Sustainable Development and Ecological Deficit in the United Arab Emirates

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Abstract: The economy of the United Arab Emirates has ranked 27th in the world for decades, which has supported its human development being rated highest among Arab nations. The country, however, has remained oblivious to its ecological deficit. This study explores sources of this deficit by analyzing three sets of data related to its economic growth, human development, and ecological deficit for 29 years from 1990 to 2019. The results of the data analyses indicate that although an increase in the country’s GDP has a high positive correlation with the nation’s human development, the indicator variables related to both measures have a significant reverse influence on the variability of the values for the country’s ecological deficit. Validating the statistical results through interviews with ten authorities from various government ministries and the oil industry shows that, when considering the nation’s finite biocapacity, the genesis of its ecological deficit lies in persistent developments that rely on petroleum revenues and the rapid influx of the millions of migrants who are needed to close the skill gaps of United Arab Emirates (UAE) citizens. Although initiatives to reduce the UAE’s ecological footprint have been in place since 2007, the lack of environmental action plans, policies, and enforcing regulations have resulted in the nation’s failure to move toward achieving sustainable development. This has pushed the country toward the brink of ecological bankruptcy.

Keywords: sustainable development; ecological footprint; ecological deficit

1. Introduction

Several decades of economic development and the mindful toil of millions of migrants in the United Arab Emirates (UAE) manifested in a gross domestic product (GDP) that ranked 27th in the world in 2019 [1]. Furthermore, the UAE’s human development index (HDI) was highest among Arab nations [2]. The country, however, remained oblivious to its ecological footprint (EF), although Vernadsky emphasized the interdependence between human life and natural resources in 1926. Nearly fifty years later, the book “Limits to Growth” highlighted Vernadsky’s view [3]. The prognostic synopsis of this book is that if population growth and economic development continue unabated, the ecological footprint (EF) will increase to a level where the Earth’s finite interlocking system will not be able to support sustainable development. However, blessed with massive oil and gas resources and believed to be the sensorium of God that ended generations of deprivation, this insight was considered a prophecy of doom for the devout UAE society.

By 2003, with heavy reliance on petroleum export revenues and migrant workers, the UAE population had increased by 76% and oil exports were raised to 2.25 million barrels per day—an increase from 180,000 barrels in 1972 that boosted the economy by 9.6%. Consequently, the country was reported to have the world’s largest EF of 11.9 global hectares per person (gh/p) [4,5]. With the available biocapacity about 1.8 gh/p, the UAE ecological deficit (ED) measured at a −10.1 gh/p, which means the...
nation’s demands for natural resources exceeded the available biocapacity and the country was unable to supply the needs of its population.

The nation, therefore, relied on bridging the gap between supply and demand by liquidating greater amounts of its natural assets. By 2006, the country’s oil exports increased to 2.53 million barrels per day; chemical exports to 700 thousand; and liquefied natural gas exports to 433.3 thousand barrels per day, while its population reached 5.24 million (86.5% of which were migrants) and its GDP escalated by 9.8% [6]. The rate of growth gave the citizens an illusion of having infinite resources, leading to the over-consumption of natural assets (such as energy, water, and raw materials).

By 2007, the impacts of human activities and the number of resources necessary to support the UAE lifestyle outpaced the nation’s biocapacity and resulted in water and environmental pollutions [7]. This triggered severe social concerns in a field fraught with criticism and contention. In response, the government announced a new initiative called Al Basam Al Beeiya in an attempt to fend off this criticism without an environmental action plan or enforcing regulations [4].

In 2010, the nation’s EF, measured at 10.68 gha/p, threw a gloom over the nation by labeling the UAE as having the world’s worst-polluted environment [8]. Of this pollution, 80% was associated with a carbon footprint that was mainly due to a 55.8% increase in energy consumption between 2003 and 2010 [9]. Furthermore, the nation was reported to have the world’s worst-polluted water and overshooting of its planetary limits [10].

Consequently, the polluted water and environment coupled with the continuous exploitation of oil and gas and an influx of migrant workers constrained agricultural developments, leading to food deficit in UAE. With a near-total dependency on the international market for food supplies, the exploitation of natural resources in exchange for food and other necessities to continue economic development was the only viable option. Still, by 2011, with a population of 8.67 million, the nation’s GDP reached US $289.8 billion, and its HDI increased to 0.836 [11]. However, concerns over environmental coercions, ranging from limited water resources and air pollution to waste accumulation, land degradation, desertification, and increasing atmospheric levels of carbon dioxide and other greenhouse gasses spanned across UAE territory to acidification and invasive species in the Persian Gulf.

Despite all these challenges and baffling as it may seem, from 2011 to 2019, the country’s annual GDP escalated from US $351.7 to US $425.00 billion, the population grew from 8.67 million to 9.75 million, and the HDI increased from 0.836 to 0.863. At the same time, the nation’s EF was measured between 9.5 to 9.75 gha/p, of which, 71% was associated with a carbon footprint, leading to −8.9 to −9.15 ED gha/p [7]. While a widespread national expectation was that the country’s fast-paced modernization and human development were being maintained by the government within its sustainable ecological boundaries, environmental threats increased in magnitude, speed, and severity.

However, fueled by instincts of self-gratification that defied taking responsibility, the government shifted the blame to households, which were marked as being responsible for 57% of the country’s carbon footprint, to commercial businesses for 30%, and to government activities as accounting for only 12% [12], but this allocation has been contested, since the country’s rapid development has been financed by liquidating its natural assets and employing millions of migrants who worked in drudgery to support the nationals in living a life of luxury. At the same time, the UAE’s submissive society has been persuaded to turn away from the ancient past toward the modernization that has transformed the country from relative obscurity to one that has assumed its place in global affairs and embraced an exceedingly copious lifestyle.

With only a decade left to achieve the 2030 Agenda for Sustainable Development adopted by UAE (along with 192 other United Nations Member States), high EF, water, and environmental pollution in UAE persist [13]. Since the devil is in the details, the goal of this study is to define the root cause of EF in the UAE. With this goal, in-depth reviews of documents from public and private sectors were followed by analyzing 29 years of data from 1990 to 2019 across the three spectrums of the GDP, HDI, EF, and their related indicator variables. The results of the analyses were validated by ten participants.
from both public and private sectors in the UAE, with an emphasis on detailed explanations of ED root causes.

This study is organized into five sections: Section 1 is the introduction to this study, followed by Section 2, which contains reviews of the literature on sustainable development. Section 3 is the methodology that comprises theoretical and practical explanations of analyses associated with three propositions that were advanced from Section 2. The fundamental methods of data collection—related to three indices, including GDP, HDI, and EF within the ecosystem—are explained as secondary quantitative data from UAE public, private, and international establishments, and primary quantitative data using interviews. Section 4 demonstrates analyses of quantitative data by addressing three contextual questions: 1. is there any relationship between these three indices (i.e., GDP, HDI, and EF)? 2. Do the recommended explanatory variables explain variation in each index? 3. Do variations in GDP and HDI have a significant influence on EF? Section 4 is an analysis of data that is followed by a summary of the study and a brief conclusion in Section 5.

2. Literature Review

A substantial body of literature is associated with defining and analyzing sustainability. Daly [14] interpreted sustainability as a valuation of the ecosystem concerning social goals. Others have decoded it as a pre-analytical representation [15]; a discipline [16]; common sense [17]; a slogan [18]; a brilliant but far-reaching metaphor [19]; or a vision [20] that has turned into a global mission [21]; and one with measurable goals [22].

A further review of the literature shows that sustainability is associated with the environment [23]; civil engineering [24]; sustainable construction and socio-technical transitions [25]; renewable and nuclear energy [26]; urban development [27]; circular design [28]; and commercial aviation [29]. Social scientists and corporations have joined the chorus that has captured the principles of sustainability from the Brundtland Report [30], the Earth Summit [31], and the United Nations Sustainable Development Goals [32] as a casuistic approach to these principles’ strategic formulation [21], while the underlying approaches are through human development [33] and business ethics [34].

Thus, arranging literature that is relevant to sustainable development in the UAE conceptually interlocks parts of a grand phenomenon on a setting with ambiguity [35] and diversity [36], while its omnipresence [37] has been articulated in political discourses that express the common future of all living beings [38], poverty reduction [39], the elimination of inequality [40], and addressing climate change [15].

Notable in this phenomenon is the distinction between sustainability and sustainable development. While sustainability refers to the capability to endure a continuum of actions without termination, sustainable development refers to a process of improvement in a balanced environment in which the exploitation of natural resources and the orientation of technological enhancements and institutional changes in each territorial boundary meet the needs of the present without compromising the ability of future generations to meet their own needs [4,7].

The US National Environmental Policy Act (NEPA, 1969) defined the goals of sustainable development as being to “create and maintain conditions, under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations.” Thus, sustainable development means that progressive changes are taking place within planetary boundaries that require partnerships among all living beings [31].

Elkington [41] orients partnerships around three interrelated factors—the planet, profits, and human formation—in a unified system. The core of this system is conducive to economic growth and human development within self-perpetuating planetary borders. In this system, the economy could grow and benefit humanity just by using natural resources, but it cannot be sustained without human development. Thus, a nation’s wealth ultimately depends on the elaboration of human capabilities that lead to innovations that deliver economic growth.
More thoughts on human capability appear in Sen’s theory [42], which assumes that human development is a process of the expansion of human capacities to perform activities that are freely chosen and economically valued. During this process, building social competencies and obtaining an education is shaped by investing in both technology and health care delivery that improve human capabilities for economic growth. Still, neither economic growth nor human development is free of any environmental constraints, since Earth’s biocapacity is not infinitely expandable. Thus, humankind remains in a state of obligated dependency, with a unified objective of maintaining Earth’s support services within a holistic system.

The objective of this system is an accurate measure of sustainable development that encircles three well-adjusted indices of economic performance (manifested in GDP) [11], social solidarity (expressed as HDI), and environmental responsibility (measured in EF) within the ecosystem. Within this system, the GDP tracks a nation’s financial performance. The HDI is an ultimate criterion for assessing a nation’s wealth [8], and the EF measures a country’s population impact on the environment within its planetary biocapacity [4]. While each index has its own manifestations, the confluence of the three generates a new set of variables emanating from the system that operates for the common purpose of meeting the needs of the present without compromising the ability of future generations to meet their own needs.

3. Methodology

This system approach is an entirely different methodology to study the three interrelated components (i.e., GDP, HDI, and EF), forming a convoluted unified whole and leading to the UAE’s ED. While each component has its own performance with an annual goal established by the government to reach, together, they must maintain an equilibrium among the three parts to minimize the ED.

Although academic literature offers a wealth of information on each part of this system from every scientific discipline, there is no theoretical framework from which to make predictive hypotheses for the system. This makes the study pre-paradigmatic in nature. According to Kuhn [43], this type of study offers a passage to usual scientific practice, while each subset is dynamic and diverse, with as many theories as there are theorists and no commonly accepted observational basis. There are, however, three propositions that can be advanced from those mentioned earlier. They are as follows:

Proposition One: the GDP and its predictor variables have significant positive influences on HDI in the UAE.

Proposition Two: the GDP and its predictor variables have significant positive influences on the variability of its EF measures in the UAE.

Proposition Three: the GDP, HDI, and their indicator variables have significant positive influences on the variability of EF and ED measures in the UAE.

To justify a methodology that is germane to the above propositions, three studies that recommend mixed-method research were followed [44–46]. According to these authors, mixed-method research is an approach that involves two sets of qualitative and quantitative data collection. From a practical perspective, the quantitative investigation takes the measures required in the statistical analysis to test the propositions. At the same time, the qualitative study illustrates the issues with subjective opinions and descriptive phrases to ratify or refute the stated propositions within the interviewees’ frame of mind. To integrate the two sets of analysis concerning propositions, the complex issue of ED can be examined from both subjective as well as objective perspectives. Furthermore, qualitative data verify the reliability of the statistical analysis and support analytical conclusions.

The quantitative data consisted of three sets of secondary quantitative data collected from UAE public and private sources, as well as international organizations, between 1990 to 2019. The quantitative data used in this study included the three sets of s, the GDP, HDI and EF, and their indicator variables. The GDP is the most common measure used to track the financial performance of a nation’s economy, as recommended by the International Monetary Fund [1] and the Statistical Portal [46]. The available indicator variables for the GDP at current prices (US$ billion) were the GDP growth rate (percent annual
variation), the unemployment rate (annual average percent), the annual inflation rate, government debt (as a percent of GDP), international reserves (in billions of $ US), government non-oil revenue (as a percent of GDP), government expenditures (as a percent of GDP), government fiscal balance on the current account (US $ billion), crude oil exports (millions of barrels/day), chemical exports (thousands of barrels/day), gas and condensates exports (barrels per day), and trade (as a percent of GDP) [1,6,11,47].

The second index was the HDI, which was introduced by the United Nations Development Program in 1990 and emphasized people and their capabilities, and not economic growth, as a measure of the wealth of a nation. This index is a geometric mean of achievement as measured in three critical dimensions of human development, which include living a long and healthy life, being knowledgeable, and having a decent standard of living. Eight predictor variables were included in calculating the HDI: the mortality rate of children under 5 years of age (per 1000 live births), life-time expectancy at birth, the maternal mortality ratio (per 100,000 live births), health expenditures per capita, education (expected years of schooling), mean years of schooling, the adult literacy rate (15 and above), and GDP per capita (as a proxy for the standard of living) [2,8].

The third index was the EF; this is an accounting tool that is used to address the underlying issue of the consumption of Earth’s resources. Tantamount to the concepts of demand and supply in economics, the consumption/demand measures the extent to which humanity is using nature’s resources. In contrast, the supply refers to the regenerative capacity (supply) of the Earth’s biological and biosphere resources [48]. Thus, biocapacity refers to the aggregate of the bio productive supply of various ecosystems in specific territorial boundaries, including land (cropland, grazing land, fishing grounds, forest land, built-up land, and the uptake land that accommodates the carbon footprint), and the water required to produce the goods consumed and assimilate the wastes generated. The equivalence factor, which represents the average amount of biological productivity of the heterogeneous resources available to each individual, was the transformation of different units (tones or hectares) as they were converted into a standardized unit of a global hectare per person (gh/p) [4].

Variables that influence the consumption of Earth’s resources and the absorption of wastes were the total number of people in a region; the population density (number of people per square kilometer); the water resources measured as m³/person/year; the number of people with no access to water; CO₂ emissions (kg per percentage per person of GDP); and the exploitation and consumption of non-renewable energy, such as oil (barrels) and gas (cubic meter), within a selected period (generally one year). The mathematical difference between the EF and the biocapacity was either the ecological reserve or deficit—the latter of which is also called the overshoot [4].

Qualitative data included primary data using interviews. Following [49], recommendations, 10 online interviews were conducted to attain information saturation using Skype and Zoom, from September, 2018 to December, 2019. The participants were volunteers from ten ministries, including the Ministries of the Economy; Health and Prevention; Education; Energy and Industry; Labor and Emiratization; the State for Future Food Security; the Emirates Wildlife Society; the Abu Dhabi Environment Agency; the Ministry of Climate Change and the Environment; and the Abu Dhabi National Oil Company.

4. Data Analysis

This was a process of capturing quantitative and qualitative data, transforming, and modeling data to discover useful information for finding the root causes of ED.

4.1. Quantitative Data Analyses

These analyses were divided into three steps using 29 years of data from 1990 to 2019. Step one examined the degree of the relationship between the indices. These included the degree of relationship between the GDP and the HDI, the GDP and the EF, and the HDI and the EF. Step two examined the degree of relationship between each index (GDP, HDI, and EF) and its associated indicator variables
in the UAE to identify which variable had a significant and positive impact on its associated index. Step three tested the propositions.

4.1.1. Examining the Degree of Relationships Between the Indices

In examining the relationships, the correlation matrix was used to test the strength and direction between each pair of indices to provide an overall explanation for each proposition. Table 1 shows that there was a high positive relationship between the GDP and the HDI \((r = 0.91)\) in the UAE, while the correlation coefficients between the GDP and the EF \((r = -0.96)\) and the HDI and the EF \((r = -0.89)\) were highly negative. These correlations indicated that an increase in the UAE’s GDP improved HDI, but an increase in both GDP and HDI significantly reversed the impact on the EF.

| Index                        | Human Development Index | Gross Domestic Product | Ecological Footprint |
|------------------------------|-------------------------|------------------------|----------------------|
| Human Development Index      | 1                       |                        |                      |
| Gross Domestic Product       | 0.912445209             | 1                      |                      |
| Ecological Footprint         | -0.890739885            | -0.964238786           | 1                    |

4.1.2. Examining the degree of relationship between each index and its indicator variables

In this step, each index was tested to assess its relationship, strength, and direction with its own indicator variables.

The Relationship Between GDP and its Indicator Variables

Table 2 presents the correlation coefficient between the GDP and its predictors. It is notable that only eight variables had high positive correlation coefficients with the GDP. These included: international reserves \((r = 0.888)\); trade \((r = 0.96)\); crude oil exports \((r = 0.813)\); chemical exports \((r = 0.795)\); the government’s fiscal balance on its current account \((r = 0.724)\); manufacturing growth \((r = 0.778)\); gas exports \((0.66)\); and government non-oil revenue as a percent of the GDP \((r = 0.648)\). While these variables were considered for further testing proposition one, the three other GDP indicator variables that had correlation coefficients of less than 0.5 or that had negative impacts (i.e., unemployment rate, inflation rate, government debt as a percentage of GDP, and government expenditure as a percentage of GDP) were excluded.

Relationship between the EF and its Indicator Variables

Table 4 shows that there was a significantly high degree of correlation between the EF and the available biocapacity \((r = 0.94)\). However the correlation coefficient between the EF and the rest of its indicator variables were negative, including: population \((r = -0.96)\), the percentage of migrants in the total population \((r = -0.94)\), the population density \((r = -0.96)\), CO\(_2\) emissions \((r = -0.94)\), the number of people with no access to water \((r = -0.96)\), gas production \((r = -0.95)\), and fuel consumption for
primary energy \((r = -0.95)\). These negative correlations mean that the nation is using nature’s resources faster than nature can regenerate them.

### Table 2. Correlation between GDP and its Indicators.

| Indicator | GDP at Current Price ($US billion) | Unemployment Rate (annual %) | Inflation Rate (Annual Average %) | Government Debt as % of GDP | International Reserve (billion $ US) | Government non-Oil Revenue % of GDP | Government Expenditure % of GDP | Fiscal Balance on Current Account (billion $ USD) | Crude Oil Exports (million barrels/day) | Chemical Exports (thousand barrels/day) | Gas and Condensates Exports (barrels per day) | Trade (% of GDP) | Manufacturing (Mfg.) Growth |
|-----------|----------------------------------|------------------------------|-----------------------------------|------------------------------|-----------------------------------|-----------------------------------|-------------------------------|-----------------------------------------------|---------------------------------------|------------------------------------------|------------------------------------------|----------------|--------------------------|
|           | 1.000                            | -                            | -                                 | 0.9824                       | 0.9244                            | 0.9244                            | 0.9824                        | 0.9728                          | 0.9244                               | 0.9244                                  | 0.9244                                  | 0.9244             | 0.9244                   |
| GDP at Current Price ($US billion) | 1.000                            | -                            | -                                 | 0.9824                       | 0.9244                            | 0.9244                            | 0.9824                        | 0.9728                          | 0.9244                               | 0.9244                                  | 0.9244                                  | 0.9244             | 0.9244                   |
| Unemployment Rate (annual %)      | 1.000                            | -                            | -                                 | 0.9824                       | 0.9244                            | 0.9244                            | 0.9824                        | 0.9728                          | 0.9244                               | 0.9244                                  | 0.9244                                  | 0.9244             | 0.9244                   |
| Inflation Rate (Annual Average %) | 1.000                            | -                            | -                                 | 0.9824                       | 0.9244                            | 0.9244                            | 0.9824                        | 0.9728                          | 0.9244                               | 0.9244                                  | 0.9244                                  | 0.9244             | 0.9244                   |
| Government Debt as % of GDP       | 1.000                            | -                            | -                                 | 0.9824                       | 0.9244                            | 0.9244                            | 0.9824                        | 0.9728                          | 0.9244                               | 0.9244                                  | 0.9244                                  | 0.9244             | 0.9244                   |
| International Reserve (billion $ US) | 1.000                            | -                            | -                                 | 0.9824                       | 0.9244                            | 0.9244                            | 0.9824                        | 0.9728                          | 0.9244                               | 0.9244                                  | 0.9244                                  | 0.9244             | 0.9244                   |
| Government non-Oil Revenue % of GDP | 1.000                            | -                            | -                                 | 0.9824                       | 0.9244                            | 0.9244                            | 0.9824                        | 0.9728                          | 0.9244                               | 0.9244                                  | 0.9244                                  | 0.9244             | 0.9244                   |
| Government Expenditure % of GDP   | 1.000                            | -                            | -                                 | 0.9824                       | 0.9244                            | 0.9244                            | 0.9824                        | 0.9728                          | 0.9244                               | 0.9244                                  | 0.9244                                  | 0.9244             | 0.9244                   |
| Fiscal Balance on Current Account (billion $ USD) | 0.1894                            | -                            | -                                 | 0.9244                       | 0.9244                            | 0.9244                            | 0.9244                        | 0.9244                          | 0.9244                               | 0.9244                                  | 0.9244                                  | 0.9244             | 0.9244                   |
| Crude Oil Exports (million barrels/day) | 0.5135                           | -                            | -                                 | 0.9244                       | 0.9244                            | 0.9244                            | 0.9244                        | 0.9244                          | 0.9244                               | 0.9244                                  | 0.9244                                  | 0.9244             | 0.9244                   |
| Chemical Exports (thousand barrels/day) | 0.0101                           | -                            | -                                 | 0.9244                       | 0.9244                            | 0.9244                            | 0.9244                        | 0.9244                          | 0.9244                               | 0.9244                                  | 0.9244                                  | 0.9244             | 0.9244                   |
| Gas and Condensates Exports (barrels per day) | 0.1890                           | -                            | -                                 | 0.9244                       | 0.9244                            | 0.9244                            | 0.9244                        | 0.9244                          | 0.9244                               | 0.9244                                  | 0.9244                                  | 0.9244             | 0.9244                   |
| Trade (% of GDP)                  | 0.1890                           | -                            | -                                 | 0.9244                       | 0.9244                            | 0.9244                            | 0.9244                        | 0.9244                          | 0.9244                               | 0.9244                                  | 0.9244                                  | 0.9244             | 0.9244                   |
| Manufacturing (Mfg.) Growth       | 0.1890                           | -                            | -                                 | 0.9244                       | 0.9244                            | 0.9244                            | 0.9244                        | 0.9244                          | 0.9244                               | 0.9244                                  | 0.9244                                  | 0.9244             | 0.9244                   |

### Table 3. Correlation between Human Development Index (HDI) and its Indicators.

| Indicator | HDI | Mortality Rate under/1000 | Mean Years of Schooling | Adult Literacy Rate—15% of Total Population | Long Expectancy | GDP/capita ($ USD) |
|-----------|-----|---------------------------|-------------------------|--------------------------------------------|----------------|------------------|
| Indicators | 1   | 0.9824                    | 0.9728                  | 0.9244                                     | 0.9244         | 0.9244           |
| HDI        | 1   | 0.9824                    | 0.9728                  | 0.9244                                     | 0.9244         | 0.9244           |
| Mortality Rate under/1000 | 1   | 0.9824                    | 0.9728                  | 0.9244                                     | 0.9244         | 0.9244           |
| Maternal Mortality Rate/100,000 | 1   | 0.9824                    | 0.9728                  | 0.9244                                     | 0.9244         | 0.9244           |
| Health Expenditure/capita ($ USD) | 0.9646 | 0.9067                  | -0.8301                  | -0.7748                                    | 0.9441         | 0.9441           |
| Estimated Education Year | 0.9780 | 0.9599                  | -0.9024                  | -0.8474                                    | 0.9441         | 0.9441           |
| Mean Years of Schooling | 0.9936 | 0.9806                  | -0.9442                  | -0.9116                                    | 0.9388         | 0.9388           |
| Adult Literacy Rate—15% of total population | 0.9326 | 0.9647                  | -0.9569                  | -0.9641                                    | 0.8455         | 0.8455           |
| Long Expectancy | 0.9894 | 0.9745                  | -0.9274                  | -0.8949                                    | 0.9543         | 0.9543           |
| GDP/capita ($ USD) | 0.8741 | 0.9013                  | -0.8776                  | -0.8414                                    | 0.8136         | 0.8136           |

### 4.2. Testing Propositions

In this step, all three propositions were tested using multiple regression in attempts to examine the influence of the indicator variables with positive correlations in each step.
4.2.1. Testing Proposition One: The GDP and its Predictor Variables Have Significant Positive Influences on the UAE’s HDI

In testing this proposition, a regression analysis was used, including GDP and its indicator variables, with a positive correlation coefficient calculated in step two (Table 5). While the GDP was the outcome of the entire UAE economy, it was highly correlated with the HDI ($r = 0.9$), which is a universal measure for gauging human development. Considering the relationship between the GDP indicator variables and the HDI, the HDI exhibited a high correlation with trade ($r = 0.95$), chemical exports ($r = 0.88$), international reserves ($r = 0.81$), government oil revenues ($r = 0.81$), non-oil revenues ($r = 0.80$), crude oil exports ($r = 0.70$), gas exports ($r = 0.65$), and the fiscal balance ($r = 0.61$), respectively.
Furthermore, a higher GDP increased the level of investment in education and healthcare, which reduced infant mortality. It increased longevity and literacy as the key aspects inherent in the basic standard of quality in human living. Examining these aspects showed that the correlations were high between the GDP and health expenditures \( r = 0.81 \), the expected years of schooling \( r = 0.86 \), the mean years of schooling \( r = 0.86 \), adult literacy \( r = 0.88 \), and life expectancy \( r = 0.85 \). Therefore, proposition one was accepted in the quantitative analysis.

In regression statistics, where the HDI was considered a dependent variable \( f(x) \) for 29 years (1990 to 2018) and the GDP and its indicator variable were independent variables (Table 6), more than 98% of the variation in the HDI could be explained by variations in the GDP and its indicator variables. With 29 observation years, the standard error of the regression was significantly small.

Table 6. Regression Statistics for Testing Proposition One.

|                | Multiple R | R Square | Adjusted R Square | Standard Error | Observations | ANOVA |
|----------------|------------|----------|-------------------|----------------|--------------|-------|
| Regression     | 0.993626397 | 0.987293417 | 0.98127451 | 0.005734931 | 29           |       |
| Residual       | -          | -        | -                 | -              | -            |       |
| Total          | -          | -        | -                 | -              | 28           |       |
| df            | 9          | 0.048554273 | 0.005394919 | 164.0319959 | 4.41569 × 10^{-16} |
| SS            | 19         | 0.000624899 | 3.28894 × 10^{-5} | -          | -            |
| MS            | 28         | 0.049179172 | -                 | -              | -            |

An examination of the analysis of the variance (Table 6) also showed a statistical significance of 95%. At the same time, the F test (164.032) was high, and the \( p \)-value \( (4.416E-17) \) was below 0.05, which reinforced the acceptance of proposition one.

4.2.2. Testing Proposition Two: The GDP and Its Predictor Variables Have a Significant Positive Influence on the Variability of the EF Measures in the UAE

The quantitative assessment of proposition two measured both the linear direction and the strength of the GDP and its indicator variables (selected in step two) for the EF. Table 7 shows a significantly high negative correlation coefficient between the EF and the GDP \( r = -0.93 \). An examination of the GDP’s predictor variables showed that they all displayed a high negative correlation with the EF, including: crude oil exports \( r = -0.76 \), chemical exports \( r = -0.88 \), trade \( r = -0.96 \), the fiscal balance \( r = -0.71 \), international reserves \( r = -0.82 \), non-oil revenues \( r = -0.60 \), the population \( r = -0.96 \), the percentage of migrants \( r = -0.94 \), the population density \( r = -0.96 \), CO\(_2\) emissions \( r = -0.94 \), and the biocapacity \( r = -0.94 \). In conclusion, as the UAE’s GDP and its indicator variables increased by liquidating its natural resources, the EF increased in a different direction due to the reduction in the country’s biocapacity. Thus, proposition two supports that the UAE, as a bio productive area (whether land, air, or water), has been heavily used to support the economy and the population using the current technology.

The analysis of the regression statistics (Table 8) showed that more than 95% of the variations in the EF could be explained by the GDP and its indicator variables over the 29 years observed. Examining the ANOVA showed that the model was significant, since the F statistics had a \( p \)-value \( = 1.14 \times 10^{-9} \), which was considerably below 0.05, with a 95% confidence level. In this model, all the GDP indicator variables, including crude oil exports, gas exports, chemical exports, trade, government revenues, the fiscal balance, international reserves, and non-oil revenues, were statistically significant.
Table 7. Testing Proposition Two: Cross-Correlation Matrix of Ecological Footprint (EF) and GDP Indicators.

|                   | EF  | GDP/Population | Crude Oil Exports | Chemical Exports | Gas Exports | Trade | Fiscal Balance |
|-------------------|-----|----------------|-------------------|------------------|-------------|-------|----------------|
| EF                | 1   | -              | -                 | -                | -           | -     | -              |
| GDP/Population    | -0.9360 | 1              | -                 | -                | -           | -     | -              |
| Crude Oil Exports| -0.7648 | 0.8475         | 1                 | -                | -           | -     | -              |
| Chemical Exports | -0.8861 | 0.8413         | 0.58269           | 1                | -           | -     | -              |
| Gas Exports      | -0.3850 | 0.5159         | 0.25885           | 0.41371          | 1           | -     | -              |
| Trade            | -0.9632 | 0.9670         | 0.77472           | 0.89792          | 0.44714     | 1     | -              |
| Fiscal Balance   | -0.7138 | 0.6238         | 0.47946           | 0.51235          | 0.36894     | 0.64302 | 1              |
| International Reserve | -0.8282 | 0.9267         | 0.85608           | 0.67548          | 0.42858     | 0.84758 | 0.4984         |
| Non-oil Revenue  | -0.6038 | 0.7462         | 0.64394           | 0.63303          | 0.64481     | 0.67025 | 0.4385         |
| Population       | -0.9626 | 0.9650         | 0.78554           | 0.83851          | 0.48844     | 0.95540 | 0.6993         |
| % of Migrants    | -0.9435 | 0.9652         | 0.78371           | 0.80115          | 0.56537     | 0.94545 | 0.7129         |
| Gas Exports      | -0.3850 | 0.5159         | 0.25885           | 0.41371          | 1           | -     | -              |
| Trade            | -0.9632 | 0.9670         | 0.77472           | 0.89792          | 0.44714     | 1     | -              |
| Fiscal Balance   | -0.7138 | 0.6238         | 0.47946           | 0.51235          | 0.36894     | 0.64302 | 1              |
| International Reserve | -0.8282 | 0.9267         | 0.85608           | 0.67548          | 0.42858     | 0.84758 | 0.4984         |
| Non-oil Revenue  | -0.6038 | 0.7462         | 0.64394           | 0.63303          | 0.64481     | 0.67025 | 0.4385         |
| Population       | -0.9626 | 0.9650         | 0.78554           | 0.83851          | 0.48844     | 0.95540 | 0.6993         |
| % of Migrants    | -0.9435 | 0.9652         | 0.78371           | 0.80115          | 0.56537     | 0.94545 | 0.7129         |
| Populatation Density | -0.9695 | 0.9517         | 0.75569           | 0.88290          | 0.45673     | 0.96409 | 0.6757         |
| Biocapacity      | 0.9415 | -0.9494        | -0.72443          | -0.92672         | -0.53452    | -0.97229 | -0.6594        |
| CO₂ Emission     | -0.9461 | 0.9852         | 0.84174           | 0.82422          | 0.50045     | 0.95674 | 0.6305         |

Since the EF was larger than the biocapacity, the renewable resource accounting resulted in a deficit. Although the national ED has been compensated through trade in exchange for liquidating petroleum assets, increasing trade still puts pressure on the biocapacity. In other words, this shows that the UAE’s ED cannot be compensated through trade. Therefore, proposition two is accepted and the country is poised to exert an enormous influence on its EF by increasing its GDP through the development of non-renewable natural resources. Therefore, this is equal to overshooting the country’s biocapacity.

Table 8. Regression Statistics for Testing Proposition Two.

|                    | Multiple R | R Square | Adjusted R Square | Standard Error | Observations | ANOVA |
|--------------------|------------|----------|-------------------|----------------|--------------|-------|
|                    | 0.987659086 | 0.975420471 | 0.954211545 | 0.418912446 | 29 | - |
| Df                 | 13 | 104.6797544 | 8.052289 | 45.88522 | 1.14369 × 10⁻⁹ | - |
| SS                 | 15 | 2.632314556 | 0.175488 | - | - | - |
| MS                 | 28 | 107.312069 | - | - | - | - |
| F                  | - | - | - | - | - | - |
| Significance F     | - | - | - | - | - | - |

4.2.3. Testing Proposition Three: The HDI and Its Indicator Variables Have Significant Positive Influences on the Variability of Its EF Measures in the UAE

In this test, attention was paid to the impact of human development on the biosphere’s available capacity. Table 9 shows that creating a high level of human wellbeing in the UAE has been accomplished by depleting the country’s ecological resources. The table shows that the HDI had a negative and high influence on the value of the EF (r = -0.96) and the biocapacity (r = -0.89). The correlation between
the HDI and CO\textsubscript{2} emissions (r = 0.92), the population (r = 0.91), population density (r = 0.92), and the percentage of migrants to the total population (r = 0.92) were also significantly high, since recruiting more migrants has resulted in a demand on the country’s natural resources that is higher than its available biocapacity can supply.

In the ANOVA analysis (Table 10), the p-value was significant (F = 4.13 \times 10^{-9}); the HDI and its indicator variables explained more than 95% of the variations in the EF. Studying the ANOVA table reinforced the significance of the relationship between the human development index and the ecological footprint.

Therefore, proposition three was accepted with the conclusion that human welfare in the UAE is critically dependent on the health of its ecological assets.
4.3. Qualitative Data

Qualitative data collection using interviews began by sharing the propositions and asking them to express their own perspectives on the three steps of quantitative data analysis, testing the three propositions, and supporting or refuting the results of the statistical results.

4.3.1. Validation of Statistical Results

All participants agreed that the three indices—GDP, HDI, and EF—were interrelated. They approved that the increase in GDP measures would positively increase HDI because more budgets are injected into the education, health, and wellbeing of UAE nationals. They expressed the fact that both economic growth and human development in UAE have a negative effect on EF due to dependencies on migrant workers and natural resources. Thus, they unanimously refuted that proposition two and three are:

4.3.2. Perspectives on the Three Propositions

Perspectives on Proposition One: The GDP and Its Predictor Variables Have Significant Positive Influences on the HDI in the UAE

All interviewees approved proposition one. They stated that the UAE’s GDP growth had a significant impact on its HDI. Considering human development in UAE relates only to nationals (10% of the total population), the government has dedicated an extensive budget and initiatives to strengthen professional development to create a knowledge-based economy ran by UAE citizens. With education being the key driver, the number of private and public schools is expected to grow in anticipation of a significant increase in enrolment. Accordingly, the allocated federal budget in 2019 was 42.3% to community development, 17% to education, and 7.3% to health care.

Consequently, the adult literacy rate increased from 71.2% in 1990 to 87.5% in 2019, while the average life expectancy surged from 70.5 to 77.4 years over the same period. These improvements were parallel with the growth in GDP per capita, from US $50.70 to US $428 billion and in the HDI from 0.72 to 0.863 over the same period. Thus, proposition one was unanimously supported.

Perspectives on Proposition Two: The GDP and Its Predictor Variables Have a Positive Influence on the Variability of the EF Measures in the UAE

The interviewees refuted proposition two. Participants from Energy and Industry, the Abu Dhabi Environment Agency, and the Ministry of Climate Change and the Environment believed that the UAE’s trend in rapid GDP increase depended on two public and private sectors. Although the sectors are highly diversified, they both remain reliant on petroleum products for their revenues. Thus, relentless exploration, production, and exports of oil, gas, and chemicals that directly link carbon dioxide-produced pollution and the unbridled depletion of the UAE’s biocapacity are inevitable. Additionally, creating a regional strategic trading hub to increase non-oil revenues, leading to an increase in air and marine transportation, contributes to air and water pollution.

These semi-enclosed 600 miles shared by eight coastal nations (Iran, Oman, UAE, Qatar, Bahrain, Saudi, Kuwait, and Iraq) have been contaminated by depleted uranium, pesticides, toxic chemicals, and oil spills during wars; extended drilling and the extraction of petroleum, which is the source of two-thirds of the world’s crude oil and more than 35% of the world’s natural gas; and oil leakage from pipelines and terminals, discard toxic wastes by ships, litter from marine accidents, dumping waste from land-bass sources, and rapid coastal developments, while being exposed to a high rate of evaporation [50,51].

The Persian Gulf, as the main source of water, is constantly being exposed to oil pollution from the UAE’s 34 oil fields, tanker shipments that export from 20 to 30 million barrels of oil per day, oil leakage in pipelines, and from active navigation, cargo ship operations, and marine accidents. The interviewees stated that an average of 100,000 to 160,000 tons of oil and oil products are presently polluting the
Persian Gulf. This is about 48 times greater than the human impact on any other similar body of water on Earth. Moreover, the artificial islands are being developed to open new territories and promote business endeavors; the geographical location, surrounded by deserts and the Persian Gulf, has high temperatures, causing Persian Gulf water evaporation; and the desalination of plants pumps extra salt and minerals into the Persian Gulf water (Kampf and Sadrinasab, 2006). Thus, proposition two is refuted.

Perspectives on Proposition Three: The HDI and Its Indicator Variables Have Positive Influences on the Variability of the EF Measures in the UAE.

This proposition was also rejected by the participants. The interviewees listed four major factors that contribute to the nation’s large EF: (1) the growing migrant population (90% of the population) to fill the skill gap among nationals, reaching 10.5 million in 2020; (2) the deliberate acceleration of economic development depending on energy resources to benefit entitled clientelism; (3) the nationals’ luxurious lifestyles and over-consumption of energy, food, and raw materials, with significant variation across income levels; (4) flowing cascades of cash into sovereign funds. These factors contribute to exceeding the consumption of natural resources at a faster rate than the nation’s ecosystems can recover. Therefore, proposition three is refuted.

5. Summary and Conclusions

With an impressive GDP and highest HDI among the Arab nations in 2019, the UAE’s ED persists and reports that its environmental degradation and the contamination of the Persian Gulf, which is the primary source of the nation’s drinking water, are escalating. This study examined 29 years of data across three spectrums of the GDP, HDI, EF, and their indicator variables to find the root causes of continuous ED. The results of the data analysis revealed that the GDP and its predictor variables have significant positive influences on HDI in the UAE; yet, indicator variables for both GDP and HDI have a significant negative influence on the variability of EF values, leading to continuous ED.

In validating the statistical results and revealing perspectives on the study’s propositions, the participants considered that persistent economic development depending on petroleum revenues, the luxurious lifestyle of the UAE citizens, and the rapid influx of millions of migrants to close the skill gaps are indeed the genesis of the country’s large EF. Given the limited biocapacity and incapability of self-sufficiency, the EF pushes this nation to continuous ED and ecological bankruptcy. Although the formulation and execution of ecological footprint initiatives have been taking place since 2007, the nation is content with mediocrity fostered by the unlimited social welfare, which instigates a false belief of achieving sustainable development.

In conclusion, the risk of pushing the UAE over the brink of ecological bankruptcy has moved beyond its land and territorial water to the Persian Gulf coastal nations, which violates their civil, political, social, economic, and cultural rights recognized by international laws. With a growing regional population and rising human necessities, the Persian Gulf coastal nations must focus on a strategic policy for sustainable development.

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