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Impact of Green Tax Policies, Industrialization and Innovation Affect Environment Pollution Evidence from SAARC: A Review

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ABSTRACT

This study investigates the impact of green taxation, industrialization, and innovation on environmental pollution in SAARC countries. Rapid economic growth and industrial expansion have significantly increased carbon dioxide (CO_2) emissions, creating serious environmental concerns in the region. The primary objective of this research is to examine whether green tax policies can effectively reduce environmental degradation while sustaining economic development, along with assessing the role of innovation in promoting environmental sustainability. The findings of this study are expected to provide empirical evidence on the effectiveness of green taxation and innovation in reducing CO_2 emissions. The study will offer important policy implications for achieving sustainable development by balancing environmental protection with industrial growth in SAARC economies.

1. Introduction

The climatic change constitutes one of the greatest environmental challenges faced by many nations in the world (Anjum, Rahman, & Idrees, 2026). According to Govindarajan and Tang's study (2013), it has been shown that the desire of many countries to develop at a greater rate contributes to the deteriorating environment and resource exploitation. CO2 emission is among the common indicators of pollution; it comes from cement productions, consumption of gas flaring, burning of fossil fuels, coal, gas, solid, liquid materials (Huang, Rahman, Meo, Ali, Khan, 2024). CO2 emissions arise from two major sources; the natural one and man-made ones. First, natural sources of CO2 include respiration, ocean releases, and decomposition. As a result of the various human activities, CO2 emission absorption in the atmosphere increased to a level of concern, especially because of the rise of industrial revolution (Zhao, Rahman**,** Afshan, Ali, Ashfaq, & Idrees, 2023). Human activities are the other source of CO2 emissions. These activities include the burning of natural gases, coal, oil, production of cement, deforestation among others (Chen &

Huang, 2013). Weather variations, severe droughts in food production, rise in the sea level, and insufficiency in supply of water pose threats to the life of people and other species. CO2, odorless, colorless, and nonpoisonous gas, mostly emitted from combustion of carbon and other anthropogenic activities, including respiration of living beings, is one major GHG causing global warming (Abdul-Wahab et al. 2015). Globalization, which arises due to changes, international competition, and development in technology in economies, brings about higher production of goods and services (Ilyas et al., 2023). Nevertheless, globalization, coupled with industrialization and urbanization, can cause negative externalities in the quality of the environment. Globalization has influence on CO2 emissions via income effect, scale effect, and composition effect approaches (Antweileret et al, 2001). The income effect approach suggests that globalization causes emissions owing to more foreign trade and foreign investments and vice versa (Hassan, Sheikh, & Rahman**,** 2022).

To avoid high manufacturing and environmental expenses, polluting firms from industrialized countries may invest in developing countries with little environmental regulation (Islam and Kakinaka et al, 2020). This investment raises EC and CO2 levels in host countries, and the investing country eventually becomes a "haven" for polluting corporations (Hao et al, 2020). The pollution haven hypothesis formalizes this relationship. Another notion related to environmental pollution and FDI is the pollution halo theory, which claims that firms from higher-income nations contribute to minimize GHG emissions in the host nation due to their green technology (Mert and Caglar et al, 2020). EC is regarded as a major input for almost all commodities and services in a modern economy. There is no way for GDP and development to progress without the use of energy (Ssali et al. 2019). However, employing a hard energy source, such as coal-fired power plants, natural gas-fired power plants, or oil refineries, rather than a soft energy source, is regretful (Sarwar, Ali, Bhatti, & Rahman, 2021). The discussion over global warming will then center on rising carbon emissions and its connection to GDP and EC (Sarwar and Wei et al, 2019). Therefore, controlling GHG emissions and guaranteeing the long-term sustainability of economic development require an understanding of the dynamic relationship between GHG emissions, FDI, EC, and GDP. Political and macroeconomic stability, a well-designed investment environment, and an abundance of inexpensive labor have been identified as the primary drivers of FDI attraction and EG in these member countries (UNCTD et al, 2019).

Therefore, a rise in FDI could serve as a trigger for higher EC in the SAARC member nations, increasing CO2 emissions. The SAARC nations are an interesting case study for examining the causal links between EC, GDP, FDI, and CO2 emissions because of these features (Ali, Rahman, & Anser, 2020). To the best of our knowledge, a significant amount of research has been done on GDP and GHG emissions in that region; however, there is limited capacity to incorporate EC, income, FDI, and GHG emissions into a university-level framework (Zafar, Rahman, Ahmad, & Idrees, 2025). Given this, the goal of this study is to fill in the gaps by examining the causal links between GDP, EC, and FDI and CO2 in order to evaluate the aforementioned hypothesis in respect to a few chosen SAARC member states (Song, Rahman, Anees, Ali, 2024). Therefore, the main study issue is how much EC, FDI, GDP, and CO2 are related in a few SAARC member nations (such Bangladesh, India, Pakistan, Nepal, and Sri Lanka) between 1980 and 2016. Decision-makers and other partners, including governments, non-governmental organizations, and corporate organizations, can use this information to make well-informed decisions that will guarantee continued GDP, reduced CO2 emissions, and increased use of clean investment. brief review of the literature is followed by econometric models and data sources in the next section (Qadri, Shi, Rahman, Anees, Ali, Brancu, & Nayel, 2023). The technical details of several econometric techniques are then covered. The test and model results are then displayed. A summary of the full

study and a conclusion with policy recommendations are included in the final part (Awan, Rahman, Ali, & Zafar, 2023).

1.1 Background of the Study

In the context of India, this study looks at the two—possibly the most significant—advantages and disadvantages of foreign direct investment: GDP expansion and environmental deterioration (Khan, Afridi, Shad, Rahman, 2022). Economic theory gives us numerous explanations for why foreign direct investment (FDI) could improve the host nation's economic performance (Rahman, Chaudhry, Meo, Sheikh, & Idrees, 2021). The positive correlation between FDI inflows and economic growth, however, is not universally accepted by empiricists. While some research shows that foreign direct investment (FDI) boosts economic growth, other studies find the opposite (Aitkin and Harrison et al, 1999), Djankov and Hoekman (2000), Damijan et al. (2001), Konings (2001), Castellani and Zanfei (2002a, 2002b), and Zukowska-Gagemann et al, 2002). According to a report by Mello (1997), FDI may boost growth through two primary channels: First, through capital spillovers, FDI can promote the adoption of new technologies in the manufacturing process. Second, FDI may promote knowledge transfers through the introduction of improved organizational structures and alternative management techniques, as well as labor training and skill acquisition (Rahman, & Bakar, 2019). These findings are supported by an OECD survey from 2002, which shows that FDI had a positive impact on factor productivity and income growth in 11 out of 14 studies. One important finding from all the research examined is emphasized by both Mello and the OECD: the impact of FDI on growth is likely to depend on the technological and economic circumstances in the host nation (Afzal, Rahman, & Aslam, 2025). Specifically, it seems that before the host nations can reap the benefits of foreign direct investment, they must attain a certain degree of infrastructure and/or education development is wealthy enough in terms of per capita income (Shen, Rahman, Hafiza, Meo, & Ali, 2024). Second, the possible advantages, such as a negligible or weak effect on economic growth, are still distant from being realized.

Four studies have examined the prerequisites for determining FDI's beneficial effect on economic growth, using a range of cross-country regressions Anees, Ali, Brancu, & Nayel, 2023). It's interesting to note that they highlight distinct but connected aspects of development. First, according to Blomstrom et al. (1994), FDI boosts a nation's growth when a country, Balasubramanyam et al. (1996) Observe that realizing the potential growth impact of FDI depends on trade openness. Third, FDI boosts growth, but only in nations where the labor force has attained a particular degree of education, according to Borensztein et al. (1998). Lastly, Alfaro et al. (2004) highlight financial markets since they discover that foreign direct investment (FDI) stimulates economic growth in nations with adequately developed financial markets (Shahzadi, Ali, Ghafoor, & Rahman, 2023). Beginning in the mid-1980s, FDI, Growth and the environment: data from India revealed a strong endogenous association between FDI and economic growth.1 45 After forty years of prudence, India has attempted to boost FDI inflows with liberal trade and investment policies since 1991 (Li, Bai, Yu, Meo, Anees, &. Rahman, 2022). if not a constrictive attitude toward it. India's policy liberalization corresponded with a sharp increase in foreign direct investment (FDI) from $50 billion annually in the mid-1980s to a peak of $350 billion in 1996. Annual inflows to India have also been steadily increasing throughout the 1990s (Zhu, Fang, Rahman, & Khan, 2021). The rise would seem remarkable, even though they would seem relatively tiny in comparison to the kinds of magnitudes that some of India's peers in Southeast or East Asia draw. Dunning (1998) found that while absolute magnitudes remained quite small, the rate of expansion of investment directed to India was significantly above average in an examination of shifting patterns of worldwide FDI inflows (Rahman, Bakar, & Idrees, 2019).

However, it is unclear whether this increase was caused only by the liberalization strategy or by an increase in the volume of foreign direct investment activity worldwide. In terms of sources, sectoral composition, and organizational structure, the inflows have likewise deviated from previous trends since the 1990s. India's GDP growth rates increased significantly between 1991 and 2004, averaging 7% annually. Therefore, it is reasonable to wonder whether and to what degree the increase in FDI inflows during that time period may have contributed to or caused such higher growth rates (Qayyum, Ali, Rahman, & Khalid, 2025). Additionally, the relationship between FDI inflow and the environment is not straightforward. On the one hand, the hotly contested capital flight and pollution heaven hypotheses (PHH) discuss how foreign direct investment (FDI) is drawn to nations with comparatively loose environmental laws or lower environmental taxes. The industrial flight and pollution heaven ideas have been covered in survey works by Beghin (1996) and Jaffe (1995). Regarding the movement of industries in this instance, the widely held belief is that "dirty industries" relocate their operations to developed nations due to their comparatively lax environmental regulations (Shen, Rahman, Hafiza, Meo, & Ali, 2024). Fast-growing economies are drawing more foreign direct investment (FDI) because larger markets increase investment profitability. Improved economic growth has historically assisted numerous nations in drawing in more foreign direct investment (FDI) (WIR, 2003). In 2004, FDI inflows sharply increased in the majority of nations and regions

The Environment Kuznet Curve (EKC), an observed inverted-U relationship between output growth and pollution levels, is central to this relationship.Both scale and composition effects are produced in the short term by FDI inflows (Sheikh, Sadiq, & Rahman, 2023). A rise in pollutant emissions and resource depletion resulting from increased economic activity driven by foreign direct investment is known as the "scale effect." The composition effect, on the other hand, is the shift in the GDP share of unclean items that may result from a change in prices that favors their production (Shahzadi, Ali, Ghafoor, & Rahman, 2023). By shifting consumer preferences toward comparatively cleaner products, income development may potentially have a positive long-term impact on the environment [Dean (1999)]. As a result, fewer pollution-intensive products are produced, which lowers pollution emissions. This effect would reduce overall pollution if the economy remained stable and the emission intensities of each industry remained unchanged (Khoula, Rahman, Idress, 2022). The upward rising portion of the EKC indicates that the detrimental scale effect appears to be more pronounced at low output and income levels, leading to overall environmental degradation owing to FDI inflow.

However, because assessing environmental damages involves numerous technical and conceptual challenges, empirical testing of these composition and scale effects is challenging. First of all, certain unclean industries—like cement, fuel, wood, and transportation—cause air pollution, while others—like chemicals, paper, and pulp—cause water pollution, and still others—like metals—cause both (Younas, Idrees, & Rahman, 2021). Combining air and water pollution emissions to determine an aggregate measure of pollution emissions or degradation of a nation's environmental quality and then connecting that measure to foreign direct investment inflow is conceptually meaningless. Second, there are both local and global contaminants, even when it comes to air pollution (Iqbal, Rahman, S. Idrees, Ijaz, & Javed, 2025). While CO2 is the primary global pollutant, SO2, CO, and NOX are the three main local air pollutants. Therefore, it is necessary to appropriately define the topic and scope of the study in order to quantify the relationship between FDI, growth, and environmental deterioration. Although we briefly examine the composition effect of FDI in India during the 1990s in terms of the proportion of dirty industries in total FDI inflow, we are limited to examining the growth-effect of FDI on CO2 emissions by India due to the lack of data on local and global air pollutants emitted by various industries over a long enough period of

time (Liang, Rahman, Shafaqat, Ali, Ali, & Khan, 2024). In the context of the global economy, however, looking at the effect on global air pollutants like CO2 emissions would be more pertinent, especially considering that India ranked fourth in the world for CO2 emissions in the late 1990s.

In light of these issues, we arrive to the following conclusions (Rahman, Majeed, Umair, & Idrees, 2023). First, a cointegration study reveals that FDI influx had a small but positive long-term effect on aggregate output growth between 1980 and 2003. Second, there is no direct evidence of PHH in India following the 3See Dinda (2004) for an EKC survey, despite the lowering proportion of dirty industries in total FDI influx. 4 Only after the mid-1990s is sectoral breakdown of FDI in India accessible FDI, Growth, and the Environment: India 47, mid-1990s. However, since the proportion of dirty industries in total output may have increased, this does not rule out the negative environmental effects of FDI flows (Shahzadi, Ali, Ghafoor, & Rahman, 2023). Third, FDI appears to have a significant long-term beneficial effect on CO2 emissions through GDP growth. Therefore, our findings offer some empirical evidence that FDI inflow has led to a decline in CO2 emissions, a measure of air quality. Given that CO2 emissions are a worldwide contaminant, this finding also has some significant effects on the ecosystem (Zulfiqar, Ansar, Ali, Hassan, Bilal, & Rahman, 2022).

1.2 Problem Statement

Global warming and other challenges related to climate change have faced different kinds of protests from different quarters throughout the world over the last few decades. In spite of the considerable climate change resulting from greenhouse gas emissions (GHG), the world community has tried to deal with the global environmental issues. Furthermore, preserve the habitability of the earth. The Paris Accord under the United Nations Framework Convention on Climate Change (UNFCCC). For example, was a key step in resolving the environmental catastrophe? The primary purpose of this agreement is to limit GHG emissions to keep global warming below 2 degrees Celsius (UNCFCCC 2015). GHG emissions from the use of fossil fuels in conjunction with other economic activities contribute significantly to global climate change. Flooding, droughts, and wildfires are some of the consequences of climate change caused by GHG emissions (IPCC 2014). It also triggers serious health effects from smog and air pollution, such as asthma and respiratory issues (IPCC 2014). Climate change has an enormous effect on crop output in many locations, resulting in food insecurity and poverty, particularly for developing countries (IPCC 2014). The IPCC emphasizes the importance of human-caused carbon dioxide (CO2) emissions, which account for the vast bulk of global GHG emissions. Over 80% of GHG emissions are driven by CO2 emissions, which are mostly created by rising countries aiming to accelerate their economic development (EG) and expand domestic production to take advantage of projected economic conditions (IPCC 2019). When it comes to climate change, the relationship between environmental pollutants, GDP, foreign direct investment (FDI), and energy consumption (EC) has received a lot of attention

The GDP of a nation can be used to gauge its progress, growth, and development. GDP stands for gross domestic product. With good reason, GDP is the most talked-about subject in economics. In essence, the gross domestic product shows the entire monetary worth of finished goods generated by a nation's citizens over the course of a year. The definition itself explains how GDP is a measure of economic growth because, to put it simply, GDP is a measure of a nation's level of economic activity. Therefore, a nation that engages in more activities is creating more, earning more, consuming more, and spending more—all three indicators of a functioning economy. Therefore, a nation is considered developed if its level of these activities is higher, and it is

considered developing if its GDP is low at larger or higher levels. A nation is considered underdeveloped if its GDP is extremely low. We can better comprehend this pattern by looking at GDP statistics from other nations. The top six nations in the world—the United States, China, Japan, Germany, the United Kingdom, and India—have GDPs of $20.89 trillion, $14.72 trillion, $5.06 trillion, $3.85 trillion, $2.67 trillion, and $2.66 trillion, respectively, according to the World Bank. Let's contrast these enormous GDP numbers with the information from the nations we will examine in this essay. Bangladesh, Bhutan, Nepal, Pakistan, Sri Lanka, Maldives, and Afghanistan have respective GDPs of $460.2 billion, $2.768 billion, $40.83 billion, $374.7 billion, $74.4 billion, $6.171 billion, and $14.27 billion, according to the World Bank. The GDP statistics makes it clear that the nations who are now leading the world have enormous GDPs, while the nations that are struggling or not doing well economically all have lower GDPs than the top countries.

A new and unprecedented threat to the future of our planet has been raised by climate change and the massive rise in carbon emissions over the past few decades, which has cast a shadow over human life and progress (Gan & Voda, 2023; Noor et al., 2024). As economies grow, people are moving from developing to more developed regions, which is accelerating environmental degradation globally (Farooq et al., 2023). Climate change poses a threat in a number of ways, including forest fires, melting glaciers, rising temperatures, droughts, floods, and deserts. The ecosystem of Earth and human survival (Xia, 2023). The substantial reliance on fossil fuels for energy production has resulted in higher greenhouse gas emissions, which have hindered modern economic progress (Zhang et al., 2022). However, it continues to be the main source of greenhouse gas emissions (Chien, 2022).

The industrial boom, urbanization, and expansion of economic activity all led to an increase in energy demand, which is considered a development indicator (Bulut, 2017). Unchecked environmental contamination poses a severe threat to long-term growth, which has increased research on the relationship between ecological degradation and GDP per capita (Shafique, Rahman, Khizar, Zulfiqar, 2021). A high GDP per capita remains the primary objective for any nation. Consequently, industrialized economies are paying more attention to the environmental impact of their growth strategies (Awan & Azam, 2022; Onakpojeruo et al., 2025). Sustainable economic growth is now a key policy goal for all nations. The requirement to lower CO2 emissions in order to accomplish this goal poses a challenge to the SDGs for sustainable development (Hafiza, Manzoor, Fatima, Sheikh, Rahman, Qureshi, 2022). Innovation is taking center stage in talks on climate change policy because of its ability to strike a balance between the need to improve environmental quality and the pursuit of economic expansion (Dauda et al., 2019; Chontanawat, 2020).

In both wealthy and developing nations, innovation is now essential to sustainable development and efficient energy generation (Shahid, Muhammed, Abbasi, Gurmani, & Rahman, 2022). By switching to different energy sources, economic growth can be encouraged without causing environmental harm. Technological developments are primarily driving this fundamental change toward sustainable economic success (Dauda et al., 2019). If we are to fight climate change, end pollution, and guarantee a consistent supply of energy, the world's economies must transition to low-carbon models. Our environment is heavily polluted, which makes sustainable growth challenging. As a result, the critical relationship between GDP and environmental sustainability is being discussed all across the world (Farooq et al., 2023). The creation of new green technology is the most efficient way to stop such emissions, even though artificial processes can also release large amounts of carbon dioxide into the atmosphere (Shao et al., 2021; Sharif et al., 2022). Recycling resources, cutting carbon emissions, monitoring green business practices, and employing purification methods are the main objectives of green technology (Guo et al., 2020;

Sharif et al., 2022). Innovations in green technology are essential to moving civilization away from the use of fossil fuels and toward the use of renewable energy. It has been stated that developing nations must swiftly replace nonrenewable energy sources with renewable energy and green technology in order to achieve long-term sustainable development and reduce carbon emissions (Obobisa et al., 2022).

Green technology innovation can be considered the main instrument for improving environmental quality by producing eco-friendly products and services, reducing energy intensity, and optimizing production capacity (Chang et al., 2023). Every country must implement energy policies and technical advancements that have the least detrimental impact on the environment for the sake of the globe (Umar et al., 2020; Su et al., 2020; Shan et al., 2021). Burning fossil fuels releases a lot of CO2s, which is one of the primary causes of greenhouse gas emissions. As a result, greenhouse gas emissions are often attributed to the energy sector. Energy and environmental policy are closely related, and each influence and develops the other in a dynamic way (Ardakani et al., 2019).

To fulfill their commitments, nations must lower their CO2 emissions. The need for significant CO2 reduction efforts is highlighted by the need to switch from non-renewable to renewable energy sources in order to meet this goal. Global economies are gradually coordinating their shift from the traditional reliance on non-renewable energy to cleaner, sustainable alternatives in order to achieve socioeconomic and environmental sustainability through the efficient use of renewable energy (Zaidi et al., 2018).

2. Literature Review

Governments, corporations, and communities are searching for more efficient ways to cut greenhouse gas (GHG) emissions due to the pressing need to address climate change (Qureshi, Zaman, Rahman, Shahzadi, 2022). Carbon taxes have become one of the most extensively discussed and used tools in the world. Carbon taxes aim to internalize environmental externalities by putting a monetary cost on carbon emissions. This encourages polluters to cut emissions and switch to cleaner technologies (Meila et al., 2024). The implementation of carbon taxes has differed greatly amongst nations worldwide. Carbon tax policies have long been in place in developed nations like Sweden, Finland, and Canada, and they have shown quantifiable results in lowering emissions while sustaining economic growth (Mukhtar, Shahid, Razzaq, Rahman, 2023).

This worldwide variance emphasizes how crucial contextual elements are in influencing the efficacy of carbon tax programs, including institutional ability, governance systems, and economic maturity (Soekarno et al., 2024). One of Southeast Asia's biggest polluters, Indonesia has progressively incorporated carbon pricing into its goal for fiscal reform (Pramita et al., 2024). As part of the Harmonized Tax Law (UU HPP), the government publicly submitted carbon tax legislation in 2021. It will go into effect in 2022, with a wider deployment anticipated in the years to come. This strategy demonstrates Indonesia's dedication to reaching both its long-term objective of net-zero emissions by 2060 and its Nationally Determined Contribution (NDC) commitments under the Paris Agreement (Wang, Rahman, Zulfiqar, Ali, Khalid, & e Ali, 2025).

This is in line with the larger trend toward environmental, social, and governance (ESG) policies, which investors, regulators, and consumers are calling for more and more. Therefore, the carbon tax acts as a market-driven incentive for innovation as well as a regulatory restraint. However, there has been disagreement over how well carbon prices work to advance sustainability (Sultan, Rahman, Munir, Ali, Younas, & Khan, 2025). According to Karlinah et al. (2025), while some studies emphasize their effectiveness in lowering emissions and fostering innovation, others

contend that the results are very context-dependent. Results can be greatly impacted by factors like rate setting, administrative capacity, industry resistance, and policy design (Pramita et al., 2024). For example, a carbon tax that is too high can cause industry and consumer resentment, while one that is too low might not encourage significant change. Carbon taxes is a complicated and multifaceted tool of policy because of these dynamics (Rahman, Idrees, & Ali, 2024). From an academic standpoint, research on carbon taxes is conducted in a number of fields, including corporate governance, public policy, economics, and environmental studies. Its effects on finances, distribution, political viability, and competitiveness have all been studied by academics (Meila et al., 2024). Examining the relationship between carbon prices, green innovation, and the sustainable development goals (SDGs) has gained attention in recent years (Halizah & Furqon, 2024). This indicates an understanding that fiscal instruments should be assessed in context of their wider contributions to sustainability rather than in isolation. Even with this expanding corpus of work, a large portion of the literature is still dispersed (Amin, Rahman, Khalid, & Idress, 2024). Few studies examine how the carbon price affects corporate behavior, innovation, and long-term sustainability results; most concentrate only on the financial or environmental effects of the tax. Furthermore, there are gaps in our knowledge of how carbon taxes work in developing nations like Indonesia since empirical evidence is inconsistent between nations, with the majority of research focused on industrialized economies.

These drawbacks emphasize the necessity of a systematic review that summarizes research from many fields and regions. Nevertheless, prior research, especially in developing nations, is still dispersed and lacks a methodical synthesis that connects carbon taxation, green innovation, and the Sustainable Development Goals (SDGs). Thus, the following research issue is addressed in this study: How does carbon price affect sustainable development and green innovation in various contexts? To close this gap, a Systematic Literature Review (SLR) provides a suitable approach. An SLR makes it possible to identify recurring themes, conflicting results, and new research trends by using transparent and systematic criteria for article selection and synthesis.

This method offers insights into areas that require more research in addition to a thorough summary of the existing state of knowledge. The findings of such a review can help policymakers create more efficient carbon pricing plans that support sustainability goals. Therefore, the purpose of this study is to compile scholarly and professional research on the relationship between carbon taxation, green innovation, and sustainable development. The study aims to document both the early discussions and more current advancements in this field by examining publications from 2015 to 2025. The study focuses on three key areas: how well the carbon tax reduces emissions and improves fiscal capacity; how it influences corporate innovation plans; and how it helps achieve more general sustainability objectives.

2.1 Theoretical review

The relationship between GHG emissions, EC, GDP, and FDI has received attention for a number of years in academic circles (Achour and Belloumi 2016). A large amount of research has been devoted to finding the reasons why these variables interact with each other in a particular way (Nawaz, Rahman, Zafar, & Ghaffar, 2023). Unfortunately, there is a lack of consensus on this issue due to problems such as model specification, omitted variable bias, and presence of some irrelevant factors (Niemand and Mai 2018). Different approaches are used by researchers when studying the interrelationship between CO2 emissions, GDP, EC, and FDI. Moreover, there are variations in terms of both considered variables and geographic scope (a particular country or countries).

The second line of research concerns the association of foreign direct investment and greenhouse gas emissions. This link has raised a debate among scholars about the positive and negative impacts of both foreign direct investment and greenhouse gas emissions. Randadi et al. (2018a) employed the panel data from 1990 to 2004 to measure the impact of foreign direct investment on greenhouse gas emissions in some GCC members. They found that foreign direct investment contributes to higher greenhouse gas emissions using the ARDL method (Ilyas, Banaras, Javaid, & Rahman, 2023).

There are three main theoretical approaches explaining the relationship between FDI and the environment (Zubair, Rahman, Sheikh, & Zafar, 2024). The study by Sethi (2021) analyzed the influence of foreign funds on the economic growth of south Asian nations. Data was used for 8 south Asian nations covering the period from 1990 to 2017. Remittances, FDI, and foreign aids were used as the indicators of foreign capital in this study. Econometric techniques such as Panel FMOLS, Johansen-Fisher panel cointegration test, and PDOLS have been applied in order to analyze the relationship between the identified variables. Results have indicated that both short and long-run relationship exists between the economic growth, remittances, foreign aids and other macroeconomic factors. Also, the findings from Granger causality approach suggested unidirectional causality between FDI inflows and economic growth. But there is no causality between the impact of remittances on economic growth in the short run (Ali, Sharif & Hameed, 2018).

On the other hand, Murshed et al. (2021) considered the relationship between environmental regulation, environmental stability, and economic growth. In the research, the reducing effect of environmental patents was also kept in mind to reduce the ecological footprint Shazad, & Rahman, 2025). This research was conducted focusing on south Asia. Four major fossil fuel consuming nations such as India, Bangladesh, Sri Lanka, and Pakistan were considered using secondary panel data analysis method over time. For the present research, technical methodologies included slope heterogeneity, cross-sectional dependency, and structural breaks. For this research, variables such as renewable energy, non-renewable energy, FDI, economic growth, environmental regulation, and ecological footprints were taken into consideration. For the present research, independent variables include financial development, energy use, human development index, biological capacity, and income inequality Shahid, Rahman, Sheikh, & Allahrakha, (2024). The growth variables used in the study included export, inflation, employment, among others the research mainly focused on SAARC nations. Panel data from 1994-2017 was used. For analysis purposes, the random effect and fixed effect models were used. Hausman specification test was also used. In this case, it was found out that remittances had a significantly positive impact on economic growth hence improving growth in SAARC nations. Moreover, it was found that export and employment also had a significantly positive relationship with economic growth. It was established that inflation had no significant relationship with GDP (Tabassum, Rahman, Zafar, & Ghaffar, 2023).

In the study, data from four south Asian countries from 1980 to 2018 was used. Pooled Mean Group technique for estimation was also used. From the findings of the study, the energy-growth relationship was positively impacted by globalization in long-run effects while negatively impacted in short-run effects. Polito-administrative factors had a negative impact on the nexus between energy and growth, but them impact on short-run was insignificant (Bint Raza, Sheikh, & Rahman, 2024). Significant negative relationship between remittances and economic growth in South Africa. While all other independent variables have a significant negative relationship with economic growth, except domestic credit, which shows a significant positive relationship with economic growth in the long run. This study used the empirical approach for the analysis of the impact of remittances on south-east European countries. The data from 2008 to 2020 were

collected. Chowdhury et al., (2022) have conducted a study about the influence of remittances on the growth of economies (Shahid, Gurmani, Rahman, & Saif, 2023).

Renewable energy consumption was not found to impact the EFs of the MENA countries in general. Nevertheless, the cases of Israel and Jordan proved that more consumption of renewable energy leads to lower EFs. Ecological inequality has become an issue since biocapacity is traded internationally (Galli et al., 2020). Ecological footprint as a term was coined in the 1990s when it became evident that land and water usage for resource generation should not be neglected because of the resources' alternative use by humans (Hassan et al., 2019). Ecological footprint as defined by Galli et al. (2012) is a good measuring instrument for environmental degradation. As can be seen from the studies above, the relationship between EF and renewables is ambiguous, suggesting that using renewable energy is no guarantee of decreasing the ecological footprint (Shahzadi, Hafiz, Idrees, Sheikh, & Rahman, 2024). Thus, there is a need for further analysis of the relationship between EF and renewables in different countries. Ecological inequality has become an issue since biocapacity is traded internationally (Galli et al., 2020). Ecological footprint as a term was coined in the 1990s when it became evident that land and water usage for resource generation should not be neglected because of the resources' alternative use by humans (Hassan et al., 2019). Ecological footprint as defined by Galli et al. (2012) is a good measuring instrument for environmental degradation. Many research studies have used the ecological footprint as an indicator of environmental damage, for instance, the work of Chowdhury et al. (2021), Ahmed et al. (2020), and Zafar et al. (2019). during. The sign will be negative or positive. As per the World Bank (2020), domestic credit to the private sector means that financial resources have been made available to the private sector by the financial corporations including loans, purchases of non-equity securities, and trade credits and other accounts receivable, establishing a claim for repayment (Raza, Sheikh, Rahman, Warriach, & Zaidi, 2024). The sign is supposed to be negative or positive. Neo-Classical economists believe in free competition market economy; according to them, the increase in population would lead to the development in market and economy, hence, leading to the creation of wealth. Neo-classical economists are concerned about maintaining the standards of living in view of increasing population (Idrees et al., 2023). This section provides a brief introduction on what has been studied so far, and what are the variables that affect EFit.

However, the most recent research results related specifically to SAARC reveal that the output in the industry sector and the consumption of fossil fuel sources continue to lead to the growth of CO2 emissions; however, renewable energy is able to mitigate this trend (Ullah, Rehman, Raman, 2023). As for Pakistan, according to the newly estimated ARDL model over 1974-2022, it is obvious that the process of increasing CO2 emissions is highly dependent on industrialization and energy use that clearly underlines the structural side of industry in environmental deterioration. Teng et al. (2021), using panel data analysis on ten countries over 1985-2018, find that institutional quality plays a positive role in environmental sustainability (Abdullah, Irshad, Ali, Parveen, & Rahman, 2024). The positive effect of political institutions on carbon emissions reduction was analyzed by Obobisa et al. (2022) for twenty-five African countries during 2000-2018.Financial development in the country may be associated with positive effects on environmental dependability and ecological sustainability (Adnan Afzalet al., 2025). Nevertheless, the financial sector can contribute to industrial production and infrastructural development that would enhance the ecological footprint of the state (in). Such countries as Bangladesh and Nepal face ecological problems because they are more vulnerable to various disasters associated with nature (Syed, Arshad, Rahman, & Sheikh, 2024). For example, there were floods and landslides in Nepal recently (Ranillgado and Anand 2022; Murshed et al. 2021.A major contribution was done by the research of Uzar (2021) on assessing the impact of institutional quality on ecological

footprint in E-7 economies between 1992 and 2015, employing CCEMG and AMG estimators, who found that the study by Wang, Zhang, and Wang (2018) analyzed the moderating role of control of corruption on economic growth and CO2 linkages in BRICS nations during the period 1996-2015 through the employment of PLS modeling technique, concluding that control of corruption weakens the economic growth-carbon emissions linkage by decreasing CO2 emissions (Arshad, Joseph, Rahman, Idress, S., & Shahid, 2024). Several empirical assessments suggested that institutional quality (IQ) exerts a negative effect on environmental quality (Hafiza et al., 2023).

However, in a country-specific study conducted by Mehmood et al. (2021), the independent role of institutional quality on CO2 emission was examined using an ARDL model for India, Pakistan, and Bangladesh during the period col – 2016, and concluded that institutional quality has a positive impact on carbon emission. Data Thus, in the theoretical perspective, there is no consensus whether the ICT and IQ impact on environmental sustainability is productive, unproductive, or inappropriate. The empirical support for PHH has been obtained from the developing nations where FDI inflows have been found to cause higher emissions of CO 2 and environmental degradation (Cole and Elliott, 2005). The studies carried out have found that the FDI flows in manufacturing and energy intensive industries have also increased pollution of air and water due to lack of enforcement of environmental regulations in the South Asia (Thebuho et al., 2024). The article by Bagchi and Sahu (2025) deals with Indian manufacturing industry and the relation between foreign investments and environmental protection. The relationship between financial development and ecological footprint in South Asia has been empirically studied by Ozturk et al. (2024), which used EKC theory along with PHH theory. Kisswani and Zaitouni (2023) have tested the Pollution Halo Hypothesis in their research, and used the ARDL model to find out the influence of foreign direct investment (FDI) on environmental degradation (Khan, Rahman, Fiaz, 2023). It was concluded from the results that FDI helped reduce CO2 emission in the long run in certain countries, meaning that the foreign investors had brought cleaner technology, better management techniques, and environment-friendly policies influence Changing the way of life of individuals from agriculture-based economy to industrial economy was done in many societies across the world in order to accelerate their economic development. Various obstacles are placed before humanity to attain these objectives (Amin, Rahman, Khalid, & Idress, 2024).

Thus, countries that have a lot of natural resources cannot improve their production and exports and therefore cannot grow fast, and natural resources cannot result in harmful effects on the environment. Another concept which has significance for studying the quality of the environment is FDI. FDI improves the growth process in countries through increasing productivity, capital formation, and technology. FDI can make a great contribution to the improvement in the quality of the environment through technology transfer from the host countries ((Adeel-Farooq et al., 2021; Doytch, 2020; Ali et al., 2020; Zafar et al., 2019). However, in case of high-income countries, the pollution of the environment is regulated by economic complexity. The coefficient for external debt and black-market premium is found to be positive and significant for all three countries (Parveen, Hanif, Rahman, & Sheikh, 2023). The researcher conducted a study on the relation between democracy and pollutants (CO2, NOx, and SO2) in about 200 countries during the period 1975-1992. The explanatory variables like income inequality, education, urbanization, and age distribution might alter the overall impact of political regime on pollution depending on societal preference and priorities set by the government (Usman, Rahman, Shafique, Sadiq, & Idrees, 2023). For the purpose of the analysis, the researchers employed a Pooled Fixed Effect OLS regression model that considers both country and time fixed effects. In the regression, the

independent variable includes sulfur dioxide and carbon dioxide emissions while the dependent variables consist of gross domestic product, squared gross domestic product, urbanization, trade openness, working-age population, and energy intensity (Chaudhary, Nasir, Rahman, & Sheikh, 2023).

3. Methodology

In given work, the study adhered to the principles of the literature review process. To gather and critically examine the relevant literature, a systematic literature review (Jesson, Matheson, and Lacey, 2011) will be used. Complete a critical analysis, the researcher constructs a critical review form toward review some of the main ideas of the earlier research, specifically the focus paper, bibliographic fine points, philosophy use (where relevant), study philosophy (Zikmund, Babin, Carr, and Griffin, 2013), key outcomes, methodology, description green tax policies, industrialization and innovation affect environment pollution field, investigation background, topographical site study, theoretic and applied review, and further conclusion and reported limitations. To carry out the critical review of study, researcher observed literature from November 1995 - April 2025. In order recognize the most significant FDI, industrialization green tax policies, and innovation affect environment pollution papers thinkable, following the documentation papers, the researcher performed thorough exploration evaluation of the applicable papers downloaded to (1) Economics journals clarivate analytics (The Master Journal List 2025 and JCR report 2020); (2) Complete records (Business Source Premier by Ebsco and Scopus). To select the literature this literature review, the researcher designs literature variety principles basis of the following characteristics, e.g., paper don't address F industrialization green tax policies, and innovation affect environment pollution, and likewise not being experiential or theoretical (like books, explanations, conference report summary, abstracts and keywords, executive summaries, editorials, and literature reviews, newspaper/magazine articles). Overall, following the repetition identification, the scholar located nearly 30 research paper. Scholar reviewed the abstract, title, and methodology of each paper to establish its relevance.

4. Conclusion

After the critical review of the literature, it is concluded that, as compare to total value of industrialization green tax policies, and innovation affect environment pollution FDI, both the negative and the positive effects are revealed. It is very much interesting to see both the findings are separately fill the gap in the literature. So, the effect of industrialization green tax policies, and innovation affect environment pollution is still under discussion and various studies have been conducted to check the impact of foreign investment on the overall economy. Some studies have observed a significant and positive, but some have examined negative and significant impact on the growth of the economy with the specific economic, financial, and technological situations of the host countries. This study will contribute to supplement the industrialization green tax policies, and innovation affect environment pollution literature and also explores the impact The study in hand attempted to relate literature insights with contributions that are relevant to the topic. Additionally, the analysis the variables are not developed in this study. Therefore, the main purpose to attempt that study is to provide a clear and comprehensive view of past investigated studies on industrialization green tax policies, and innovation affect environment pollution' including contextual approaches and practices.

5. Future Recommendations

This Review of the literature calls for further research on three different grounds. First, most of the studies conductance to investigate the industrialization green tax policies, and innovation affect

environment pollution are used the RDL model, OLS regression and GMM approach. It is observed that during the literature review, a dynamic vector error correction model (VCEM) is implemented only limited studies to carry out the investigation. This VCEM procedure helps to ensures the time series dynamics that are under consideration is accurately captured, during endogeneity issues and causality issues are carrying out simultaneously. Additionally, any indirect effects and feedback that might be exists also be captured with the VECM procedure. Second, most of the industrialization green tax policies, and innovation affect environment pollution, FDI studies are conducted in the past mostly related to host country GDP and the economic growth, only few studies have been examined in the context of manufacturing growth, so it is suggested that further investigation required to reveal the proper execution of the manufacturing growth while industrialization green tax policies, and innovation affect environment pollution inflows are significant in the host country. Third, the studies are conducted in the past, analyzed in the context of south east Asian countries, for instance, Malaysia and US economy with the capital and growth in manufacturing sector in Japan, France, Germany and UK as well, as compare to under developed states. But limited investigation has been done in south Asia such as Pakistan.

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