






Balancing Growth and Ecology: Evidence from Indonesia's Economic Development and Environmental Impact

Andi Mahdi Ahmad Satrio¹, Sanusi Fattah², Retno Fitrianti³

Hasanuddin University, Makassar, Indonesia

satrioama23a@student.unhas.ac.id

Abstract. This research investigates the correlation between economic growth (GDP), foreign direct investment (FDI), and urban population in relation to the ecological footprint (EF) while testing the Environmental Kuznets Curve (EKC) hypothesis within the Indonesian context. Employing a robust time series analysis, the study utilizes an Error Correction Model (ECM) to analyze annual data spanning from 1971 to 2021. The novelty of this research lies in its approach of using the ecological footprint as an environmental indicator, moving beyond traditional metrics such as CO₂ emissions. Furthermore, the study leverages a more extensive time series dataset than previous research, providing a comprehensive understanding of the dynamics between economic growth and environmental impact in Indonesia. The research findings support the Environmental Kuznets Curve (EKC) hypothesis, showing that while economic growth initially increases the ecological footprint, it eventually leads to a decrease as income levels rise, indicating a shift towards environmental sustainability. Additionally, both foreign direct investment (FDI) and urban population have a significant negative impact on the ecological footprint in both the short and long term. This suggests that increased FDI and urbanization enhance environmental efficiency, likely through cleaner technologies and improved infrastructure. These results emphasize the need for sustainable economic practices and the importance of integrating environmental considerations into policymaking as economies continue to develop

Keywords: Ecological Footprint, GDP, Environment Kuznets Curve, FDI, Urbanization, Error Correction Model.

1 Introduction

Environmental degradation is a significant global challenge, akin to issues like climate change and biodiversity loss [1]. Human activities, including fossil fuel burning and deforestation, are the primary causes of climate change and environmental degradation [2]. These processes lead to various security risks, such as food shortages and natural disasters. Globalization's impact on environmental degradation varies, with overall and economic globalization potentially reducing degradation in industrialized countries [3]. Governments and international

© The Author(s) 2025

M. Nohong et al. (eds.), *Proceedings of the 9th International Conference on Accounting, Management, and Economics 2024 (ICAME 2024)*, Advances in Economics, Business and Management Research 331,

https://doi.org/10.2991/978-94-6463-758-8_267

organizations across the globe are enforcing strict environmental regulations and adopting sustainable development practices to address this problem.

Trade-offs between human welfare and environmental sustainability have caused some developing countries to experience faster environmental degradation. In the initial stages of their pursuit of economic growth, many countries participating in the global race for development failed to adequately consider the negative environmental externalities associated with their progress. The intense focus on expanding economies, increasing industrial output, and boosting GDP often overshadowed the potential long-term harm being inflicted on natural ecosystems. As a result, issues such as pollution, deforestation, and the overexploitation of resources were often ignored or minimized in the early phases of growth strategies. This oversight has contributed to significant environmental degradation, which many nations are now struggling to address as they balance the need for continued economic development with the imperative of environmental sustainability.

Developing countries like Indonesia, endowed with a wealth of natural resources, often face a heightened risk of environmental degradation due to their reliance on resource extraction. Indonesia's economy remains heavily dependent on industries such as mining, forestry, and agriculture, which exploit its rich reserves of minerals, oil, gas, timber, and fertile land. This dependence has contributed to the formation of what scholars refer to as an "extractive regime," where economic growth is driven by the large-scale extraction of natural resources [4]. While this approach has spurred economic development, it has also accelerated environmental degradation through deforestation, habitat destruction, soil depletion, and pollution.

Moreover, Indonesia's integration into global markets, supported by regional and international economic forces, has amplified this extractive process. The demand for commodities like palm oil, coal, and timber has incentivized extensive land clearing and resource overexploitation, contributing to severe deforestation, biodiversity loss, and carbon emissions. Globalization has also intensified competition for resources, often prioritizing short-term economic gains over long-term environmental sustainability. This resource-driven economic model has led to significant ecological damage, creating challenges in balancing development needs with environmental protection. Consequently, Indonesia faces the pressing task of transitioning towards more sustainable practices, addressing the ecological costs of its extractive economy while continuing to meet the developmental aspirations of its population.

Given this condition, the importance of understanding the dynamic interplay between human activities and environmental impact cannot be understated. Traditional measures of environmental impact, such as carbon dioxide (CO₂) and sulfur dioxide (SO₂) emissions, have long been used as proxies for pollution. However, these indicators often capture only specific facets of environmental degradation. The ecological footprint, by contrast, offers a more comprehensive metric by assessing the total productive land and water required to sustain a population's consumption patterns and assimilate waste [5]. While this approach has spurred economic development, it has also accelerated environmental degradation through deforestation, habitat destruction, soil depletion, and pollution. It quantifies the total productive land and water required to sustain a population's resource consumption and waste assimilation [6]. This metric thus allows for a broader examination of environmental strain, extending beyond greenhouse gas emissions to

encompass all forms of biocapacity usage, thereby presenting a holistic view of human demand on the ecosystem [7].

This study focuses on three pivotal factors potentially influencing Indonesia's ecological footprint: Gross Domestic Product (GDP), Foreign Direct Investment (FDI), and urban population. As GDP growth remains a central policy goal, the environmental repercussions of economic expansion have raised concerns about the sustainability of current development paths [8]. Moreover, there is an EKC hypothesis that said connection between economic growth and environment degradation make an inverted U-shaped curve. FDI, a major driver of industrial and infrastructural development, is often double-edged, enhancing economic growth while potentially exacerbating environmental degradation [9]. Similarly, urban population growth, a hallmark of Indonesia's rapid urbanization, intensifies demand for resources and contributes to pollution, further impacting ecological stability [10].

Given Indonesia's unique ecological and socio-economic context, this study seeks to quantify the impact of GDP, FDI, and urban population on the country's ecological footprint. Through this analysis, we aim to understand how these factors shape Indonesia's environmental sustainability and resource use patterns, providing insights into balancing economic growth with ecological preservation.

2 Literature Review

2.1 Ecological Footprint and GDP

The correlation between Gross Domestic Product (GDP) and ecological footprint has been a focal point in environmental and economic studies, as GDP growth often intensifies the demand for resources, resulting in a larger ecological footprint. The ecological footprint measures the biocapacity required to support a population's resource consumption and waste generation, providing insight into the environmental impacts of economic activities [11]. As GDP reflects the economic output of a nation, higher GDP levels typically correlate with increased energy consumption, infrastructure development, and industrial production, which place additional strain on natural resources [12].

Many studies support the EKC hypothesis, which suggests that environmental degradation initially increases with GDP but eventually decreases as economies develop and adopt greener technologies [13]. Several papers found evidence supporting the EKC hypothesis in various contexts, including Uruguay [14], Chile [15], and a panel of complex economies [16]. However, results varied across countries and income levels. Some studies reported mixed findings, with EKC supported in some countries but not others [17]. Research also indicates that while high-income countries may experience a decoupling of GDP from ecological footprint through technological advancements and environmental policies, middle- and low-income countries often see their ecological footprint increase with economic growth due to limited access to sustainable technologies (Knight & Rosa, 2011). For instance, Jorgenson (2003) found that GDP growth in developing countries often intensifies the ecological footprint, as economic expansion generally relies on resource-intensive industrialization.

Studies have further explored how economic structures impact the GDP-ecological footprint relationship. In economies reliant on manufacturing and industrial sectors, GDP growth tends to correlate strongly with a larger ecological footprint due to significant energy demands and pollution. Conversely, in economies with a substantial service sector, the correlation is generally weaker, as services typically have a lower environmental impact [18]. For example, Wiedmann et al. [19] highlight that economies with diverse, service-oriented sectors are often better positioned to reduce the ecological footprint relative to GDP increases, as these sectors are less resource-intensive.

In summary, the correlation between GDP and ecological footprint is influenced by a nation's economic structure, development stage, and environmental regulations. While higher GDP generally correlates with an increased ecological footprint, especially in developing nations, sustainable practices and green technologies can help moderate this relationship. As nations strive for economic growth, understanding these dynamics becomes essential for balancing economic and environmental objectives.

2.2 Ecological Footprint and GDP

FDI is widely recognized as a catalyst for economic growth, enhancing technological development, infrastructure, and employment opportunities in host countries [20]. However, this investment influx often comes with environmental trade-offs, as increased industrial activities and resource extraction contribute to higher levels of ecological stress, particularly in developing nations. Several studies suggest that FDI can contribute positively to environmental sustainability under certain conditions, particularly when investments are directed toward environmentally friendly technologies [21]. However, this "green FDI" remains less common, especially in developing countries where environmental regulations may be less stringent. Instead, FDI in resource-intensive sectors often exacerbates environmental degradation, expanding the ecological footprint by increasing demands on local ecosystems for raw materials, water, and waste assimilation [22]. For example, Shahbaz et al. [22] found that in emerging economies, higher levels of FDI correlate with a larger ecological footprint due to increased energy consumption and emissions associated with industrialization.

Further, the type of FDI plays a crucial role in determining its environmental impact. Manufacturing and industrial FDI, for instance, tend to elevate ecological footprints by intensifying resource extraction and energy use, whereas service-based FDI may have a lesser impact on local ecosystems [23]. A study by Omri and Bassem [24] specifically highlights that in countries where industrial FDI is predominant, the ecological footprint tends to increase significantly compared to countries receiving FDI in the services sector. This relationship suggests that FDI impacts vary widely depending on the host country's economic structure, regulatory framework, and type of FDI received.

2.3 Ecological Footprint and Urbanization

The correlation between ecological footprint and urban population has become a focal point in environmental research, as urbanization intensifies globally. Rapid urbanization is a leading factor influencing the ecological footprint, as cities concentrate populations, intensify resource use, and increase environmental pressure [10]. Urban population growth escalates resource demands through heightened consumption of energy, water, and land, alongside increased waste and pollution, leading to a larger ecological footprint [25].

Studies have shown a significant positive correlation between urban population density and ecological footprint. Research by York et al. [12] indicates that as urban areas grow, they tend to use resources more intensively, often exceeding the biocapacity available locally or regionally. This relationship is attributed to higher consumption patterns typically seen in urban centers, which are driven by increased income levels, infrastructure demands, and transportation [26]. Urban residents also generally consume more goods and services, increasing per capita ecological footprints compared to rural populations [27].

Moreover, urbanization influences ecological footprints through lifestyle changes that accompany urban living, such as shifts in dietary habits, housing, and energy use. For example, urban populations typically exhibit higher meat consumption and depend more heavily on imported goods, both of which significantly raise the ecological footprint [28]. Urban areas also often promote an energy-intensive lifestyle with reliance on fossil fuels, which further exacerbates their ecological impact [29].

However, some studies suggest that urbanization can, in certain contexts, have a mitigating effect on ecological footprint through economies of scale and resource efficiencies [30]. For instance, densely populated urban areas may enable more efficient public transportation systems and reduce individual carbon footprints due to shared infrastructure. Yet, even with these potential efficiencies, the net impact of urban population growth on the ecological footprint generally remains positive, given the concentration of economic activities and elevated consumption patterns within cities [31].

In summary, research consistently underscores a positive correlation between urban population growth and ecological footprint, with urbanization intensifying the demand for resources and environmental impact. This relationship points to a critical need for sustainable urban planning and policies that mitigate the ecological footprint while accommodating urban population growth [7].

3 Methodology

This study adopts a quantitative approach, selected to rigorously test hypotheses through the use of measurable data. Specifically, the research aims to examine the relationships between economic growth, investment, and urbanization, and their impact on environmental degradation, as measured by the ecological footprint. Additionally, it seeks to determine whether the Environmental Kuznets Curve (EKC) hypothesis holds true. This study utilizes secondary time series data sourced from Footprint Network and the World Bank, covering period from 1971 to 2021. The

research was conducted in Indonesia. A detailed summary of the operational definitions and descriptions of the variables is provided in Table 1.

Widarjono [32] explains that time series data are often non-stationary, which can lead to unreliable regression results, known as spurious regression. In this case, the regression may show statistically significant coefficients and high R-squared values, but the variables in the model may not be genuinely related. To address non-stationary time series data, the error correction model (ECM) is an appropriate approach. This method also allows for the identification of both short-term and long-term relationships resulting from cointegration between the variables. Therefore, we use the ECM model because the data used in the study is not stationary at the level. Firstly, ordinary least square (OLS) has been conducted in order to establish a long-term relationship between the variables. The model is expressed as follows.

$$\text{LNEF}_t = f(\text{LN GDP}_t, \text{FDI}_t, \text{UP}_t) \quad (1)$$

$$\text{LNEF}_t = 0 + 1 \text{LN GDP}_t + 2 \text{FDI}_t + 3 \text{UP}_t + t \quad (2)$$

Equation (2) is linear model in this study, but in order to test EKC hypothesis we need to capture the nonlinear relationship between GDP and EF, therefore we inject log GDP per capita in quadratic form as the most appropriate functional form for estimation which expressed as follows.

$$\text{LNEF}_t = 0 + 1 \text{LN GDP}_t + 2 \text{LN GDP}_t^2 + 3 \text{FDI}_t + 4 \text{UP}_t^2 + t \quad (3)$$

The co-integration analysis typically requires the variables to be stationary, as confirmed through the Engle-Granger [33] test. And for the short run we use ECM model, the short-term regression equation is as follows after the logarithmic transformation is carried out.

$$\Delta \text{LNEF}_t = 0 + 1 \Delta \text{LN GDP}_t + 2 \Delta \text{LN GDP}_t^2 + 3 \Delta \text{FDI}_t + 4 \Delta \text{UP}_t^2 + 5 \Delta \text{ECT}_t + t \quad (4)$$

From the results of the ECM linear regression analysis, it is evident that the model includes an Error Correction Term (ECT), which represents the residuals in the ECM method and reflects the equilibrium between variables. If the ECT coefficient is statistically significant, with a value of $\text{ECT} < 1$ and a significance level of $\alpha = 5\%$, it indicates that the model specification is valid. The coefficient expected to form an EKC curve in accordance with the Kuznets hypothesis is positive on LN GDP_t and negative on LN GDP_t^2 so an inverted U curve will be formed.

4 Result

4.1 Data Stationarity Test

The purpose of the data stationarity test is to ensure that the data generation process is stationary, which helps prevent spurious regressions. Before applying the ECM to analyze short-term and long-term relationships, it is essential to conduct a stationarity test. The Augmented Dickey-Fuller (ADF) test is used for this purpose. If the ADF test value exceeds the 5% significance level, the data is considered stationary. According to Table 2, the variables in the stationarity test are not stationary at their levels. Therefore, it is necessary to proceed with an integration test by performing a unit root test at the first difference.

Table 1. Variable Description

Variable	Symbols	Unit	Data Source
Ecological Footprint	LNEF	Gha (global hectares)	Footprintnetwork
Economic Growth	LNGDP	GDP per capita (constant 2015 US\$)	World Bank
Economic Growth square	LNGDP2	GDP per capita (constant 2015 US\$)	World Bank
Foreign Direct Investment	FDI	net inflows (% of GDP)	World Bank
Urban Population	UP	% of total population	World Bank

Table 2. Data stationarity test results

Variables	At Level		1 st Difference		Stationarity
	Z(t)	p value	Z(t)	p value	
LNEF	-0.759	0.8309	-6.8000	0.0000	I(1)
LNGDP	0.887	0.7922	-4.6030	0.0001	I(1)
(LNGDP)	0.505	0.8911	-4.6260	0.0001	I(1)
FDI	2.634	0.0862	-5.4790	0.0000	I(1)
UP	0.235	0.9741	-5.1820	0.0000	I(1)

Source : Stata 17 (processed), 2024

4.2 Cointegration Test

The cointegration test assesses whether a long-term relationship exists between the independent and dependent variables. Its purpose is to determine if the residuals are integrated. If the variables are integrated, it indicates a stable long-term relationship. Therefore, before performing the cointegration test, a regression for the long-term equation must be conducted to obtain the residual values. The results of the long-term regression estimation are presented as follows:

Table 3. Long-run estimation of regression

Variable	Coefficient	Std. Error	t-statistic	Prob
LNGDP	1.421994	0.4405619	3.23	0.002
LNGDP2	-0.0554757	0.0305355	-1.82	0.076
FDI	-0.008597	0.0046425	-1.85	0.070
UP	-0.0656702	0.0108334	-6.06	0.000
R-squared	0.9911			
Adjusted R-squared	0.9903			

Root MSE	.03664
F-statistic	1274.06
Prob (F-statistic)	0.0000

Source : Stata 17 (processed), 2024

The cointegration test is conducted by applying the Augmented Dickey-Fuller (ADF) unit root test to the residuals. The results of the cointegration test for the equation are as follows:

Table 4. Cointegration test

Variable	Coefficient	Prob
ECT	-5.182	0.0000

Source : Stata 17 (processed), 2024

Engle Granger residual cointegration test showed that error correction term (ECT) was stationer at the level which states that there is cointegration, so the equation being tested has a long-term equilibrium relationship. Then you can do the next Error Correction Model (ECM) test to do the short-run estimation.

Table 5. Short-run using ECM

Variable	Coefficient	Std. Error	t-statistic	Prob
LNGDP	-1.436309	1.720652	-0.83	0.408
LNGDP2	0.1188577	0.1144682	1.04	0.305
FDI	-0.0026257	0.0041303	-0.64	0.528
UP	-0.0140713	0.0207095	-0.68	0.500
ECT-1	-0.4831899	0.1311824	-3.68	0.001
R-squared	0.3055			
Adjusted R-squared	0.2266			
Root MSE	0.03069			
F-statistic	3.87			
Prob (F-statistic)	0.0054			

Source : Stata 17 (processed), 2024

The results of the long-run estimation (Table 3) indicate a significant long-term relationship between the dependent variable, ecological footprint (EF), and the independent variables: natural logarithm of GDP (LNGDP), its square (LNGDP2), foreign direct investment (FDI), and urbanization (UP). The coefficient for LNGDP is positive (1.421994) and statistically significant ($p = 0.002$), suggesting that an increase in GDP is associated with a substantial increase in the ecological footprint, indicating that economic growth tends to increase environmental pressures. Conversely, the coefficient for LNGDP2 is negative (-0.0554757) and marginally significant ($p = 0.076$), hinting at a potential quadratic relationship where the positive impact of GDP on EF may diminish at higher levels of GDP. The negative coefficients for FDI (-0.008597, $p = 0.070$) and UP (-0.0656702, $p < 0.000$) suggest that higher levels of foreign direct investment and urbanization are associated with a

decrease in the ecological footprint, which could imply that these factors contribute to more efficient resource use or cleaner technologies in economic activities.

The subsequent cointegration test (Table 4) results demonstrate that the residuals from the long-run equation are stationary, as indicated by the significant error correction term ($ECT = -5.182$, $p < 0.0000$). This implies a long-term equilibrium relationship between the variables, suggesting that even if short-term fluctuations occur, the system will tend to return to this equilibrium over time. Thus, the cointegration confirms the hypothesis that these variables are linked in the long term.

Moving to the short-run estimation using the Error Correction Model (ECM) (Table 5), the coefficient of the ECT (-0.4831899 , $p = 0.001$) indicates that approximately 48.3% of the deviation from the long-term equilibrium is corrected in the following period. This strong negative coefficient suggests a significant adjustment mechanism, where any disequilibrium in the ecological footprint due to short-term shocks will be corrected over time. However, the other independent variables (LNGDP, LNGDP2, FDI, and UP) show insignificant effects in the short run, with p-values above 0.05, indicating that while they may play a crucial role in the long run, their impact is less pronounced in the immediate term. The overall goodness-of-fit measures reveal that the model explains approximately 30.55% of the variance in the ecological footprint, as indicated by the R-squared value, while the adjusted R-squared of 0.2266 accounts for the degrees of freedom in the model. The F-statistic of 3.87 with a p-value of 0.0054 indicates that the overall model is statistically significant, suggesting that the independent variables jointly influence the ecological footprint, despite the individual coefficients being statistically insignificant.

In summary, the statistical analysis indicates a robust long-term relationship between economic growth, FDI, urbanization, and the ecological footprint, while the short-run dynamics suggest that immediate adjustments towards equilibrium occur, albeit with less significance in individual variable effects. Theoretically, these findings align with the notion that economic growth influences environmental outcomes, highlighting the importance of incorporating sustainability considerations into economic development strategies to mitigate ecological impacts.

5 Discussion

The findings of the research align with the Environmental Kuznets Curve (EKC) hypothesis, which posits that as an economy develops, environmental degradation initially increases but eventually decreases after reaching a certain level of income. In the long term, the results indicate that GDP contributes to an increase in the ecological footprint during the early stages of economic growth. This pattern is characteristic of developing economies, where initial industrialization leads to increased resource extraction, higher fossil fuel consumption, and greater emissions. As these countries strive for economic advancement, the immediate focus on economic output often results in environmental degradation, reflecting the upward trajectory of the EKC.

However, the research also reveals a critical shift in the relationship as economies mature. In the later stages of development, GDP begins to contribute to a reduction in

the ecological footprint. This transition supports the latter part of the EKC hypothesis, which suggests that after achieving a certain income level, economies prioritize environmental protection and sustainability. Factors such as the adoption of cleaner technologies, improved efficiency in resource usage, and heightened public awareness of environmental issues play significant roles in this shift. Mature economies often invest in renewable energy sources and implement stricter environmental regulations, effectively mitigating the ecological impacts associated with earlier phases of growth.

In contrast, the short-term dynamics challenge the conventional EKC narrative, as the immediate effects of GDP growth can lead to an increase in the ecological footprint. During periods of economic boom, firms may prioritize maximizing production, resulting in heightened resource consumption and waste generation. This underscores the importance of effective environmental policies, which may be lacking in rapidly growing economies. Consequently, while the long-term trends support the EKC hypothesis, the short-term dynamics illustrate the complexities of managing environmental degradation during phases of rapid growth. Policymakers must recognize these nuances and develop strategies that encourage sustainable practices throughout the entire economic development process to achieve a balance between economic prosperity and ecological health.

The research findings indicate that foreign direct investment (FDI) and urban population have a statistically significant negative effect on the ecological footprint, both in the short run and long run. This result is particularly noteworthy as it suggests that these two factors play crucial roles in shaping the environmental impact of economic activities. The negative relationship between FDI and ecological footprint can be attributed to several theoretical frameworks. Firstly, FDI often brings advanced technologies and managerial expertise into host countries, leading to improved efficiencies in resource use and production processes. Multinational corporations, which typically engage in FDI, are often bound by stricter environmental standards and sustainability practices, thereby contributing to lower levels of pollution and reduced resource depletion. Additionally, FDI can facilitate investments in cleaner production technologies and renewable energy sources, further mitigating environmental impacts.

The urban population also demonstrates a negative effect on the ecological footprint, which aligns with the concept of urbanization contributing to environmental efficiency. Urban areas tend to be more efficient in resource utilization due to concentrated infrastructure and services. Higher population density can promote the development of public transportation systems, reduce per capita energy consumption, and encourage the use of shared resources. Moreover, urban centers often foster a more environmentally conscious population that advocates for sustainable practices and policies. The shift towards urban living may also drive demand for greener technologies and sustainable urban planning, further supporting the reduction of ecological footprints.

Importantly, the findings highlight that the negative effects of FDI and urbanization on the ecological footprint are consistent across both short and long-term horizons. This consistency suggests that the mechanisms through which these factors exert their influence are robust, regardless of the economic context or timeframe considered. As economies continue to globalize and urbanize, policymakers should recognize the importance of promoting FDI that prioritizes sustainability and

investing in urban infrastructure that enhances environmental efficiency. By fostering an environment conducive to sustainable practices, countries can effectively manage the balance between economic growth and ecological preservation, ultimately contributing to a more sustainable future.

6 Conclusion

The research findings highlight the complex relationship between economic development, foreign direct investment (FDI), urbanization, and the ecological footprint, aligning with the Environmental Kuznets Curve (EKC) hypothesis. Initially, GDP growth is associated with increased ecological degradation due to industrialization, but as economies mature, GDP begins to reduce the ecological footprint. This shift emphasizes the need for sustainable practices, cleaner technologies, and stricter environmental regulations as nations progress economically.

The negative effects of FDI and urbanization on the ecological footprint indicate their potential to promote environmental sustainability. FDI often brings advanced technologies that enhance resource efficiency, while urbanization encourages better infrastructure and resource utilization. Policymakers should focus on attracting responsible FDI and developing urban areas that prioritize sustainability.

In conclusion, while long-term economic development supports the EKC hypothesis, short-term growth can pose environmental challenges. Effective environmental policies are essential during periods of rapid growth to mitigate negative impacts. By understanding the connections between economic factors and environmental outcomes, policymakers can achieve a sustainable balance between economic prosperity and ecological health, paving the way for a more sustainable future.

References

1. de Jong, R., de Bruin, S., Schaepman, M., Dent, D.: Quantitative mapping of global land degradation using Earth observations. *Int. J. Remote Sens.* 32, 6823–6853 (2011). <https://doi.org/10.1080/01431161.2010.512946>.
2. Rahman, M.M.: CLIMATE CHANGE AND ENVIRONMENTAL DEGRADATION: A SERIOUS THREAT TO GLOBAL SECURITY. *Eur. J. Soc. Sci. Stud.* 8, (2023). <https://doi.org/10.46827/ejsss.v8i6.1493>.
3. Aluko, O.A., Osei Opoku, E.E., Ibrahim, M.: Investigating the environmental effect of globalization: Insights from selected industrialized countries. *J. Environ. Manage.* 281, 111892 (2021). <https://doi.org/10.1016/j.jenvman.2020.111892>.
4. Gellert, P.K.: Extractive Regimes: Toward a Better Understanding of Indonesian Development. *Rural Sociol.* 75, 28–57 (2010). <https://doi.org/10.1111/j.1549-0831.2009.00001.x>.
5. Rees, W.E., Wackernagel, M.: Ecological Footprint and Appropriated Carrying Capacity. In: Redclift, M. (ed.) *Sustainability: Sustainability indicators*. Routledge, Oxfordshire (2005).
6. Gülmez, A., Altıntaş, N., Kahraman, Ü.O.: A puzzle over ecological footprint, energy consumption and economic growth: the case of Turkey. *Environ. Ecol. Stat.* 27, 753–768 (2020). <https://doi.org/10.1007/s10651-020-00465-1>.

7. Rees, W.E.: Ecological Footprint, Concept of. In: Reference Module in Life Sciences. Elsevier (2017). <https://doi.org/10.1016/B978-0-12-809633-8.02398-0>.
8. Stern, D.I.: The Rise and Fall of the Environmental Kuznets Curve. *World Dev.* 32, 1419–1439 (2004). <https://doi.org/10.1016/j.worlddev.2004.03.004>.
9. Kearsley, A., Riddel, M.: A further inquiry into the Pollution Haven Hypothesis and the Environmental Kuznets Curve. *Ecol. Econ.* 69, 905–919 (2010). <https://doi.org/10.1016/j.ecolecon.2009.11.014>.
10. Grimm, N.B., Faeth, S.H., Golubiewski, N.E., Redman, C.L., Wu, J., Bai, X., Briggs, J.M.: Global Change and the Ecology of Cities. *Science* (80-.). 319, 756–760 (2008). <https://doi.org/10.1126/science.1150195>.
11. Bazan, G.: Our Ecological Footprint: reducing human impact on the earth. *Electron. Green J.* 1, (1997). <https://doi.org/10.5070/G31710273>.
12. York, R., Rosa, E.A., Dietz, T.: Footprints on the Earth: The Environmental Consequences of Modernity. *Am. Sociol. Rev.* 68, 279 (2003). <https://doi.org/10.2307/1519769>.
13. Grossman, G.M., Krueger, A.B.: Economic Growth and the Environment. *Q. J. Econ.* 110, 353–377 (1995). <https://doi.org/10.2307/2118443>.
14. Ergun, S.J., Rivas, M.F.: TESTING THE ENVIRONMENTAL KUZNETS CURVE HYPOTHESIS IN URUGUAY USING ECOLOGICAL FOOTPRINT AS A MEASURE OF ENVIRONMENTAL DEGRADATION. *Int. J. Energy Econ. Policy.* 10, 473–485 (2020). <https://doi.org/10.32479/ijeeep.9361>.
15. Hervieux, M.S., Darné, O.: Production and consumption-based approaches for the environmental Kuznets curve using ecological footprint. *J. Environ. Econ. Policy.* 5, 318–334 (2016). <https://doi.org/10.1080/21606544.2015.1090346>.
16. Neagu, O., Neagu, M.-I.: The Environmental Kuznets Curve revisited: economic complexity and ecological footprint in the most complex economies of the world. *Stud. Univ. „Vasile Goldis” Arad – Econ. Ser.* 32, 78–99 (2022). <https://doi.org/10.2478/sues-2022-0005>.
17. Uddin, G.A., Alam, K., Gow, J.: Does Ecological Footprint Impede Economic Growth? An Empirical Analysis Based on the Environmental Kuznets Curve Hypothesis. *Aust. Econ. Pap.* 55, 301–316 (2016). <https://doi.org/10.1111/1467-8454.12061>.
18. Doytch, N.: The impact of foreign direct investment on the ecological footprints of nations. *Environ. Sustain. Indic.* 8, 100085 (2020). <https://doi.org/10.1016/j.indic.2020.100085>.
19. Wiedmann, T., Lenzen, M., Turner, K., Barrett, J.: Examining the global environmental impact of regional consumption activities — Part 2: Review of input–output models for the assessment of environmental impacts embodied in trade. *Ecol. Econ.* 61, 15–26 (2007). <https://doi.org/10.1016/j.ecolecon.2006.12.003>.
20. Blomström, M., Kokko, A., Mucchielli, J.-L.: The Economics of Foreign Direct Investment Incentives. In: *Foreign Direct Investment in the Real and Financial Sector of Industrial Countries*. pp. 37–60. Springer Berlin Heidelberg, Berlin, Heidelberg (2003). https://doi.org/10.1007/978-3-540-24736-4_3.
21. Eskeland, G.S., Harrison, A.E.: Moving to greener pastures? Multinationals and the pollution haven hypothesis. *J. Dev. Econ.* 70, 1–23 (2003). [https://doi.org/10.1016/S0304-3878\(02\)00084-6](https://doi.org/10.1016/S0304-3878(02)00084-6).
22. Shahbaz, M., Nasreen, S., Abbas, F., Anis, O.: Does foreign direct investment impede environmental quality in high-, middle-, and low-income countries? *Energy Econ.* 51, 275–287 (2015). <https://doi.org/10.1016/j.eneco.2015.06.014>.
23. Doytch, N., Uctum, M.: Does the worldwide shift of FDI from manufacturing to services accelerate economic growth? A GMM estimation study. *J. Int. Money Financ.* 30, 410–427 (2011). <https://doi.org/10.1016/j.jimonfin.2011.01.001>.
24. Omri, A., Kahouli, B.: The nexus among foreign investment, domestic capital and economic growth: Empirical evidence from the MENA region. *Res. Econ.* 68, 257–263 (2014). <https://doi.org/10.1016/j.rie.2013.11.001>.

25. Al-Mulali, U., Ozturk, I.: The effect of energy consumption, urbanization, trade openness, industrial output, and the political stability on the environmental degradation in the MENA (Middle East and North African) region. *Energy*. 84, 382–389 (2015). <https://doi.org/10.1016/j.energy.2015.03.004>.
26. Jorgenson, A.K., Clark, B.: Assessing the temporal stability of the population/environment relationship in comparative perspective: a cross-national panel study of carbon dioxide emissions, 1960–2005. *Popul. Environ.* 32, 27–41 (2010). <https://doi.org/10.1007/s11111-010-0117-x>.
27. Zhang, R., Li, P., Xu, L.: Evaluation and analysis of ecological security based on the improved three-dimensional ecological footprint in Shaanxi Province, China. *Ecol. Indic.* 144, 109483 (2022). <https://doi.org/10.1016/j.ecolind.2022.109483>.
28. Hoekstra, A.Y., Wiedmann, T.O.: Humanity's unsustainable environmental footprint. *Science* (80-.). 344, 1114–1117 (2014). <https://doi.org/10.1126/science.1248365>.
29. Wiedmann, T.: A review of recent multi-region input–output models used for consumption-based emission and resource accounting. *Ecol. Econ.* 69, 211–222 (2009). <https://doi.org/10.1016/j.ecolecon.2009.08.026>.
30. Dodman, D.: Blaming cities for climate change? An analysis of urban greenhouse gas emissions inventories. *Environ. Urban.* 21, 185–201 (2009). <https://doi.org/10.1177/0956247809103016>.
31. Seto, K.C., Dhakal, S.: Human Settlements, Infrastructure, and Spatial Planning. In: *Climate Change 2014: Mitigation of Climate Change*. pp. 923–1000. Cambridge University Press (2015). <https://doi.org/10.1017/CBO9781107415416.018>.
32. Widarjono, A.: *Ekonometrika : Pengantar dan Aplikasinya*. UPP STIM YKPN, Yogyakarta (2016).
33. Engle, R.F., Granger, C.W.J.: Co-Integration and Error Correction: Representation, Estimation, and Testing. *Econometrica*. 55, 251 (1987). <https://doi.org/10.2307/1913236>.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

