies. However, truly sustainable development would cost billions of dollars; so, it is worth looking toward external sources of funding for these projects. In addition, opportunities within the Pakistani government can also play a significant role in reducing conventional pollutants.

Non-governmental organizations (NGOs) have an impact on decreasing conventional pollutants in Pakistan. NGOs that focus on sustainability in Pakistan raise money, provide expertise, and mobilize support for sustainable goals. They can provide private industries with suggestions for alternative sustainable practices and private funding for non-renewable energy projects that will provide energy in a more sustainable manner. An example is the Pakistan Environmental Trust. This organization has three main goals: achieve a net zero Pakistan by 2050, restore the ecosystem through private investments, and reintroduce wildlife into Pakistan to bring back its biodiversity (Pakistan Environment Trust 2023). Many organizations like this can have a large impact on the future of Pakistan by creating alternative routes to achieving sustainable development goals.

Within the government, a subset of agencies exists that also play a role in reducing conventional pollutants. Pakistan founded the Environmental Protection Agency in 1997 that focuses on projects working toward achieving new sustainable development goals. Some of its functions include "[taking] measures to promote research and development of science and technology which may contribute to the prevention of pollution, protection of the environment, and sustainable development" (Pakistan Environmental Protection Agency 2023a). The Environmental Protection Agency takes on a multitude of tasks to ensure that conventional pollutants are being scrutinized, such as visiting factories and completing inspections, conducting research on air quality, and consulting on waste management rules and regulations (Pakistan Environmental Protection Agency 2023b). However, Pakistan's Environmental Protection Agency can improve by increasing its monitoring practices to ensure that companies are working within the standards regulations. It can also be improved through more transparency with environmental information and engaging citizens more in environmental management (Acerbi 2019).

Top leaders within the government also can play an important role in pushing for environmentally sustainable goals. In 2018, the Prime Minister launched the Clean Green Pakistan Movement. This movement is intended to make sustainability a priority in Pakistan by having government recognition of cities and institutions that put in impressive efforts to reduce pollutants. This campaign envisions "the need to address five components: plantation, solid waste management, liquid waste management/hygiene, total sanitation, and safe drinking water" (Clean Green Pakistan 2023). This is an effort more so to entice the people rather than create a concrete plan on how to improve the environmental degradation that has been taking place.

In 2018, the National Transport Policy of Pakistan is committed to improve the transportation availability and the sustainability of transportation. As part of its goals, the Pakistani government intends to “foster sustainable urban development” and “preserve and conserve the environment” (Ministry of Planning, Development & Reform 2018). These efforts are made by implementing urban planning practices, modernizing facilities, and implementing rules and regulations for development (Ministry of Planning, Development & Reform 2018).

Pakistan’s government also has been engaging in many environmentally sustainable pledges in order to work towards reducing conventional pollutants. Some of these initiatives include joining the Paris Agreement, which is a public declaration of the Nationally Determined Contributions (NDC) that plans to “cut emissions and adapt to climate impacts” (United Nations 2023). In addition, these contributions need to be publicly updated at least once every five years, which holds Pakistan responsible for its declarations. In 2021, the Pakistani government also joined the US and EU Global Methane Pledge which is “committing to the collective goal of reducing global methane emissions by at least 30% from 2020 levels by 2030” (Climate & Clean Air Coalition 2023). In 2022, Pakistan updated their NDCs with an in-depth report about what their mitigation efforts are going to be to decrease their conventional pollutants.

Meanwhile, beyond the scope of the government there are other opportunities for which Pakistan has strived to gain support, one of which is by getting funding for projects through partnerships. Since 2017, Pakistan has joined the Climate and Clean Air Coalition, which is a partnership of “governments, intergovernmental organizations, businesses, scientific institutions and civil society organizations committed to improving air quality” (Climate & Clean Air Coalition 2023). It has been helping “activities in the bricks, household energy, agriculture, and waste sectors” (Climate & Clean Air Coalition 2023). In addition to these long-term construction

plans, recent efforts have been undertaken to work on short-term planning for reducing air pollution. With the Climate and Clean Air Coalition, the government has been working on educating individuals working in the brick making industry about “cost-effective alternatives to traditional kiln technology that will simultaneously reduce emissions and produce health and agricultural benefits” (Climate & Clean Air Coalition 2023).

The United Nations has also been a helpful supporter in decreasing conventional pollution. The UN has a Regional Office for Asia and the Pacific focused on “[promoting] a green and just transition that delivers inclusive solutions to address the triple planetary crisis of climate change, nature and biodiversity loss, and pollution and waste”. In 2006, the Government of Pakistan joined as a “One Pilot country” (United Nations 2023). This is a program that involves eight countries that work with the UN to develop their country through different practices. The UN and the Pakistani government work together to support national development while being able to reduce costs. Working with the UN Sustainable Development Framework for Pakistan, two major contributors (United Kingdom and the United Nations) donated over $34 million to jumpstart the project (UN MPTF Office Partners Gateway 2023). More recently, due to the floods in 2022 the United Nations CERF donated $13 million relief funds to the country. These donations can help decrease conventional pollution through sustainable reconstruction projects. In addition to donations, the UN works on reports for Pakistan’s Sustainable Development Goals. In these reports the UN works with the government to improve “national, regional and international private sector investments aligned with Agenda 2030” (UN Development Programme 2021). Reports on these findings to the public can help garner donations and support from global initiatives.

While Pakistan does not have a lot of forest land, there are opportunities to improve its forestation coverage. The UN started a program called REDD+ in 2008. The focus of this program is "to pay off for countries stepping up efforts to halt deforestation" (Green Climate Fund 2019). This program is supposed to incentivize countries to develop their forest lands to better their environment. In order to reach this goal, countries will implement strategies recommended by REDD+ which include sustainable planning, the integration of new technologies, and obtaining result-based payments (UN Climate Change 2023). In order to get the financial funding, countries must report their results to the UN (UN Climate Change 2023). This may be a great opportunity for Pakistan. While it is considered to be a country with low levels of forestation, in which there is only five percent coverage, it is still important to protect and rejuvenate those lands (UN Environment Programme 2021). The money involved with this project is also a great incentive for countries to become more environmentally conscious of their conventional pollutants. Since the REDD+ program has started, the activities listed have shown "emission reductions of 6.3 billion t CO2 eq." (UN Climate Change 2023).

The UN also provides seed funding for innovative projects focused on promoting sustainability within the country. The UN has taken initiative to financially support some corporate social responsibility projects because of the environmentally friendly opportunities they provide. In 2018, the UN provided an environmentally sustainable startup with $10,000 to support their focus on making lives in Pakistan more sustainable (UN Environment Programme 2018). Opportunities like this are an incentive for people in the country to mobilize and start working towards a more sustainable future.

Other global organizations also play a role in promoting the reduction of conventional pollutants in Pakistan. The World Bank group consists of 5 different institutions: the

International Bank for Reconstruction and Development, the International Development Association, the International Finance Corporation, the Multilateral Investment Guarantee Agency, and the International Centre for Settlement of Investment Disputes (World Bank 2023c). Each of these play a role in providing support for Pakistan when working on their sustainable development goals. What this institution does is that it reduces "poverty by lending money to the governments of its poorer members to improve their economies and to improve the standard of living of their people" (World Bank 2012). It aims to help implement projects that promote sustainability. Such projects include financing developments in the energy sector, reporting on climate and development within the country, and researching more practical practices to improve climate in the country. One recent project that was started in 2020 was approved by the International Bank for Reconstruction and Development and the International Development Association. They donated $727 million to the "Khyber Pakhtunkhwa Hydropower and Renewable Energy Development" initiative (World Bank 2023b).

The World Bank group also provides support for sustainable agriculture projects. In 2022, the World Bank group approved a loan of $200 million to finance a transformation in the agricultural sector (World Bank 2022d). This money is intended to go toward implementing technologies that will "improve water-use efficiency, build resilience to extreme weather events and increase incomes of small farmers" (World Bank 2022d). These loans make a big impact on the agricultural environment by providing the adequate funding that establishes a healthier lifestyle for the people living and working in the area. In 2012, the World Bank group also provided funding for the PK Punjab Irrig Agri Productivity Improvement Program Project, focused on improving the agricultural irrigation systems in Pakistan (World Bank 2022c). In order to reach this goal, the World Bank loaned $423.5 million in funding to improve "physical

delivery efficiency and irrigation practices, crop diversification and effective application of inputs that will translate into greater agricultural output per unit of water used" (World Bank 2022c). In 2021, this project came to a close with seeing improvements in the agricultural system. However, recent weather events and natural disasters have created setbacks in the ability for the agricultural industry to fully take advantage of this infrastructure expansion.

In addition to nonprofit organizations and banks, there is also government aid from other countries. One of the large contributors is the U.S. International Development Agency (USAID). This agency works to advance "U.S. national security and economic prosperity, demonstrates American generosity, and promotes a path to recipient self-reliance and resilience" (USAID 2023). Under a USAID contract in 2017, Pakistan created a plan to develop its sustainable energy (USAID 2021a). This plan was focused on creating "a creditworthy business environment that attracts private sector investors… expand capacity within the Government of Pakistan to bring projects to financial close… transform the transmission system operators into an entity capable of managing and expanding… overcome barriers to RE investment" (USAID 2021a). This project included the donation of millions of dollars into the energy sector in Pakistan as well as contributions from other investors (USAID 2021a). Not only did the United States help provide financial relief for these projects, but it also improved the process for seeking climate funding so that Pakistan can start independently running their businesses without support from outside aid.

Meanwhile, there are other opportunities in which Pakistan can work to help reduce conventional pollutants. One is through organizations dedicated to informing people about unsustainable practices. One of these companies is called Better Cotton. Better Cotton partners with industries in Pakistan to improve the sustainability of the cotton industry (Better Cotton

2023a). One of its initiatives is to educate farmers who are unaware of the unintended consequences of current agriculture practices (Better Cotton 2023b). Since it started this initiative, it has licensed 495,809 farmers, who have produced 682,000 tons of cotton that come from more sustainable practices (Better Cotton 2023a). Pakistan should increase its efforts to gain support from nonprofit organizations because of its many opportunities to get private funding for sustainability projects from international sources.

The Intergovernmental Panel on Climate Change (IPCC) is a body of the United Nations that researches and analyzes climate change in countries (IPCC 2023). They dedicate time and money to assess a country's emissions and propose possible ways to decrease pollutants. As part of their effort to relieve developing countries of their output of pollutants is by funding scholars dedicated to researching environmental concerns in their country. These scholarships are focused on students who are focused on "research that advances the understanding of the scientific basis of risks of climate change, its potential impacts and options for adaptation and mitigation" (IPCC 2023). By granting students scholarships, the IPCC provides an incentive to increase the number of individuals who are interested in the environment.

Pakistan has also been given the opportunity to get industry focused funding that promotes sustainable development. Working alongside the UN, other private funders promote the development of specific projects. These projects are tailored to change the practices and energy sources of industries. Partnering with the United Nations Environment Fund, organizations such as the Global Environment Facility, the Green Climate Fund and the European Commission have contributed substantial funds to help with sustainability developments. The Green Climate Fund is a fund dedicated to promoting four transitions in developing countries- "built environment; energy and industry; human security, livelihoods and

wellbeing; and land-use, forest and ecosystems" (Green Climate Fund 2023). In 2022, it approved a project that invests heavily in expanding the reliance on solar products. This fund has initially guaranteed the implementation of a solar facility in Pakistan that is supposed to "finance 43 MW solar PV installations for households, agribusinesses and small and medium enterprises" (Green Climate Fund 2022). This project funding is a starting point in introducing sustainable energy into Pakistan and can result in positive outcomes of relying on sustainable energy. According to the Green Climate Fund, emissions should decrease by 848.7k tonnes (Green Climate Fund 2022).

The State Bank of Pakistan (SBP) also promotes conserving energy and decreasing conventional pollution by supporting individuals who make sustainable energy investments. As of 2009, this Bank has promoted clean energy use by offering "concessional loans to customers to acquire solar PV systems" (Green Climate Fund 2022). This is used as an incentive for individuals looking to engage in renewable energy projects because it offers "debt financing at fixed subsidized interest rates of only 6.00% per annum" (Malik, Qasim, and Saeed 2018). In order to ensure this, the State Bank provides loans to commercial banks and development finance in which they pay the State Bank of Pakistan two percent on the loans and then get a four percent return from customers looking to make these investments (Malik, Qasim, and Saeed 2018). However, the target for these subsidies is to "utility-scale renewable power projects and to rooftop solar power projects being installed by commercial entities like factories" (Malik, Qasim, and Saeed 2018). Therefore, individuals who are interested in the option have a harder time with implementing it at their own homes. The SBP could improve its lending system by allowing loans to be extended to individuals and to "companies selling distributed energy systems and services" (Malik, Qasim, and Saeed 2018).

The Pakistani government also has been implementing projects that promote sustainability within the country. One of these initiatives is the Ten Billion Tree Tsunami. Starting in 2019, this project aims toward planting ten billion trees by 2023 (UN Environment Program 2021). As of June 2021, Pakistan successfully planted one billion trees (UN Environment Programme 2021). This project is necessary in restoring the ecosystem in the country and decreasing the amount of emissions created by Pakistan (UN Environment Programme 2021). It has also been helpful in rejuvenating the natural capital of Pakistan and has provided almost 85,000 individuals with daily wages (UN Environment Programme 2021). Pakistan is incentivizing individuals to think more about the environment and is bringing awareness on the necessity of being more environmentally friendly.

To deal with toxic waste, the Pakistani government has teamed up with the Chemicals and Waste Management Programme on a three-year project. The goal of this initiative is "to strengthen institutional capacity and also develop, adopt, monitor and enforce a sustainable chemical and hazardous waste management policy" (UN Environment Programme 2019). Since Pakistan has historically been dealing with an increase in toxic waste, the Pakistani government is creating a plan to combat it. Through funding provided by the UN Environmental Programme and through consultation with this treatment program, Pakistan is able to work on decreasing their level of waste toxicity. This project aims to create a national agenda that places stricter regulations on harmful chemicals and waste, update their "HS coding and GHS for chemicals", develop a plan for where to put hazardous waste, and integrate thinking of toxic waste into national budget and planning (UN Environment Programme 2023). Pakistan was able to get $243,000 in funding for this project (UN Environment Programme 2023). By implementing

stronger regulations and working on improving waste allocation, industries in Pakistan as well as the government will be more mindful of the toxic waste that is generated.

The Pakistani government also ended its subsidies program for energy sources. These subsidies provided individuals with the ability to buy fuel and energy at a lower price than they normally would. However, these subsidies were not properly funded and therefore put the Pakistani government in $1.289 billion debt (Welsh 2022). The International Monetary Fund started an agreement with Pakistan in 2019 which ensured that three billion dollars in bailout funds would be provided to Pakistan if it uses the financial advice given to them (Welsh 2022). Therefore, Prime Minister Imran Khan cut energy and fuel subsidies to continue receiving these funds (Welsh 2022). This has been helpful with decreasing conventional pollution by making it more expensive to use fossil fuels as an energy source.

The International Monetary Fund has been providing Pakistan with research and funding for its Sustainable Development Goals adopted by the United Nations. The IMF Fiscal Affairs and African Departments have examined development strategies to reach sustainable goals. Pakistan is one of the four case studies for the IMF (IMF 2022). Recent initiatives are written in the Staff Discussion Note which focuses on Sustainable Development goals post-pandemic (IMF 2022). Through this research, the IMF provides Pakistan with information on where to find financial resources and consult on policy options that would help with sustainable progression (IMF 2022).

The European Union (EU) is a contributor to supporting green energy development in Pakistan. In the beginning of 2023, the EU provided Pakistan with €87 million to fund a green economy. Since the major flooding event in 2022, Pakistan has been rebuilding its infrastructure. This funding is working toward three initiatives while in close collaboration with the Pakistani

government (Pakistan Today 2023). The first initiative is called the KP Rural Economic Transformation Project. This project is focused on "[improving] rural households' income by supporting farmers in the transition toward more sustainable and profitable agriculture" (Pakistan Today 2023). The second initiative is the Energy Plus program, which aims to create hydropower facilities and "support more efficient use of energy for sustainable transition to renewable energy" (Pakistan Today 2023). The third program is the Technical and Vocational Education and Training program that provides funding to introduce "environmentally-friendly skills in the agribusiness, water and energy sub-sectors" (Pakistan Today 2023).

Throughout the year, Pakistan has made substantial improvements in finding ways to get support and funding for environment focused projects. NGOs, foreign governments, and nonprofits have been helpful in devising sustainability plans, providing funding for projects, and researching ways to help mitigate pollutants. However, there is more that can be done and Pakistan should continue to broaden the scope of organizations and governments with which they work to achieve their sustainability goals. The sustainable development goals should be a benchmark for progress, but Pakistan should continue to surpass those expectations as 2030 gets closer.

What Can Be Done?

Due to Pakistan's environmental crisis, it is crucial for the Pakistani government and supporting countries to take steps to relieve the effects of conventional pollution on individuals, communities, and environments. This includes enforcing sustainability goals among industries and workers, encouraging the reduction of wasteful practices, and being more assertive with sustainability requirements. In order to achieve sustainable development goals, the Pakistani government will need to work with communities and external sources for financial support and implementation of projects throughout the country.

An opportunity for Pakistan to reach its sustainable development goals is to increase participation from the private sector. One way Pakistan can do this is by organizing a public credit guarantee scheme (PCGS). PCGSs are attractive to investors because they protect against default by diminishing credit losses (Gozzi and Schmukler 2015). This would help with climate goals because it would force industries to consider integrating climate conscious planning into their operations (Calice 2021). Public credit guarantee schemes improve sustainable development by having companies focus on climate strategies, consider climate risk, increase climate investments, and track climate information (Calice 2021). In order to support these PCGSs, the government needs to create a "policy framework to ensure that supportive policies and regulations are in place" (Calice 2021). While the State Bank of Pakistan has started to implement this into its system, there is still a credit gap between small and medium companies that produce goods that are environmentally sustainable.

Pakistan should also look to receive funding to improve environmental management. Environmental management oversees the interaction between humans and the environment. By strengthening this aspect of government in Pakistan, conventional pollution would decrease

because of stricter regulations on industries and individuals. An example is in 2022, Bangladesh received funding from the World Bank Group that will "help construct four vehicle inspection centers using private-public partnership modality… [and] an E-waste management facility will be set up" (UNESCAP 2020). These inspections and facilities are crucial to the health of the environment because it puts more pressure to comply with regulation standards.

The Climate Investment Fund (CIF) is an important funder to help developing countries reach their sustainable development goals. This Fund focuses on helping countries work toward developing climate focused planning. It does this by investing in projects for countries that "are the least prepared yet the most prone to the challenges of climate change" (CIF 2022). However, Pakistan is behind in getting funding for its projects in comparison to other countries. As of now, Pakistan has one project approved by this fund with a total of $0.57 million. This project is focused on "scaling up renewable energy programs in low-income countries" (CIF 2021a). Bangladesh, a country facing a similar environmental crisis, is working on a total of 12 projects and has received about $194 million from the CIF and a total of $1.85 billion from co-financing projects (CIF 2021b).

The United Nations Framework Conventions on Climate Change has a variety of funding opportunities for sustainable development that Pakistan should consider expanding into. While Pakistan has already received funding from bilateral agencies such as USAID and the DFID, there are other countries that are willing to provide funding with which Pakistan should partner. Many of these countries have been supportive of Pakistan by providing millions of dollars to help with flood relief, but dwindles when providing environmental protection. Therefore, additional countries should consider creating relationships with Pakistan concerning their sustainable development goals.

In order to achieve Sustainable Development goals in Pakistan, it would have to increase the amount of money that is annually allocated in its budget. From 2021 - 2022, the budget allocated to environmental protection has increased from Rs 436 million to Rs 749 million (Government of Pakistan 2023). However, in order to achieve the 2030 Sustainable Development Goals, "these sectors would require additional annual spending of about 16 percent of GDP… from public and private sectors combined" (IMF 2023). The Pakistani Government should focus on improving its own finances so that it can allocate more money from its own budget to reduce conventional pollution and see progress in the environment.

The Agriculture Industry

The Pakistani government can also decrease conventional pollution by reducing wasteful practices in the agricultural sector. One way in which Pakistan can improve its agriculture industry is by increasing the availability of educational opportunities for farmers. This includes informing farmers of the better farming techniques, such as what is considered to be a sufficient amount of pesticides and fertilizers. Increasing educational resources can also make farmers aware of alternative practices. A common practice for many farmers is to burn excess waste, such as leaves, sticks, and brush. By making sustainable farming practices more readily available, farmers can implement "on-farm composting of agricultural waste materials" (Hashim et al. 2022). This would reduce conventional pollution and improve the working conditions. In order to implement these ideas and projects, the government can work alongside communities and local governments to increase awareness by providing pamphlets, educational courses, and starting conversations in communities.

Implementing additional technologies within the agriculture industry also will reduce conventional pollution. One way that Pakistan can reduce conventional pollution is by investing

in solar-powered irrigation systems. Currently, many farmers in Pakistan are reliant on diesel-powered tube wells for their irrigation. However, in some areas, they were able to switch to this high-efficiency irrigation system (HEIS), farmers would also be able to reap the benefits of subsidies that come with using renewable energy sources. Punjab is "promoting solar technology by providing a 60% subsidy on installing a HEIS system and an 80% subsidy for a solar system if coupled with HEIS" (Shah and Akbar 2021). However, farmers are currently hesitant to use this because of the high costs of implementation and the low levels of discharge that the pump is capable of producing (Shah and Akbar 2021). Additionally, 90 percent of Pakistan's irrigation system uses flood irrigation that is not piped (Shah and Akbar 2021). Therefore, Pakistan should consider combating this with increasing research to improve the technology and allocate funding for farmers.

The Brick Industry

While the brick industry is limited in opportunities to be more sustainable, there are minor changes that companies can integrate into the brick kiln process that would decrease the amount of conventional pollution. As stated before, Pakistan has converted about 8,000 of the 20,000 brick kilns to use zig zag technology (Climate & Clean Air Coalition 2021). However, there are still 12,000 brick kilns that rely on older technology. Pakistan has focused on decreasing the pollution outputs of this industry by partnering with large organizations such as the United Nations and the World Bank to find solutions. As a quick way to decrease emissions among the kilns that rely on old technology, the EELA (Eficiencia Energética en Ladrilleras Artesanales), a group dedicated to improving the industry has suggested adding "a fan that blows air at smoldering kiln fires to boost their combustion" (Schmidt 2013). This would reduce the need for fuel by about 30 percent which will reduce total emissions (Schmidt 2013). While

waiting for more funding for projects, this is a cheaper alternative for improving the brick kiln industry as it is more available to kiln operators (Schmidt 2013).

The Textile Industry

The textile industry can reduce conventional pollution by monitoring wastewater generation. Improving water conservation and regulating the amount of toxins put into the water is essential in developing the industry. In order to achieve this, textile companies can focus on implementing water treatment centers. Textile water treatment can be improved by integrating a biological or chemical process. One potential treatment type is to add membrane filtration into the water (Petrinic and Helix-Nielsen 2015). This process is considered to be advantageous because of the lack of chemicals used to develop high quality water after treatment. The membrane process also takes up less space because it is smaller than other water filtration systems (Petrinic and Helix-Nielsen 2015). However, the membrane filtration system struggles to dissolve dye retention in the water (Petrinic and Helix-Nielsen 2015).

Companies could also treat "waste water by activated sludge reactor[s]" (Iqbal et al. 2011). Before biological treatment, it is important to use techniques that absorb pollution in wastewater (Iqbal et al. 2011). Sludge reactor is activated carbon that removes dye coloring and decreases BOD and COD by about 60 percent each (Iqbal et al. 2011). While there are many forms of wastewater treatment, textile companies in Pakistan need to consider options that are inexpensive and effective. Different approaches are optimal in different circumstances. Therefore, technical assistance should be increased to advise companies which approaches are optimal in each circumstance.

Domestic and Municipal Waste

Domestic and municipal waste can be improved through increasing private and public sector investments. Over the years, there has been growth in FDI contributions that can be utilized to start projects focused on waste collection and waste treatment (ITA 2023). Pakistan can improve municipal waste by integrating low-cost waste collection systems within communities and centralizing a waste processing center (Schmidt et al. 2022). This would be beneficial by reducing conventional pollution, which would decrease the health problems many individuals living or working in those areas face (Schmidt et al. 2022). One of the main difficulties with this project is that communities have distinctive problems that need to be addressed, but implementing a set of procedures that use improved technology would be a starting point to improving waste management systems.

Renewable and Non-renewable Energy

Pakistan should move away from non-renewable energy sources as a main source of energy, and focus on developing renewable energy. In order to achieve its goal of having 60 percent of its energy coming from renewable energy sources, Pakistan should consider making significant private and public investments in energy. This can include expanding wind, hydro, and solar energy in the country.

Wind energy should be considered an alternative to the non-renewable energy sources. Areas in southern Pakistan, located in Sindh and Balochistan are rich in wind energy (ITA 2023). Recently, the Pakistani government has been working on developing their wind program in the south with a total of 26 private projects and 10 public projects that are under construction (ITA 2023). However, Pakistan should consider expanding its wind power to the west of Pakistan as they have the opportunity to produce electricity due to the high wind levels in that region (Knight 2021). Additionally, Pakistan should consider implementing more projects in the west of

Balochistan because of the high levels of wind produced (Knight 2021). Increasing wind energy is beneficial to the public by providing job opportunities and creating roads to serve the wind farms (World Bank IFC 2023).

Pakistan is also rich in hydroelectric power. A majority of the current projects are focused on large dams; however, Pakistan could benefit from using small hydropower (ITA 2023). The current small hydropower plants are located in the North of Pakistan (ITA 2023). Pakistan has hydropower potential in the "north along the Indus River in the provinces of Gilgit-Baltistan and Khyber Pakhtunkhwa, as well as the Jhelum River in the provinces of Punjab and Azad Jammu and Kashmir" (IHA 2017). Constructing hydropower plants, small and large, is beneficial to the Pakistani population because it provides the opportunity to improve flood control, develop irrigation systems, and improve drinking water quality (U.S. Department of Energy 2023).

Pakistan should also focus on implementing more solar power projects into its sustainable development plans. On average, Pakistan receives nine and a half hours of sunlight per day (ITA 2023). In large cities, there has been an increase in solar panel installations on rooftops; however, there is opportunity for this to expand to more rural areas (ITA 2023). This would be especially helpful for individuals and industries, because in recent years non-renewable energy sources have been increasing in cost and have been experiencing blackouts (ITA 2023). "Utilizing just 0.071 percent of the country's area for solar PV would meet Pakistan's current electricity demand" (Knight 2021). Implementing community solar panels into regions would be a good investment, because everyone can benefit from using non-renewable energy sources.

There are many different approaches with which Pakistan can decrease conventional pollution outputs. The only way that Pakistan can achieve this is by making sustainability a

priority within the government and in regions to implement sustainable energy projects. Pakistan should utilize the 2022 flooding as an opportunity to integrate new sustainability plans into its reconstruction. This would be beneficial by also improving systems that could potentially reduce flood catastrophes. Making the effort now can significantly improve standard of living and GDP.

Concluding Thoughts

Pakistan is behind many other countries in its ability to improve the environment. Even though it is a developing country, it plays a significant role in producing goods that many people living in and outside the country rely on. Pakistan, along with many other developing countries in South Asia, needs to be more concerned about the ongoing environmental crisis because it affects productivity and the health of a country.

In recent years, more attention has been focused on Pakistan's conventional pollution. There has been an increase in publications about the poor environmental conditions, the effects that pollution has on the health of workers, and pressure from the international stage. Therefore, the Pakistani government in response to this has been making more of an effort to fund and find funding for sustainable development projects. Since these efforts have been more recent, Pakistan has a lot more improvements that it needs to work on before seeing adequate effects.

An important insight in examining Pakistan's conventional pollution is that understanding limiting conventional pollutants goes hand in hand with reducing CO2 emissions. Many of the ways in which industries can decrease conventional pollutants will also decrease the output of CO2 emissions. For example, making brick kilns in Pakistan more efficient will reduce the conventional pollutants and CO2 levels.

The environmental crisis also shows that the Pakistani government has a limited impact on sustainable projects as other organizations do. This is because it does not have enough funding to finance the billion-dollar projects that are necessary to decrease conventional pollutants substantially. Much of the funding that supports these projects come from other nations, private organizations, and intergovernmental organizations. With donations and funding as large as these, often the Pakistani government is given specific requirements and

responsibilities that it has to meet in order to continue getting financing for projects. It exposes the limited power that the Pakistani government has on its sustainability initiatives.

The Pakistani government is also limited in power because of international pressure to be more concerned with the environment. Due to concerns among consumers about the environmental degradation that industries have, there is more pressure on the Pakistani government to regulate industries. This is an important focus for Pakistan because its industries rely on consumers buying their goods. Therefore, when revenue decreases because consumers do not want to support an unsustainable industry, it affects the economy and the life of many workers. This exterior pressure constrains the Pakistani government from disregarding pollution outputs.

The rise in conventional pollution in Pakistan most significantly impacts individuals living or working near industrial areas. This is true as well of rural areas. Many Pakistanis are unaware of the extent to which they are being impacted and of the lasting health impacts. Therefore, they should be educated so that they can be mobilized to deal with the consequences of loosely regulated industries. With a lack of education about conventional pollutants, many individuals also use practices that could produce harmful toxins. Much work needs to be done by the government and by supporting nations to educate and protect the people living in industrial areas and workers from contamination.

As Pakistan works on creating a more sustainable country, it should consider making use of new opportunities that will help support development. This includes expanding the types of funding that they get for sustainable development projects, increasing research within the environmental field, and prioritizing environmental science in the education system. The Pakistani government's goals for 2030 are ambitious, but it needs to be more committed to

finding solutions to achieve these goals. Looking at other developing countries and understanding what has been successful for them would be another way to find inspiration for projects or find funding. The government also can look at developing countries that have successfully developed, such as South Korea.

An issue that prevents Pakistan from decreasing its conventional pollutants is that many industries are loosely regulated by the government. While on paper, the Pakistani government has attempted to improve industries' environmental impacts, it has been more difficult to achieve. The Pakistani government's checks on industries are a lot less strict and infrequent than they need to be. This could be because the government does not have the will or capacity to place stricter regulations. The lack of will could come from the desire to see fast economic growth. Since the polluting industries are sources of economic growth, it becomes much more difficult for the Pakistani government to reprimand industries.

The Pakistani government should be investing more into researching and developing sustainable solutions that will decrease conventional pollutant outputs. With a variety of industries in Pakistan and distinctive situations for each region, it is important to dedicate funding towards developing new, more sustainable solutions. Research and development would also be beneficial in find environmentally sustainable and cost-efficient options for industry leaders who do not want costly changes. For example, the brick kiln industry has seen significant reductions in pollution outputs through reconstructing brick kilns with zig-zag technology. Although, this only reduces pollutants by about 60 percent more can be done, including the traditional brick kilns that are still operating.

Pakistan needs to move away from relying on coal. While there are high demands for energy because of a growing population, it is important to become more reliant on renewable

energy sources. This should be a priority for the Pakistani government because coal is a major contributor to conventional pollution. The China and Pakistan Economic Corridor played a significant role in increasing the coal usage in Pakistan. While the project has stopped, expansion of electricity has increased reliance on electricity. This is a difficult position for the Pakistani government because there is the need to meet the electricity demands of the population. However, there is also the need to meet the environmental concerns of the world.

The Pakistani government is starting to create a community that relies on renewable energy sources, but they should encourage the transition for individuals by increasing incentives for using less polluting cookstoves and more reliable sanitation facilities. These projects take time to implement which makes it difficult for the Pakistani government to meet the demands of the population.

The Pakistani government needs to be more concerned with the water quality located around the country. With leaks from industries and domestic practices that release conventional pollutants, many individuals are suffering severe consequences of contaminated water. In order to achieve this, the Pakistani government should be investing more money and resources into constructing water testing facilities and boosting the sanitation processes. The Pakistani government could increase the amount of funding dedicated toward this project by working with outside organizations on urban planning developments.

Advancing the agricultural system in Pakistan would result in the reduction of conventional pollutants. There are many opportunities for Pakistan to improve its system. This ranges from improving technology, implementing more efficient practices, and educating workers on the farms about health and environmental impacts of certain practices. In order to work towards a more sustainable future, the Pakistani government and other organizations

should work to implement sustainable projects and increase awareness about farming techniques. This would be beneficial because once providing farms with access to those resources will protect individuals, produce, and animals from the toxins produced by those farms about which the people may be unaware. Pakistan could also provide incentives for farmers to use more sustainable technologies and products by subsidizing or providing tax benefits to farmers.

Pakistan joins the other developing countries in South Asia in facing an ongoing environmental crisis. While there has been aid provided for these countries to work towards and build a more sustainable future, it is difficult to implement in such a short period of time. Countries in South Asia should start to look towards each other for ideas on how to improve its environmental initiatives. Providing support and combining research and development will create progress at a faster pace.

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