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Impact of Environmental Degradation on Sustainable Economic Development: An Empirical Assessment for Selected Developing Countries

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***Abstract*:** The most critical issue faced by the world today is the increasing degradation of the environment. The developing world in this case has no exception in this regard. To understand the nature of the issue and its impact on the developing countries this study, therefore, attempts to empirically assess the impact of environmental degradation on sustainable economic development for a panel data of 40 developing countries from different regions of the world over a period of 2005 to 2020 through Generalized Method of Movements (GMM) approach. Results of the study showed that environmental degradation negatively and significantly determine the sustainable economic development, other control variables namely financial development, foreign direct investment and research & development positively determine the sustainable economic development for the selected countries. This negative relation between environmental degradation and economic development poses a matter of great concern for the developing countries. It is suggested that a collective effort is required from the selected countries to take measure to control the environmental degradation and the path for sustainable economic development can be set.

Key Words: Critical Issue, Environmental Degradation, Sustainable Economic Development, FDI

1. Introduction

In contemporary era of development, environmental sustainability is deemed as the key policy agenda for all developed and developing countries. And, it has earned a critical role in achieving Sustainable Development Goals (SDGs) set out by United Nations (2016), which all countries have pledged to achieve it by the year 2030. Out of total (17) Seventeen SDGs, four goals are directly and indirectly related with environment and climate related targets. These included responsible consumption and production (SDG-12), climate action (SDG-13), life below water (SDG-14), and life living on land (SDG-15). All these sustainable development goals maintain focus on the sustainability of the overall natural environment (United Nations, 2018). Since then, majority of the countries prioritized the environmental sustainability by formulating the policies to sustain the efficient quality of natural resources, securing ecosystem, preserving the plant and animal species, and protecting the human living environment (Ulucak *et al*; 2020). Nonetheless, after the 20th century specifically the second half era, environmental degradation has emerged as the prominent problem, which could have calamitous influences on many aspects of human life, and it may be a significant hindrance on the way to maintain sustainable development all over the world including developing and developed countries.

Defining environmental degradation has been a debatable and challenging task. For this purpose, World Bank (1992) has defined, that deforestation, depletion of natural resources such as land degradation, water shortage, loss

of biodiversity, and air pollution, and depletion of many other environmental resources are termed as environmental degradation. Similarly, the Unified Countries Worldwide Technique for Calamity Decrease has characterized natural corruption as "the decrease in the limit of the climate to meet social and environmental targets and needs". Primarily, the negative changes in natural environment are caused by human activities not by environment itself—the landscape naturally evolves, but misuse or overuse of it by human makes it disturb, which results in degradation of landscapes. The natural process does not degrade environment, it just may change them (Rozello, *etal*; 1997; Rjoub, *etal*; 2021).

Natural change is most likely going to go probably as a bet multiplier, upsetting water lack. Water lack of course subverts food security by diminishing cultivating productivity, as well as forestalling human prosperity and monetary new development; water deficiency can similarly incite extra naturally pressure, as well as augmentation strains inside and between nations sharing water resources. The IPCC, 2007 characterizes environment changeability as the varieties in the mean state and different measurements (like standard deviations, insights of limits, and so on) of the environment on all transient and spatial scales past that of individual climate occasions. Changeability might be because of regular interior cycles inside the environment framework (inside fluctuation), or to varieties in normal or anthropogenic outer powers (outside fluctuation). The IPCC further characterizes environmental change as any adjustment of environment after some time, whether because of normal fluctuation or because of human action. In fact, since the industrial revolution (after the late 1700s), a significant amount of GHGs is emitting frequently through energy-driven consumption of fossil fuels and other human activities.1 GHG emissions (in which 72% CO2 emission) are the main cause of global warming and environmental degradation.2 Therefore, it is limpid that GHG emissions are one of the main factors of global warming or present climate change. Acknowledging that carbon emissions hurt the environment, the current study picks carbon dioxide (CO2) emissions to measure environmental degradation in developing countries. The convergence of CO2, one of the significant ozone depleting substances, in the environment has expanded essentially since the modern upset. This has added to the improved nursery impact known as 'a worldwide temperature alteration'. The CO2 fixation in the air is as of now around 370 sections for every million (ppm) — an increment of over 30% beginning around 1750. The increment is generally because of anthropogenic emanations of CO2 from petroleum product ignition and less significantly land-use change, a few modern cycles, and biomass burning (IPCC 2001a).

Proof of environmental change is mounting. As per the IPCC reports (2007), an Earth-wide temperature boost is unequivocal (for example earth's environment is warming); worldwide surface air temperature expanded from 1850 to 2005 by 0.76ºC. The straight warming pattern throughout recent years is recorded by 0.13ºC each ten years, with a full scope of projected temperature increment of 1.1 ºC to 6.4 ºC before the century's over, prompting broad liquefying of snow and ice and a rising worldwide mean ocean level. The report likewise focuses to the extended expansion in outrageous climate occasions (storms, precipitation, dry spell), noticing that typhoons (typhoons and hurricanes) are probably going to turn out to be more extraordinary, with higher pinnacle wind speeds and heavier precipitation related with hotter tropical oceans. These outrageous occasions are projected to increment in greatness and recurrence throughout the long term. Moreover, there has been an expansion in the quantity of intensity waves, a lessening in the recurrence and length of ices, and an expansion in the recurrence and power of outrageous occasions in many regions of the planet.

Middle East and North Africa (MENA)	**Sub-Saharan Countries (Djibouti, Somalia, and Sudan)**	**States of the Gulf Cooperation Council (GCC)**
Before this century's over, this locale is projected to encounter an increment of 3°C to 5°C in mean temperatures and a 20% decrease in precipitation (IP CC, 2007). Because of lower precipitation, water run-off is projected to drop by 20% to 30% in a large portion of MENA by 2050 (Milly etal.,	Environment models anticipate hotter temperatures and more factor precipitation for this area under an unnatural weather change. Desertification and loss of useful land is supposed to speed up, while an expansion in outrageous occasions — like dry spells and floods — could prompt food deficiencies and	In the event that temperature climb isn't halted, furthermore, especially assuming it surpasses 2°C to 3°C, the IP CC cautions that the world could confront gigantic species annihilations, broad starvation, declining creation of harvests, and a diligent ascent in ocean levels

2005). Decreased stream and groundwater re-energize could prompt a decrease in water supply of 10% or more prominent by 2050. More prominent occasional temperature changeability. More serious climate occasions, like dry seasons and floods. Critical ocean level ascent: the Mediterranean is anticipated to ascend between 30 cm and 1 meter before the century's over — making flooding seaside regions along the Nile Delta (IP CC,2007b). Mediterranean biomes are supposed to move 300-500 km toward the north in the event that a 1.5°C warming was to happen, which could imply that Mediterranean biological systems (e.g.in Jordan) would turn out to be more desert-like. An expansion in vector-borne illnesses and nuisances, as well as mortality.	starvations. A hotter environment could extend the scope of transporters of intestinal sickness, yellow fever, dengue fever, and other vector-borne infections. The absence of satisfactory new water is an issue looked by a few nations in these parts Africa. Ecological tensions, for example, lessening food and water supplies might prompt clash between striving countries, releasing relocations of natural exiles on the African landmass (Boko et al., 2007). 70% of the Nile's water streams from the Ethiopian good countries. Environmental change, intensified by quick people advancement, sabotages a development in competition for water in the locale. A concentrate by Strzepek et al. (2001) found a tendency for lower Nile streams in 8 out of 8 climate circumstances, with impacts going from no change to a for the most part 40% diminishing in streams by 2025 to over 60% by 2050 out of 3 of the stream circumstances.	that could suffocate significant pieces of the world's waterfront regions. Environmental change is viewed as by numerous security specialists to be a more noteworthy danger than worldwide illegal intimidation. In particular, the effect of ocean level ascent is thought of as serious for a large number of the Middle Easterner nations (for example Agrawala et al.,2004). Underground water saltiness will increment, more land debasement will happen in the district, and biodiversity ashore and in the Bay will be impacted. Rising ocean levels will influence shorelines and marine life harshly and could affect desalination establishes that are the wellspring of water for the GCC locale Territorial environment models for temperature and precipitation in Bay locale).

Ecological change is furthermore expected to grow the repeat and force of over-the-top climatic conditions and related disasters, introducing more people to bet with conditions and provoking more serious events, for instance, dry seasons, floods, hurricanes and buildup storms (IPCC, 2007). This current situation could really annoy the locale's shortcoming to devastating occasions, which consolidate, despite drought and food need, floods, dust whirlwinds, and bug invasions. Growing occasion of El Niño, which is the warming of sea surface temperature (SST), presents a climate quirk that changes the common breeze plan. This will perhaps be joined by changes in a periodic appointment and consistency of precipitation over the African Sahel, more phenomenal precipitation events and related streak flood bets, changes in the transport and occasion of vermin and disorders, for instance, grasshoppers, wilderness fever and dengue and likely changes in case of buildup storms.

Environmental change — with its many aspects (social, ecological, monetary and political) — is supposed to prompt numerous effects at different scales and levels. The effects on regular biological systems will be considered all financial levels, influencing occupations and human prosperity. The predominant climatic circumstances in the Bedouin area have profoundly critical influences on the various parts of the biological systems. Significant effects could be credited to the innate delicacy of the ruling parched biological systems of the area. These bone-dry biological systems are by and large described by mediocre physiochemical properties, powerless versatility of soil assets and somewhat restricted accessibility of surface/ground-water assets. Environmental change is additionally expected to bring about enormous scope populace developments across and inside areas (natural displaced people), bringing about mind channel, lower monetary development and dangers to public safety.

Future circumstances project further decreases in precipitation and thusly more unmistakable strains on water

resources. Considering a part of these projections, the water lack is most likely going to augment from around 28.3Bcm in the year 2000 to 75.4Bcm in 2030 due to climatic and non-climatic components. The change of the value of surface overflow will depend upon the movements in temperatures and precipitation, among various elements. According to Smith et al. 2000, a temperature addition of 5°C will reduce the snow cover from 170,000 km² to 33,000 km² in the upland sections of the Euphrates and Tigris watersheds. This accordingly would basically reduce the arrival of the Euphrates and Tigris streams. A survey coordinated by Abdulla and Al-Omari 2008 in showed that raising temperature by 2°C-4°C in Jordan would diminish the movement of the Azraq Stream by some place in the scope of 12% and 40%. Smith et al. 2000 showed that a development in temperature of 5°C would achieve the lessening of Euphrates arrival of 40%.

Moreover, literature has indicated some other determinants of the environmental degradation such as unsustainable transportation, energy consumption, industrialization, urbanization, foreign direct investment (FDI), and trade openness etc. are the prominent determinants of the environmental degradation (Javed & Sharif, 2016; Pata, 2018; Shahbaz etal; 2018; Hanif, 2018; Pham etal; 2020). Specifically, with the emergence of developing economies, which are the attractive destinations for foreign direct investment, increasing globalization, and other investment-led activities have brought about the polluted production move from developed countries, where strict environmental policies have been promulgated, while host countries are relatively not good in environmental policies (IPCC, 2020).

In empirical literature, different indicators are being employed as an estimate of the environmental degradation. These indicators related to the environmental degradation are further classified into different sectors as well. For example, Saidi and Hammami (2017) has used CO2 emissions from transport (% of total fuel combustion) to indicate the environmental degradation, while Wang and Zang (2017) have used the CO2 intensity as the indicator of environmental degradation, and Acar and Lindmark (2018) have employed CO2 emission from manufacturing industries for industrialized countries. Furthermore, available literature is suggesting the usage of CO2 emission related indicators to estimate the environmental degradation for their empirical purpose in developing countries (Ulucak *etal*; 2022; Gorus & Aslam, 2021). The literature is replete with numerous studies which have documented the relationship between environmental degradation and economic development. Economic growth is the one of the significant parts of the development. The relationship is best explained by the Environmental Kuznet Curve (EKC), which explains the relationship between environmental degradation and economic growth. The literature is very rich in this regard (e.g.Ulucak etal., 2020; Saidi and Hammami, 2017). However, the economic development is not stick to the GDP growth rate; it encompasses the all aspects of the development which lead to the prosperity of the people and economies on the whole. Such indicators are health quality, learning quality, and living standard of the people (Miller,1992, Constable et al, 1999; Thakur, 2010); Seinfeld and Pandis, 2016; Balaguer and Cantavella, 2018); Ozturk and Majeed, 2020; Naghavi et al., (2022).

An unnatural weather change and ozone harming substance outflows have turned into an extreme danger to our biological system. As a matter of fact, since the modern upset (after the last part of the 1700s), a lot of GHGs are emanating much of the time through energy-driven utilization of petroleum derivatives and other human activities. GHG outflows (in which 72% CO2 discharge) are the primary driver of an Earth-wide temperature boost and natural degradation. Thusly, it is clear that GHG emanations are one of the fundamental variables of an unnatural weather change or present environmental change. Environmental degradation is defined as the depletion of natural resources through consumption of resources, which cause the obliteration of climate and the annihilation of untamed life, or natural environment negotiated here and there, decreasing biodiversity, and the overall strength of the climate (World Bank, 1992; Rozello et al., 1997). In empirical literature, defining environmental degradation has been challenging task, because of the availability of indicators for respective countries. Nonetheless, literature has employed different indicators which are significantly being used to define the environmental degradation. The widely used indicator is CO2 emissions. The main indicators of environmental degradation that affect the environment and cause to the serious threatened for the world. Pollution issues which cause by the CO2 emissions which mainly cause by the burning of fossil fuels and this emission convert into greenhouse gas when number of trees are not available for absorption (Zang and Lin, 2012; Farhani et al., 2014; Maggazino, 2015; Saidi and Hammami, 2017).

FDI has so far ended up being the most steady and promising unfamiliar capital inflows into agricultural nations for certain years now. As per the 2008 report of the Association for Financial Co-activity and Advancement (OECD), FDI as an outer wellspring of subsidizing for non-industrial countries has out-played out the Authority Improvement Help (ODA) since the 1990s. Adams (2009) underlined that; "FDI fills in as expansion of

homegrown capital and improvement of proficiency through the exchange of new innovation, advertising and administrative abilities, advancement, and best practices across the world into have nations". Asiedu (2006) declared that an expansion in FDI would improve the accomplishments of the Unified Countries' MDGs by killing destitution in Sub-Sahara Africa by 2015 as well as clear method for emerging the SDGs' objectives in 2030 plan. While certain works found that FDI emphatically influence Maintainable turn of events (Reiter and Steensma, 2010; Tvaronavičienė and Lankauskienė, 2011; Kardos, 2014; Ridzuan, Ismail and Che Hamat, 2017), others tracked down an adverse consequence (Yahouedeou et al., 2018). Additionally, the discoveries of certain examinations held that FDI essentially affects development and advancement (Gui-Diby and Renard, 2015).

The observational writing on trade openness and financial advancement turned out to be overwhelmingly significant during the 1980s. In 1982 many created economies confronted obligation emergencies and monetary implosion, weakening the effect of exchange security. The observational writing recommends the positive connection among exchange and financial development of both creating and created economies. Makki and Somwaru (2004) researched whether trade openness prods monetary development and tracked down a positive relationship. A further examination by Rodriguez and Rodrik (2000) uncovered that the connection between financial development and products in four created and four creating economies utilizing the mistake remedy and co-reconciliation model. Their discoveries portray a stable long-run relationship and a bi-directional causality connection between financial development and development of products moreover, the ideal extension of equilibrium of exchange is subject to effective administration of imports and market-situated foundations of serious market procedures for extension of commodities. Exchange progression expands a nation's degree of seriousness and creation proficiency in the homegrown area. Blanchard and Leigh (2013) contend that trade openness helps the economy through proficient asset portion intrinsic to social minor expenses and advantages consequently opening admittance to better innovation and creation inputs. Along these lines, created and creating economies can exploit economies of scale in this manner giving positive development.

The customary hypothesis of economy guarantees that the innovation moves uninhibitedly between the nations generally and mechanical change plays a key part in making sense of the development. Nonetheless, it is realized that there are enormous and consistent contrasts among the development paces of nations. The New Development Hypothesis created by a gathering of financial experts leaded by Romer (1986) and Lucas (1988) by taking a gander at the lacks of the conventional economy has not just made another interest on determinant capabilities of monetary development and mechanical advancement, yet additionally restored the conversations on the ideal job of the State in Research and development exercises. It is seen inside the new endogenous hypotheses that the essential drive ability to guarantee the manageability of the development depends on the Research and development area and models putting significance to help the information sources applicable to Research and development have a significant spot. Notwithstanding the way that writing remembers many examinations for the subject, three methodologies can be viewed as unmistakable and different investigations are the subordinates which depend on these three. These three models are Paul Romer's model (1990), Grossman and Helpman's model (1991), and Aghion and Howitt's (1992) model. The normal attributes of these three examinations ought to be; Research and development exercises, Human resources utilized in the Research and development area, and the development models in view of the Research and development explicit new items.

The way that the economy makes the level difference as well as the ceaseless development impact in the long haul relies upon the quantity of analysts (science individuals, engineer, specialized work force) moved to the area by the economy. The more economy has such data sources and guarantees the advancement of new items and innovations through passing these assets on to the Research and development area effectively, the more the pace of the financial development will be higher (Romer 1990, Grossman and Helpman 1991, Aghion and Howitt 1992, Ateş 1998).

In the present writing of economy, it is seen that innovation reinforces its place in all creation capabilities as an endogenous however not an outer component for financial matters. The expense decreasing nature of the innovation in given capital and workforce conditions through opportunity utility starts things out among the most examined and intrigued subjects. The examinations completed in such manner likewise focuses on the highlights of Research and development and the mechanical change brought about by it as following:

I. Innovative change is basically molded by the Research and development exercises of the organizations under their own body,

ii. The possibility that the little and gradual mechanical change is the main determinant of the efficiency increments both in organization level and large-scale level began to be acknowledged by a lot of people,

iii. The examinations on industrialized nations demonstrate that these little and steady mechanical changes have

been acted in the various divisions inside the organization as opposed to the customary Research and development offices,

iv. This little and steady mechanical change doesn't just diminish the unit costs, yet in addition affects limit increment, quality and info increment, and numerous different factors thereof.

The underlying study could contribute multiple ways in existing literature: contribution in existing literature regarding environmental degradation and economic development, and contribution in suggesting the implication of the findings regarding formulating the environmental policies. To best of our insight, the continuous review would contribute in existing writing in more than one way: first and foremost, the previous studies used different components for measuring the environmental degradation while this study will use CO2 as a main environmental degradation as it is considered to be the indicator which shows 70% of environmental degradation (Zang and Lin, 2012; Farhani et al., 2014; Maggazino, 2015; Saidi and Hammami, 2017). Secondly, the determinants of environmental degradation are explored for selected number of countries Ulucak et al., 2020. Thirdly, studies on the natural strategies and economic growth or development nexus are also almost negligible in the literature Tomasz Koźluk and Vera Zipperer. Fourthly, the literature focused mostly on the relationship of economic development and environmental degradation.

The underlying study could contribute multiple ways in existing literature: contribution in existing literature regarding environmental degradation and economic development, and contribution in suggesting the implication of the findings regarding formulating the environmental policies. To best of our insight, the continuous review would contribute in existing writing in more than one way: first and foremost, the study would update the time periods, because majority of the related studies have used data up to 2015. The need to update the time duration is required due to lots of developments regarding environmental policies have been come off in world during last 5 to 6 years. Moreover, the climatic and environmental changes have been continuingly happening, so it is very significant to collect evidences by updating the time duration of the data. Secondly, the study would employ the different indicators of economic development, which is not specific to economic growth. Two indices will be employed to indicate the economic development: conventional human development index (HDI), and environmental degradation adjusted HDI, which is termed as the sustainable HDI. In addition current study also hypothesize that does improvement in financial development and research & development expenditure alter the environmental quality and sustainable economic development relationship. For this purpose interaction variables are constructed from financial development, research & development expenditures and environmental quality.

2. Literature review

2.1 Environmental Degradation and Its Indicators

Environmental degradation is defined as the depletion of natural resources through consumption of resources, which cause the annihilation of climate and the destruction of natural life, or natural environment negotiated here and there, decreasing biodiversity, and the general health of the environment (World Bank, 1992; Rozello et al., 1997). In empirical literature, defining environmental degradation has been challenging task, because of the availability of indicators for respective countries. Nonetheless, literature has employed different indicators which are significantly being used to define the environmental degradation. The widely used indicator is CO2 emissions. The main indicators of environmental degradation that affect the environment and cause to the serious threat for the world. Pollution issues which cause by the CO2 emissions which mainly cause by the burning of fossil fuels and this emission convert into greenhouse gas when number of trees are not available for absorption (Zang and Lin, 2012; Farhani et al., 2014; Maggazino, 2015; Saidi and Hammami, 2017).

Moreover, these indicators related to the environmental degradation are further classified into different sectors as well. For example, Saidi and Hammami (2017) has used CO2 discharges from transport (% of all out fuel burning) to indicate the environmental degradation in their study. They have used the data of 75 countries to investigate the connection between natural debasement and economic development in developing countries. Similarly, different studies have other indicators of the CO2 emission -CO2-discharge from assembling ventures, CO2 intensity, and CO2 emissions per capita in order to estimate the impacts of environmental degradation. Wang and Zang (2014) have used the CO2 intensity as the indicator of environmental degradation, while Acar and Lindmark (2017) have employed CO2 emission from manufacturing industries for industrialized countries. Similarly, the available literature is suggestive of the usage of CO2 emission related indicators to define the environmental degradation for their empirical purpose in developing countries (Ulucak et al., 2020; Gorus and Aslam, 2019; Bilgili and Ulucak, 2018; Maggazino, 2015; Farhani et al., 2014).

The different studies use different indicators as proxy of environmental degradation, in the first group of researchers used CO2 as proxy of environmental degradation (Ersin, 2016; Madison, 2010, Uddin, 2020). While other group of researchers involved biological impression as an intermediary of ecological corruption (Solarim. 2020). The next indicator of environmental degradation is the biodiversity which threatened the species in freshwater and in the forests. Further, land degradation is also a main indicator of this, because changes in land use that cause to decline the production and. Other indicator is forest degradation, which means that change of timberlands (forests) into the rural land for grazing or urbanization. Deforestation contains Transformation of forest land into the agricultural land, grazing or for urbanization Kooten and Bulte (2000). Although, deforestation cause to expand the land to use for agriculture and for livestock, also use of wood as raw material for fuel, these all are necessary for economic growth of the economies. Yet, then again, these activities also cause vanished the half of the world's forest. This phenomenon causes to loss of biodiversity that is an alarming situation for the life of the forest animals Nobel et al., (2000). So, the intensity of energy use indicate that which kind of energy used by the most of the economies (Sharif et al., 2020; Danish et al., 2020; Solarim. 2020; Tiwari et al., 2013; Destek et al., 2018).

The leading theory of the environmental Kuznets curve which postulated by Kuznets in 1950s, this theory indicates that per capita pollutant levels first rise, as income level rise; then this relationship reverses after certain point. Researchers have been used several indictors of environmental degradation. A number of studies that links energy consumption and environmental degradation shows similarity with the consensus that non-renewable energy consumption cause to enhance the environmental degradation through increasing usage of land that cause the global warming and loss of biodiversity (Sharif et al., 2020; Tiwari et al., 2013; Destek et al., 2018); while with the utilization of sustainable power consolidate the natural weight of monetary exercises by diminishing emanation level, promoting eco-friendly consumption (Jebli et al., 2023; Danish et al., 2020; Destek et al., 2018).

Situation regarding environmental degradation in developing countries is different from developed countries; the reason is that developing countries mainly dependent on natural resources to achieve the required development level, management system of this natural resource base is not easy to sustaining economic development. For the purpose of achieving development, uses of resources are not appropriate level as should be, cause to bear high welfare cost in developing economies. In rural areas of developing economies, mainly rich in renewable resources, but unfortunately debasement of assets forces altogether huge government assistance misfortunes and monetary expenses. Recent literature also suggest that these economies are abundant with natural resources, day by day wasting this endowed potential, exploiting it efficiently for the purpose to sustain development.

For example, a few low pay economies, particularly those economies showing low development rates are exceptionally reliant on natural resources (Barbier 1994). These economies not just depend on direct abuse of their resources bases over main industries (forestry, fishing and agriculture), but also more than 50% of their exports rely on few primary commodities. These countries are highly indebted and rapidly land-use changes for the purpose of attaining required productivity from land forest areas converted into agricultural land. Developing economies also face low productivity, degradation of land and population. A pioneer work on across country analysis by Sachs and Warner (1995) argue that economies having high natural resources exports to GDP grow less rapidly as compared to that economies are poor in resources. The reason given by author that economies depend on resources effect growth but point out many linkages with advancement, exchange, long haul development and climate that are applicable to low-pay nations. In this manner Matsuyama (1992) proposed that the exchange progression a land concentrated economy could slow financial development by convincing the economy to concession assets from assembling (which produces learning-prompted development) toward farming (which doesn't).

Contrary with developing economies, where mostly dependent on resources, in developed economies services sector has most contributor in the environmental degradation. In this way a pioneer work conducted by Suri and champa (1998) investigate the relation among trade, energy and economic growth. Panel data of 33 economies for the period 1971-1991 has been used to investigate this relation. Empirical findings suggested that developed countries have not reached at point which suggested by the Kuznets curve, but are at the flatter portion of the curve, when developed economies consumed exports goods from industrialized economies, on the other hand imports of developed economies from the less developed industrialized economies cause to reduce the pollution in developed economies. The studies of Coondoo and Dinda (2008) have examined the income inequality across countries and its effect on ratio of emission. Due to heterogeneous country effects emission is not similar across the countries, because some economies intensive in services sector while others in different sector.

2.2 Environmental Degradation, Environmental Policy, and Foreign Direct Investment

During last couple of years, world has experienced immense increase in FDI across the countries. The countries started depending a lot on the expansion of FDI in countries. Nonetheless, amongst its positive impacts, one strand of researchers is of the view, FDI inflows brings about environmentally unfeasible technologies, and products which exacerbate environmental degradation in particular countries. As the study of Jiang et al (2018) has tested whether FDI has any significant influence on environmental degradation, and they established that FDI had found influencing the environmental degradation through the channel of international trade. The results found that the host countries were found increased level of pollution during the increase in FDI. Moreover, this hypothesis is further found by the study of Zhu et al., (2016) that heavy pollution generating industries take FDI inflow into developing countries from developed countries, which deteriorated the environmental quality in host countries especially in those countries which have poor environmental regulations. The study conducted by Xiong et al (2021) also supported the notion that FDI brings about environmental degradation in developing countries. They also estimated that FDI has adverse impacts on the quality of environment such as exacerbating the pollution, deteriorating the air quality, water contamination, and depletion of environmental resources in host economies. Similar sort of the findings are suggested by the other studies available in literature (see e.g.;Zang, 2018; Satrovic and Muslija, 2018; Alvarado et al., 2021).

There is one more strand of writing which showed the positive impacts of FDI on natural quality. Following out the impacts of FDI on the nature of climate ready that far off nations bring about advanced technology and effective management skills which help the host countries to have improved-level of environment quality. A commendable amount of the studies supported this notion or hypothesis. The study of Bakirtas and Cetin, 2021) has found that FDI emphatically affects natural quality. Similarly, Sbia et al explored that positive income effect on quality of environment due to increase in FDI and international trade. The inflow of FDI brings about new skills and quality management skills. Grossman and Krueger (1991) explored the three mechanisms through which FDI influenced the environmental quality: i) scale impact, ii) composition impact, and iii) technology impact. Ahmed et al., (2022) suggested that according to composition impact, FDI benefits the country to diminish the contamination level which grows the natural quality. Similarly, the rests of the two impacts also have positive impacts on the quality of environmental quality (see e.g.; Heerink et al., 2001, Xu, 2018; Dong et al., 2019; Jabeen, 2021).

3. Methodology and Data

3.1 Sustainable Economic Development

As the essential goal of the continuous examination is to investigate the impacts of the environmental degradation on sustainable economic development. So, this is the major dependent variable of the study. In empirical research, mainly economic development is indicated by Human Development Index (HDI), which represents the combination of the three dimensions' health, education, and living standards. UNDP (2020) emphasizes human capabilities must be the ultimate criteria to assess the development of any country, which should not rely economic growth alone. In sum, HDI gauges the accomplishment in key elements of improvement a long and solid life, having education, and decent standard of living. It is estimated by taking the mathematical mean of standardized lists of the wellbeing, education, and living standards. In standard HDI, the health dimension is measured by life expectancy, education is measured by mean years schooling, while the living standard is estimated by the per capita income of a country.

Hence, by combining these three dimensions HDI is constructed, which is the proxy of economic development (UNDP, 2020). It is widely used by the researchers to estimate the policy impacts on economic development in developing and developed countries (UNDP, 2020; Tamazian et al., 2009; Panayotou, 1993). HDI has fail to capture the environmental impacts. To capture this problem, HNDP (2020) have created the index for sustainable development which includes conventional HDI as well. Hence, the new index of the economic development is called Sustainable Human Development Index (SHDI), which is one of the most extensive forms of the HDI. Hence, the underlying study use SHDI to estimate the impacts of the environmental degradation on economic development in developing countries.

3.2 Control Variables

The study would employ the control variables which are expected to have impacts on economic development in developing countries. Such variables include foreign direct investment (FDI) inflow, trade openness (TO) which is measured by dividing the amount of products and imports with Gross domestic product, monetary turn of events (FD) estimated by homegrown credit to private area and last control variable is consumptions on Research and

development.

3.3 Econometric Models Specifications

3.3.1 Generalized Method of Movements (GMM)

This study utilizes dynamic board relapse investigation to assess the effect of environmental degradation on economic development. A powerful board relapse model means to represent sequential connection and limit the possibilities assessing a misleading relapse. The overall portrayal of the said model is given as:

$$SED_{it} = \beta ED_{i\,t-1} + \beta X_{it} + \gamma X_{it-1} + \pi_i + \varphi_t + \varepsilon_{it} \dots\dots (1)$$

where SED_{it} is Sustainable Economic Development measured by Sustainable Human Development index (SHDI) , $SED_{i\,t-1}$ is lagged Economic Development, X_it and X_(it-1) are sets of (K×1) vector of stringently autonomous covariates of logical and slacked informative factors separately, π_i is mistake term of individual impact and φ_t is individual time impact, β γ are vector of boundaries to be assessed, I,… ,N address cross segments and t,… ,T mean time span and ε_itis ~iid(0,Ω). In such model the primary issue is the relationship of slacked subordinate variable with the mistake term ε_it and such issue exist regardless of whether no autocorrelation is accepted. Thus, to conquer this issue a general methodology of Arellano and Bover (1995) and later changed by Blundell and Security (1998) powerful framework summed up strategy for developments (sys-GMM) with instrumental variable produced from slacked upsides of informative variable can be utilized. Sys-GMM gauges are effective than least square gauges when there is heteroscedasticity in error variance alongside obscure structures (Baum, Schaffer, and Stillman, 2003).

Taking into account equation (1) and embedding the chose factors into it and changing it for exact investigation the accompanying equations are acquired:

$$SED_{it} = \beta_1 SED_{i\,t-1} + \beta_2 EQ_{it} + \beta_3 (EQ_{it})\text{^}2 + \beta_4 FD_{it} + \beta_5 EQFDINT_{it} + \beta_6 FDI_{it} + \beta_7 TO_{it} + \beta_8 RD_{it} + \beta_9 EQRDINT_{it} + \varepsilon_{it} \dots\dots (2)$$

Where SED is Sustainable Economic Development, EQ is Environmental Quality (Degradation) measured by Carbon Emissions per metric ton, FD is Financial Development which is proxy for domestic credit to private sector, FDI is Foreign Direct Investment, TO is Trade Openness, RD is Research and Development expenditures, EQFDINT is interaction term for EQ and FD, EQRDINT is interaction term for EQ and RD. $\beta_{,S}$ are coefficients to be assessed, ε_{it} is the error term, I represent cross segments and t address time series (years). Equation (2) is assessed by Unique Framework Summed up Strategy for Developments (DSGMM) method which has the properties of holding vigorous evaluations within the sight of endogeneity issue and it contains inbuilt system for settling the endogeneity that emerges from the omitted variable biasness among other powerful panel procedures (Roodman, 2006). The same equation also measure the non-linear relationship between environment quality and economic development.

4. Results and Discussion

Table 1: Descriptive Statistics

	ED	SED	EQ	FD	FDI	TO	RD
Mean	0.571984	0.612738	3.270159	23.20777	5.004025	74.23388	0.203915
Maximum	0.771000	0.815000	17.58000	74.31674	43.91211	272.9491	0.785770
Minimum	0.332000	0.357000	0.290000	1.201066	-37.17265	25.47204	0.010810
Std. Dev.	0.124484	0.121884	2.305233	15.15338	7.439466	36.12697	0.142023

The values in table 1 shows the description of data.

Table 2: Correlation Matrix

	ED	SED	EQ	FD	FDI	TO	RD
ED	1	0.9685	-0.0617	0.5035	0.1816	0.4824	-0.11820
SED		1	-0.0001	0.3941	0.1855	0.4652	-0.1316
EQ			1	0.1497	0.0894	0.3365	-0.1062
FD				1	0.1285	0.2963	0.1260
FDI					1	0.4003	-0.0232

TO	1	-0.2076
RD		1

The correlation table 2 shows that none of the variables are highly correlated except sustainable economic development (SED) and environmental quality (EQ).

Table 3: Cross-section Dependence and Unit Root Tests (2nd Generation)

Cross-section Dependence test
Null Hypothesis: No Cross-section Dependence

	Test				
Variable	**BP LM**	**PS LM**	**BCS LM**	**PCD**	**Decision**
SED	10486.6(0.00)	245.756(0.00)	244.32(0.00)	95.4996(0.00)	Reject Null
EQ	3522.40(0.00)	75.1907(0.00)	73.729(0.00)	0.37926(0.70)	Reject Null*
FD	NA	NA	NA	NA	None
FDI	1402.99(0.00)	15.7732(0.00)	14.4398(0.00)	6.28406(0.00)	Reject Null
TO	2714.33(0.00)	51.2598(0.00)	49.9598(0.00)	7.14782(0.00)	Reject Null
RD	NA	NA	NA	NA	None

p-values in parenthesis and * mean Reject Null Except PCD Test

Cross-section Dependence Unit Root Testing
Null Hypothesis: Series has Unit Root

	PAIN test		**CIPS test**	
Variable	**Statistic value**	**Decision**	**Statistic value**	**Decision**
SED	14.03117(0.00)	*I(0)*	-2.08273(0.10)	*I(1)*
EQ	0.59485(0.55)	*I(1)*	-0.63158(0.01)	*I(1)*
FD	NA	None	NA	None
FDI	2.7567(0.00)	*I(0)*	-2.28470(0.05)	*I(0)*
TO	-6.0715(0.00)	*I(0)*	0.29871(0.10)	*I(1)*
RD	NA	None	NA	None

p-values in parenthesis

Table 3 shows both the cross-section dependence tests and unit root tests. Most of the tests confirm the cross section dependence in the variables. In case of unit root testing both PAIN and CIPS tests gives mixed order results. Mean some variables are stationary at level while some are not.

Table 4: Impact of Environmental degradation on Sustainable Economic Development

Dependent Variable: SED

Variable	**Coefficient**	**Std. Error**	**Prob.**
SED (-1)	0.811	0.060	0.000
EQ	-.0.091	0.008	0.050
EQ^2	0.006	0.001	0.004
FD	0.049	0.007	0.004
EQFDINT	0.051	0.026	0.061
FDI	0.089	0.007	0.000
TO	-0.004	0.003	0.160
RD	0.036	0.008	0.000
EQRDINT	0.031	0.017	0.091
J-statistic	11..90	Prob.(J-statistic)	0.155

Table 4 shows the impact of environmental quality measured by carbon emissions along with other control variables on the sustainable development of selected countries. The results revealed that carbon emissions negatively determine the sustainable development for the countries. This negative impact of environmental

degradation on already adjusted development measure indicates that the selected countries are in quite worse situation. Environmental degradation can have an effect on economic development which we are measuring by using the Human development Index which is have three components namely per capita income, heath care and education. The environmental degradation has adverse effect on all these three components for example due to high pollution different diseases can cause to human body which in turn have an increasing effect on the health expenditures. Similarly natural disasters such as floods, drought which are the outcomes of the environmental changes or climatic changes have an impact on per capita income due to the destruction of the infrastructure developed for the economic activity. In the same manner drought weather have a negative impact on the production of the agriculture sector. Though the coefficient of environmental measure is weak but still can be used a policy reference to control the situation in future (Peng et al.2016; Cai et al.2018; Cheng-Feng Wu et.al; 2020; Jebli et al.2024).

The financial sector development significantly and positively determine the economic development. The interaction term of financial development and environmental quality sign is positive and significant. It means that financial sector development weaken the negative impact of environmental quality on sustainable economic development (Smith 1994; Akıncı and Sevinç 2013; Erçakar and Karagöl 2011; Chaabouni and Abdnnadher 2017). Foreign direct investment, significantly and positively determine the sustainable development for the selected countries. Although FDI is crucial for economic development but research also suggest that weak environmental policy in a country can attract more FDI inflow and can deteriorate the environmental quality and also the economic development. Research and development can play important role in economic development process and also controlling the environment degradation. Today, income and economic development contrasts between nations depend on the ongoing degree of innovation, talented work, normal assets, and financial solidness peculiarity (Smith 1994). (Erdal and Tatoğlu 2002; Crespo and Fontoura 2007; Erçakar and ,Karagöl 2011; Akıncı and Sevinç 2013; Göçer et.al; 2014). Research and development positively determine the economic development. The interaction term of environmental quality and R&D is positive which indicates that investing in R&D for more environmental friendly technologies can weaken the negative effect of environmental quality on sustainable economic development. These benefits incorporate presentation of new innovation, rivalry and expanded productivity underway, minimal expense and great assembling development, and a positive commitment to creation and work (Bor et al. 2010; Göçer et al. 2012; Karagöl and Karahan 2014; Erdil 2015).

5. Conclusion and Policy Recommendations

One of the most critical issues faced by the world is the increasing environmental degradation. The developing world in this case has no exception in this regard. To understand the nature of the issue and its impact on the developing countries the current study, therefore, attempts to empirically assess the impact of environmental degradation on sustainable economic development for a panel of 40 developing countries from different regions of the world over a period of 2005 to 2020 through Generalized Method of Movements (GMM) approach. The study uses sustainable economic development measured by sustainable human development index (SHDI) as dependent variable and independent variables are environmental degradation (or quality) measured by carbon dioxide emissions (EQ), the financial development (FD) measured by domestic credit to private sector, foreign direct investment (FDI). Trade openness (TO) and expenditures on research and development (RD). The results of the study revealed that environmental degradation negatively and significantly determine the sustainable economic development, other control variables namely financial development, foreign direct investment and research & development positively and significantly determine the sustainable economic development and trade openness sign is negative but is statistically insignificant for the selected countries. In addition, the study also finds non-linear relation between the environmental quality and sustainable economic development which indicates that the impact of environmental quality on development is not everlasting but will eventually goes in opposite direction. This negative relation between environmental degradation and economic development poses a matter of great concern for the developing countries.

It is suggested that a collective effort is required from the selected countries to take measure to control the environmental degradation and the path for sustainable economic development can be set. Moreover, the control variables empirical values also suggest that they can also take part in determining the sustainable economic development. Specifically, the research and development variable can make a difference if the research is properly directed toward environmentally friendly inventions and innovations.

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