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Determinants of Life Satisfaction and Happiness: Empirical Evidence from an Emerging Economy

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Abstract

This study aims to highlight the determinants of life satisfaction and happiness in an emerging economy characterized by a poor air quality index. In Pakistan lifestyle, pleasure, and happiness tendencies constantly accelerated after 2000. Based on existing literature this study focused on testing the effect of carbon emission, business density, fossil fuel energy consumption, renewable energy consumption, innovation and development, social contribution, and economic development on the life satisfaction and happiness of people living in Pakistan. The data for the selected variables were retrieved from the World Happiness Report 2020 and the online database of the World Bank from 2000 to 2020. The results of the LASSO version of regression revealed that social contribution, innovation and development, and business density index have significant effects on life satisfaction and happiness. Whereas life satisfaction and happiness are negatively influenced by carbon emission, fossil fuel consumption, renewable energy consumption, and economic development. This research has the potential to benefit all contributors to society because it offers deep insights into how green technology develops. The insights generated from these studies can tell policies geared toward reducing environmental harm and improving social welfare.

Keywords: *economic development, carbon emission, innovations, quality of life, emerging economy*

INTRODUCTION

According to most studies, life satisfaction is more complex than happiness. Nonetheless, the term is frequently used interchangeably with happiness or well-being. Most people define life satisfaction as an assessment of one's life. As a result, it is more than just one's current state of happiness. Happiness, according to research, is more of an immediate, in-the-moment experience; although enjoyable, it is ultimately fleeting (Helliwell et al., 2017). As a result, while a healthy existence undoubtedly contains periods of enjoyment, happiness by itself does not always guarantee a happy and satisfied life (Argan et al., 2018). According to research, life satisfaction is more stable and long-lived than happiness and has a greater reach (Valente & Berry, 2016). Life satisfaction typically represents our overall attitude toward our lives and how pleased we are with how things are going (Bieda et al., 2019). According to research, numerous elements contribute to life satisfaction. Work, relationships, ties with family and friends, personal development, health, and other aspects are examples of such areas (Becchetti & Conzo, 2022). According to this line of thinking, a person's income level about their expectations rather than their total income determines how satisfied they are with their lives. When change is quick, many people

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experience income increases that are better than anticipated, which raises life satisfaction (Wijaya et al., 2021).

The current study focuses on the determinants of life satisfaction and pleasure in a growing economy, with a special emphasis on Pakistan. While the terms life satisfaction, happiness, and wellness are frequently used interchangeably in the literature, the study aims to distinguish their subtle differences and determine which feature is more relevant in the Pakistani setting. The importance of researching life satisfaction and happiness stems from their ability to serve as significant markers of a country's economic and social outlook. Increased levels of life satisfaction and happiness not only reflect individual well-being, but also correspond with societal prosperity and stability. Positive indicators like these are critical for promoting social cohesiveness, productivity, and innovation.

The study dives into the function and importance of these characteristics in the fields of economic and business administration, managerial practices, and the larger policy framework, examining the economic and social ramifications of life satisfaction and pleasure (Becchetti & Pelloni, 2013). It recognizes that happy and fulfilled people are often more productive, healthier, and contribute positively to societal harmony. The study anticipated differences in happiness indices when comparing underdeveloped and developed countries, with developed nations often scoring higher due to greater living circumstances (Araki, 2023). It acknowledges the difficulties that emerging countries experience, such as poverty and political instability, which may have an impact on the overall well-being of their citizens (Argan et al., 2018).

The study supports for holistic methods that include social programs targeting poverty, education, and healthcare, as well as workplace initiatives targeted at establishing pleasant and supportive environments, while investigating measurements and efforts to promote life satisfaction and happiness (Sujarwoto et al., 2018). Previous research has revealed many variables of life satisfaction and happiness, including social relationships, economic stability, and access to health and education. Recognizing a research need in the context of emerging economies, notably Pakistan, the study aims to add to the current body of knowledge by giving insights into the unique problems and dynamics that occur in such regions (Jovanović & Joshanloo, 2019). The study's goal is to provide personalized answers to specific questions about the factors of life satisfaction and happiness in Pakistan.

With record levels of global warming, climate change has become one of the most important challenges in the modern world. Climate change is commonly linked to industrialization and economic activity. Green innovations give a key stimulus for productivity growth while maintaining macroeconomic factors developing at the same time (Huong et al., 2021). Another component of green innovation is information spillover, which encourages horizontal spread and adoption of green technologies around the world, allowing for coordinated efforts aimed at mitigating environmental damage (Sun & Sun, 2021). External environment architecture is critical in motivating businesses to pursue green innovation with zeal. Enterprises are not immune to societal realities, as attempts are being made to guarantee that corporations exclusively pursue green innovation in a sustainable manner (Tolliver et al., 2021).

According to research conducted in Pakistan, there is a substantial association of family factors (such as income, consumption, housing) and environmental issues (such as air pollution) with happiness in Pakistan. As the air pollution index is climbing day by day and cases of sickness due to depression are increasing (Rafique et al., 2022). The relevance of fair education, expectations for everyday conveniences, and government management in addressing issues impacting overall well-being and mental well-being. Future well-being initiatives should prioritize the elderly and give financial medical care, as in Western and European countries (Oyebanji & Kirikkaleli, 2023).

The impact of energy consumption, industrial emissions, economic progress, and social contribution on life satisfaction and happiness is discussed in this section. These factors are defined differently by each researcher (Razzaq et al., 2021). The data is derived from the advancement of green technologies. Life satisfaction is a dependent variable in this article, while business density rate and GDP growth are independent factors. This section describes the contribution to existing literature (Majeed & Mumtaz, 2017).

The study adopts a comprehensive methodology, combining surveys and interviews to acquire essential data. To generate relevant insights from the collected data, statistical methods such as regression and

factor analysis are used. The expected findings and their significance stem from their ability to provide managerial insights for improving employee satisfaction, policy recommendations for the Pakistani government, and academic contributions by expanding our understanding of life satisfaction and happiness dynamics in emerging economies. The paper's structure follows a natural evolution, beginning with an introduction and literature review and progressing to a detailed methodology, results, discussion, and conclusion that summarizes major findings and proposes future study options.

LITERATURE REVIEW

Effect of carbon emissions on life satisfaction and happiness

The effect of carbon emissions on life satisfaction and pleasure is inextricably linked to psychological theories dealing with environmental stress and well-being. Folkman (1984) Transactional Model of Stress and Coping provides a theoretical framework for understanding how humans appraise and cope with environmental stressors such as those connected with carbon emissions. This concept proposes that the perception of a stressor, such as climate change caused by carbon emissions, can elicit emotional and psychological responses (Folkman et al., 1986). Chronic worry, anxiety, and a sense of powerlessness may result from heightened awareness of the repercussions of carbon emissions, such as catastrophic weather events and environmental destruction. These emotional responses are likely to contribute to lower levels of life satisfaction and happiness (Folkman, 1997).

Being happy is a crucial value. It is even the highest value according to some beliefs. For instance, the Scottish school of "utilitarian" thought in the 19th century held that every action should evaluate morally according to how it affects "the greatest happiness for the greatest number." The policy objective of contemporary Bhutan is to promote Gross National Happiness (Vita et al., 2020). Understanding happiness, mainly what it is and how to increase it, is necessary for putting this idea into practice. People react to events, but over time, they eventually revert to earlier levels of happiness and satisfaction, according to set-point theories of subjective well-being (Apergis & Majeed, 2021).

The most popular and accurate metric used in studies on people's happiness is life satisfaction, a cognitive judgment of a person's living status (Majeed & Mumtaz, 2017). According to the "happiness paradox," the theoretical underpinning for studies relating to happiness and well-being, having more money does not necessarily translate into having more satisfaction (Salahodjaev et al., 2021).

Studies suggest that fossil fuel byproducts can negatively impact life satisfaction by increasing illnesses, pollution, and global temperature rise, while also causing anxiety about climate change (Welsch, 2006). However, some scholars argue that there is no direct connection between these emissions and life satisfaction (Thormann et al., 2022).

Effect of economic development on life satisfaction and happiness

The link between economic progress and life satisfaction/happiness has been a focus of the literature, with ideas such as the Easterlin Paradox frequently used to study it. The Easterlin Paradox, proposed by Easterlin (1974), contends that, while people with higher earnings tend to report higher levels of life satisfaction within a country, a society's total happiness does not inevitably improve with economic progress over time. This paradox calls into question the widely held belief that continuing economic expansion leads to an inexorable increase in well-being (Easterlin, 1974).

Are economic growth and happiness positively correlated? This subject is usually addressed using the point-in-time bivariate relationship between happiness and real GDP per capita (Selim, 2008). The mean values of these two variables for each of a wide range of countries at a certain period are the key data used in this relationship (Contu et al., 2021). A growing number of financial experts who have investigated the relationship between money and indicators of emotional well-being believe that compensation makes little difference to life fulfillment. They imply that additional installment benefits on our contentment are quite insignificant (Kumari et al., 2021).

Using GDP to measure lifestyle quality and environmental impacts reinforces concerns about a dichotomy between development and sustainability. To maintain the political viability of sustainable development, these goals must be separated both rhetorically and conceptually (Boo et al., 2016). The most plausible beginning of an explanation mentions economic progress inside a country because it is

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obviously linked to psychological changes that conveniently affect people's happiness (Vintilă, 2021). Many studies of different countries show that happiness varies widely. Furthermore, economic advancement and happiness are inextricably linked: After reviewing data from 24 countries with varying levels of economic growth (Inglehart, 2017).

Effect of social contribution on life satisfaction and happiness

The impact of social contribution on life satisfaction and happiness has been extensively researched within the context of numerous psychological and sociological theories, with a focus on the Social Identity Theory (Tajfel et al., 1979). Tajfel et al. (1979) established Social Identity Theory, which claims that individuals gain a sense of self and belonging from their group memberships and social roles. Volunteering or doing community service, for example, strengthens one's social identity and promotes a sense of purpose and connection. Based on this notion, research has found a link between active social involvement and higher levels of life satisfaction and happiness (Turner et al., 1979).

The key factors for the poor income-happiness relationship include societal comparisons, which render average increases ineffectual, and an individual's ability to adapt to changing circumstances. These characteristics suggest that the simple policy conclusion drawn from individual-level research – that an increase in average wages would make people happier – is unlikely to have an influence on overall happiness (Vinson & Ericson, 2014). Because people frequently adjust relatively rapidly to a greater quality of life and the level of social comparisons remains constant, the degree of pleasure becomes insignificant at the macro level because it does not alter (Rohrer et al., 2018). A similar paradox may occur in the relationship between happiness and health (Olivos et al., 2021). Adapting to a longer projected lifespan may obstruct feedback from objective health to happiness (Lutz et al., 2021). Many additional studies using other research methods, such as the bigger cross-sectional data given as an example, provide further evidence of a causal relationship (Nordheim & Martinussen, 2020). One of the most convincing discoveries in happiness research is that, while wealthier individuals are happier than less fortunate people, the significant association between money and happiness does not hold across countries and time spans (Easterlin, 2005). Happiness and the belief that one has free will and control over one's life appear to be closely linked, and this link appears to be widespread (Wolfe & Patel, 2018). People's sense of freedom is associated with happiness in all major civilizations (Welzel & Inglehart, 2005). In many civilizations, people value their freedom of choice just as much as they cherish their economic security (Inglehart et al., 2008).

Effect of industrial emission on life satisfaction and happiness

Environmental Justice Theory emphasizes the unequal distribution of environmental liabilities, implying that vulnerable groups frequently bear a disproportionate amount of the detrimental impacts of industrial pollutants (Schlosberg & Collins, 2014). Studies based on these theories consistently show a negative relationship between proximity to industrial emissions and overall well-being, highlighting the importance of sustainable industrial practices and effective pollution control measures to mitigate the negative impact on the life satisfaction and happiness of affected populations (Figueroa, 2022).

Some ideas tie happiness to the environment of our study. One of the earliest publications describes the "biophilia hypothesis," which establishes the link between happiness and surroundings (MacKerron & Mourato, 2009). According to the biophilia theory, those who spend more time in nature experience better mental and physical health (Godovykh et al., 2021). This attraction's inspiration came from the history of humankind when people lived in the wild for a very long time. Cozzarelli et al.(2017) study support the biophilia theory. It demonstrates how living in a beautiful, green community helps create a happy society. Environmental factors like urban planning significantly impact people's levels of life satisfaction (Steckermeier, 2021). Environmental deterioration is the main worry in the happiness-environment nexus. According to numerous types of research, ecological deterioration severely threatens people's happiness and health (Orru et al., 2016). According to a World Health Organization report, air pollution contributes to nearly 8 million fatalities (Easterlin et al., 2021). s

This chapter illustrates the background of the study and hypothesis development. This chapter shows the positive impact of economic growth on life satisfaction and happiness and the effect of the business density rate on life satisfaction and happiness. Many researchers find a positive relationship between

economic growth, social contribution, carbon emission, and industrial emission on life satisfaction and happiness. The literature supports the hypothesis development.

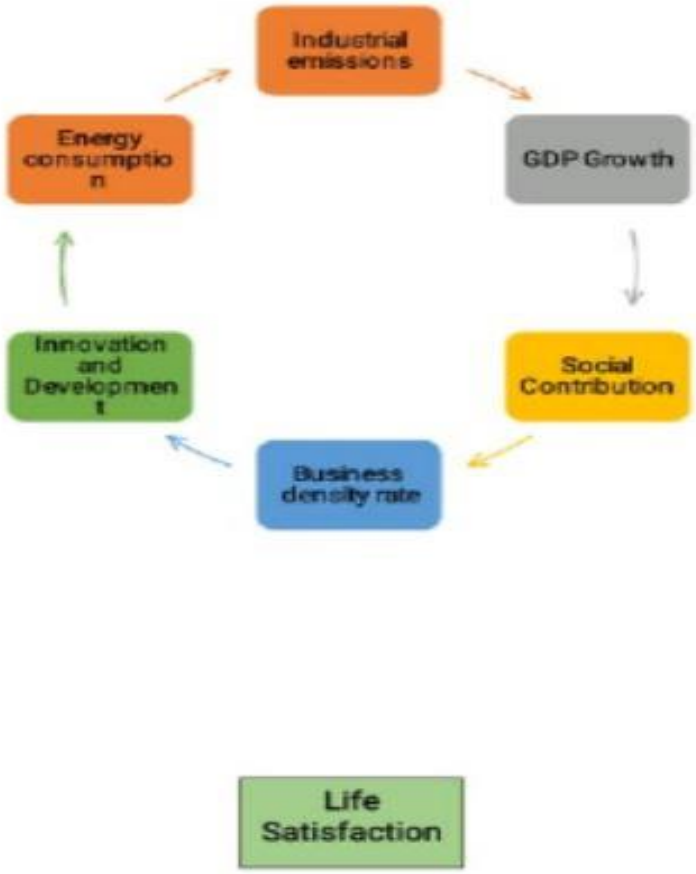

Figure 1. Conceptual framework

MATERIAL AND METHODS

Data and Its Sources

The World Happiness Report 2020 and the World Bank (WB) data portal were used to collect data for this study. The World Bank's data portal makes data available to the general public for free and without restriction. The World Systems section of the WB collects data that is made available to the public, and new datasets are added on a regular basis. One of the most tempting features is that they offer this as a free service, allowing customers to use it without restrictions (Zhongming et al., 2020). Other parts detail how the data was compiled, gathered, and arranged, among other things. The World Bank's website has a plethora of statistical data on a wide range of topics, including human development, health, and environmental challenges. The numerous country profiles on this page contain socioeconomic data such as total population, population density, literacy rates, life expectancy at birth, and primary school enrollment (Diaz, 1998). It also provides international comparisons of several additional variables. Table 1 summarizes the data collecting procedures used to determine LSH. From 2000 to 2021, highly recognized surveys such as the World Happiness Report, which incorporates subjective well-being ratings on a worldwide scale, permitted a comprehensive examination of life satisfaction and happiness (LSH). At the same time, GDP growth (GDPG), a major economic indicator, has been intensively researched, with annual measures providing insights into a country's economic performance (Lambert et al., 2022). As societies around the world battled with the requirement of sustainable development, the concept of social contribution (SC) became more important (Mert, 2022). Although fundamentally subjective, metrics like as volunteerism rates, charity contributions, and involvement in social programs have been used to assess social impact (Iram et al., 2020). The study's environmental components

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include a look at CO2 emissions from the industrial sector (CO2) and renewable energy usage (REC). Environmental agencies and studies have provided data on CO2 emissions, illustrating the changing influence of industrial activity on the environment (Scott & Gössling, 2021). Renewable energy consumption, on the other hand, has been a focus point in the transition to sustainable practices, with the International Energy Agency offering significant statistics and insights into worldwide trends (Hattori et al., 2022).

The innovative and Development Index (IDI) has been useful in assessing a country's innovative capabilities and overall development in the field of innovation and development (Onyshchenko et al., 2022). Organizations such as the World Intellectual Property Organization (WIPO) have made contributions to this field by providing detailed assessments of worldwide innovation trends (Ragavan & Deswal, 2023). The number of enterprises per unit of population or land area is used to calculate the business density rate (BDR), which is a metric indicating entrepreneurial activity and economic vigor. National statistics agencies have played a critical role in collecting and publishing data on business density, which has provided insights into economic dynamics (Carlsen, 2021). The analysis includes a dimension of fossil fuel energy consumption (FFEC), which reflects the worldwide energy landscape. National energy consumption statistics and databases, such as the BP Statistical Review, provide useful information about the trends and patterns of fossil fuel consumption (Dale, 2021).The study's focus on the period between 2000 and 2021 is justified by increased data availability, technological advancements that allow for more comprehensive analyses, and the implementation of notable policy frameworks aimed at sustainable development, renewable energy promotion, and environmental protection in various nations around the world (WBG & IMF, 2021). The changing landscape of these factors highlights the dynamic interplay between individual well-being, economic performance, environmental sustainability, and innovation throughout the timeframe indicated (Carlsen, 2021). The study provides a solid foundation for comprehending the nuanced interactions between these variables during the last two decades because it is built on recognized literature and reputable data sources.

Table 1. **Determinants of Quality of Life**

Sr. No.	Variables	Dependent/ Independent (DV/IV)	Data Range	Source	Data Mode
1	Life satisfaction and happiness (LSH)	DV	2000-2021	World Bank Happiness Index (WBHI)	Yearly
2	GDP growth (GDPG)	IV	2000-2021	World Bank (WB)	Yearly
3	Social contribution (SC)	IV	2000-2021	World Bank (WB)	Yearly
4	CO2 emissions from industrial sector (CO2)	IV	2000-2021	World Bank (WB)	Yearly
5	Renewable energy consumption (REC)	IV	2000-2021	World Bank (WB)	Yearly
6	Innovation and development index (IDI)	IV	2000-2021	World Bank (WB)	Yearly
7	Business density rate (BDR)	IV	2005-2020	World Bank (WB)	Yearly
8	Fossil fuel energy consumption (FFEC)	IV	2005-2020	World Bank (WB)	Yearly

METHODOLOGY

A time series plot is a graphical depiction of data points in sequential order that reveals patterns, trends, and variations across time. This analysis entails charting the data against time to discover any temporal patterns, which aids in the identification of trends, seasonality, and anomalies. The correlation coefficient is used to quantify the strength and direction of linear correlations between two variables. It can be used to determine the degree of relationship between variables. Least Absolute Shrinkage and Selection Operator (LASSO) Regression is a statistical method that incorporates variable selection by penalizing the absolute size of regression coefficients, allowing the most influential predictors to be identified. Variable Importance with LASSO ranks variables further by evaluating their contribution to forecast accuracy. These strategies are especially useful in predictive modeling and feature selection, as they ensure a lean model that maintains important information while avoiding over fitting. The utility of each study is determined by the context and research objectives, with time series plots providing visual insights, correlation analysis revealing relationships, and LASSO approaches assisting in model refining. Benchmarks or threshold values are frequently context-specific and defined depending on the analysis's aims or established industry norms.

Time series plot

A time series plot can be used to represent data that changes over time. The time series graph is excellent for analyzing large data sequences (Boniol & Palpanas, 2020). The human brain's ability to assimilate such huge amounts of data, discover patterns within the data (such as sinusoids, spikes, and the beginning of a trend), and then filter out the noise is astonishing. On the temporal axis, it depicts a narrative. The graph formed by the dots depicted helps us to search for patterns in the data (Blázquez-García et al., 2021).

The time series graphic has a wide range of statistical applications. It can be difficult to discern any trend or pattern when the same component's values are given over a longer period of time. Certain functions, on the other hand, appear quickly when the same data points are visually shown. Trends can be identified using time series visualizations (Souza, 2001). These designs are significant because they have the potential to be realized in the future.

Statistical Summary

Statistical summary is critical for data analysis because it provides a thorough picture of the data's central tendency, variability, range, skewness, and other significant feature (Piazza et al., 2013). A statistical summary is essential for choosing relevant statistical tests for data analysis, allowing for informed decisions and a comprehensive comprehension of the data prior to further research (Prangle, 2018).

Correlation analysis

Correlation coefficients between sets of variables can be displayed using a matrix. Each random variable (Xi) (Xj) corresponds to one of the remaining integers in the Table. Looking closely, one may discover which combinations are the most tightly associated. In this matrix, each diagonal element is a 1. When the units of measurement differ or the standard deviations of the variables are large, a correlation matrix is used (Sheng et al., 2019). Correlation analysis is a series of processes for determining the degree of link between two variables. A correlation analysis' principal purpose is to discover the similarity between two variables. By evaluating the correlation coefficient of two variables, researchers can discover how strongly they are related linearly (Gauthier et al., 2020). The Pearson correlation coefficient is used to evaluate the strength of a linear relationship between two variables, with r = 1 representing a perfect positive correlation and r = -1 representing a perfect negative correlation Eq. 1

$$R = \frac{\Sigma(xy) - (\Sigma x)(\Sigma y)/n}{\sqrt{\Sigma x^2 - (\Sigma x)^2/n)(\Sigma y^2 - (\Sigma y)^2/n)}} \text{---------- Eq.1}$$

In the preceding equation, n represents the sample size, and x and y represent individual sample points.

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Least Absolute Shrinkage and Selection Operator (LASSO) Regression

The Least Absolute Shrinkage and Selection Operator (LASSO) is a regularized linear regression approach for identifying predictors that contribute to a target variable and performing feature selection by setting specific coefficients to zero. This strategy supports parsimony by lowering model complexity by downsizing some coefficients to zero. LASSO, unlike other regularization methods, employs an absolute value penalty component in its cost function, which reduces the size of the coefficients to zero. LASSO is widely utilized in a variety of applications, including the prediction of economic and financial time series, the accuracy of machine learning models, and the investigation of gene-disease correlations. It describes the individual effects and importance of variables in the context of all others, highlighting crucial predictors. LASSO is utilized in linear and logistic regression and comes in two varieties: standard lasso regression with an intercept and grouped lasso regression without an intercept. Grouped LASSO can be used to group subjects based on shared traits, whereas frequentist inference can be utilized for independent observations obtained from the same population. The fundamental equation is as follows:

$$\sum_{i=1}^{n}\left(y_i-\sum_{j}x_{ij}\beta_j\right)^2+\lambda\sum_{j=1}^{p}\left|\beta_j\right|----Eq.2$$

The regression model makes the sum of squared distances less extreme while ensuring that the Beta that represents the mean are equal to zero. A tuning parameter, lambda, governs how strong the L1 regularization penalty will be. Essentially, lambda represents the amount of shrinkage.

- For every parameter eliminated, lambda gets one step closer to zero.
- The more lambda is, the more the coefficients become zero.
- At an arbitrarily large value of lambda, all coefficients vanish.
- The more lambda is reduced, the higher the variance will be.

Variable Importance with LASSO

The Lasso algorithm is a statistical method that uses a penalty term to identify important variables in a dataset. It multiplies the absolute value of each feature's coefficients, reducing unimportant coefficients and keeping important ones close to their original values. This helps in decision-making, allocating resources, and developing more interpretable models for non-technical audiences(Hesamian & Akbari, 2019; Ni et al., 2020).

RESULTS

Life satisfaction and Happiness (LSH)

Figure 2 displays Pakistan's life satisfaction and happiness (LSH) developments since 2000. LSH increased after 2006, however there were several ups and downs in LSH patterns from 2010 to 2020.Life satisfaction and happiness trends continuing to climb after 2019 and will continue to rise even into 2021, according to the 2020 World Happiness Report. Various criteria, including economic, social, environmental, and educational indices, are used to determine life satisfaction and happiness in any country, according to the research (Helliwell et al., 2020; Xu, 2021). For the indicator study, data for Pakistan are provided from 2005 to 2020. From 2000 to 2021, Pakistan's average value was 5.02 points, with a low of 4.41 points in 2000 and a high of 5.87 points in 2021. In 2021, the most recent value was 5.87, putting it #94 globally that year. According to data from 141 nations, the global average in 2022 is anticipated to be 5.97 points (Mishra & Dash, 2019; Xu, 2021).

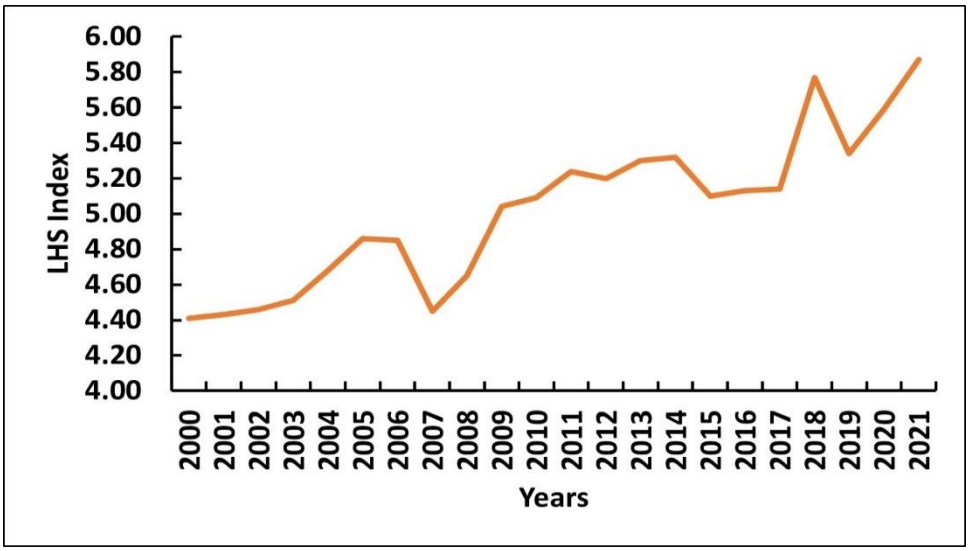

Figure 2. Life satisfaction and happiness (LSH) trends in Pakistan since 2000

Statistical summary

Summary statistics summarize data by delivering as much information as possible with as little effort as possible. Box plots are often used, and they can be 5- or 7-number summaries. The dependent variable (LSH) and independent factors are shown in Table 2, with a maximum value of 5.87 and a mean value of 5.02

Table 2 The dependent variable (LSH) and independent factors are statistically summarized.

	Variables							
Statistics	LSH	SC	GDPG	FFEC	REC	CO2	BDR	IDI
Mean	5.02	30.42	8.67	86.01	16.32	31.29	5.07	46.03
SD	0.43	3.22	2.49	2.61	5.73	1.75	2.56	5.52
Kurtosis	-0.69	1.03	1.68	1.11	0.76	-0.23	-1.58	2.29
Skewness	0.20	1.28	-0.12	-1.42	1.42	-0.33	0.59	-0.62
Minimum	4.41	26.25	2.24	79.84	11.34	27.72	2.25	30.00
Maximum	5.87	37.86	14.23	88.90	29.63	34.34	9.08	54.80

Note: Life satisfaction and happiness (LSH); CO2 emissions from industrial sector (CO2); GDP growth (GDPG); Social contribution (SC); Fossil fuel energy consumption (FFEC); Innovation and development (IDI); Business density rate (BDR); Renewable energy consumption (REC).

Correlation matrix

Table 3 lists the correlation coefficients by their respective values. According to Table3, SC has the highest coefficient correlation value with LSH, with a correlation coefficient value of 0.82, followed by BDR with a positive coefficient value of 0.79 and REC (-0.69). The coefficient with the lowest value is -0.18, which is connected with CO2.

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Table 3. Correlation of selective variables which shows positive/negative association among each other

	LSH	SC	GDPG	FFEC	REC	CO2	BDR	IDI
LSH	1							
SC	0.82	1						
GDPG	-0.59	-0.54	1					
FFEC	-0.57	0.37	0.01	1				
REC	-0.69	-0.51	0.16	-0.69	1			
CO2	-0.18	0.07	0.31	0.66	-0.68	1		
BDR	0.78	0.69	-0.68	0.34	-0.51	-0.05	1	
IDI	0.39	0.42	-0.03	0.27	-0.34	0.09	0.51	1

Note: Life satisfaction and happiness (LSH); CO2 emissions from industrial sector (CO2); GDP growth (GDPG); Social contribution (SC); Fossil fuel energy consumption (FFEC); Innovation and development (IDI); Business density rate (BDR); Renewable energy consumption (REC).

LASSO Regression

We used R programming to evaluate LHS trends since 2000 for this project. The response variable was LHS, while the predictors were SC, GDPG, FFEC, CO2, BDR, IDI, and REC. We used methods from the 'glmnet' package to do lasso regression. This package requires a vector as the response variable and a data matrix as the set of predictor variables. Following that, we used the glmnet() method to fit the lasso regression model with alpha=1. To choose which lambda value to utilize, we used k-fold cross-validation to get the lambda value with the lowest test mean squared error (MSE). The function cv.glmnet () conducts k-fold cross validation with k = 10 folds automatically. The lambda value that minimizes the test MSE is 0.0048 (see Figure 3).

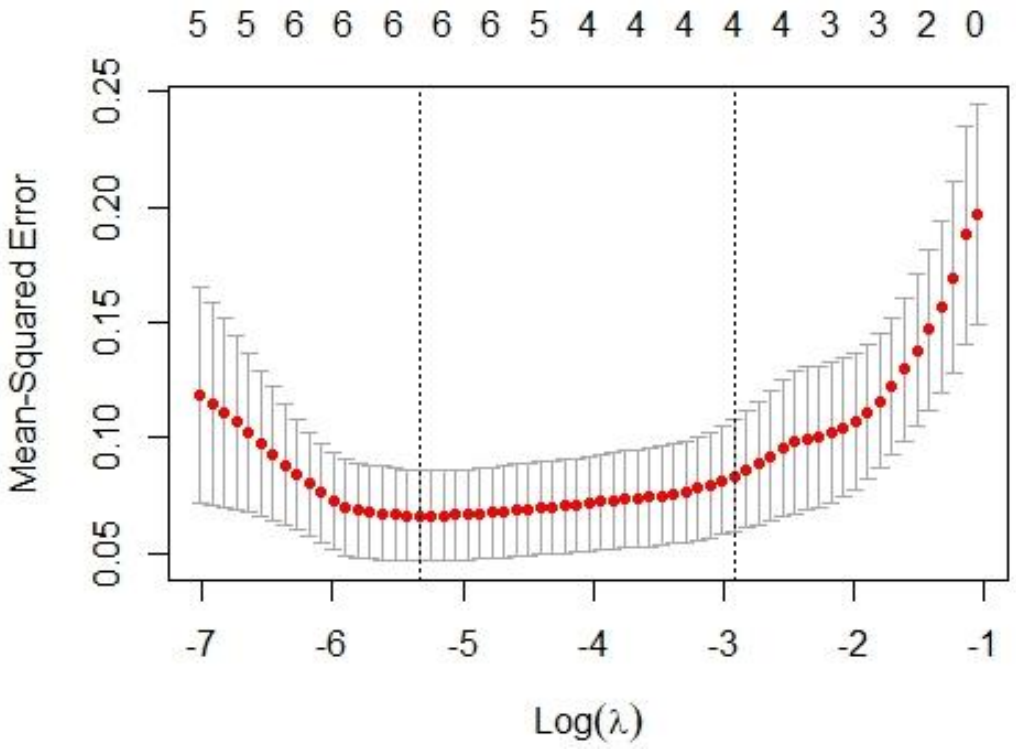

Figure 3. The lambda value that minimizes the test MSE turns in LASS regression

Finally, we examined the final model generated with the optimal lambda value. The predictor FFEC has the lowest coefficient (-0.003) because the lasso regression reduced the coefficient all the way to zero (Eq.3).

$$LASSO_{LSH} = 5.06 + 0.06\,(SC) - 0.04\,(GDPG) - 0.003\,(FFEC) - 0.03\,(CO2) + 0.04\,(BDR) + 0.01\,(IDI) - 0.04\,(REC) \quad \text{Eq.3}$$

The p-values associated with each coefficient must be examined to evaluate the significance of the coefficients and the acceptance or rejection of hypotheses. A standard threshold for significance in statistical hypothesis testing is 0.05. If a coefficient's p-value is less than, it indicates that the relevant predictor is statistically significant in explaining the variability of the response variable (in this case, LSH). If the p-value exceeds, there may not be enough evidence to determine that the coefficient differs significantly from zero. As a result, the related predictor in the model may not be statistically significant. These p-values determine whether hypotheses are accepted or rejected. If the null hypothesis is that the coefficient is equal to zero and the p-value is less than, the null hypothesis is rejected and the alternative hypothesis, that the coefficient is not equal to zero, is accepted.

The final lasso regression model was also utilized to make predictions on new observations. The model expects the LSH to have the values shown in Figure 3 based on the input inputs. Finally, we calculated the model's R-squared on the data. The correlation coefficient (R) between observed and simulated LHS is 0.91, and R-squared is 0.83. That is, the best model can describe 83% of the variation in training data response values with a sum of square error (SEE) of 0.64.

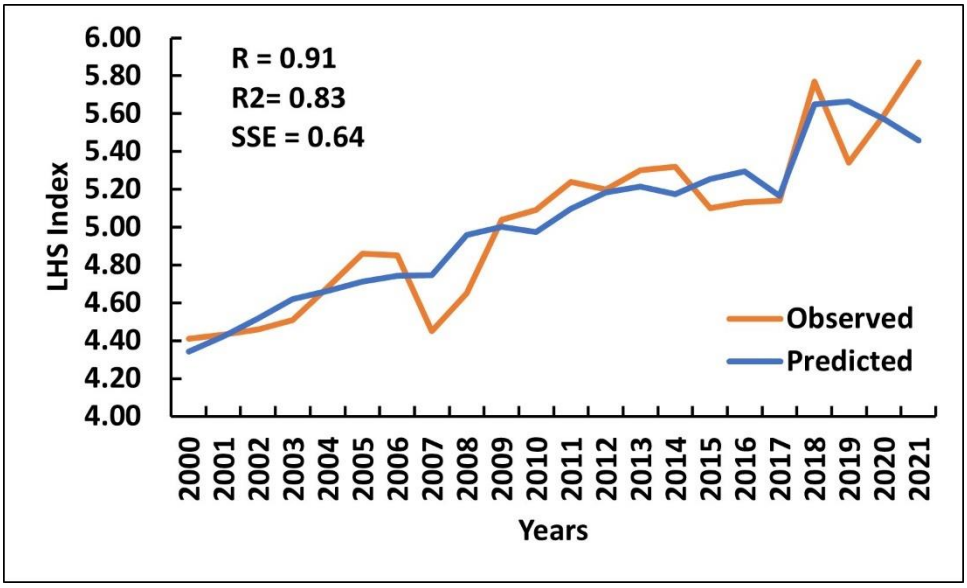

Figure 4. Temporal trends of actual LSH data and LASSO predicted LHS since 2000 in which R, R2 and SSE is also presented

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Variable importance (VI score)

Variable importance evaluation functions can be categorized into model-based methods and those that don't. Model-based methods are more closely related to model performance and can incorporate predictor correlations. Classification models assign separate variable importance for each class, with scaled measures of significance. The LASSO model ranks SC as the most important variable.

DISCUSSION

The study project employs a comprehensive methodology that integrates data from the World Happiness Report 2020 and the World Bank data portal to investigate trends in life satisfaction and happiness (LSH) in Pakistan from 2000 to 2021. The inclusion of a diverse set of independent variables, such as GDP growth, social contribution, and environmental circumstances, enables a full examination of the factors influencing well-being. The time series plot displays the temporal variations in LSH, revealing an overall increasing trend with major fluctuations from 2010 to 2020. The statistical summary and correlation matrix are critical for understanding the central tendencies and correlations between variables. Notably, as seen by the strong correlation coefficient, social participation emerges as a crucial element positively connected with life satisfaction. The addition of LASSO regression to the study adds a sophisticated layer, emphasizing variable importance and underlining the role of social input in predicting life satisfaction. The model's excellent explanatory power, as measured by the R-squared value of 0.83, demonstrates its ability to capture variance in LSH. Overall, this multifaceted approach not only emphasizes the relevance of social elements in determining well-being, but also demonstrates the integration of traditional statistical approaches and modern regression techniques for a comprehensive understanding of the issue.

The increasing global energy consumption, industrial emissions, economic development, and social contributions necessitate a comprehensive understanding of their impact on life satisfaction (Mohammadi Mehr et al., 2019). This work explored how green technology can enhance life satisfaction by reducing energy consumption, industrial emissions, economic development, and social contribution (Mehr et al., 2019; Naseem, 2018).

Moreover, green technology can contribute to improved social conditions. For example, access to affordable clean energy allows communities to improve their living standards by powering homes with electricity or providing clean water. Additionally, green energy initiatives often come with educational and community-building initiatives, allowing people to be better informed and participate in decision-making (Aboalshamat et al., 2018; Ruggeri et al., 2020). Ultimately, green technology can positively impact life satisfaction as it reduces energy consumption, industrial emissions, economic development, and social contribution. As this technology becomes more widely adopted, we should expect improved quality of life and greater sustainability in our planet's resources(Aboalshamat et al., 2018; Ruggeri et al., 2020). The development of green technology can also affect global climate change. By reducing emissions from traditional energy sources, green technology can help reduce the impact of climate change and ensure a healthier planet for future generations. This improved outlook on the environment can result in increased life satisfaction for people worldwide (Scott & Gössling, 2021). Overall, green technology development has numerous benefits for life satisfaction. By reducing emissions from traditional energy sources, providing access to renewable energy sources, reducing energy costs, and contributing to a healthier planet, green technology can positively impact people's lives both directly and indirectly. As technology advances, these benefits only expect to grow(Ghaffari, 2020; Mehr et al., 2019; Ngamaba & Soni, 2018).

In today's modern world, industrial emissions are a significant cause of environmental degradation, resulting in many health and social problems. Industrial emissions include pollutants such as carbon dioxide, sulfur dioxide, nitrogen oxides, and particulate matter, which can significantly impact air quality and human health. Studies have shown that exposure to these pollutants can increase the risk of respiratory and cardiovascular illnesses and other health problems. More important, however, is the impact that industrial emissions can have on life satisfaction. While the direct effects of air pollution on life satisfaction are hard to measure, research has demonstrated that when individuals live in areas with higher concentrations of air pollution, they experience lower levels of life satisfaction. It is because air pollution not only affects physical health but it can also lead to mental and emotional distress, including decreased happiness and increased stress levels (Argan et al., 2018).

Furthermore, the economic costs associated with air pollution can contribute to life dissatisfaction. For example, high levels of air pollution often necessitate expensive medical care and treatments. Additionally, the economic costs of air pollution can be considerable, as polluted environments often reduce the value of the real estate and cause businesses to operate at a loss. All of this can lead to lower levels of life satisfaction for individuals living in areas with high concentrations of air pollution(Olawa & Idemudia, 2021). Fortunately, green technology development has emerged as a promising solution to reducing industrial emissions and mitigating their negative impacts on life satisfaction. By investing in green technology, governments and businesses can create healthier environments while simultaneously reducing economic costs associated with air pollution. Ultimately, this could lead to higher levels of life satisfaction for individuals living in areas where green technology is being developed(Di Fabio & Gori, 2016). Research has shown that higher energy consumption often leads to higher levels of life satisfaction. With the implementation of green technology, energy consumption significantly reduces. It not only helps to reduce environmental pollution but also boosts economic productivity. Industrial emissions are another essential factor in determining life satisfaction. By reducing industrial emissions, green technology can help improve air quality and reduce health risks. It improves citizens' health and well-being, which contributes to greater life satisfaction (Sujarwoto et al., 2018).

Economic development is an essential part of improving life satisfaction. Implementing green technology can help stimulate economic growth by creating jobs, increasing incomes, and boosting consumer spending. This increased economic activity can lead to increased happiness and life satisfaction(An et al., 2020).Green technology development can lead to increased social contribution, which can, in turn, lead to improved life satisfaction. Social assistance can increase feelings of purpose, connection with others, and happiness. Research has found that when people are engaged in meaningful activities that contribute to their community, they tend to be more satisfied with their lives(Mert et al., 2021; Olawa & Idemudia, 2021). Green technology can increase job opportunities and economic development in disadvantaged communities. It leads to an improvement in the quality of life for those living in these communities, as they can now make money from a reliable source and improve their standard of living (Sun & Sun, 2021).

CONCLUSION

The analysis is enriched by the varied array of variables, which includes GDP growth, social contribution, environmental issues, and innovation indices, providing a holistic perspective on factors impacting well-being. The time series plot clearly depicts the temporal dynamics of LSH, demonstrating a general growing tendency with nuanced changes since 2006. The statistical summary and correlation matrix provide useful information, highlighting the positive relationship between life happiness and characteristics such as social contribution and firm density rate. The use of Least Absolute Shrinkage and Selection Operator regression improves the study by putting light on variable importance and emphasizing the role of social contribution in predicting life happiness. The model's R-squared score of 0.83 demonstrates its effectiveness in explaining 83% of the variation in LSH. This multifaceted approach, which combines traditional statistical approaches with modern regression techniques, not only elucidates the dynamics of well-being in Pakistan, but also highlights the critical role of social variables in determining individuals' life satisfaction and pleasure (Omri et al., 2022).

In this way, the result is steady with prior examinations that found a connection between energy use and life fulfillment, showing a relationship between human existence delight and fossil fuel byproducts(Wu, 2022). As per assessments of heterogeneity, more seasoned people impact by changes in power use regarding life fulfillment. Fuel is an economical energy source. Hence an expansion in fuel utilization altogether affects life fulfillment for people who acquire less, have less schooling, or are more seasoned(Ngamaba & Soni, 2018).Subsequently, social correlation with the reference gathering can successfully cause. Spending on fuel and power can characterize as non-positional or fundamental, and unnecessary energy use might bring about excessive fossil fuel byproducts and asset consumption. Utilizing energy (like coal, kindling, charcoal, and so forth) reflects customary energy use and generally old ways of life. This spending is less naturally valuable than energy, resulting in more critical fossil fuel byproducts(Sran et al., 2021).

Subsequently, the following are a few speculations that could fit this finding: Initial, a clarification of social correlation. Individuals now and again notice and contrast themselves with their reference bunch

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through data gathering or accidental perception of others' lives since they need to be seen well by others and themselves(Argan et al., 2018). Consumptions on fuel and power are necessities irrelevant to social standing and boasting to other people. As indicated by Veblen's hypothesis of prominent utilization, the significant expense may not serve human requirements; all things being equal, it helps to show that one consumes more than others, which doesn't make individuals more joyful(Ruggeri et al., 2020). The discoveries are predictable with other people who found that increasing expenses for necessities influence individuals' happiness. As indicated by the second blameworthy clarification, a higher fuel and power use among reference bunches causes individuals to be more joyful since they don't genuinely regret what their conduct means for the climate(Wu, 2021).

IMPLICATIONS, FUTURE DIRECTION AND LIMITATIONS

Practical implications

uture policy should strive to strike a balance between environmental and human welfare concerns. Because environmental issues like as carbon emissions and energy consumption have a significant impact on people's quality of life, carbon emission reduction and energy strategies should focus on their implications on inhabitants' life satisfaction. Second, plans for energy and carbon reduction should take regional and regional characteristics into account. A more aggressive target for reducing carbon emissions should be encouraged because it will meet the population's demand for a higher standard of living in these locations. Other provinces' economic systems must alter to promote renewable energy sources, as increased energy consumption can reduce life satisfaction and increase carbon emissions. Third, advanced publicity could persuade people that energy-saving and low-carbon lifestyles are becoming more widespread within their peer groups, particularly among rural and less educated people who are more sensitive to the energy use of others. Such rules may enhance residents' motivation to save energy and live a low-carbon lifestyle. Numerous researches that examined the links between happiness and life satisfaction discovered that there was frequently a considerable association between the two. Besides, the review encourages establishments to slice loan fees to support ventures among lower-and center pay gatherings, which might build their resources. Without social capital, there should be no boundaries and defers in getting the well-being administrations. This concentrate likewise proposes that the public authority foster lodging projects for leased individuals, give reasonable lodging on simple portions comparable to their lease, and register on their names when the rental sum becomes equivalent to lodging esteem. The current exploration is significant for public arrangement and to reshape the public authority's account for individuals' prosperity.

Policy implications

Because social contribution is so important in predicting life happiness, policies and management practices that promote community participation, social projects, and corporate social responsibility may have a favorable impact on overall well-being in Pakistan. Given the links between renewable energy use and CO2 emissions, policy interventions concentrating on sustainable behaviors, renewable energy development, and environmental protection can help to boost both economic growth and life happiness. The beneficial impact of the Innovation and Development Index emphasizes the importance of encouraging innovation in a variety of areas. To improve overall life satisfaction, policymakers and management should prioritize efforts that foster research, technology adoption, and entrepreneurship.

Future Direction and Limitations

While the findings are useful for understanding the dynamics of well-being in Pakistan, they may not be globally applicable. Future research should look into cross-cultural differences in variable relationships to improve the generalizability of results. Longitudinal studies could provide a more nuanced picture of how the indicated characteristics change over time. This would strengthen the findings' robustness and lead to a more thorough understanding of the dynamics of life happiness. Using qualitative methodologies to supplement quantitative investigations can provide greater insights into the subjective experiences that contribute to life satisfaction. Future study could include in-depth interviews or focus group discussions to obtain individuals' perspectives. Because of differences in economic, social, and environmental circumstances, the conclusions cannot be extended to other nations.
The research is based on data from the World Happiness Report 2020 and the World Bank data site. While these sources are useful, differences in data collection methods and potential conflicts in reporting across countries may restrict the accuracy and comparability of the results. The study spans the years 2000 to 2021, and the time series analysis focuses mostly on patterns within that timeframe. External influences, such as global events or policy changes, could, however, influence life satisfaction patterns beyond the study's time frame. The study contains multiple independent variables, however there may be other factors influencing life satisfaction that have not been investigated. The variables were chosen based on existing literature and availability of data. The complexity of human well-being suggests that other components could be added. While correlation analysis and regression models provide insights into links, establishing causal relationships necessitates additional research. Because the study is observational in nature, causation should be regarded with caution. The findings of the study are limited to Pakistan and may not be applicable to other cultural or socioeconomic contexts. Cross-cultural differences in life satisfaction perception may alter the results' application to other areas.

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