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Correlating happiness and environmental initiatives at the international level using machine learning

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Abstract

This study investigates the relationship between national happiness levels and environmental protection efforts by comparing the World Happiness Index (WHI), and the Environmental Performance Index (EPI). Analyzing data from 135 countries, regression-based analysis revealed a strong positive correlation between WHI scores and EPI scores, with statistical significance. These results suggest that countries with higher levels of environmental sustainability initiatives tend to report greater citizen happiness. While a direct causal link cannot be established, the findings imply that effective environmental protection correlates with enhanced life satisfaction. The correlation may reflect a shared sense of security and well-being tied to environmental efforts. Further research is needed to explore specific factors within these indices that contribute to this relationship and determine any causal links. This study contributes to the broader understanding of how environmental quality impacts human happiness and underscores the importance of sustainability in enhancing life satisfaction globally.

Keywords: happiness, machine learning, regression models, life satisfaction, environmental protection, sustainability

Introduction

How we view and protect the natural world, particularly in the face of growing evidence of climate change, has become an important issue to citizens globally. Grass-roots efforts and polling have signaled the need for policy changes on both a national and international scale. The *World Happiness Report* performs an annual analysis and ranking of countries with the happiest citizens. In 2020, the focus of its annual research and report was the effect of the quality of the natural environment on the level of life satisfaction of people in different countries (Helliwell et al., 2020).

The Gallup World Poll also surveys subjects regarding their views of the global environment. According to this poll of over 160 countries, 62% of the Gallup respondents said they value the protection of the natural environment more than economic growth. Only half of the respondents felt that their government (and other non-governmental agencies) were doing enough to preserve the environment (Gallup, 2002). In terms of human happiness, the World Population Review has developed the *World Happiness Report,* and the resulting *World Happiness Index*. Since 2002, the World Happiness Index has employed statistical analyses to determine the happiest countries in the world. This process consists of a comprehensive analysis of data that monitor gross domestic product per capita, social support, healthy life expectancy, freedom to make

life choices, generosity of the general population, and perceptions of internal and external corruption levels. Data are gathered and analyzed across 143 countries each year.

Annual data are also gathered regarding the state of the natural environment worldwide. The *Environmental Performance Index* (EPI) offers a data-driven aggregate of the state of sustainability in countries across the globe. Fifty-eight performance indicators in 11 different categories are evaluated and ranked among 180 categories related to climate change mitigation, environmental health, and ecosystem vitality. The data provide a relative comparison of countries and the level to which each country develops sustainable practices and environmental initiatives on a national scale. This aggregate, according to the EPI website, allows for a comparative perspective, which aids in defining environmental progress, with the goal of refining policy choices (Block et al., 2024).

Some prior research has attempted to uncover a correlation between the results of the World Happiness Report and the extent of natural, protected areas. Unfortunately, this research did not determine a significant correlation between happiness and environmental sustainability (Araujo et al., 2022). However, there have been some favorable results regarding a possible connection between environmental sustainability and human happiness. Oxford researchers concluded that progress on United Nation's Sustainable Development Goals (SDG) had a positive correlation with human well-being. The researchers suggested that countries with higher SDG indices have citizens with a higher subjective well-being. The findings of this study suggest that as a country grows richer, the well-being of their citizens appears to level-off, unless additional economic growth occurs. It was further concluded that long-term sustainability efforts had a positive relationship on the well-being of citizens, while short-term initiatives may have a negative correlation (De Neve & Sachs, 2020).

Prior to the current research, a formal comparison between the World Happiness Index (WHI) and the Environmental Performance Index (EPI) has not been conducted. Therefore, the goal of the current research is to compare the two indices to determine if a relationship exists. In more general terms, does a relationship exist between the measured happiness of a country's citizens and the country's level of environmental protection and sustainability? Specifically, the study seeks to answer the following two research questions:

RQ1. *Does a correlation exist between the WHI score and the EPI score among various countries around the world?*
RQ2. *If a correlation exists between WHI and EPI among the various countries, is that correlation statistically significant?*

Literature Review

The connection between the natural environment and happiness is not new. Considerable research has been published in recent years on the relationship between experiences in natural areas and the well-being of humans. A catalyst for this has been the increase in available datasets that capture impactful data. One particular study determined that participants were significantly happier in natural areas than they were in urban environments (MacKerron & Mourato, 2013). Another similar study found that access to "green space" in urban areas is positively associated with life satisfaction, while access to wasteland or abandoned areas is negatively associated (Krekel et al., 2016). "Green space" in this context would be parks or other outdoor community space designed for meeting and recreation.

In a 2017 cognitive study, researchers found a significant positive association between forest areas and the amygdala integrity in the brain. In humans, the amygdala is a major processing center for emotions. The

researchers of this study concluded that forests, in particular, have a positive impact on the promotion and maintenance of well-being. The researchers in this study also suggest that those individuals with higher levels of amygdala structural integrity choose to live in proximity to forested areas (Kuhn et al., 2017).

Most of the prior research on the relationship between exposure to the natural environment has focused on the effects on well-being in humans. However, there has also been research into how increased sustainability and environmentally proactiveness may be related to higher levels of well-being (Helliwell et al., 2020). The World Happiness Report initially looked at how the natural environment impacts human happiness on the international level. For example, the Report explored the differences that exist between the value a country places on its natural areas and its environmental quality, and the level of well-being in its citizenry. However, the World Happiness Report (and other similar reports) have failed to examine the connection between happiness and human perspectives on the natural world. If there is a connection, how can it be explained? Wilson (1984) proposed that humans, as part of the biosphere, are naturally connected to other organisms in an evolutionary link that forges an inescapable relationship. Our human evolutionary past and our ancient status are intertwined with other living ecosystems and species. When humans return to, or embrace natural areas, we experience a profound sense of returning. This sense of returning to the natural world has a direct and constructive impact on our happiness.

Even though the connection between humans and the natural environment has not been well defined, a number of studies have suggested that experiences in natural areas lead to improvements in human well-being. These studies propose that natural areas may be the catalysts for human behaviors that are known to improve mental and physical health. Examples of such human behaviors include exercise and socialization. The authors of these studies propose that if natural areas can encourage exercise and socialization in humans, then human happiness will ultimately be fostered (Guite et al., 2006; O'Campo et al., 2009; Annerstedt et al., 2012). A 2021 study demonstrated that the availability of public, open space can improve mental health, physical health, and overall longevity. Also, natural areas have less pollution of all types (chemical, air, noise, etc.) that are linked to respiratory disease and stress, and fear or apprehension. According to one study, a marked improvement in these factors leads to an overall increase in human happiness (Kwon et al., 2021).

A few prior studies have attempted to correlate human happiness to the amount of time spent in natural environments. In these studies, regression analysis was performed to determine any possible relationship between human happiness and accessibility to natural areas. In one study, no significant correlation was observed between self-reported life satisfaction and per-capita area of natural forest (Helliwell et al., 2020).

Methodology

The objective of this current study is to determine if a relationship exists between the World Happiness Index (WHI) of a country and the Environmental Performance Index (EPI) of a country. Statistical analysis, specifically regression analysis, was used to determine what, if any, relationship exists between these two indices. Since these indices exist at the granular level, the aggregation of data on a mathematical basis was necessary to derive the index. The indices were then generated, based on a solid mathematical derivation from the raw data, and therefore, represent a high-level interpretation of a broad spectrum of relevant data. The dataset for the current study consisted of WHI scores and EPI scores for 135 countries. The indices were then combined, and matched country to country. It should be noted that the WHI and EPI datasets each contained scores for more than 135 countries. However, the 135 countries referenced in the current study are the countries that were common to both indices. Simple regression analysis was run on the 135 records in the dataset using the linear model, lm() function, in R/RStudio. The Ordinary Least Squares

assumptions were evaluated. During evaluation, it was found that the residual variance was non-constant across the observations. A weighted least squares analysis was then performed with the results showing no indication of any violation of the Ordinary Least Squares assumptions.

Results

In order to answer the first research question, "Does a correlation exist between the WHI score and the EPI score, among various countries around the world?," regression analysis was performed. Regression was run on the dataset to compare the World Happiness Index (WHI) to the Environmental Protection Index (EPI) for the 135 countries included in the study. This comparison was made with the objective of determining if a relationship exists between WHI and EPI. The correlation coefficient for the variables was 0.54, which indicates a fairly strong, positive correlation between the two variables. The regression statistics are shown in Table 1. In order to address the second research question, "If a positive correlation exists between WHI and EPI among various countries, is that correlation statistically significant?," the statistical significance of the F statistic was determined. The p-value of $2.2 * 10^{-16}$ is far below a level of significance of 0.001, which indicates very strong support for the statistically significant correlation. Figure 1 shows a clear visualization of a strong positive correlation between the Happiness Index and the Environmental Protection Index.

Table 1. Regression Statistics

Coefficients:	Estimate Std.	Error	t value	Pr (>|t|)
Intercept	2.574451	0.280882	9.166	7.96e-16 ***
EPI (2024)	0.062306	0.004988	12.490	< 2e-16 ***

Sig. Codes: 0 = '***', 0.001 = '**', 0.01 = '*', 0.05 = '.', 1
Residual standard error: 1.267 on 133 degrees of freedom
Multiple R-squared: 0.5398, Adjusted R-squared: 0.5363
F-statistic: 156 on 1 and 133 DF, p-value: < 2.2e-16

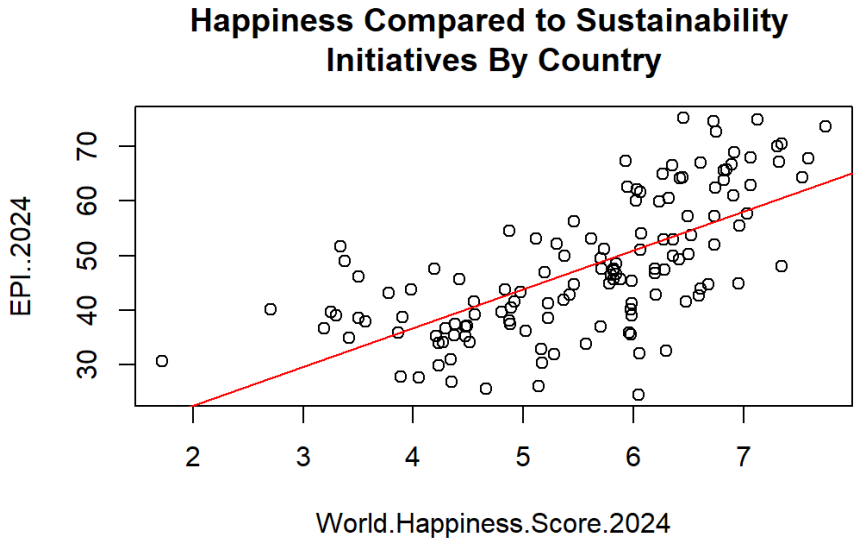

Figure 1. Happiness Compared to Sustainability Initiatives by Country

Discussion and Conclusion

The results of the current study indicate that a positive, statistically significant correlation exists between the level of life satisfaction in a particular country and the level of initiatives present to protect the environment (or other sustainability efforts). More specifically, these results indicate that there is a positive correlation between the World Happiness Index (WHI) score of a particular country and the Environmental Protection Index (EPI) score of the same country. While there cannot be a direct causality implied between the two indices, these results indicate that those countries that (collectively as a citizenry or via elected officials) undertake environmental protection initiatives, generally have a higher reported happiness score.

Obviously, there are other factors contributing to the life satisfaction and happiness of individuals in a specific country that go beyond environmental protection efforts. Happiness has been documented to be potentially related to a number of factors. However, the current research focused exclusively on the two variables in this study (i.e., WHI and EPI).

It cannot be conclusively determined why this correlation between WHI and EPI exists. The correlation may exist because controlling and securing resources for the common good creates a sense of happiness and life satisfaction among a country's citizens. Trust has been well documented as an influence on the general happiness of a population (Bjørnskov, 2022; 2024). The collective trust by the citizenry that all people (including the government) are contributing to protecting natural resources and supporting sustainability efforts may be an underlying factor. The correlation may simply exist because humans are (and always have been) an inseparable part of the natural world, and therefore, the feeling or belief that there are collective efforts to preserve it brings a sense of security, and consequently, well-being.

Clearly, further research is necessary to determine any existing causality between these two indices. Further research would also be necessary to determine if there are specific data within the indices that may shed further light on the relationship between the variables. Future research may drill deeper into specific data, factors and variables that comprise and impact both indices in this analysis. Insight from the results of a finer perspective may offer clues to the causal relationship between happiness and efforts to improve natural environmental conditions on the planet. In the interim, it may be suggested that, in general, those living in countries and regions where a preference is given to environmental sustainability initiatives, have greater life satisfaction.

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