



International Conference on Management and Economics

Manchester, United Kingdom

18 - 20 October 2024

Utilizing Machine Learning Algorithms and SEM Analysis to Investigate the Relationship Between Environmental Deterioration, Health Expenditure and Economic Development in ECOWAS Region

Seth Acquah Boateng¹, William Godfred Cantah², Andy Asare³, Joshua Sebu⁴

¹ School of Public Policy and Administration, Northwestern Polytechnic University, China

² Department of Data Science and Economic Policy, University of Cape Coast, Ghana

³ Department of Computer Science, University of Calgary, Canada

⁴ Department of Data Science and Economic Policy, University of Ghana, Ghana

Abstract

This study utilized advanced machine learning techniques and SEM to investigate the relationships between environmental degradation, health expenditure, and economic development in the ECOWAS region, from 2000 to 2021. This study reveals that there are statistically significant direct associations between environmental factors and economic growth. GDP per capita is significantly influenced by positive carbon emissions ($\beta = 0.716$, $p < 0.001$). Nitrous oxide emissions also showed a positive influence on GDP per capita ($\beta = 0.123$, $p < 0.001$). Inversely, poor air quality measured by PM2.5 levels negatively influences economic growth ($\beta = -0.306$, $p < 0.001$). Health expenditure significantly mediates the relationship of nitrous oxide emissions with economic growth, the indirect effect being $\beta = -0.008$, $p = 0.009$, accounting for 13.91% of the total effect. However, there is a very minimal mediation effect between carbon emissions and economic growth indirect effect: $\beta = -0.010$, $p = 0.019$, and no significant mediation in the relationship between air quality and economic growth. Gradient Boosting model had very high predictive accuracy among the machine learning models, explaining 98.85% of the variance in GDP per capita across countries. Feature analysis shows that carbon emissions account for approximately 68.6% of the model's predictive power, followed by PM2.5 levels at 27.5%. The study showed context-specific dynamics in the ECOWAS region. The high reliance on carbon-intensive activities for economic development implies that sustainable development strategies have to be emphasized. We recommend investing in clean energy technologies, air quality management, sustainable agricultural practices, and health infrastructure in the ECOWAS countries. This will enable the region to integrate policies in a way that economic development balances with environmental protection and improvement in public health towards the attainment of SDGs.

Keywords: Environmental degradation, Economic development, ECOWAS region, Machine learning, Health expenditure, CO2 emissions, Environmental Kuznets Curve