Environmental Health Engineering and Management Journal

Original Article

Environmental Health Engineering and Management

Open Access
Publish Free

CrossMark
click for updates

Income inequality and environmental degradation in the provinces of Iran

Habib Ansari Samani[1*] , Masumeh Rouzbahani[1], Hadis Dalvandi[2], Reza Sadeghi[3]

[1]Department of Economics, Faculty of Economics, Management and Accounting, Yazd University, Yazd, Iran
[2]Department of Economics, Faculty of Administrative Sciences and Economics, Isfahan University, Isfahan, Iran
[3]Department of Public Health, Sirjan School of Medical Sciences, Sirjan, Iran

Abstract

Background: Despite the detrimental environmental and distributional effects of economic activity in Iran, these effects are not uniform across provinces. Environmental degradation and income inequality are increasing in some provinces of Iran. This study aimed to determine the causal relationship between environmental degradation and income inequality in provinces. It investigates whether environmental degradation is a cause or consequence of income inequality.

Methods: Data were collected from official statistical publications in Iran. Then, two simultaneous regression models were estimated to investigate the causal relationship between environmental degradation and income inequality. Finally, Granger causality tests were performed to verify the results.

Results: The results show a one-way causality from income inequality to environmental degradation, and environmental degradation is not the cause of income inequality. While income inequality leads to environmental degradation, other factors are at play in causing income inequality. Income inequality, per capita gross domestic product (GDP), and industrial structure increase environmental degradation. Energy intensity, education, and environmental government budget reduce environmental degradation. Environmental degradation, education, and per capita GDP negatively impact income inequality, while the environmental protection budget and taxation worsen income inequality.

Conclusion: To reduce environmental pollution and income inequality, policies should be adopted that aim to improve the level of education, increase per capita income, increase the budget for environmental protection, reduce polluting industrial structure, and reduce energy intensity. Also, attention should be paid to better management and improvement of the quality of life in different regions of the country to improve the compatibility of different parts of the society with the environment.

Keywords: Income inequality, Environmental degradation, Panel data, Provinces of Iran

Citation: Ansari Samani H, Rouzbahani M, Dalvandi H, Sadeghi R. Income inequality and environmental degradation in the provinces of Iran. Environmental Health Engineering and Management Journal 2024; 11(1): 25-30. doi: 10.34172/EHEM.2024.04.

*Correspondence to:
Habib Ansari Samani,
Email: H.samani@yazd.ac.ir

Introduction

Combating poverty alongside sustainable development has become the major goal in today's world. Environmental degradation, as one of the major challenges of the modern world and a significant consequence of economic growth, significantly impacts income inequality. This destruction negatively impacts human health, quality of life, economic opportunities, and income inequality. One of the environmental impacts of income inequality is the reduction in employment opportunities (1). Environmental degradation may cause jobs to disappear and be relocated to other areas where people with lower incomes usually reside. Additionally, environmental destruction may lead to economic crises in areas dependent on environmentally-related activities (2,3).

Environmental degradation can also affect income inequality through its impacts on the health of affected individuals. For instance, air pollution and chemical substances in the environment may lead to an increase in respiratory diseases, disruptions in the nervous system function, and an increase in cancer risks. These issues typically impact individuals with lower incomes more because they may have fewer opportunities to benefit from healthcare and medical services, making them less able to resist these problems. As a result, environmental degradation impacts income inequality, as people with lower incomes experience lower economic and health status due to lost employment opportunities and illness related to environmental pollution. While expanding polluting industries may create income and employment for some individuals, these activities are usually located in poor and geographically marginalized regions that exhibit severe environmental impacts (4). Therefore, individuals with lower incomes bear the most negative environmental

impacts (5,6).

On the other hand, income inequality can also contribute to environmental degradation. For example, individuals with higher incomes may be able to use more natural resources and purchase heavily used and polluting products. Conversely, individuals with lower incomes may also be forced to resort to unsustainable methods such as deforestation or illegal use of natural resources to make ends meet. Given that environmental degradation and income inequality are complex issues, income inequality is recognized as an important social issue worldwide. This inequality can have a significant impact on the environment, as individuals with different income levels may have different lifestyles and resource consumption patterns. In countries with high levels of income inequality, individuals with lower incomes often resort to unsustainable practices due to high prices for resources such as fuel, energy, and water. As a result, they may inadvertently cause greater harm to the environment (7). Furthermore, in countries with higher income inequality, some segments of society with higher incomes may have a greater tendency to buy expensive goods and services that have greater environmental impacts. For example, they may be able to use large and fast cars, which consume much more fuel and increase air pollution. Therefore, income inequality can lead to environmental degradation by forcing individuals with lower incomes to adopt unsustainable consumption patterns, while higher-income individuals may inadvertently cause greater harm to the environment. Thus, reducing income inequality and promoting equal opportunities for all is necessary to mitigate these negative impacts. To devise effective policies for breaking the cycle between environmental degradation and income inequality, the relationship between these two variables must be clearly understood (8,9). Ehigiamusoe et al (2) show that poverty and income inequality lead to an increase in CO_2 emissions and environmental impacts in a sample of 70 countries. Yang et al (10) showed that income inequality had a negative impact on carbon emissions when it was low in France, but as income inequality increased, the impact changed to positive. In the US, the emission-enhancing effect of income inequality reversed with deepening income inequality. Das and Basu (5) find that pollution threatens the health and prosperity of vulnerable groups and increases their vulnerability, resulting in a vicious cycle. In addition, pollution increases income inequality in countries with higher or lower human or natural capital. These results depend on the stage of development. Khan et al (8) in a study on 180 countries from 2002 to 2019 showed that income inequality, institutional quality, financial development, and economic growth have a positive and significant impact on carbon emissions, while openness to trade and renewable energies significantly reduce carbon emissions. Ali (11) found that the relationship between

income inequality and CO_2 in Egypt from 1975 to 2017, emissions is not bilateral and in the long run, income inequality leads to environmental degradation supported by the political economy approach to explaining the inequality-environment relationship. Belaïd et al (12) indicated that there was a negative long-term relationship between income inequality and carbon emissions in Mediterranean countries from 1990-2012. However, the short-term relationship is positive. Kusumawardani and Dewi (13) showed that income inequality, urbanization, and CO_2 dependence have a negative effect. Also, there is a U-shaped relationship between GDP per capita and CO_2 emissions. Yameogo and Dauda (14) showed that in Nigeria, there is an inverse U-shaped relationship between environmental degradation and income growth, while in Burkina Faso, this relationship is U-shaped. However, government spending and poverty increase carbon emissions in the long run in Nigeria. Uzar and Eyuboglu (15) find that income inequality has a positive effect on CO_2 emissions in Turkey, also, the Gini coefficient is the Granger-causality of CO_2 emissions. Moreover, worsening income distribution reduces environmental quality. Baloch et al (16) showed that carbon emissions increased with increasing income inequalities in Pakistan. Also, industrial structure and population density have negative effects on CO_2 emission.

This study aimed to investigate the mutually reinforcing relationship between income inequality and environmental degradation in the provinces of Iran using the most extensive available data. In the next section, the methodology and data used are specified, and in the following section, research findings are presented. Finally, a discussion and conclusion are provided.

The data on inequality and environmental degradation in the provinces are drawn in Figures 1 and 2. Figure 1 shows the values of income inequality versus environmental degradation for the provinces' data. Figure 1 does not show a clear and strong relationship between inequality and environmental degradation. However, after averaging for each year and removing the provincial effects in Figure 2, it was observed that in the whole country, with the decrease in inequality,
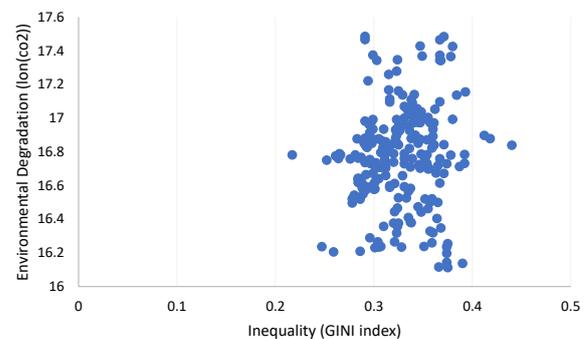
Figure 1. Provincial-year data for inequality and environmental degradation

the destruction of the environment increases. The lack of relationship in raw provincial data indicates cross-sectional fixed effects. These results are consistent with the results of the Hausman and F tests in the next section. Therefore, it is revealed that after removing the cross-sectional effects, the environmental degradation of the provinces is associated with an increase in inequality. But the cause of change in the other is the main issue of this research.

As the literature review has shown, most studies have focused on the impact of income inequality on environmental degradation. However, some studies have also examined the question of whether environmental degradation can affect income distribution. To this aim, we proposed and tested two models that simultaneously consider the interrelated impact of the environment and income distribution. Additionally, to determine the causal direction of this relationship, we estimated causality panel data tests. Therefore, this study's contribution in the literature is (1) a two-way relationship, (2) two-way causality, and (3) focusing on provincial data.

Materials and Methods

In this study, a model was presented to test the relationship between income inequality and environmental degradation. The model consists of two equations, one indicating an endogenous variable for income inequality and the other indicating environmental degradation. Based on the models presented in 2, 10, and 5, the model is designed as the model (1):
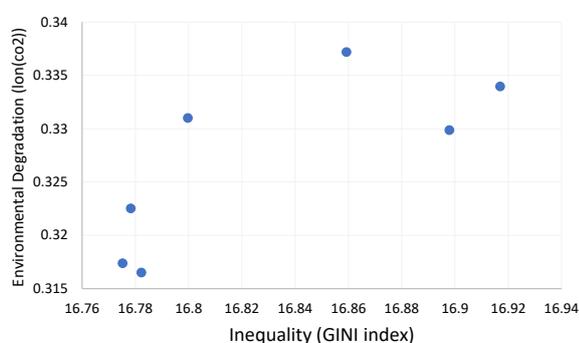
Figure 2. Yearly averaged data for inequality and environmental degradation

$$\begin{cases} Pol_{i,t} &= \gamma_1 Inq_{i,t} + \alpha_1 X_{1i,t} + \varepsilon_{1i,t} \\ Inq_{i,t} &= \gamma_2 Pol_{i,t} + \alpha_2 Y_{2i,t} + \varepsilon_{2i,t} \end{cases} \quad (1)$$

Where *Pol* represents pollution and *Inq* represents income inequality. *X* and *Y* are exogenous variables that affect degradation and income inequality, including per capita GDP and literacy rate. X_1 and X_2 represent a set of exogenous variables that are included in the pollution (inequality) equation. *X* includes technology improvement (measured using the energy intensity index) and the share of industry in GDP, while *Y* includes the unemployment rate, environmental protection budget, and government tax revenues by province. ε_1 and ε_2 are individual effects, time effects and error terms, while γ_1 and γ_2, β_1 and β_2, and α_1 and α_2 are the estimation parameters of the model.

The description of the dependent, independent, and control variables used in the regression equations is presented in Table 1.

All variables that are absolute numbers and not ratios are calculated as logarithms.

Model 1

Based on the theoretical foundations stated in Section 1 and what is observed in Table 1, the equation tested for the dependent variable of pollution is formulated as Eq. (2).

$$Pol = \alpha_1 + \beta_1 Inq + \beta_2 PGDP + \beta_3 Ed + \beta_4 EI + \beta_5 Str + \beta_6 EX \ (2)$$

Model 2

Equation (3) is designed to estimate the effect coefficients of pollution variables and control variables on the dependent variable of inequality.

$$Inq = \alpha_2 + \gamma_1 Pol + \gamma_2 PGDP + \gamma_3 Ed + \gamma_4 Unemp + \gamma_5 Tax + \gamma_6 Ex \ (3)$$

The level of income inequality's impact on pollution and the effect of environmental pollution on income inequality have been estimated using models (5 and 6) with 217 observations, i.e., 31 provinces of the country in seven years (2014-2020). To estimate the model using panel data, it must first be determined whether the data

Table 1. Indexes used in regression models

Variable	Abbreviation	Calculation Method	Source
Pollution	Pol	Calculation of provincial CO_2 emissions	Energy's energy balance sheet
Income inequality	Inq	Provincial Gini coefficient	Statistical Center of Iran
Per capita GDP	PGDP	Per capita gross domestic product (GDP) from the National-Regional Accounts	Statistical Center of Iran
Education	Ed	Number of university graduates	Statistical Center of Iran
Energy intensity	EI	The ratio of total provincial fuel consumption to GDP	Energy balance sheet
Industrial structure	Str	The ratio of industrial value-added from national-regional accounts to GDP	Statistical Center of Iran
Government spending	Ex	Environmental protection budget from the Department of Environment	Statistical Center of Iran
Unemployment rate	Unemp	Unemployment rate	Statistical Center of Iran
Taxes	Tax	Direct tax revenues	Tax annual report

is Pool or Panel. For this purpose, the Breusch-Pagan test is used to examine between Pooled or Random effects estimation methods. Then, the Hausman test is used to choose between fixed effects and random effects. Finally, generalized White's test has been performed to check the existence of heteroscedasticity. The results of these three tests for both models are presented in Table 2, and the selected test results are also estimated and presented in each case.

Because there is a simultaneity effect, the model should be estimated by simultaneous equation methods considering the simultaneity of the model. The use of separate equation methods causes bias in estimation and inconsistency of estimators. Therefore, we will use the Generalized two-stage least squares (G2SLS) regression method to estimate simultaneous panel equations (17).

Results

As shown in Table 2, the F test and Hausman test prove the Panel data fixed effects method for two models. The statistical values and significance level of the heteroscedasticity test in both patterns indicate the absence of heteroscedasticity. The results are reported in Table 2.

As shown in Table 3, the Gini coefficient had a positive effect on environmental degradation, meaning that increasing income inequality, increases the level of environmental degradation (CO_2 emissions). Per capita GDP had a positive and significant effect on the environmental degradation. This means that environmental degradation increases with economic growth. According to the results, during the study period, Iran provinces are in the ascending part of the environmental Kuznets curve. The education variable had a negative effect on the environmental degradations that with an increase in education, environmental degradation decreases. The intensity of energy and government budget in the environmental sector in a province had a significant effect on environmental degradation. The results show that the effect of the industrial structure on the environmental degradation was positive. This indicates that the industrial structure in different provinces has changed towards industries that have higher levels of CO_2 emissions.

As shown in Table 3, the level of CO_2 emissions does not

affect the income inequality. Per capita GDP negatively affects income inequality. This means that as per capita GDP (income) increases, inequality decreases. Based on the results, during this period, Iran is in the descending part of the Kuznets curve. The effect of education on inequality was negative. Universal education makes it possible for all classes to access the job market and reduces income inequality. The budget of the Environmental Protection Organizations had a positive effect on inequality at the 10% level. As expected, an increase in the unemployment rate leads to an increase in income inequality. Finally, the increase in taxes has led to an increase in inequality, it means households with lower incomes have paid a larger proportion of their income as taxes to the government, and the tax burden has been higher on low-income social groups.

Granger panel causality test is used to investigate the causal relationship between these two variables. In this test, a control variable is added to eliminate spurious causality errors in the Granger causality test. The null hypothesis has no possible causality. The results of this test are presented in Table 4 and 5. The results of the causality test confirm the estimated regression equation system. These results show that income inequality affects environmental degradation, but environmental degradation is not an important factor for changes in income inequality. This shows the priority of inequality for environmental policymaking.

The results of the causality test between income inequality (Gini coefficient) and environmental degradation (CO_2 emissions) with one and two lags are presented in Tables 4 and 5. The results of the causality test confirm the estimated regression equation system. These results show that income inequality affects environmental degradation, but environmental degradation is not an important factor for changes in income inequality. This shows the priority of inequality for environmental

Table 2. Model estimation tests

Model	Test	Statistics	P value
1	F	63.89	0
	Hausmann	53.33	0
	Heteroscedasticity	2.19	0.07
2	F	12.01	0
	Hausmann	26.55	0.08
	Heteroscedasticity	1.33	0.15

Source: Research findings.

Table 3. The results of estimating simultaneous equations system with panel data and G2SLS method

Model	Variable	Coefficient	P value
1	Inq	13.55	0.032
	PGDP	3.99	0.019
	Ed	-0.02	0.000
	EI	-8.03	0.000
	Str	0.06	0.000
	EX	0.06	0.003
2	Pol	0.02	0.325
	PGDP	-0.02	0.032
	Ed	-0.51	0.011
	Ex	0.61	0.078
	Unemp	0.02	0.031
	Tax	0.05	0.000

Source: Research findings.

Table 4. The results of the panel causality test with one lag

Test statistic	F-statistic	Significance level	Null hypothesis
Income inequality causes environmental degradation	5.27	0.22	Rejected
Environmental degradation causes income inequality	0.267	0.605	Not rejected

Source: Research findings.

Table 5. The results of the panel causality test with two lags

Test statistic	F-statistic	Significance level	Null hypothesis
Income inequality causes environmental degradation	2.629	0.75	Rejected
Environmental degradation causes income inequality	1.505	0.225	Not rejected

Source: Research findings.

policymaking.

Discussion

The findings revealed a positive correlation between income inequality, GDP growth, industrialization, and the budget allocated to environmental protection, with environmental degradation. However, the impact of education and energy intensity on environmental degradation is predominantly negative.

Moreover, while production and education exert a detrimental impact on income inequality, the expenses associated with environmental protection, unemployment, and taxes tend to exacerbate income inequalities.

The results of the causality test indicate that inequality is the statistical cause of pollution, but pollution is not the causal effect of inequality. In general, it should be said that the government by collecting taxes and paying expenses to reduce pollution, not only increases pollution but also increases income inequality. This can be due to inefficiency and improper implementation of pollution reduction policies and income inequality. On the other hand, to reduce pollution, special attention should be paid to the issue of inequality and education.

Previous research has shown that economic growth in Iranian provinces leads to environmental pollution, as demonstrated by several studies (2,8,11,14-16). However, these results are inconsistent with those of other studies (13,18). Previous studies have primarily focused on the relationship rather than causality and have estimated regression models without conducting causality tests on the relationship between income inequality and environmental degradation. Along with a few previous studies that have estimated causality tests, this study examined the direction of the relationship. The results indicate that the long-term causal relationship only exists from income inequality to pollution, which is inconsistent with the results of the study by Belaïd et al (12), who found a direct relationship between inequality and environmental degradation in the short term but an inverse relationship in the long term.

Conclusion

In this study, we provided evidence of a positive correlation between income inequality and environmental degradation in Iran's provinces, with unidirectional causality from income inequality to pollution. Additionally, the cost of pollution cleanup has fallen mainly on the poor

in Iran. These findings highlight the need for appropriate policies that can prevent the decline in welfare in the country and reduce income inequality while preserving the environment. The study suggests that increasing the education rate and reforming the industrial structure can effectively improve environmental conditions and reduce income inequality. Furthermore, policymakers should implement economic and social policies that concentrate on issues related to pollution and environmental degradation, particularly in regions experiencing economic growth, to prevent the negative impacts of growth on the environment. Overall, the findings of this study can guide policymakers in developing effective policies that address both environmental and social issues, thereby enhancing the well-being of the population and promoting sustainable development in Iran.

Authors' contribution

Conceptualization: Habib Ansari Samani.
Data curation: Masumeh Rouzbahani, Habib Ansari Samani, Hadis Dalvandi.
Formal analysis: Hadis Dalvandi, Reza Sadeghi.
Funding acquisition: Habib Ansari Samani.
Methodology: Masumeh Rouzbahani, Habib Ansari Samani.
Project administration: Masumeh Rouzbahani, Habib Ansari Samani.
Resources: Habib Ansari Samani.
Software: Masumeh Rouzbahani.
Supervision: Habib Ansari Samani, Reza Sadeghi.
Validation: Masumeh Rouzbahani.
Visualization: Habib Ansari Samani, Masumeh Rouzbahani.
Writing–original draft: Masumeh Rouzbahani.
Writing–review & editing: Habib Ansari Samani, Hadis Dalvandi, Reza Sadeghi.

Competing interests

The authors declare that there are no conflicts of interest.

Ethical issues

There were no ethical issues in writing this article. The

authors certify that the article has not been published before and is not currently being considered for publication elsewhere (Ethical code:IR.YAZD.REC.1402.108).

References

1. Ansari Samani H, Khilkordi R. Unemployment and income inequality in Iran provinces. Iran J Econ Res. 2019;24(81):157-86. doi: 10.22054/ijer.2019.11689. [Persian].

2. Ehigiamusoe KU, Majeed MT, Dogan E. The nexus between poverty, inequality and environmental pollution: evidence across different income groups of countries. J Clean Prod. 2022;341:130863. doi: 10.1016/j.jclepro.2022.130863.

3. Wang S, Zhang W, Wang H, Wang J, Jiang MJ. How does income inequality influence environmental regulation in the context of corruption? A panel threshold analysis based on Chinese provincial data. Int J Environ Res Public Health. 2021;18(15):8050. doi: 10.3390/ijerph18158050.

4. Bagheri S, Ansari Samani H. Forecast of carbon dioxide emissions in Iran and polluting sectors: long-term memory approach. J Iran Econ Issues. 2022;8(2):67-90. doi: 10.30465/ce.2021.6691. [Persian].

5. Das M, Basu SR. Understanding the relationship between income inequality and pollution: a fresh perspective with cross-country evidence. World Dev Perspect. 2022;26:100410. doi: 10.1016/j.wdp.2022.100410.

6. Afroz R, Limon RA, Afroz S. Role of human capital, income inequality and renewable energy consumption on CO2 mitigation in Malaysia. Res Sq [Preprint]. October 6, 2022. Available from: https://www.researchsquare.com/article/rs-2034768/v1.

7. Nasrollahi Z, Ansari Samani H, Rouzbahani M. Estimate the impact of income inequality on sustainable development indicator: study of Iran. Economic Growth and Development Research. 2018;8(32):78-61. doi: 10.30473/egdr.2018.4564. [Persian].

8. Khan H, Weili L, Khan I, Han L. The effect of income inequality and energy consumption on environmental degradation: the role of institutions and financial development in 180 countries of the world. Environ Sci Pollut Res Int. 2022;29(14):20632-49. doi: 10.1007/s11356-021-17278-9.

9. Manigandan P, Alam MS, Alagirisamy K, Pachiyappan D, Murshed M, Mahmood H. Realizing the Sustainable Development Goals through technological innovation: juxtaposing the economic and environmental effects of financial development and energy use. Environ Sci Pollut Res Int. 2023;30(3):8239-56. doi: 10.1007/s11356-022-22692-8.

10. Yang Z, Ren J, Ma S, Chen X, Cui S, Xiang L. The emission-inequality nexus: empirical evidence from a wavelet-based quantile-on-quantile regression approach. Front Environ Sci. 2022;10:871846. doi: 10.3389/fenvs.2022.871846.

11. Ali IM. Income inequality and environmental degradation in Egypt: evidence from dynamic ARDL approach. Environ Sci Pollut Res Int. 2022;29(6):8408-22. doi: 10.1007/s11356-021-16275-2.

12. Belaïd F, Boubaker S, Kafrouni R. Carbon emissions, income inequality and environmental degradation: the case of Mediterranean countries. Eur J Comp Econ. 2020;17(1):73-102. doi: 10.25428/1824-2979/202001-73-102.

13. Kusumawardani D, Dewi AK. The effect of income inequality on carbon dioxide emissions: a case study of Indonesia. Heliyon. 2020;6(8):e04772. doi: 10.1016/j.heliyon.2020.e04772.

14. Yameogo CE, Dauda RO. The effect of income inequality and economic growth on environmental quality: a comparative analysis between Burkina Faso and Nigeria. J Public Aff. 2022;22(3):e2566. doi: 10.1002/pa.2566.

15. Uzar U, Eyuboglu K. The nexus between income inequality and CO2 emissions in Turkey. J Clean Prod. 2019;227:149-57. doi: 10.1016/j.jclepro.2019.04.169.

16. Baloch A, Shah SZ, Noor ZM, Magsi HB. The nexus between income inequality, economic growth and environmental degradation in Pakistan. GeoJournal. 2018;83(2):207-22. doi: 10.1007/s10708-016-9766-3.

17. Ravallion M, Heil M, Jalan J. Carbon emissions and income inequality. Oxf Econ Pap. 2000;52(4):651-69. doi: 10.1093/oep/52.4.651.

18. Amemiya T. A comparison of the Amemiya GLS and the Lee-Maddala-Trost G2SLS in a simultaneous-equations Tobit model. J Econom. 1983;23(3):295-300. doi: 10.1016/0304-4076(83)90058-1.