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Relationship between Industrialization and Environmental pollution in Tajikistan

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Abstract

Environmental pollution is a serious issue in the majority of countries due to industrial activities. In this context, the present study aimed to investigate the relationship between industrialization and environmental pollution in Tajikistan. Explanatory variables employed included population growth, urbanization, economic growth (GDP), GDP per capita, and energy consumption. Environmental pollution was treated as the explained variable, and the study applied the Theory of Environmentally Responsible Behavior, Reasoned/Responsible Action theory, and the Environmental Citizenship Model of Human Interaction with the Environment, forming the theoretical framework for this research. A correlational research methodology was employed in this study. The results of the econometric tests revealed the following: Industrial output (resulting from industrial activities), population growth, urbanization, economic growth (GDP), and energy consumption have a positive and significant impact on the emission of greenhouse gases (environmental pollution) in Tajikistan. Conversely, GDP per capita has a negative impact on the emission of greenhouse gases (environmental pollution) in Tajikistan. Furthermore, there exists a bidirectional causality between all variables and environmental pollution (greenhouse gas emission), with the exception of GDP per capita. Based on the findings, the analysis concluded that a long-term association exists between industrialization, the alternative variables, and environmental pollution, except for GDP per capita. The study also presented several recommendations on how to promote industrial symbiosis (IS).

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1. Introduction

1.1 Research Background

Environmental pollution issue is a serious one in the majority of countries because of industrial activities. The uncontrolled industrial activities in many countries lead to consequences such as air pollution, water pollution, acid rain, smog and oil spills. The issue of environmental pollution is constantly becoming real today as many developing countries are industrializing. Industrial growth has been impacting the world with severe problems since time immemorial. The ecosystem and the elements of natural structures such as water, air, land and habitats, especially the environment, are under immense pressure. To understand the gravity of the issue, the environmental effects of industrialization should be analyzed more carefully and sensibly (Patnaik, 2018). Li et al. (2018) opined that industrial effluents contain various critical nutrients or have properties that can effectively be used with commensurate social and environmental advantages for many value-added purposes. The implementation of green approaches in the context of the integrated framework for industrial ecology (IE), using technology focused on the 6Rs (reducing, reuse, recycling, regeneration, redesign, rethinking), offers an outstanding chance to protect natural resources in the region, while improving the regional economy sustainably. It calls for an effective strategic approach, which covers factors that can influence industrialization regarding technology, climate, socio-culture and economy. It is often important to benefit from other related scenarios before creating a realistic approach to strategic growth (Bauer et al., 2019). A structured approach to situations with the same implications can help to better explain how the instance took place and can objectively examine circumstances, strategies, actions and general scenarios relevant to the problem. Against this backdrop, this study investigates the relationship between industrialization and environmental pollution in Tajikistan.

1.1.1 Industrialization

Oqubay (2018) defines industrialization as the method of transforming an economy predominantly from an agricultural to a manufacturing-based one. Human manual labour is also supplemented by the development of mechanized mass and the assembly lines replaced by craftsmen. Industrialization features include rapid development, greater division of labour, and the use of technology innovation to address challenges rather than reliance on factors beyond human influence. In addition, the social and economic transition of society from rural to manufacturing is referred to as industrialization. Between 1760 and 1840, the industrial revolution was witnessed worldwide, where many countries developed many factories, especially in Europe and North America. During this era, new computers were replaced by conventional manual work and processes which could more easily execute tasks. While modern tools and machines made work simpler and production higher, new challenges were also brought on by industrialization. Some of the negatives included air, water and soil pollution, which contributed to a major decrease in the quality of life and life expectancy (Merriman, 2019). While industrialization has many benefits, its principal adverse consequence is pollution which can have an adverse impact on the health of human beings. If businesses do not pay for the environmental harm or are not priced for it, this is called a negative externality. Deforestation, species extinction, widespread pollution, unsustainable waste and other types of environmental degradation put the cost pressure on human society (Pata, 2018).

1.1.2 Environmental Pollution

The environment is the overall surrounding and it is made of the biological as well as the natural resources. According to World Bank (2020), the term environment refers to social and natural conditions that surround the human race including future generations to come. The environment covers elements and components including land, air as well as water. It also

covers the layers that are found in the atmosphere, the organic as well as inorganic matter. In general, the term environment is used to refer to natural habitats for human beings that are made up of various components. The environment can be seen as the total surrounding found within the context of human beings (Bauer et al., 2019). Environmental pollution is the introduction of various substances and agents that are harmful to all life that depend on the environment for survival. Environmental pollution is brought about the pollutants and it can generally refer to pollution of air, water and land (Gumede & Savage, 2017). Pollution of the environment is a serious challenge with far-reaching influence on human life and health as well as the level of agricultural productivity. In fact, environmental pollution is regarded as a serious challenge in the present world. Several activities of human beings include the application of technology to change the ecosystems resulting in pollution of the environment (Nadal et al., 2016). Environmental pollution has remained a challenge across the world. For instance, a total of 342,000 contaminated sites were identified in Europe for the year 2018. According to the Statistics by the World Health Organization (WHO), the year 2017 saw a total of 4.3 deaths in households across the world largely attributed to air pollution while a total of 842,000 households died the same year due to water pollution around the globe (Triassi et al., 2019). Pollution of the environment can be considered as the unwanted change in the biological, physical and chemical composition of the soil, water and air and this is particularly harmful to the life that relies on the environment for survival. There are several forms of pollution for instance energy or chemical substance like light, heat or noise. The pollutants of the environment can either be foreign energies/substances or contaminants that occur naturally (Gworek et al., 2016).

1.1.3 Industrialization and Environmental Pollution in the Context of Tajikistan

Tajikistan is a Central Asian country with Afghanistan, Kyrgyzstan, China, and Uzbekistan surrounding it. In the last few years, because of the ease with which the Government has made land, water, cheap labour, electricity and various incentives and concessions available, Tajikistan has attracted a large number of industries. This includes tax concessions, power subsidies and tax holidays. Tajikistan had impressive industry establishments in 5,673 sectors representing a cross-sector of various industries by mid-2019, as annual industrial growth varied from 1.86-12.28% (Abdullaev, 2018). Today, Tajikistan's industrial development is driven by seven well-established industrial estates. New industrial estates are also being planned because of the industrial-friendly environment as several big industrial firms with a national reputation and many prominent multinationals have shown considerable interest in building their plants in Tajikistan in the near future. Along with economic growth, this accelerated industrialization led to sudden population growth, urbanization and apparent stress on basic life support structures, which took environmental impacts closer to tolerance threshold limits. In Tajikistan, factories have been rated as Red, Orange and Green based on the type and intensity of emissions, with respect to extreme, middle and low pollution capacity in that order. Currently, 19% of the overall sectors are in the red band, 21% orange and 60% green. By mid-2019, Tajikistan was expected to generate about 36,768 tons per year of hazardous waste (Мирзоев, 2019). Although some industries sell their waste in another area except for a single unsafe recycling unit and no protected waste site to ensure proper management of industrial wastes, waste is inadequately disposed of and in a manner that is not proper which burdens the environment in many waste disposal units. Uncontrolled, insufficient and unsystematic waste disposal poses a significant risk to the health of the region's ecosystem.

1.2 Research Objectives

The main objective of this study is to investigate the relationship between industrialization and environmental pollution in Tajikistan. The following specific objectives guided the study:

1.2.1 Specific Objectives

1) To assess the effects of industrial output on environmental pollution in Tajikistan.
2) To determine the long-run and short-run relationship between industrialization and environmental pollution in Tajikistan.
3) To understand the effects of explanatory variables (population growth, urbanization, economic growth (GDP), GDP per capita, energy consumption) on environmental pollution in Tajikistan.
4) To draw policy implications from the results of (i), (ii) and (iii) above.

1.3 Research Questions

1) What dangers does industrialization pose to our environment and natural resources in Tajikistan?
2) Does a long-run and short-run relationship exist between industrialization and environmental pollution in Tajikistan?
3) Do other explanatory variables (population growth, urbanization, economic growth (GDP), GDP per capita, and energy consumption) cause environmental pollution in Tajikistan?
4) How industry, and the environment together can contribute towards achieving environmental sustainability?

2. LIRERATURE REVIEW

2.1 Theoretical Underpinning

2.1.1 Behavioral change model

This reasoning is directly linked to the assumption that if people were better informed they would become more aware of environmental issues and therefore be motivated to conduct themselves in an environmentally sound manner. As can be seen in the following figure when knowledge increases, environmental positions are developed that lead to responsible environmental action.

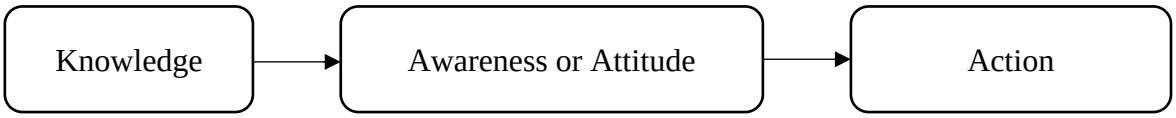

Figure 2. 1: Behavioral Change Model

Further research nevertheless denied the arguments of those who saw this model as changing the principles of human behaviour. This has long failed to recognize or support the legitimacy of such a simplified linear model. In the course of the following years, researchers focused on the assumption that a number of variables interact at various levels to influence the inclusion of environmental responsibility. Varela-Candamio et al. (2018) discuss that although very simplistic, the behavioural model provides a basis for assessing the possible relationship between environmental awareness and attitudes and how these can result in action or inactivity. Well-known environmental variables may not necessarily mean good and sustainable environmental performance. However, a lack of knowledge or awareness of the environment cannot necessarily mean poor environmental practice. Other factors such as the locus of control, the intention to act and the responsibility of the individual should therefore be considered. While this model can decipher a possible line of connection, the reality is far more complex than this linear trend, hence a more advanced model that includes this line of relation offers a brief explanation of the interaction between the interacting variables in the preservation of the natural environment.

2.1.2 Theory of environmentally responsible behavior (ERB)

Hines, Hungerford and Tomera proposed and Lee and Oh (2018) further developed the theory of ERB. The theory suggests that the desire to behave is a significant element that affects ERB. The model of responsible environmental behaviour suggests that the following factors are intended to function, place of control (a feeling of personal control over activities in one's lives), behaviours, the sense of personal responsibility and awareness. The model notes that the internal control center has an important effect on the purpose of to act that significantly defines the ERB of a person. This model further illustrates that the control center, people's attitudes and their intention to behave exist. The authors have stated that the control center explicitly influences the attitudes of the person and can contribute to positive intervention and changed behaviour. The theory thus concentrates more on current relationships between parameters which affect the behavior of an individual than on the singular impact of a particular variable. The following figure summarizes the different relations between the concepts of ERB. The internal control center has an influence on people's decision to behave according to this ERB theory.

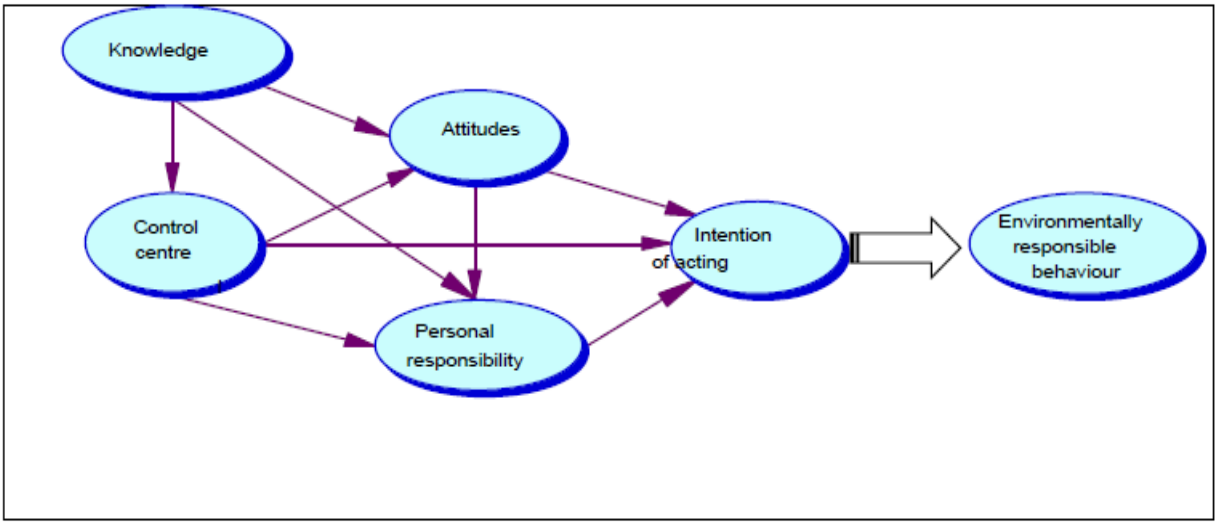

Figure 2. 2: Theory of Environmentally Responsible Behavior (ERB)

No single mechanism is responsible for existing behaviours of waste management systems or is necessary to trigger behavioural changes or changes in behaviour. For example, despite laws from waste control agencies, people pile up their waste materials in the middle of the street in big cities to prevent this from occurring. Many such flutters are doing this at strange times when law enforcement authorities are unavailable; some people are affected by the indiscriminate disposal of such garbage, as they see others doing so (Su et al., 2020). From the figure, Knowledge alone is not enough to take responsibility for the environment, whilst some people's knowledge and regulations of the environment could lead them to a good attitude that could lead to positive actions, other people could have internal and external controls, such as influenced by others' actions or a strong belief to act. A separate attitude system and control core as well as an acting will are not necessary to establish a purpose to act unified by a general definition, they are a foundation on which environmental predisposition is constructed. In the management of waste, there exists no single factor that brings about a change in current behaviour. For instance, despite the existence of stiff regulations forbidding people and industries from dumping waste materials, some industries still damp waste and other particles in large cities. As indicated in the Figure above, knowledge on its own is not adequate for enhancing responsible actions and behaviour towards the environment.

2.1.3 Reasoned/Responsible action theory

The Reasoned / Responsible action theory was proposed by Ajzen and Fishbein but has been advanced by (Akintunde, 2017). The theory argues that various human behaviours are influenced and shaped by rational thoughts. According to the theory, there exists a link between intentions to act and the final behaviour of an individual as predicted by attitudes. They are the subjective beliefs and norms that shape these attitudes. The theory of reasoned action is used to account for the time when individuals are guided by good intentions, but ensuring that these intentions are translated into good actions is affected by inadequate confidence.

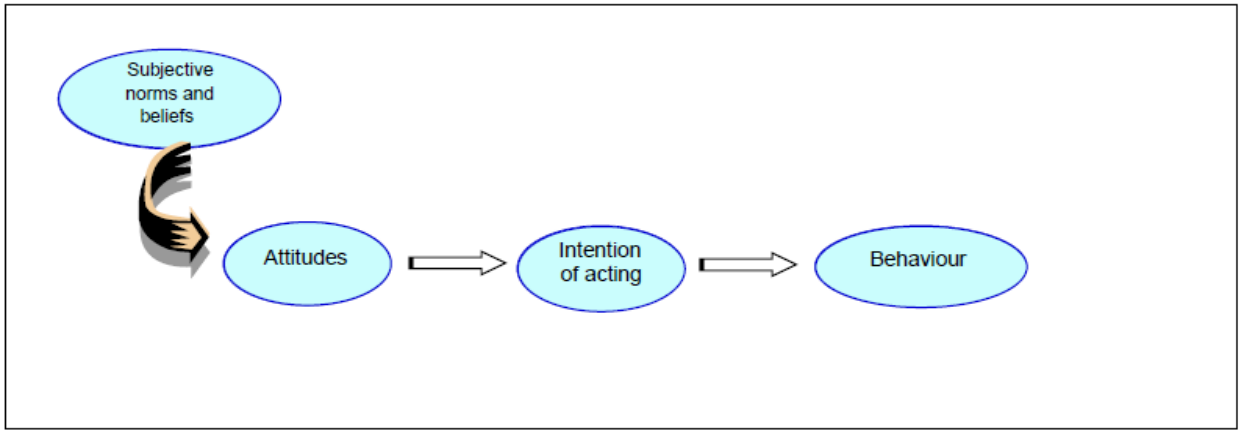

Figure 2. 3: Theory of Reasoned/Responsible Action

Reasoned action theory is important in so far that it provides a foundation for understanding why people may not act for their environment, whether because of their lack of trust or because they feel they have no control over behaviour. The theory of reasoned action is important. In addition, as stated (Akintunde, 2017), people can form different beliefs about the consequences of conduct on the basis of various experiences and various normative beliefs. These convictions in turn determine attitudes and subjective norms that then determine intent and behavior. As shown in the figure, a better understanding of a behaviour can be gained by tracing the determinants of a behaviour back to the underlying beliefs, thereby changing the number of such beliefs. The model explains further how good environmental intentions are not enough to drive action in themselves. As can be observed in the image, attitudes and subjective norms help to predict behavioural intentions. The social environment has been shown to mediate the effects of environmental behaviour. Likewise, Chakrabarty (2020) offers the basis for integrating demographic characteristics because they positively or negatively influence individual environmental attitudes.

2.2 Empirical Literature

2.2.1 Cross-sectional Studies

Several cross-section studies have proved there exists a significant positive relationship between industrialization and environmental pollution. Nasrollahi et al. (2020) suggest that today's pollution from industries is integrally linked to financial manufacturing, contemporary technology, lifestyles, sizes of populations of humans and animals, and a host of other variables. Except for wide macro transitions with various social benefits, it is unlikely to yield. These transitions include moving away from fossil fuels and waste-intensive techniques, bringing to bear our most advanced science, changing prices and other financial incentives, perceiving emissions as either transboundary or global, and moving towards a world population that is very stable. According to Majolagbe et al. (2017), Land is frequently used as a waste treatment recipient for effluents from industries. Land also gets spills of waste. The land pollution is the

degradation of the earth's land surface by bad farming methods, mineral exploitation, industrial waste dumping, and indiscriminate urban waste disposal. For a lot of municipal and some industrial waste, recycling materials is practical to some extent, and a tiny but increasing percentage of solid waste is being recycled. However, when waste is mixed, recovery becomes hard and costly. New methods have been created to sort ferrous and nonferrous metals, paper, glass, and plastics, and many communities with recycling programs now need separation of waste. Developing better handling techniques, inventing new products for recycled materials and finding new markets for them are crucial problems in recycling. Environmental pollution is currently a major problem around the world on a large and unprecedented scale (Chowdhary and al., 2018). Trends point in two ominous directions: towards big and increasing releases of certain chemicals primarily from burning fossil fuels as a result of industrialization, which are now considerably modifying natural systems on a worldwide scale and towards constant rises in the use and release of countless biocide goods and poisonous substances into the atmosphere. These raise a more severe issue presenting tremendous problems to the societies, both developed and developing. Several large-scale social and technological transitions are required to tackle the severe pollution problems for decades to come.

2.2.2 Country-specific Studies

In order to look for the presence of a relationship between industrial water pollution and economic growth, Khan et al. (2019) took international panel data from 12 countries from 2007 to 2019. They calculate the effects of growth in income on three pollution determinants: manufacturing share in overall output; the sectorial composition of production; and the industrial pollution rate at the end of the pipe per unit of output. Regression analysis demonstrated that the manufacturing output follows the curve trend of Kuznet while the other two do not conform. When these three relationships are merged, however, the curve of Kuznets is not noticed. Total industrial water pollution grows quickly and stays approximately steady by middle-income status. Data from many countries have been extended and LDCs have shown that OECD countries have been the top contributors to industrial water pollution. Negative responses from economic development to pollution intensity are adequate to keep world pollution over the twelve-year sample span at about 15 percent.

Aniyikaiye et al. (2019) did a comparison of industrial pollution loads in 14 industries in Lagos, Nigeria, with conventionally analyzed effluent pollution loads computed using the Industrial Pollution Projection System (IPPS). Statistically validated data have been conducted with t – a test at the 95 per cent confidence interval (2-tailed) and the variance analysis (ANOVA) for determining whether the IPPS pollution load is substantially different in terms of jobs and overall output; and the traditional effluent analysis has pollution loads at $p > 0.05$. In all industries except basic industrial gas production, where two means vary greatly, they found that no substantial difference occurs between the pollution loads measured in respect of these two variables. IPPS pollution loads at the traditional effluent study at this limit often were positive compared with pollution loads. The consequence is that the IPPS techniques offer an inexpensive way to estimate pollution in developed countries. In developing economies with limited resources to protect the environment, industrial emissions management also would be improved. The effectiveness of the intervention steps will decrease gross industrial pollution significantly.

2.2.3 Industrial Growth and Environmental Pollution

Industrialization has contributed to the deterioration of the environment In terms of industrial pollution. A 100% pollution-free world is a fallacy with manufacturing running. It is neither necessary nor feasible. As a result of heavily polluting factories like thermal power stations, coal mining, cement, iron sponge, steel & ferroalloys, gasoline, and chemicals, waste, haze,

fumes, and greenhouse gas emissions exist. These clusters have not only been harmful to manufacturing but often do irreparable harm to our environment and ecosystems, frequently infringing the potential of the environment. Environmental pollution is a harmful by-product of industrialization and can adversely affect human health. If businesses do not pay for the environmental harm or are not priced for it, this is called a negative externality. Deforestation, species extinction, widespread pollution, unsustainable waste and other types of environmental degradation put cost pressure on human society (Nasrollahi et al., 2020).

In an analysis by Rahman and Kashem (2017), the environmental impacts of industrial development are defined and quantified, with particular reference to developed countries, and with policy recommendations, including the use of renewable technology and environmentally sustainable manufacturing techniques. The researchers think that developed countries are mostly shown to be particularly polluting in their industrial sector. This has led to severe pressures on the environment in combination with a large agriculture sector which contributes to deforestation, erosion of the topsoil and desertification, and the depletion of its natural resource base has made the population poor. This crisis shows that strong industrialization policies are highly necessary for the economic growth of developed countries and calls for natural resource conservation and the use of low-waste or environmentally clean technology.

The more industrial capability a nation has built, the greater the economic growth and development prospects. This would achieve sustained changes in living standards, jobs, working conditions, schooling and welfare if applied sustainably, taking note of the sometimes-fragile existence of the surrounding environment, social patterns and economic circumstances. If technological growth on the other hand is accompanied by the destruction of the environment and depletion of resources, social exploitation and economic imprudence, the related gains will not remain (Zafar et al., 2020). There is also a need to ensure developing countries have access to basic utilities and new, secure and sustainable electricity. Access to electricity will also help achieve universal elementary education and foster gender equality through the Millennium Development Goals (MDGs).

2.2.4 Population Growth and Environmental Pollution

A high population growth rate, in addition to low per-capita income, has weakened environmental conditions, although population growth has proved to be a significant source of growth. The effect of population growth on the environment is mainly attributed to the use of natural resources and waste production, environmental pressures such as depletion of habitats, air and water contamination and increased pressure on arable land (Liang & Yang, 2019). In addition to rising stresses on marginal lands, soil erosion, overgrazing, timber burns, soil erosion, silting or floods, the rapidly growing population increases the use of pesticides, fertilizers, and damage of the soil and water contamination. The three fundamental demographic factors birth (natality), death (mortality), and migration and immigration (population flows into countries contribute to higher population) lead to changes in population size, density, distribution, etc. (Adu & Denkyirah, 2018).

Poverty is a major consequence of population growth, and it plays a major role in environmental destruction, and this uneven allocation of wealth and scarce possibilities contribute to pushing and pulls for people living below the poverty line (Polasky et al., 2019). Poorer people who can't fulfil their needs by buying are required to use common property services such as forests for food farming and fuel, woodland pasture and get water from ponds and rivers. This also helps to deteriorate the environment by exploiting natural resources, such as land, air and water. The human burden caused by the overuse of surface and groundwater

waters by the poor has contributed to the degradation and depletion of water supplies, the use of rivers for raw wastewater and agricultural waste management and the acceleration of the poverty phase begins (Baloch et al., 2020). Nasir et al. (2021) on environmental degradation and the role of economic development, and industrialization in India opined that Population growth is a factor determining the degree to which environmental and natural resources are under threat. India is the world's second most populated nation with more than 1,271 billion (17.5 percent) inhabitants. In India, population growth is very high annually and decade, with little decline. Indian urbanization (population growth) has continued as it has been in other parts of the world, with continuous populations and activities in large towns with backward areas and small towns which seem to stagnate. This problem is catastrophic because if the environment is not well managed, the structural systems are divided, the architecture requirements are not rigorous and the measures are improperly adapted to various facilities to implement environmental concerns (Panwar et al., 2018). The relationships between people and the environment have also been seen as having a connection to sustainability, and the relationship between them needs to be understood (Panwar et al., 2018).

2.2.5 Urbanization and Environmental Pollution

One of the most irreversible human effects on the global biosphere is the conversion of Earth's surface to urban uses. It speeds up the depletion of highly productive agricultural fields, affects energy use, and changes the environment, changing hydrology and biogeochemical cycles. These effects can be observed on many occasions. For example, potential urbanization will pose imminent challenges to ecosystems: in the next few decades, the biggest rates of land conversion will most probably be in biodiversity hotspots largely unsettled by urban development in 2000. In cities, the essence of urban expansion also determines the susceptibility of urban residents to environmental stress (Liang et al., 2019).

According to Munir and Ameer (2018), urban expansion's environmental consequences spread far from the urban centers themselves. Agriculture is stepping up the remaining undeveloped land in increasingly urbanization areas and is likely to extend to new zones, thus stressing land supplies. In comparison, urban areas shift cycles of precipitation to hundreds of kilometers in length. Urban development will also impact the global climate. About 5 percent of the overall tropical deforestation and land use pollution are projected to increase in direct reduction of plant biomass from areas with a high likelihood of urban growth. These impacts are yet to be studied in their depth and scope. While various studies have represented how urbanization impacts CO_2 emissions and heat budgets, the climate system is starting to understand the impact of flowing water, aerosol and nitrogen. A big cause of this environment pollution situation is the overwhelming scale of the city population, the haphazard and unforeseen rise of urban settlements, and the desperate shortage of infrastructure. The exponential development of both natural and migrating urban communities has exerted heavy demand on public services, such as infrastructure, hygiene, transport, power, housing, sewage, water transport, power, public health and education. Rural immigrants then suffer from hunger, unemployment and under-employment, beggary, robbery, dacoity, burglary and other social evils. Urban spread soon invades valuable farmlands (Effiong, 2018).

2.2.6 Economic Growth (GDP Growth) and Environmental Pollution

Some researchers evaluated the role of economic growth in the environment based on the concept of mass preservation: the growth of production ultimately results in an increase in the exploitation of natural resources in the economic system. But the natural world is constrained by the absorption of waste generated by the industrial system that grows to excessive global economic growth. In the end, continuous economic growth can harm a region, a nation and even the global environment more or help boost the quality of the environment (Adu &

Denkyirah, 2018). Pollution is also rising as the economy grows. Both are not in lock, though, as the latest Economic Synopses (2020) indicate that pollution is growing slower than economic growth. Aung et al. (2017) conclusion is different from the "Environmental Kuznets Curve" (EKC). The EKC variation suggests that in the early stages of production, pollution rises with economic growth. However, the trend reverses beyond a certain degree of development, and economic growth improves environmental conditions by creating resources that are used to ensure environmental sustainability. The researchers find that pollution increases monotonically with economic growth. Economic activity is rising by 1 percent, which also raises pollution but at a slower rate. In other words, pollution is slowing down GDP. Scholars have carried out many studies and are primarily concerned with the environmental pollution effects of economic growth. One of these is the Environmental Kuznets Curve (EKC) proposal and related scientific research. In order to explain the relationship between these variables better. The researchers found the reverse U relationship between economic growth and environmental pollution. The lower the stage of economic growth, the less environmental pollution. Environmental degradation is on the rise as industrialization increases. The heavily polluting industrial economy is becoming a service economy or technology-driven economy with improvements to the country's economic structure and the pollution level is decreasing in the higher stage of economic growth (Bildirici & Gökmenoğlu, 2017). First, most EKC literature believe that EKC exist and later will be confirmed with numerous evidence and methods of analysis. Western researchers use national cross-sectional data and panel data in particular to validate EKC by matching the cubic or quadratic polynomial model (Ssali et al., 2019). Most studies in China use time series data directly to match a quadratic or cubic polynomial model and then find authentication linking points (Lu et al., 2017).

2.2.7 GDP Per Capita and Environmental Pollution

The GDP Per Capita is not necessarily theoretically linear in its relationship with environmental quality. Although per capita income increases can increase environmental degradation by increased resource use as a result of economic growth, higher levels of production can also mitigate environmental damage. This counteracting impact on environmental effects is accomplished through multiple channels. The relationship between GDP per capita growth and environmental degradation in China was investigated by Hao et al. (2020). The study aimed to examine the relationships between environmental pollution and economic growth in Zhejiang's industrial development according to time series data on three forms of pollution index from 1981 to 2018, using Johansen's co-integration tests and the Granger causality test. The findings showed three kinds of pollution indexes, each with a negative long-term per capita GDP co-integration relationship which does not result in environmental degradation as a result of economic growth. The findings also reveal that, with exception to industrial solid residue discharge, the per capita GDP granger caused emissions from industrial waste water and gasses emission.

On the other hand, Cederborg and Snöbohm (2016) on their research question, is there a relationship between economic growth and carbon dioxide emissions? In order to investigate the potential impact of economic growth on environmental degradation, the study explored the relationship between per capita GDP and per capita emissions of carbon dioxides (CO_2). The research was carried out on cross-sectional data in 69 industrial and 45 developing countries. Several hypotheses were reviewed with differing views on potential environmental destruction impacts of economic growth. Their research concluded, however, that there is a correlation between economic growth and degradation of the environment. The empirical result of the cross-sectional analysis in turn suggests a correlation between GDP per capita and

carbon dioxide emissions per capita. The correlation is strong, indicating that rising GDP per capita contributes to increasing emissions of carbon dioxide. There is no tipping point where emissions start to decline when high enough GDP is reached, as some hypotheses say.

Among the mechanisms for explaining why the Human Development Index (HDI) can actually result in better environmental quality as countries grow richer, are improved technology, increased demand for environmental quality and better government regulation. The environmental model of the Kuznets Curve is based on the counterbalancing impact and forecasts a rise in environmental degradation as the countries get wealthier, with comparatively high per capita incomes. This theoretical setting includes watching declining environmental sustainability as less developed economies rise. However, the environmental consequences of economic growth could slow down and gradually revert, beginning at some amount of income per capita (Keng & Khan, 2019). The theory of EKC is the most commonly used methodology for evaluating the GDP per capita relationship with environmental pollution. The inverted U-shaped pattern was dubbed an environmentally-friendly Kuznets curve after the original Kuznets curve after Grossman's first EKC analytical analysis and it represents the inverted U-figures of Kuznets' income-equality. The EKC suggests that the environmental condition continues to drop at an early stage of economic growth before the average benefit in the developed stage hits a certain level and then increases (Armeanu et al., 2018).

2.2.8 Energy Consumption and Environmental Pollution

The research on energy consumption and environmental pollution was carried out by Rafindadi et al. (2018): data from the Simultaneous Equations Panel Model in developed countries. The paper´s findings indicate that energy consumption raises CO_2 emissions. The source of energy consumption and CO_2 pollution occurs in a bi-directional manner. Their findings also indicate the per capita effects of GDP on CO_2 emissions. The empirical findings show energy use and environmental pollution in these countries. The economic relationship shows, thus, that reducing the CO_2 emissions of developed countries depends on the change of the energy consumption trend and renewable energies simultaneously replace fossil fuels in their production. Therefore, it is important to commit to sustainable growth in those countries in international negotiations to control CO_2 emissions and energy consumption. Martins et al. (2019) opined that many sources of energy have an environmental impact. By most acts, including air and water pollution, public health damage, biodiversity and habitat destruction, water use, land use and greenhouse gas emissions, fossil fuel, oil and natural gas cause significantly higher harm than renewable energy sources. However, the environmental effects of renewable energy, such as wind, solar, geothermal, biomass and hydropower, may also be significant. Depending on the particular technology, the geographical condition and some further considerations, the precise form and severity of environmental impacts differ. By recognizing the environmental problems currently and the potential associated with each, renewable energy sources can effectively mitigate or prevent these consequences, as they become an increasing part of our energy supply.

Liu & Lin (2019) studied energy consumption, economic development and environmental improvement in China. Researchers have addressed that China is under more and more pressure to curb pollution, as the largest developing country in the world. However, will China achieve parallel growth in energy consumption, economic growth and environmental protection? The paper analyzed the long-term and causal relationship between energy consumption, economic growth and environmental pollution in China from 1993 to 2017, in order to address the issue. This approach is based on a multivariable vector error correction model based on the Johansen cointegration test and the Granger causality test. Empirical

studies showed that long-term relationships occur between energy consumption, economic growth and degradation of the environment. The test findings show that the cause of pollution is both energy use and industry effluents, while the cause of environmental pollution is energy consumption, and vice versa. The strategy would suggest that strategies to save resources and mitigate pollution can be implemented without impeding economic growth.

2.3 Conceptual Framework

A conceptual framework is concept of connection between variables in a research and it shows the connection graphically or dramatically. The independent variable in this case is industrialization and the dependent variable is environmental pollution. The moderating variable between the independent and dependent variable will be government policy.

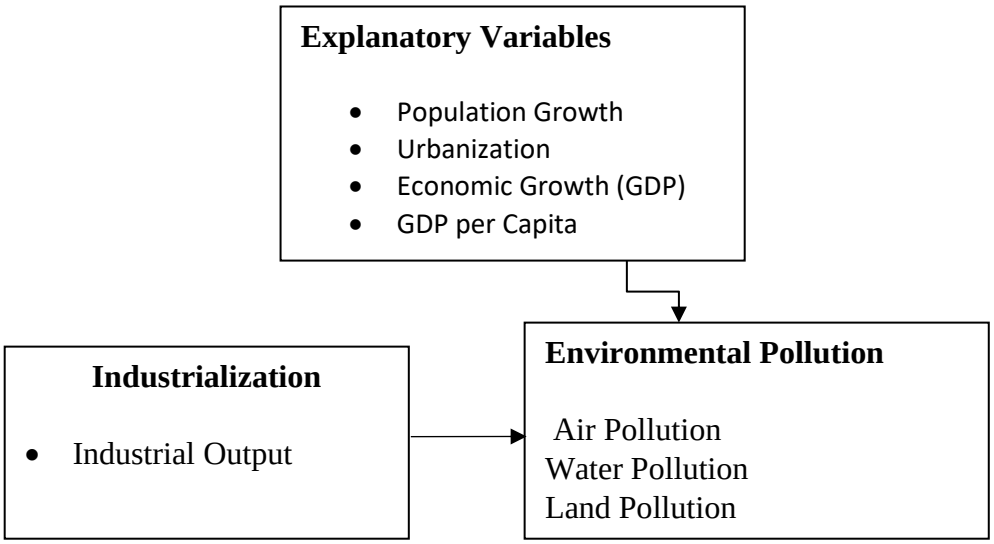

Figure 2. 4: Conceptual Framework

2.4 Research Hypothesis

According to Abdullaev (2018), industrialization has caused environmental pollution in terms of industrial waste. The high-polluting industries, such as thermal power plants, coal mining, cement, iron and sponge, steel and ferroalloys, oil and chemical products are the cause of dust, smoke, fumes and toxic gasses. As mentioned earlier, the objective of this research is to investigate the relationship between industrialization and environmental pollution in Tajikistan adopting other explanatory variables such as population growth, urbanization, economic growth (GDP), GDP per capita and energy consumption in order to provide a detailed conclusion.

2.4.1 Industrialization lead to environmental pollution

A study carried out by Abdusamadzoda et al. (2020) showed that apart from causing economic growth which his positive, industrialization´s negative side has resulted in a sudden increase in population, urbanization, over-representative stress on basic life-support systems and environmental impacts has been created together with economic growth which have led to the thresholds of tolerance. Based on the nature and severity of pollution, the Tajikistan industry is now classified as Red, which means high pollution. To test this hypothesis, the researcher will carry out an analysis to check whether industrialization has led to environmental pollution in Tajikistan.

***H_1**: Industrialization lead to environmental pollution in Tajikistan.*

2.4.2 Population growth leads to environmental pollution

Мирзоев (2019) viewed that the rapid population growth could be attributed to major causes of environmental degradation in Tajikistan. The population growth of Tajikistan is increasing pressure on the constantly degrading and limited natural resource base in Tajikistan. The growing population has led to rapid growth in Tajikistan's energy production, consumption, and environmental degradation. To test this hypothesis, the researcher will carry out an analysis to check whether population growth has led to environmental pollution in Tajikistan.
H_2: *Population growth lead to environmental pollution in Tajikistan.*

2.4.3 Urbanization leads to environmental pollution

Uncontrolled urbanization in Tajikistan has resulted in very rapid environmental degradation, causing many problems such as soil degradation, worsened water quality, increased air pollution, noise and waste disposal problems. While Tajikistan is one of the least urbanized countries in the world, it has now undergone a severe urban growth crisis although urbanization is an instrument of economic, social and political progress. To test this hypothesis, the researcher will carry out an analysis to check whether urbanization has led to environmental pollution in Tajikistan
H_3: *Urbanization leads to environmental pollution in Tajikistan.*

2.4.4 Economic growth (GDP) leads to environmental pollution

The Tajikistan economy has been growing by an average of 7% since 2011. While this is good, it has come up at the expense of the environment due to increased industries and urban sprawling. The effect of economic growth on the environment includes increased usage of energy sources which are non-renewable, increased pollution levels, global warming and possible habitat loss. The higher economic growth has come at the expense of the environment. To test this hypothesis, the researcher will carry out an analysis to check whether economic growth (GDP) has led to environmental pollution in Tajikistan
H_4: *Economic growth (GDP) lead to environmental pollution in Tajikistan.*

2.4.5 GDP per capita leads to environmental pollution

Cederborg and Snöbohm (2016) on their research question, is there a relationship between economic growth and carbon dioxide emissions? In order to investigate the potential impact of economic growth on environmental degradation, the study explored the relationship between per capita GDP and per capita emissions of carbon dioxides (CO_2). The research was carried out on cross-sectional data in 69 industrial and 45 developing countries. Several hypotheses were reviewed with differing views on the potential environmental destruction impacts of economic growth. Their research concluded, however, that there is a relationship between economic growth and the degradation of the environment. As Tajikistan´s economy improves, the GDP per capita is improving and an increase in the middle class which is aware of environmental degradation hazards. Does this have any effect on environmental pollution in Tajikistan? To test this hypothesis, the researcher will carry out an analysis to check whether GDP per capita has led to environmental pollution in Tajikistan.
H_5: *GDP per capita leads to environmental pollution in Tajikistan.*

2.4.6 Energy consumption leads to environmental pollution

Alvarez et al. (2017) discussed that today's global energy consumption helps pollute, and degrade the environment and global greenhouse emissions. The rise of population and the economic growth that continues to increase per capita energy usage are causing rises in energy consumption. So, the inevitable population rise in the short term and the economic growth required for many countries have significant environmental effects, because energy usage is already growing. Currently, oil, gas and coal are the second most used energy sources in

Tajikistan. However, most of these decisions to use oil, natural gas and fossil fuels do substantially more damage than renewable energy sources. These damages include air and water pollution, public health damage, wildlife and habitat loss, poor quality water use, land use and greenhouse gases emissions. To test this hypothesis, the researcher will carry out an analysis to check whether energy consumption has led to environmental pollution in Tajikistan.

***H_6**: Energy consumption lead to environmental pollution in Tajikistan.*

3. RESEARCH METHODOLOGY.

3.1 Research Design

The type of research design that will be employed in this study is co-relational research design. In general, correlation research examines co-variation between two or more variables (Bloomfield & Fisher, 2019). It can be accomplished by a variety of data which include the collection of empirical data. Often times, co- relational research is considered type of observational research as nothing is manipulated by the experimenter or the individual conducting research. Co-relational explanations argue that phenomenon Y (such as environmental pollution) is related or affected by factor X (such as industrial activities).

3.2 Population and Sample

Population is a collection of items with the appropriate knowledge that can respond to research questions and which the researcher is interested in (Creswell & Creswell, 2017). The target demographic for the research was industrial growth, index of industrial output, other alternative variables indexes included population growth, urbanization, economic growth (GDP), GDP per capita and energy consumption data in Tajikistan. This data is time series and is a collection for the period 1990 to 2019.

3.3 Data Collection

To achieve the objective of this study, secondary data was be used. Secondary data can be defined as information collected by someone other than a researcher for a purpose other than the research project at hand (Martins, Cunha & Serra, 2018). The secondary data included information on the industrial output (industrialization) population growth, urbanization, economic growth (GDP), GDP per capita, energy/power consumption and greenhouse gases emission index (environmental pollution). This data was collected from World Bank, relevant institutions inside Tajikistan and other publications.

3.4 Data Analysis and Presentation

This research aim is to examine the relationship between industrialization and environmental pollution in Tajikistan. Co-integration and Causality analysis were adopted on long and short run dynamics and causal relationships between industrial output, population growth, urbanization, economic growth (GDP), GDP per capita, energy consumption and greenhouse gases emission (environmental pollution) in Tajikistan over the period of 1990–2019. The collected data was analyzed using quantitative techniques notably Statistical Package for the Social Sciences (SPSS) software to enable the carrying out of the analysis. Because we have more than one independent variable, multiple regression analysis will be the best statistical tool to use. The analyzed data will be presented in tables, graphs and charts. The multiple regression analysis was specified as follows;

$$\mathbf{Y = \beta_0 + \beta_1(X_1)_t + \beta_2(X_2)_t + \beta_3(X_3)_t + \beta_4(X_4)_t + \beta_5(X_5)_t + \beta_6(X_6)_t + e \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)}$$

Where,

Y = Environmental Pollution (Green House Gases Emissions)

X_1 = Industrial Output

X_2= Population Growth

X_3= Urbanization (Urban Population)
X_4= GDP (Economic Growth)
X_5= GDP Per Capita
X_6= Energy (Power) Consumption
e= is the error term
t= time dimension
Whereby:
β_0 = the minimum Y when the rest of the variables are held at a constant zero

In statistical studies like this, consisting of the analysis of large numbers, it is advisable to use the logarithm function to avoid the advent of problems such as "heteroskedasticity" during the results. To avoid such a problem, equation (1) will be defined as follows:

$L(GHGE) = \beta_0 + \beta_1 L(IO)_{30} + \beta_2 L(PopG)_{30} + \beta_3 L(U)_{30} + \beta_4 L(GDP)_{30} + \beta_5 L(GDPPC)_{30} + \beta_6 L(EC)_{30} + \mu t$. (4)……………………………………………… (2)

Here, log is used for natural logarithm and t for the time period of twenty-nine years. GHGE is used for Greenhouse Gases Emissions, IO for Industrial Output, PopG for Population Growth, U for Urbanization, GDP for Economic Growth, GDPPC for GDP per Capita and finally EC for Energy Consumption.

4. DATA ANALYSIS, RESULTS AND DISCUSSIONS

4.1 Descriptive Statistics Analysis

Table 4.1 below presents descriptive statistics for the key variables used in this study. The total number of observations in the analysis is 30, representing annual time series data, during the period 1990 to 2019. The main topic for this study is to research the relationship between industrialization represented by industrial output and environmental pollution in Tajikistan represented by greenhouse gas emissions values. The industrial output mean was found to be \$0.46 billion while the standard deviation was \$0.22 billion. For greenhouse gas emissions mean was 14440.35 Kiloton of CO_2 and the standard deviation was 3183.45 Kiloton of CO_2. The low value of standard deviation in these variables compared to means indicates the values collected were uniform following a certain pattern, which in this case proves as industrialization increases, environmental pollution in Tajikistan also increases. Explanatory variables, economic growth (GDP) has the highest mean and the highest standard deviation of \$3.89 billion and \$2.85 billion respectively. Population growth (POPG) (M=6.95 million people, SD=1.20 million people). Urbanization (UPop) (M=1.90 million persons, SD=0.28 million persons). Power consumption (PC) (M=2075.12 Kw/h, SD=509.33 Kw/h). GDP per Capita (GDPPC) (M= \$516.36, SD=\$312.57). Therefore, the standard deviation of each individual series is small from its mean, indicating a low coefficient of variation of the series.

Table 4. 1: Descriptive Statistics

	N	Mean	Maximum	Minimum	Std. Deviation	Skewness	Kurtosis
IO	30	0.460	0.897	0.186	0.223	0.403	-1.432
PopG	30	6950267.60	9321018	5283814	1196129.450	0.469	-0.928
UPop	30	1899851.195	2544637.914	1640069.148	280930.104	0.959	-0.322
GDP	30	3.887	9.113	0.861	2.845	0.532	-1.393
GDPPC	30	516.358	1104.172	138.429	312.568	0.391	-1.347
PC	30	2075.121	3358.560	1296.140	509.331	0.726	0.731
GHGE	30	14440.345	22661.267	10059.396	3183.453	0.895	0.780

4.2 Correlational Analysis

Table 4.2 shows the pairwise correlation matrix for the key variables involved in the analysis. There is a positive linear association between industrial output, population growth,

urbanization GDP growth, GDP per capita and greenhouse gas emissions (environmental pollution). In addition, the results show that there is a negative impact between power consumption and all other variables but a positive correlation on greenhouse gas emissions (environmental pollution) in Tajikistan. In addition, the variable´s Pearson correlation is more than .05. This indicates that there is a strong correlation between the variables. According to Kozak and Piepho (2018), Pearson Correlation values greater than 0.05 suggest that the variable under analysis is highly correlated.

Table 4. 2: Correlations

	IO	PopG	UPop	GDP	GDPPC	PC	GHGE
IO	1	0.606**	0.754**	0.782**	0.785**	-0.295	0.754**
PopG	0.606**	1	0.968**	0.899**	0.825**	-0.906**	0.115
UPop	0.754**	0.968**	1	0.925**	0.861**	-0.804**	0.323
GDP	0.782**	0.899**	0.925**	1	0.987**	-0.711**	0.412*
GDPPC	0.785**	0.825**	0.861**	0.987**	1	-0.606**	0.492**
PC	-0.295	-0.906**	-0.804**	-0.711**	-0.606**	1	0.272
GHGE	0.754**	0.115	0.323	0.412*	0.492**	0.272	1

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

4.3 Stationarity Properties

The stationary test applied the unit roots test which is better in testing the unit roots before the co-integration of the variables in order to avoid lying problems (Engle and Granger, 1987). As previously stated, the unit root test method was the Augmented Dickey-Fuller (ADF) test. For easier analysis, because the values are big, the data was log-transformed. The results of the unit root test are shown in table 4.3 below.

Table 4. 3: Unit Root Test Results

	AT LEVEL		FIRST DIFFERENCE	
	t Stat	P-value	t Stat	P-value
LIO	-1.143	0.264	-3.24	0.003
LPopG	4.992	0.000	-3.489	0.002
LUPop	0.238	0.814	-2.611	0.002
LGDP	-0.424	0.676	-2.891	0.008
LGDPPC	-0.664	0.513	-2.911	0.008
LPC	-0.745	0.463	-3.074	0.005
LGHGE	-2.248	0.034	-2.718	0.012

From the analysis, the variables at the level appear to be non-stationary but seem to be stationary at first difference. The results show that the null unit root hypothesis could not be rejected at the level. However, when the first differences of the logged variables are considered, the null hypothesis is rejected in favour of an alternative hypothesis which states that the series is stationary. Thus, their first difference turns out to be stationary. These results provide an indication of the existence of a possible long-term relationship in the model. This justifies the test of co-integration and causality in checking whether the model has a long-term relationship or not.

In addition, the results are presented in the form of an interception. Critical value statistics are given in response to MacKinnon values. All variables are transformed by applying the logarithm. According to table 4.3, the variables were not stationary at the first difference, this is because some values were less than the calculated critical value at 95% which is -1.711. But after taking the first difference, all variables become stationary i.e. the values of the t-statistic were greater than -1.711 which means rejecting the null hypothesis but accepting the alternative hypothesis. This shows that the series is stationary. In conclusion, the series is

integrated in order of *1*(1) i.e. stationary after the first difference. *NB: The values are only taken in absolute terms hence we ignore the negative.*

4.4 Cointegration Analysis

After detecting that all series are *I* (1), the Johansen maximum co-integration analysis was applied to test for the existence of a long-term relationship between the variables that are non-stationary. The results were as shown in Table 4.4.

Table 4. 4: Johansen Test for Co-integration

Maximum Rank	Trace Statistics	Critical Value	Max-Eigen Statistic	Critical Value
0	190.8045	94.15	79.9541	39.37
1	110.8504	68.52	44.4495	33.46
2	66.4009	47.21	36.0369	27.07
3	30.3641	29.68	16.9203	15.97
4	13.4138	13.26	10.9327	10.07
5	6.2143	5.54	5.2361	6.31
6	2.4810	3.76	2.48810	3.76

** Trace test indicates 5 eqn (s) of cointegration at the 0.05 level
* denotes rejection of the null hypothesis at the 0.05 level

The approach of Johansen was used to test the cointegration. The Johansen test generally involves two tests namely "Trace statistics" and "Maximum eigenvalue". The null hypothesis to be tested for the case of the trace test is there at most "r" number of co-integration vectors while the null hypothesis for the eigenvalue test is there "r" co-integrating vectors against the existence of alternative r + 1 (Naidu et al., 2017). Based on the results of co-integration in Table 4.4, the Trace Statistics and Max Eigenvalues of maximum rank from 0-5 are higher than the critical value hence we reject the null hypothesis. This means we have more than 5 cointegration equations in this model. This leads to the conclusion that we reject the null hypothesis of no cointegration in this model hence this indicates there exists a long run indication that there is a long-term relationship between the variables.

4.5 Causality Test Analysis

The study employed the Granger causality Wald Test to test for causality between variables. The results were as seen in table 4.5 below.

Table 4. 5: Granger causality Wald Test

Independent Variable	**Dependent Variable**	**Prob > chi2**
Log IO	Log GHGE	0.019
Log PopG	Log GHGE	0.000
Log U	Log GHGE	0.000
Log GDP	Log GHGE	0.044
Log GDPPC	Log GHGE	0.455
Log EC	Log GHGE	0.035

From the results, we can deduce that the P value on industrial output is 0.019 which is less than 0.05 which shows there is a causal relationship between IO and GHGE we reject the null hypothesis and accept the alternative hypothesis that industrial output causes the emission of greenhouse gases (environmental pollution). The P value of population growth is 0.000 which is less than 0.05 which shows there is a causal relationship between population growth and emission of greenhouse gases hence we reject the null hypothesis and accept the alternative hypothesis that population growth causes the emission of greenhouse gases (environmental pollution). The P value of urbanization is 0.000 which is less than 0.05 which shows there is a causal relationship between urbanization and the emission of greenhouse gases hence we reject the null hypothesis and accept the alternative hypothesis that urbanization causes

emission of greenhouse gases (environmental pollution). The P value of economic growth (GDP) is 0.044 which is less than 0.05 which shows there is a causal relationship between economic growth (GDP) and the emission of greenhouse gases hence we reject the null hypothesis and accept the alternative hypothesis that economic growth (GDP) causes the emission of greenhouse gases (environmental pollution). The P value of GDP per capita is 0.455 which is more than 0.05 which shows there is no causal relationship between GDP per capita and emission of greenhouse gases hence we do not reject the null hypothesis that GDP per capita does not cause emission of greenhouse gases (environmental pollution). Finally, The P value of energy consumption is 0.000 which is less than 0.05 which shows there is a causal relationship between energy consumption and the emission of greenhouse gases hence we reject the null hypothesis and accept the alternative hypothesis that energy consumption causes the emission of greenhouse gases (environmental pollution).

4.6 Regression Analysis

Since all the variables are found to be co-integrated at most 5, there exists a long-run dynamic relationship between the variables. Granger shows that if at least two variables are co-integrated, there will be causality between them at least in one direction. In order to determine the direction of causation between the variables, a regression analysis was carried out. The results are shown in table 4.6.

Table 4. 6: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.977[a]	0.954	0.942	0.0216375

a. Predictors: (Constant), Log EC (Kwh per capita), Log IO (Billions of US $), Log GDPPC (US $), Log UPop, Log PopG (Millions), Log GDP (Billions of US $)

Based on the results, the coefficient value of R is 0.977, representing 97.7 per cent, which indicates that there is a coefficient between the study variables. The value of R Square is 0.954, which constitutes 95.4% per cent, suggesting that there is a 95.4% chance of variables other than Industrial Output, Population Growth, Urbanization, GDP, GDP per Capita and Energy consumption that affects the Environmental Pollution (Greenhouse Gases Emissions) in Tajikistan.

At a 5% confidence level, analysis of variance was carried out (ANOVA). Findings are shown in Table 4.7.

Table 4. 7: Analysis of Variance (ANOVA)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	0.198	6	0.040	84.680	0.000[b]
	Residual	0.011	23	0.000		
	Total	0.209	29			

a. Dependent Variable: Log GHGE (KT of CO2)

b. Predictors: (Constant), Log EC (Kwh per capita), Log IO (Billions of US $), Log GDPPC (US $), Log UPop, Log PopG (Millions), Log GDP (Billions of US $)

From the table, (0.000 < 0.05) which shows that the model was significant. This finding show that the overall regression was significant in determining the relationship between industrialization (Industrial output) and environmental pollution (Greenhouse gases emission). According to Piepho (2018), if the p-value is less than 0.05, then the overall regressions is significant.

Table 4. 8: Regression Coefficients

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	3.486	3.383		1.030	0.002
	Log IO	0.329	0.052	0.831	0.247	0.000
	Log PopG	0.355	0.391	0.294	1.596	0.000
	Log UPop	0.708	0.486	0.503	3.023	0.000
	Log GDP	0.154	0.036	0.640	4.327	0.000
	Log GDPPC	-0.158	-0.041	-0.544	-3.847	0.001
	Log EC	0.545	0.202	0.618	2.705	0.013

a. Dependent Variable: Log GHGE (KT of CO2)

The regression equation of long run which obtained is:

LGHGE= 3.486+0.329LIO+0.355LPopG+0.708LU+0.154LGDP-0.158LGDPPC + 0.545LEC

From the overall regression coefficient Table 4.8, the findings prove that, all factors kept constant, environmental pollution would be at 3.486. The finding also showed that an increase in industrial output would increase environmental pollution (greenhouse gases emission) by 32.9%. A unit change population growth would increase environmental pollution (greenhouse gases emission) by 35.5%. Urbanization would increase environmental pollution by 70.8% when there is unit increase. A unit increase of GDP would increase environmental pollution by 15.4%. A unit increase of GDP per Capita would reduce environmental pollution by 15.8%. Finally, a unit increase of energy consumption would increase environmental pollution by 54.5 %.

4.7 Results and Discussions

The discussion of the results consists of tests which were applied to the annual time series data, during the period 1990 to 2019. The first test was descriptive statistics, showing the total number of observations in the analysis is 30. Additionally, the standard deviation of each individual series is small from its mean, indicating a low coefficient of variation of the series. The second test is that of the correlation which indicates the existence of a linear and positive association between industrial output, population growth, urbanization, economic growth, GDP per capita and emission of greenhouse gases (environmental pollution). Third, the stationarity test was applied and at the level, the variables were not stationary but after the first differentiation, all the variables are stationary. Then the cointegration test was undertaken which showed that there is a long-term relationship between the variables. Since all variables are co-integrated at plus 4, there is also a causal relationship between them.

The regression gives the equation below, the interpretation here will be done one by one from a statistical point of view and also from the Tajikistan point of view.

$L(GHGE) = \beta_0 + \beta_1 L(IO)_t + \beta_2 L(PopG)_t + \beta_3 L(U)_t + \beta_4 L(GDP)_t - \beta_5 L(GDPPC)_t + \beta_6 L(EC)_t + \mu t.$

LGHGE =3.486+0.329LIO+0.355LPopG+0.708LU+0.154LGDP-0.158LGDPPC + 0.545LEC

i.IO represents industrial output (Industrialization)

The results show that showed that an increase in industrial output would increase environmental pollution (greenhouse gas emission) by 32.9%. This means there exists a positive relationship between the independent variable and the dependent variable. The p-value of the variable is 0.000 which is less than 0.05 meaning industrial output has a significant relationship with environmental pollution in Tajikistan.

This result was observed in a study carried out by Abokyi et al. (2019) indicating a positive link between industrialization and environmental pollution when they opined that the global

environment has been deteriorating over the years this is because industrial processes play a significant role. Environmental policy and emerging technology in developed countries decrease environmental damage per produced unit, but industrial activity and increased demand continue to place environmental and natural resource stresses on the basis of production. The environmental effects in developed countries are two-fold: old environmental issues, such as deforestation and land degradation, remain largely unresolved. Newer industrialized challenges, such as increased greenhouse gas emissions, air and water contamination, increased waste volumes, desertification and pesticides, arise concurrently.

Tajikistan's industrial development is driven by seven well-established industrial estates. New industrial estates are also being planned because of the industrial-friendly environment as several big industrial firms with a national reputation and many prominent multinationals have shown considerable interest in building their plants in Tajikistan in the near future. Along with economic growth, this accelerated industrialization led to sudden population growth, urbanization and apparent stress on basic life support structures, which took environmental impacts closer to tolerance threshold limits. In Tajikistan, factories have been rated as Red, Orange and Green based on the type and intensity of emissions, with respect to extreme, middle and low pollution capacity in that order. Currently, 19% of the overall sectors are in the red band, 21% orange and 60% green. By mid-2019, Tajikistan was expected to generate about 36,768 tons per year of hazardous waste (Мирзоев, 2019).

ii.PopG refers to population growth.

The results obtained in this study show that a unit change population growth would increase environmental in pollution (greenhouse gas emission) by 35.5%. This shows that there exists a positive relationship between the independent variable and the dependent variable. The p-value of the variable is 0.000 which is less than 0.05 meaning population growth has a significant relationship with environmental pollution in Tajikistan. This is held true by Liang and Yang (2019) when they discussed that a high population growth rate, has weakened environmental conditions, although population growth has proved to be a significant source of growth. The effect of population growth on the environment is mainly attributed to use of natural resources and waste production, environmental pressures such as depletion of habitats, air and water contamination and increased pressure on arable land. In addition to rising stresses on marginal lands, soil erosion, overgrazing, timber burns, soil erosion, silting or floods, the rapidly growing population increases the use of pesticides, fertilizers, and damage of the soil and water contamination. Rapid population growth could be attributed to major causes of environmental degradation in Tajikistan. The population growth of Tajikistan is increasing pressure on the constantly degrading and limited natural resource base in Tajikistan. The growing population has led to rapid growth in Tajikistan's energy production, consumption, and environmental degradation. The impact on soil, surface water pollution, air pollution and global warming, lead to absolute poverty, which has become more and more of an issue. In developing countries such as Tajikistan, the rate of environmental destruction and degradation is much higher than in developed countries. Population growth is the annual demographic change caused by disparities in birth over death and emigration and immigration imbalances.

iii.U is the urbanization

The results showed that urbanization would increase environmental pollution by 70.8% when there is a unit increase. This shows that there exists a positive relationship between the independent variable and the dependent variable. The p-value of the variable is 0.000 which is less than 0.05 meaning urbanization has a significant relationship with environmental

pollution in Tajikistan. This was proved by Effiong (2018) when he discussed that, the big cause of this environmental pollution situation is the overwhelming scale of the city population, the haphazard and unforeseen rise of urban settlements, and the desperate shortage of infrastructure. The exponential development of both natural and migrating urban communities has exerted heavy demand on public services, such as infrastructure, hygiene, transport, power, housing, sewage, water transport, power, public health and education. Urban spread soon invades the valuable farmlands leading to the direct loss in vegetation biomass. Areas with high probability of urban expansion are predicted to contribute about 5 percent of the overall tropical deforestation and land use pollution are projected to increase in direct reduction of trees and forests from areas with a high likelihood of urban growth. As a result of uncontrolled urbanization in Tajikistan, there has been a very rapid environmental degradation and a large number of problems such as land insecurity, water quality deterioration, excessive air pollution, noise and waste disposal problems. While Tajikistan is one of the least urbanized countries in the world, the country today is facing a severe crisis in urban development from the little sprawling towns. These problems are economic, social and political difficulties which have generated serious socio-economic problems. Urbanization, attributable to industrialization and economic development is a phase that leads to cities' growth. The population of Tajikistan increases by about 2.4 percent per year, averaging 820 live births per day. By 2050, if the trend persists, the world would have nearly 16.2 million inhabitants, which is almost twice the current population.

iv.GDP or Economic growth

The study found that a unit increase of GDP would increase environmental pollution by 15.4%. This shows that there exist a positive relationship between the independent variable and the dependent variable. The p value of the variable is 0.000 which is less than 0.05 meaning economic growth (GDP) has a significant relationship with environmental pollution in Tajikistan. This was shown in a study by Kong and Khan (2019) when they discussed that the relationship between the level of income and environmental degradation is reversed. Economic growth is related to deterioration of the environment in the first stage. At this point, the rise in manufacturing activities in low-level countries leads to an increase in the output of high-oil energy and an increase in pollutant emissions. The pattern of environmental destruction gradually decreases due to environmental consciousness, along with manufacturing shifts and tighter environmental laws, as utilities grow and technologically intense businesses dependent on information. Tajikistan economy has been growing with an average of 7% since 2011. While this is good, it has come up at the expense of the environment due to increased industries and urban sprawling. The effect of economic growth on the environment includes increased usage of energy sources which are non-renewable, increased pollution levels, global warming and possible habitat loss. The higher economic growth has come at the expense of environment.

v.GDP per Capita (GDPPC)

The coefficient in this case is negative, hence the study observed that a unit increase of GDP per Capita would reduce environmental pollution by 15.8%. This shows that there exists a negative relationship between the independent variable and the dependent variable. The p-value of the variable is 0.001 which is less than 0.05 meaning GDP per capita has a significant relationship with environmental pollution in Tajikistan. This was discussed by Keng and Khan (2019) when they observed that, among the mechanisms for explaining why the Human Development Index (HDI) can actually result in better environmental quality as countries grow richer, are improved technology, increased demand for environmental quality and better government regulation. The environmental model of the Kuznets Curve is based on the counterbalancing

impact and forecasts a rise in environmental degradation as the countries get wealthier, with comparatively high per capita incomes. This theoretical setting includes watching declining environmental sustainability as less developed economies rise. However, the environmental consequences of economic growth could slow down and gradually revert, beginning at some amount of income per capita.

As Tajikistan´s economy improves, the GDP per capita is improving and an increase in the middle class which is aware of environmental degradation hazards. The governments of Tajikistan decided to phase out substances used in refrigerators as they have the ability to destroy stratospheric ozone. People are now aware of the need to conserve the environment and the importance of green spaces in cities and towns. This is attributable to the rising middle class which is well-educated and wants quality life. The booming Tajikistan construction industry as a result of the demand for houses from the middle class, has established ways to minimize building energy use, by constructing buildings that are more economical in heating, illumination, cooling, ventilation and the provision of hot water.

vi.EC Meaning Energy (power) Consumption

The results revealed that a unit increase in energy consumption would increase environmental pollution by 54.5 %. This means that there exists a positive relationship between the independent variable and the dependent variable. The p-value of the variable is 0.013 which is less than 0.05 meaning energy consumption has a significant relationship with environmental pollution in Tajikistan. This is shown by Rafindadi et al. (2018) when they conducted research on energy consumption and environmental pollution: data from the Simultaneous Equations Panel Model in developed countries. The paper´s findings indicate that energy consumption raises CO_2 emissions. The source of energy consumption and CO_2 pollution occurs in a bi-directional manner. Their findings also indicate the per capita effects of GDP on CO_2 emissions. The empirical findings show energy use and environmental pollution in these countries. The economic relationship shows, thus, that reducing the CO_2 emissions of developed countries depends on the change of the energy consumption trend and renewable energies simultaneously replace fossil fuels in their production. Therefore, it is important to commit to sustainable growth in those countries in international negotiations to control CO_2 emissions and energy consumption. Hydropower is Tajikistan's main energy source, followed by power generated from oil, gas and coal. These non-renewable sources of energy have led to environmental pollution when the power plants are operating. This includes air and water pollution, public health damage, wildlife and habitat loss, water use, land use and carbon emissions, which have significantly more harm than if Tajikistan could have adopted renewable energy sources such as wind and solar.

5. CONCLUSIONS AND POLICY RECOMMENDATIONS

This section is divided into two points, the first of which will be the conclusion according to the empirical studies carried out, the second, the policies recommended to reduce environmental pollution in Tajikistan.

5.1 Conclusion

The relationship between industrialization and environmental pollution is discussed in the literature review in addition to other alternative variables. The theories of Environmentally Responsible Behavior, Behavioral Change Model and Reasoned Action have also been widely reviewed in this study, we note at the end of this study that the relationship between industrialization and environmental pollution in Tajikistan is complex, to say the least. Based on a Johansen and Max Eigen co-integration test, the empirical results demonstrated the existence of a long-term relationship. Reasoning at the aggregate level, the results indicate that:

Population growth has a positive and significant impact on the emission of greenhouse gases (environmental pollution) in Tajikistan hence the conclusion that population growth causes environmental pollution in Tajikistan. Urbanization has a positive and significant impact on the emission of greenhouse gases (environmental pollution) in Tajikistan hence the conclusion urbanization causes environmental pollution in Tajikistan. Economic growth (GDP) has a positive and significant impact on the emission of greenhouse gases (environmental pollution) in Tajikistan hence the conclusion that economic growth (GDP) causes environmental pollution in Tajikistan. GDP per capita has a negative impact on the emission of greenhouse gases (environmental pollution) in Tajikistan hence the conclusion that GDP per capita does not cause environmental pollution in Tajikistan. Energy consumption has a positive and significant impact on the emission of greenhouse gases (environmental pollution) in Tajikistan hence energy consumption causes environmental pollution in Tajikistan. The main question this thesis was trying to answer is, does industrialization affect environmental pollution in Tajikistan? Based on the findings that industrial output (industrialization) has a positive and significant relationship with emission of greenhouse gases (environmental pollution) in Tajikistan, this study concludes that industrialization causes environmental pollution in Tajikistan. Such a result, therefore, indicates the implication of industrial activities in Tajikistan and is linked to the promotion policy that the State has to put in place. The results of causality tests indicate short and long-term bidirectional causality in Granger's sense, from industrialization to environmental pollution, in other words, industrial activities/industrialization is the source of environmental pollution.

5.2 Recommendations

Rampant industrialization, urbanization, population growth, energy consumption and economic growth have had a significant role in putting pressure on natural resources and also causing environmental pollution of various magnitudes. Tajikistan has been experiencing a similar kind of situation for many decades. The study recommends the following to curb this trend:

1) Major efforts are highly required to ensure the sustainability of industrialization both in terms of environmental pollution reduction measures as well as the promotion of more eco-friendly industries. As a dynamic plan to protect the country's natural wealth, a transformation of the sector into an eco-industrial network is required. Strong ties between industries and employing clean technology measures will facilitate the transition to a diversified, high-income economy while ensuring a safer environment.
2) Industry should recognize that the environmental and economic advantages of the eco-industrial network will certainly bring in the long run and the socio-economic growth and the sector will be improved greatly.
3) The Government of Tajikistan should develop strategies to overcome problems by changing or introducing appropriate approaches and addressing missing aspects of the related policies for reinforcing sustainable industrialization.
4) In order to provide for conditions under which industrial symbiosis (IS) can thrive, industries require a combination of incentives, laws, management, intelligence and other technology mechanisms.
5) Regional development agencies and local governments should accept the responsibility for balancing economic development with maintaining a clean environment such that an industry caught polluting the environment and unhealthy waste disposal should face the full force of the law even if it’s providing employment opportunities and economic growth to the region
6) Giving back to the environment is the best way to reduce environmental degradation. Industries should consider it one of the CSR activities as planting trees, since trees give us clean air to breathe, basically filter the bad carbon dioxide and pump the good oxygen, so without

trees, we would never be able to survive. This is initiative industries and companies can consider.

7) Recycling should be adopted in Tajikistan by industries as the best way of slowing environmental degradation and should be shared by everyone. Recycling is the best way to prevent environmental degradation and this is a mission everybody in the world should take to save the planet.

8) Industries and individuals should minimize the use of fossil fuels, such as oil in their machine operations. The government should provide incentives and tax reductions for the assembly of electric cars, and solar panels, energy-saving building materials. This way industrialization will be realized at the same time promoting environmental protection. Companies should switch to go green for the purpose of cutting down their overall resource consumption, such as power.

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