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FORECASTING INDIA'S DEVELOPMENT INDICATORS TOWARDS VISION 2047 USING ARIMA MODELS: A STATISTICAL ASSESSMENT

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ABSTRACT

This study statistically evaluated India's progress towards achieving developed nation status under Vision 2047 using major economic and human development indicators, such as Gross Domestic Product (GDP) per capita, the Human Development Index (HDI), inflation rate, unemployment rate, and Research and Development (R&D) expenditure. Secondary data from 1991 to 2023 were analyzed using trend analysis, correlation analysis, and Auto-Regressive Integrated Moving Average (ARIMA) models. A comparative analysis with developed countries such as the United States, Japan, and Canada was conducted. The findings indicate that India has achieved steady progress in GDP per capita, HDI, and R&D expenditure, whereas inflation and unemployment have remained relatively stable. Correlation analysis showed a strong positive relationship between the GDP and HDI. The forecasting results suggest continued improvement in major development indicators until 2047. However, India may still face challenges in fully achieving developed-country benchmarks for GDP, HDI, and R&D expenditure by 2047. The study concludes that sustained economic growth, technological advancement, and strong policy support are essential for achieving developed-nation status.

Keywords: ARIMA Model, Time Series Forecasting, Vision 2047, Development Indicators, GDP per capita, Human Development Index (HDI).

1. INTRODUCTION

India is on a transformative journey, aiming to become a developed nation by the year 2047, when it celebrates 100 years of independence. This goal is not just about economic growth—it reflects a broader vision of improving people's quality of life, strengthening infrastructure, and achieving global standards of development.

This study focuses on understanding India's progress using important indicators such as GDP per capita, Human Development Index (HDI), Inflation rate, Unemployment rate, and Research & Development (R&D) expenditure. These indicators help measure both economic strength and social well-being, giving a complete picture of development. To better evaluate India's position, the study compares its performance with developed countries such as the United States, Japan, and Canada. These countries represent high standards of development, and comparing India with them helps identify how far India has progressed and where it still needs improvement.

The data used in this analysis covers the period from 1991 to 2023, capturing major economic changes after liberalization. By applying statistical tools such as trend analysis, correlation analysis, and forecasting using Auto Regressive Integrated Moving Average (ARIMA) models, the study not only examines past trends but also predicts future progress up to 2047.

Overall, this study aims to answer an important question: Is India on the right path to becoming a developed nation by 2047? It highlights both the achievements and the challenges, providing a clear and realistic view of India's development journey.

Indicators	Definition	Typical Developed-Country Criteria
GDP per Capita	Average income per person	Above USD 20,000
Human Development Index (HDI)	Composite of health, education & income	≥ 0.800 (Very High HDI)
R&D Expenditure	Investment in Innovation & technology	2% – 4% of GDP

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Inflation Rate	Measure of price stability	2% – 4% annually
Unemployment Rate	Share of labor force without jobs	< 5%

Table 1. Typical Indicators and Benchmark for a developed country

Note: The criteria presented are approximate benchmark indicators commonly associated with developed economies and may vary across international organizations.

2. REVIEW OF LITERATURE

Several studies have examined India's progress toward achieving developed nation status under Vision 2047 using economic and social development indicators. Ajab Singh (2025) analyzed India's development pathway using secondary economic data and literature review methods. The study emphasized the importance of infrastructure development, innovation, human capital, and sectoral growth in achieving long-term economic transformation. Similarly, Shrikant Fulsundar (2025) examined India's economic performance using indicators such as GDP growth, exports, infrastructure, and MSME contribution. The findings indicated that although India maintains stable economic growth, challenges such as unemployment, inequality, and infrastructure gaps continue to hinder balanced development.

Arati Mule (2024) discussed the Vision 2047 framework using indicators related to economic growth, social equity, sustainability, and technological advancement. The study highlighted that sustainable development requires balanced progress across economic, social, and environmental dimensions. Likewise, Satyanarayana and Rao (2023) evaluated India's progress toward developed nation status using indicators such as GDP, HDI, infrastructure, education, and income distribution. Their study emphasized the role of government initiatives including Make in India, Digital India, and Skill India in accelerating economic and social development.

In a broader development context, Pelletier et al. (1995) analyzed the relationship between malnutrition and child mortality using data from developing countries. The study demonstrated that even moderate malnutrition significantly increases mortality risk, highlighting the importance of human development indicators in measuring national progress. Although previous studies have discussed India's development prospects and socio-economic challenges, limited research has focused on forecasting multiple development indicators up to 2047 using ARIMA time-series models. Therefore, the present study attempts to fill this gap by statistically analyzing and forecasting India's major development indicators to assess its potential for achieving developed nation status under Vision 2047.

3. OBJECTIVES

- To analyze the trends in major development indicators of India from 1991 to 2023.
- To examine the relationship among selected economic and development indicators using correlation analysis.
- To develop appropriate ARIMA models for forecasting selected development indicators.
- To forecast India's development indicators up to the year 2047 using time-series analysis.
- To assess India's progress toward achieving developed nation status under Vision 2047.

4. DATA AND METHODOLOGY

The study is based on secondary data, collected from reliable national and international sources such as the World Bank, United Nations Development Programme (UNDP), Human Development Report, and Reserve Bank of India (RBI). The data covers the period from 1991 to 2023, reflecting India's post-liberalization economic progress. The study considers key development and economic indicators such as Gross Domestic Product (GDP) per capita, Human Development Index (HDI), inflation rate, unemployment rate, Research and Development (R&D) expenditure. These variables were selected because they collectively reflect economic growth, human development, macroeconomic stability, employment conditions, and technological advancement.

To evaluate India's developmental progress, comparative analysis was carried out with selected developed countries such as the United States, Japan, and Canada. The comparison was based on trends and levels of major development indicators over the study period.

The statistical analysis was conducted using software such as Excel, R, Python, and Minitab. Various statistical techniques were used to analyze the data. Trend analysis was employed to examine long-term movements in the selected indicators, while correlation analysis was applied to examine patterns and relationships among economic and development variables.

For forecasting purposes, time series analysis was employed. Stationarity of the data series was tested using the Augmented Dickey- Fuller (ADF) unit root test. If a series was found to be non-stationary at level, differencing was

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applied to achieve stationarity. Based on the stationarity conditions, appropriate Auto-Regressive Integrated Moving Average (ARIMA) models were identified and selected.

The ARIMA models were chosen using model selection criteria such as Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC), where models with lower AIC and BIC values were considered more suitable. After model selection, diagnostic checking was performed using the Ljung-Box test to examine whether the residuals behaved like white noise, thereby confirming the adequacy of the fitted models.

Finally, the selected ARIMA models were used to forecast the future values of the major development indicators up to 2047. The forecasted values were then compared with commonly accepted developed – country benchmarks to assess India's potential for achieving developed nation status under vision 2047.

5. RESULTS AND DISCUSSION

5.1 Comparative Analysis of Development Indicators

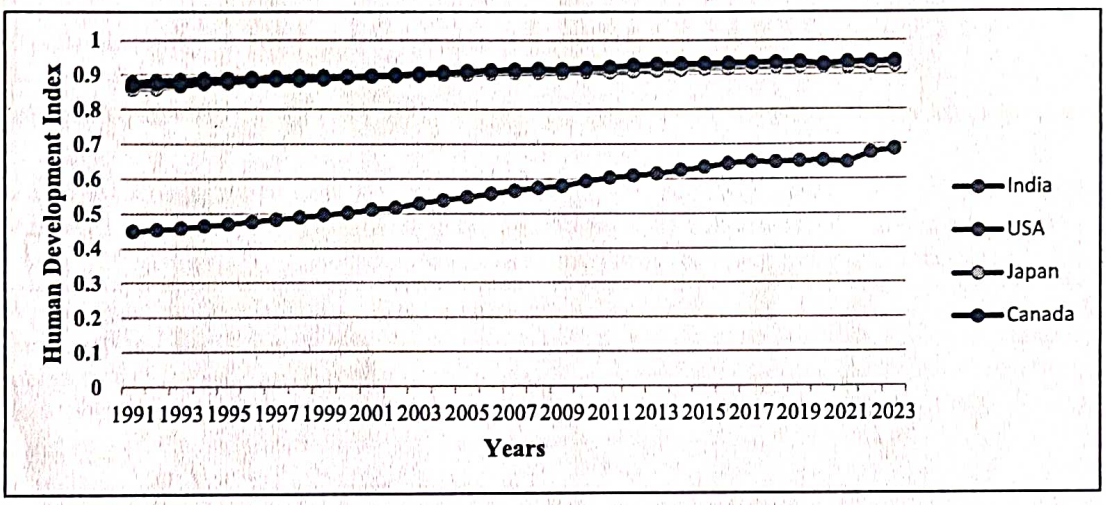

Figure 1: Human Development Index (HDI) Comparison Between India and Developed Countries (1991–2023)

Figure 1 indicates that the developed countries maintained consistently very high HDI values throughout the study period, indicating strong performance in education, healthcare, and living standards. India showed steady improvement in HDI over time, increasing from around 0.45 in 1991 to nearly 0.69 in 2023. Although India has achieved significant progress in human development, a considerable gap still exists compared to developed nations.

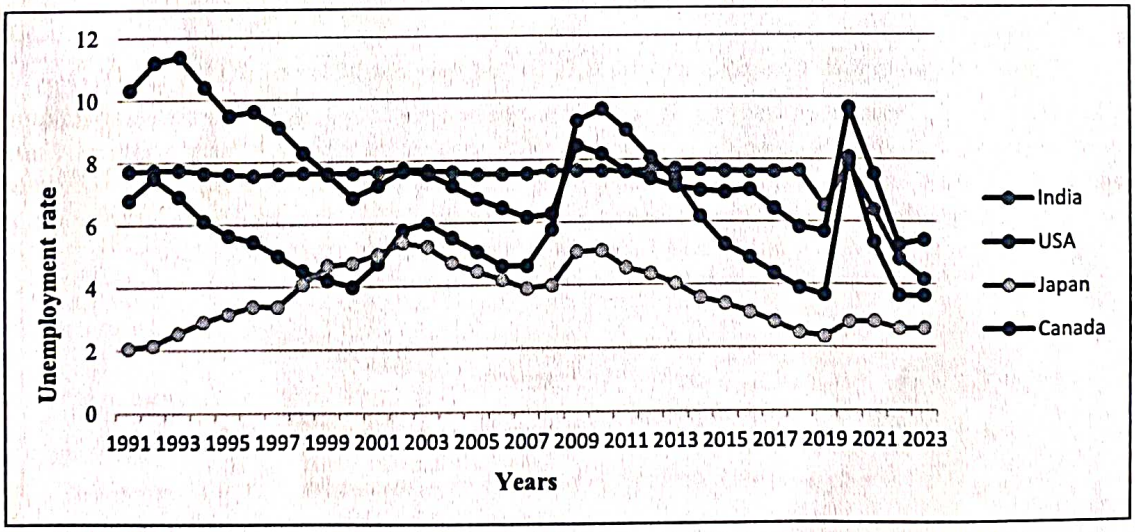

Figure 2: Unemployment Rate Comparison Between India and Developed Countries (1991–2023)

Figure 2 shows that India's unemployment rate remained relatively high and unstable compared to developed countries, with a sharp increase observed around 2020. Although some improvement is visible in recent years, unemployment continues to remain a significant challenge for India's development.

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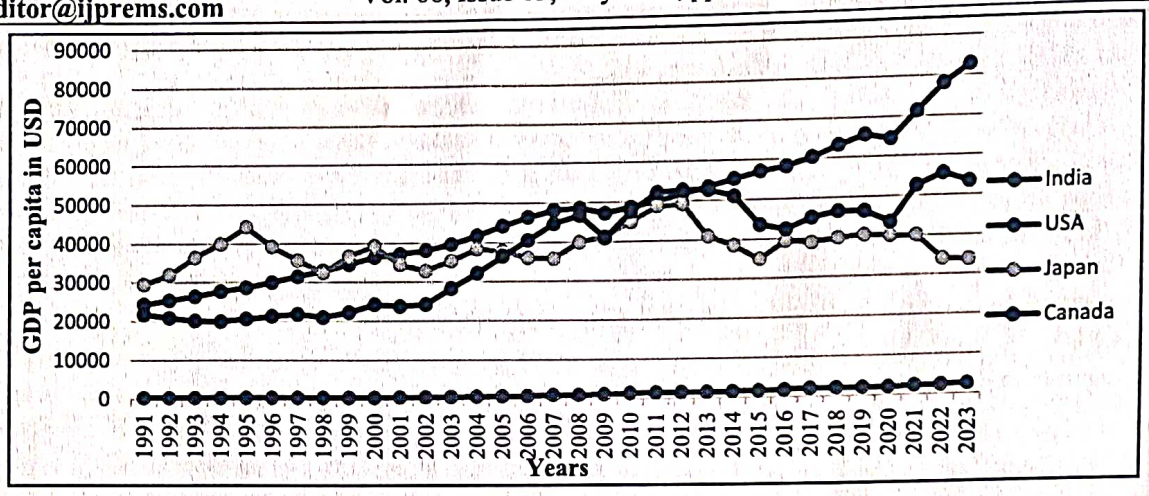

Figure 3: Gross Domestic Product (GDP) per capita Comparison Between India and Developed Countries (1991–2023).

Figure 3 indicates that India showed a steady increase in GDP per capita over time, reflecting sustained economic progress after liberalization. However, India's GDP per capita remains significantly lower than that of developed countries, indicating that a considerable income gap still exists.

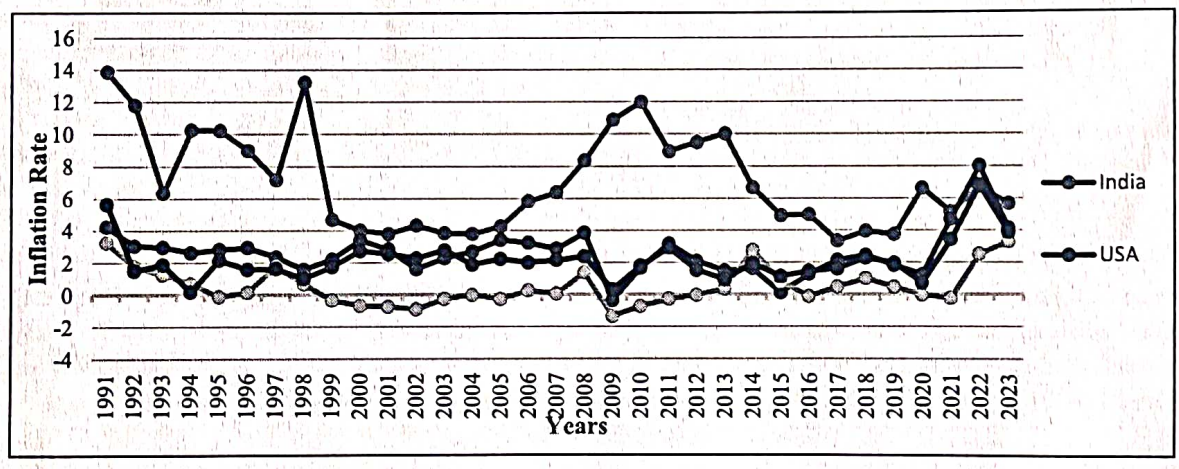

Figure 4: Inflation Rate Comparison Between India and Developed Countries (1991–2023).

Figure 4 shows that India experienced relatively high and fluctuating inflation rates during the earlier years, indicating periods of economic instability. In contrast, developed countries such as the United States, Japan, and Canada maintained comparatively lower and more stable inflation levels throughout the study period. Japan even experienced near-zero and negative inflation in some years, reflecting deflationary conditions. Although India's inflation rate has shown improvement in recent years, it still remains more volatile compared to developed economies.

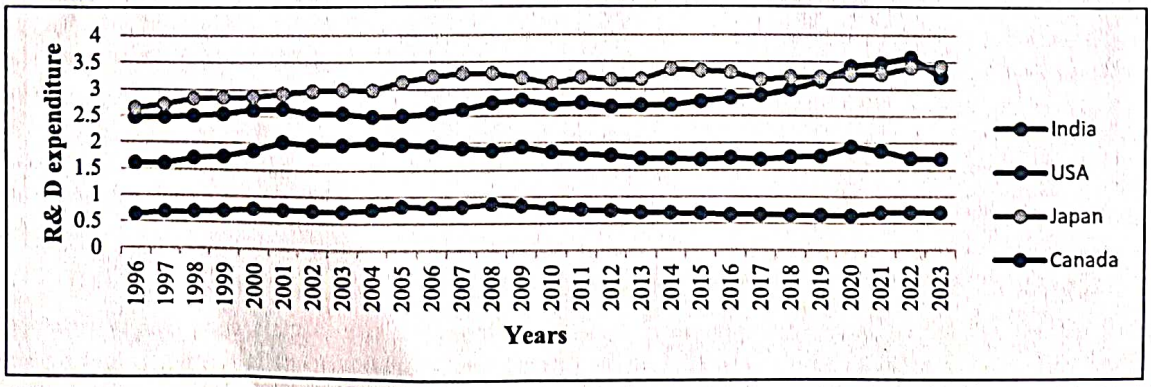

Figure 5: Research and Development (R&D) expenditure Comparison Between India and Developed Countries (1991–2023).

***The R&D expenditure analysis is based on data available from 1996 to 2023.

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The graph shows that the USA and Japan consistently spent a higher share of GDP on R&D, reflecting strong focus on innovation and technological development. Canada maintained moderate and stable R&D expenditure, while India recorded the lowest spending throughout the period. Although India showed slight improvement over time, a significant gap still exists compared to developed countries.

5.2 Correlational Analysis of Development Indicators

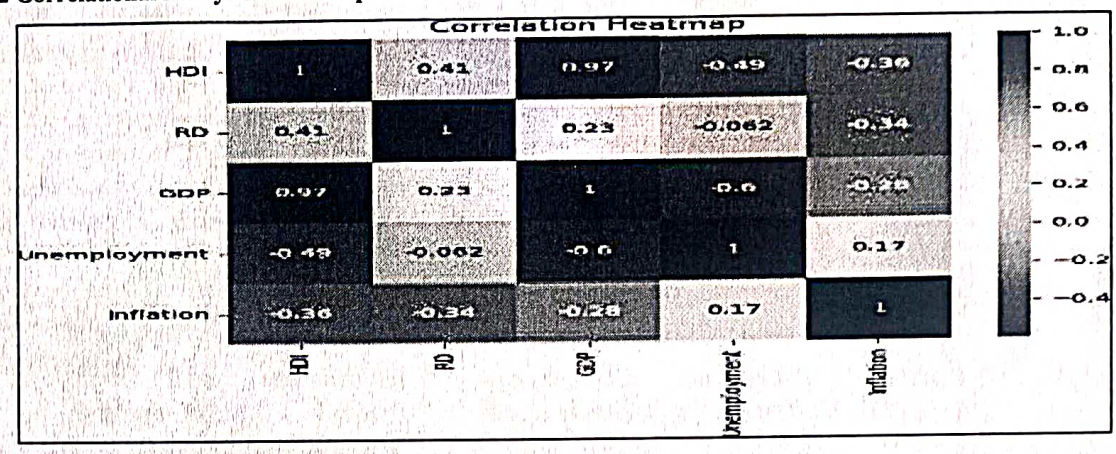

Figure 6: Correlation Analysis of Development Indicators for India.

Figure 6: indicates the correlation among the selected development indicators. GDP and HDI show a very strong positive correlation (0.97), indicating that economic growth is closely associated with improvements in human development, GDP has a moderate negative correlation with unemployment (-0.60), suggesting that higher economic growth is linked with lower unemployment levels. Inflation shows weak negative relationships with development indicators, while R&D expenditure demonstrates a moderate positive association with HDI.

5.3 ARIMA Forecasting for Development Indicators

Table 2: Stationarity Testing, ARIMA Model Selection, and Diagnostic Checking

Sr. No	Development Indicator	ADF test for Stationarity			Selected ARIMA Model	AIC	BIC	Ljung Box Test for Residuals	
		ADF Statistic	P-value	Result				P-value	Model Adequacy
1	GDP (Original Series)	-1.60	0.99	Non-stationary	ARIMA(1,1,1)	304.67	307.67	0.88	Adequate
	GDP (1st difference)	-3.45	0.01	Stationary					
2	HDI (Original Series)	0.16	0.97	Non-stationary	ARIMA(1,1,1)	-340.85	-337.85	0.52	Adequate
	HDI (1st difference)	-5.81	0.002	Stationary					
3	Unemployment (Original Series)	-3.52	0.007	Stationary	ARIMA(1,0,0)	56.17	60.66	1.00	Adequate

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4	Inflation Rate (Original Series)	-2.83	0.053	Non-stationary	ARIMA(0,1,1)	61.99	63.49	0.45	Adequate
	Inflation Rate (1st difference)	-3.68	0.004	Stationary					
5	R&D (Original Series)	-3.97	0.001	Stationary	ARIMA(1,0,1)	-227.70	-224.70	0.42	Adequate

Table 3: Forecasted Values for Development Indicators Using Selected ARIMA Models

Forecasted Period	GDP Forecast ARIMA(1,1,1)	HDI Forecast ARIMA (1,1,1)	Unemployment Rate Forecast ARIMA(1,0,0)	Inflation Rate Forecast ARIMA(0,1,1)	Research & Development Forecast ARIMA(1,0,1)
2025	2659.44	0.694339	4.54	4.9130	0.71503
2030	3108.32	0.699993	5.25	4.4783	0.72202
2035	3560.47	0.700576	5.73	4.0435	0.72908
2040	4015.91	0.700636	6.06	3.6087	0.73621
2047	**4659.1**	**0.700642**	**6.36**	**3.0528**	**0.74776**

Table 4: Development Gap Analysis: India vs Global Benchmarks (2047)

Metric	Typical Developed Country Threshold	India (2023)	India 2047 Forecast	Status
Unemployment Rate	< 5%	4.17%	6.36%	Needs Improvement
Inflation Rate	2% – 4%	5.6%	3.05%	Approaching Benchmark
HDI	≥ 0.800	0.68	0.700	Needs Improvement
R&D Expenditure	2% – 4% of GDP	0.69%	0.747%	Below Benchmark
GDP Per Capita	Above USD 20,000	USD 2,480	USD 4,659	Below Benchmark

6. MAJOR FINDINGS

- India has shown steady improvement in GDP per capita and HDI since 1991, indicating gradual economic and human development progress.
- Comparative analysis shows India still lags behind developed countries in GDP per capita, HDI, and R&D
- expenditure.
- Correlation analysis shows a strong positive relationship between GDP and HDI, suggesting that economic growth contributes significantly to human development.
- ARIMA forecasting indicates continued growth in GDP, HDI and R&D expenditure up to 2047.
- Inflation and unemployment are expected to remain relatively stable in the long term.
- Although the forecasts indicate substantial progress in economic and human development, India may still face challenges in fully achieving developed-country benchmarks by 2047.

7. CONCLUSIONS

This study statistically assessed India's progress toward achieving developed nation status under vision 2047 using

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major economic and human development indicators such as GDP per capita, Human Development Index (HDI), inflation rate, unemployment rate, and Research and Development (R&D) expenditure. The analysis was carried out using secondary data from 1991 to 2023 and forecasting techniques based on ARIMA models. The results shows that India has achieved significant progress in economic growth and human development during the post-liberalization period. GDP per capita, HDI, and R&D expenditure have shown continuous improvement over time, whereas inflation and unemployment have remained relatively manageable in recent years. Comparative analysis with developed countries such as the United States, Japan, and Canada revealed that although India is progressing steadily, significant gaps still exist in income levels, human development, and technological investment. The ARIMA forecasting results suggest that India is likely to continue its development path up to 2047, with steady improvement in major indicators. However, the forecasted values also indicate that achieving developed – country standards in HDI, GDP per capita and R&D expenditure may remain challenging without stronger policy support and sustained long-term growth. Overall, the study concludes that India possesses strong growth potential and is moving in a positive developmental direction. However, achieving developed nation status by 2047 will require continued economic reforms, greater investment in education and healthcare, technological advancement, employment generation, and balanced socio-economic development.

LIMITATIONS

- The study covers data only from 1991 to 2023, earlier historical trends were not included in the analysis.
- Development of a country depends on numerous economic, social, political, and environmental factors; however, the present study considers only selected major indicators.
- Social behaviour, lifestyle patterns, governance quality, and cultural factors may also influence development, but such variables are difficult to measure quantitatively.
- The study is based entirely on secondary data collected from various national and international sources; therefore, any inaccuracies in the original data sources may affect the results.
- Statistical forecasts provide an estimate, but they may not be fully accurate since development depends on many changing and uncertain factors.
- The criteria used to classify a country as "developed" may evolve over time, therefore, future standards of development may differ from the benchmarks considered in this study.

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