

# **Prospect and Opportunities for ISO Standards in Bangladesh**

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## **Abstract**

This study focused on analyzing the prospective diffusion of ISO standards in the context of Bangladesh. The popular ISO standards in Bangladesh are ISO 9001, ISO 14001, ISO 45001 and ISO 22000. Grey Forecasting model was employed to analyze the future diffusion. Relative growth rates and major industrial sectors for these standards were also identified as of the year 2021. The ISO survey published on its official website was used as the main source of data. The findings illuminate the possibility of increased diffusion, albeit at a gradual pace. Textiles and textile products have been a major industrial sector for ISO 9001, ISO 14001 and ISO 45001 certification. Notably, ISO 9001 and ISO 14001 exhibit significant growth compared to other standards. As of 2030, Bangladesh is expected to have obtained 1261, 834, 7156, and 66 certifications for ISO 9001, ISO 14001, ISO 45001, and ISO 22000, respectively. Organizations might be beneficial from this study in case of policy development and business decisions. This study will offer valuable insights to open new avenues for further study in the context of Bangladesh. Furthermore, methodological insights gained through employing Grey Forecasting Model may be applicable to other developing economies.

## **Keywords**

Management System, ISO standards, Forecast, Prospects and Bangladesh

## **1. Introduction**

Businesses in today's globalized world constantly battle to keep a competitive edge. To thrive in this environment, many companies are actively seeking effective business solutions (Casadesús and Karapetrovic 2005). These organizations are concerned with satisfying both their customers and stakeholders by delivering top-quality products and services, considering the environmental impact and health hazards of their employees. In this intricate context of priorities, ISO standards have emerged as a cornerstone for minimizing trade barriers on a global scale. By adhering to ISO standards, businesses can streamline their operations, reduce costs, and minimize risks, making them more competitive in the global market. Moreover, these standards facilitate international trade by harmonizing regulations and fostering trust between trading partners, ultimately promoting economic growth and innovation on a global scale. In an increasingly interconnected world, ISO standards are indispensable in driving businesses towards excellence and bolstering their ability to thrive in a highly competitive global marketplace. In addition to economic benefits, these standards have a significant impact on society. They enhance consumer protection, encourage eco-friendly practices, facilitate international cooperation, and foster innovation, ultimately creating a safer, more interconnected, and sustainable global society. So, adoption of ISO standards has garnered widespread acceptance across public and private sector organizations, in both developed and developing countries, to be competitive in national and international markets (Mabrouk and Ibrahim 2021) (Ikram et al. 2021) (Castka and Corbett 2015) (Šolc et al. 2022) (Fikru 2014) (Hashem and Tann 2007) (Turk 2009) (Murmura et al. 2018) (Sambasivan and Fei 2008). ISO 9001 certification stands as a vital tool for ensuring quality assurance within organizations and facilitating their participation in the expanding international trade arena, thereby satisfying stakeholders (Fonseca and Lima 2015) (Samad et al.

2014) (Ikram et al. 2021) (Fonseca 2015). Conversely, ISO 14001 has become a paramount concern for organizations aiming to reduce their detrimental impact on the environment (Sartor et al. 2019). Organizations today are focusing on adopting ISO 45001 to ensure safety of their employees, while ISO 22000 is being popular for maintaining continuous improvement of food safety. Moreover, these ISO standards align with key Sustainable Development Goals (SDGs) referred to in Table 1.

Table 1. Contribution of standards to SDGs

| ISO Standards | Contribution to SDGs        |
|---------------|-----------------------------|
| ISO 9001      | 1,9,12,14                   |
| ISO 14001     | 1,2,3,4,6,7,8,9,12,13,14,15 |
| ISO 45001     | 3,5,8,9,10,11,16            |
| ISO 22000     | 2,3,12                      |

Bangladesh is also committed to achieving sustainable development goals by 2030. Furthermore, it is a country with a rapidly growing economy. Bangladesh has made remarkable strides in economic growth and development since its independence in 1971. In addition, the country aspires to achieve upper middle-income status by 2031. Despite global uncertainties, the economy has shown resilience. Real GDP growth, although slightly slowed, remains positive. Annual GDP growth of Bangladesh is represented in Figure 1:

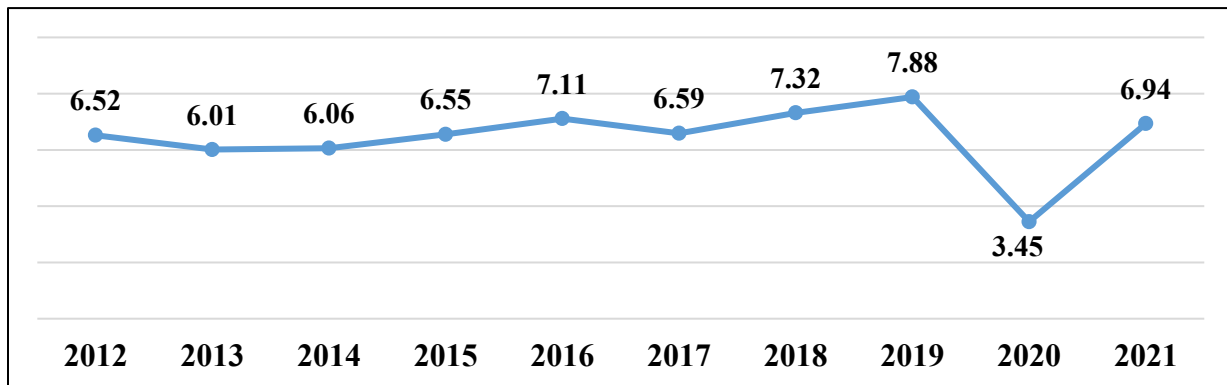


Figure 1. Annual GDP growth of Bangladesh (%) (Source: The World Bank)

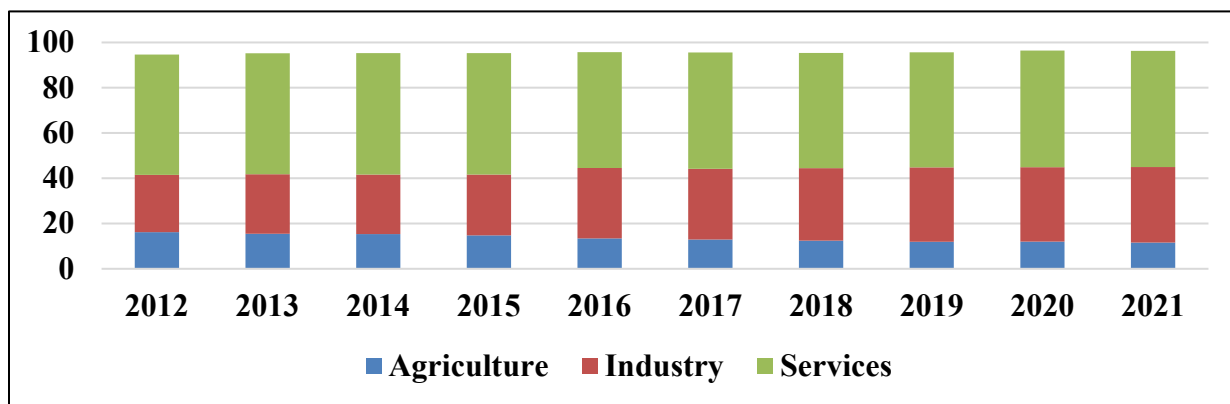


Figure 2. Share of economic sectors in the GDP in Bangladesh (Source: Statista)

Figure 2 shows that, the economy of Bangladesh is diversified, with agriculture, industry, and services contributing to its GDP. Priorities for development involve diversifying exports, addressing financial sector issues, and attracting private investment. The economy of Bangladesh, fuelled in part by its export industry, plays a pivotal role in national

development. The Ready-Made Garments (RMG) sector has propelled Bangladesh to the position of the world's second-largest exporter of garments and apparel products (Galib et al. 2019). But, after tragic incidents like the Rana Plaza collapse in 2013 and the Tazreen Fashions fire in 2012, ensuring occupational health and safety became a critical concern for RMG industries. Similarly, Bangladesh's growth in global frozen food exports and other sectors, including jute, leather, pharmaceuticals, and plastics, has driven demand to meet international standards and regulations. Following the COVID-19 pandemic, the importance of food safety has become more essential, both domestically and internationally. So, exporters in Bangladesh are also navigating solutions to coordinate and unify the diverse requirements on an international basis due to fierce competition, heightened consumer expectations, and stringent quality and safety standards in this rapidly evolving global business landscape. Since Bangladesh continues to emerge as a key player in the global marketplace, organizations face heightened pressure to demonstrate their commitment to quality, environmental sustainability, and operational excellence. The implementation of ISO management systems fosters a culture of continuous improvement and accountability, driving long-term sustainability and resilience in the face of evolving market dynamics and stakeholder expectations. As a result, implementing ISO standards in Bangladeshi organizations is crucial for building trust, fostering innovation, and promoting responsible business practices of excellence, quality, and sustainability. So, ISO standards hold great significance in Bangladesh as well. But the literature on ISO implementation in Bangladesh remains relatively limited. Furthermore, ISO standards have been adopted since very early, but the rate of diffusion to date is not significant. So, investigation into the diffusion of ISO standards is essential for enhanced business performance. Considering these circumstances, this study aims to investigate the prospects for certifications for ISO 9001, ISO 14001, ISO 22000, and ISO 45001, the most widely adopted standards in Bangladesh.

The current study is distinct from earlier research. Extensive research on these popular standards has been conducted in the context of various countries, such as China, India, the USA, the UK, Italy, Japan, Germany, Malaysia and Pakistan (Sousa Lira et al. 2021) (M. R. Shaharudin et.al. 2018). Bangladesh presents a unique context characterized by specific socio-economic factors and institutional frameworks. But surprisingly, no study has yet ventured into predicting the future diffusion of ISO standards in the context of Bangladesh. This study serves as a foundational step towards understanding standards diffusion dynamics in diverse socio-economic contexts of developing economies. Therefore, this study also holds significant importance in both academic and practical aspects. It explores possible diffusion trends, which is imperative to formulate sustainable global trade strategies and competitive business policies (Hikichi, Salgado and Beijo 2017). Besides, it can help align with international regulations to enhance management practices through the adoption of ISO standards in Bangladesh.

This study is essential for academic inquiry and practical decision-making, with potential implications for organizational performance, regulatory compliance, and socio-economic development. The study will enrich the existing literature and provide invaluable guidance for stakeholders, strategic planners, policymakers, and management personnel. It will help them Furthermore, the methodology employed in this research can serve as a template for similar studies, whether examining different contextual variables, regions, or cultural settings.

The structure of this research comprises an introductory section that defines the problem, its purpose, and the paper's contribution. Then a comprehensive review of relevant literature is delved into, addressing the interconnected topics of this research. Subsequently, the methodology has been elucidated, which serves as the foundation for the subsequent presentation and discussion of results conveyed through tables and graphs. Finally, the findings are summarized, highlighting the practical implications and outlining potential future research avenues in this field.

## **2. Literature Review**

This section describes the literature review regarding ISO standards and certification, forecast-related previous research, the Grey (1,1) model, and related topics addressed in the research.

### **2.1 Evolution of studies about ISO Standards**

The evolution of studies about ISO standards reflects a dynamic journey characterized by shifting paradigms, emerging trends, and evolving research interests. Initially, research in this field primarily focused on the development and implementation of ISO standards, tracing its roots to the establishment of the International Organization for Standardization (ISO) in 1947. The International Organization for Standardization, commonly known as ISO, is a global body that develops and provides a universal framework for quality, safety, and efficiency across industries to ensure products and services meet high-quality standards. ISO 9001 is considered as the most popular standard for

quality management systems within organizations to achieve customer satisfaction and organizational objectives (Bravi et al. 2019) (Kafel and Simon 2017) (Marimon Viadiu et al. 2006) (Sá et al. 2022) (Ciravegna Martins da Fonseca et al. 2019). Besides, an internationally recognized environmental management system called ISO 14001 outlines the organizational needs and environmental policy procedures for enhancing continual improvement (Marimon Viadiu et al. 2006) (Deyassa 2019). ISO 45001 serves as a systematic program to ensure the health and safety of workers within organization (Yurizki, E. and Ikatrinasari, Z. 2022) (Asih and Latief 2021) (Darabont et al. 2017). Currently, ISO 22000 has also become popular worldwide. It plays an important role in ensuring food safety (Granja et al. 2021). Globalization and interconnected industries have led to a shift in research on ISO certification's socio-economic implications. Emerging technologies like blockchain and artificial intelligence are enhancing standardization processes and combating counterfeit products. Interdisciplinary perspectives are being used to contextualize ISO standards, particularly in developing economies.

The historical adoption of ISO standards in Bangladesh has been a significant milestone in the country's pursuit of quality and excellence. These standards were essential in enhancing the competitiveness of Bangladeshi products in the global market, ensuring product quality, and improving overall business practices. Bangladesh began incorporating ISO standards into various sectors with a primary focus on industries like textiles, garments, food processing, etc. during the late 1990s and early 2000s. Over the past few years, the certification of ISO standards has expanded notably to encompass a wide range of sectors, including agriculture, healthcare, and information technology. This adoption has not only boosted the country's export potential but has also led to improved consumer safety and environmental protection, reflecting Bangladesh's commitment to international best practices and quality assurance. According to a study conducted by (Pushpo and Uddin 2022), an overview of the current state of ISO adoption in Bangladesh is represented in Figure 3:

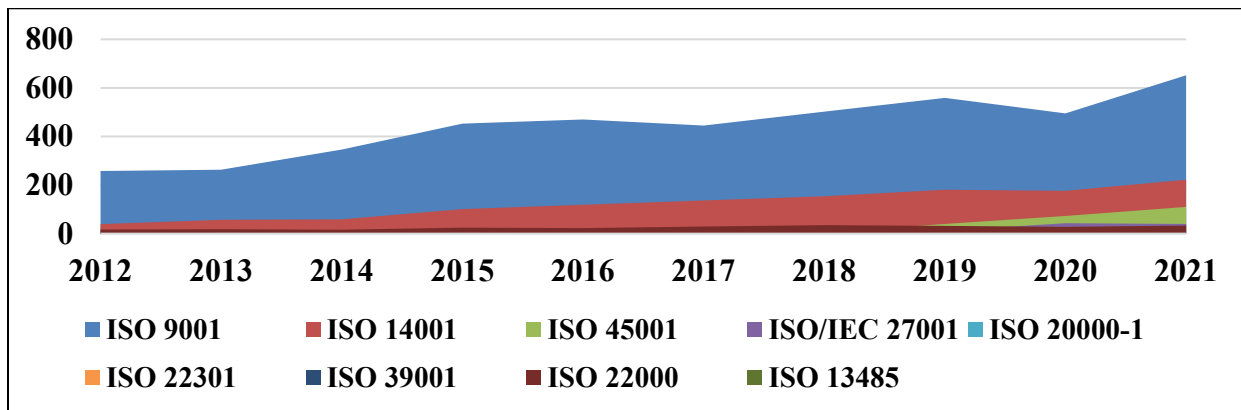


Figure 3. Current state of ISO adoption in Bangladesh

According to the study, the number of ISO certifications indicates a promising upward trend and ample opportunity for Bangladesh to implement ISO standards. From Figure 1, it is evident that, ISO 9001 is the most widely used management standard in Bangladesh, followed by ISO 14001, ISO 45001, ISO 22001, and ISO/IEC 27001. Textiles and textile goods are the business areas where ISO certification is growing at the fastest rates. The study also showed that the Bangladesh Standards Institution (BSI) as national standards agency and member of ISO raised awareness among various organizations and business owners for the implementation of ISO standards.

## 2.2 Forecasting of ISO Certification

Prior studies primarily used a logistic curve or model to analyze the diffusion for ISO 9001 and ISO 14001 (Franceschini et al. 2004) (Marimon Viadiu et al. 2006) (Casadesús et al. 2008) (Marimon et al. 2010). (Ikram et al. 2021) used Even GM (1, 1), Discrete GM (1, 1), and Nonhomogeneous Discrete Grey model (NDGM) with an accompanying synthetic growth rate and synthetic doubling time grey models to analyze the forecast trends related to ISO 9001 certification in China, Italy, Germany, Japan, the United Kingdom, and India. The purpose of the analysis was to examine the differences between these countries. Over time, research on the ISO 14001 spread process has been conducted, with a focus on demand forecasting (Sousa Lira et al. 2020). (Ikram et al. 2019) have presented three Grey Models- Even GM (1,1), Discrete GM (1,1), and Nonhomogeneous Discrete Grey Model (NDGM)—to forecast ISO 14001 certifications for China, India, the USA, Italy, Japan, and Germany during the next ten years. Gompertz

model has been employed to analyze the diffusion of ISO 22000 in Europe (Granja et al. 2021). But no research was conducted in Bangladesh to predict the diffusion of ISO standards using Grey Model. Due to higher accuracy, this study aims to apply the Grey (1,1) Model to predict ISO certification in Bangladesh.

### 2.3 Grey (1,1) Model

This model has been widely applied in various fields to solve problems with inadequate information due to its accuracy and practicality.

The basic formula can be written as:

$$x(0) = x(0) (1), x(0) (2), \dots, x(0) (n),$$

$$x(1)(k) = \sum_{m=1}^k x(0)(m)$$

The GM (1,1) model:

$$dx(1)/dt-ax(1)=U$$

The solution to the equation is:

$$x^1(k+1) = (x^1(1) - \frac{U}{a})e^{-ak} + \frac{U}{a}$$

Mean Absolute Percentage Error (MAPE):

$$\frac{1}{n} \sum_{k=1}^n \frac{|Actual Data - Predicted Data|}{Actual Data} * 100$$

Mean Absolute Percentage Error (MAPE) is calculated to measure the performance of the forecasting model. Accuracy Level for performance measure is presented in Table 2 (Bilgil, H. 2021):

Table 2. Contribution of standards to SDGs

| MAPE (%) | Forecasting Power |
|----------|-------------------|
| ≤10      | Excellent         |
| 10-20    | Good              |
| 20-50    | Reasonable        |
| 50≤      | Incorrect         |

### 3. Methods

Grey forecasting model is employed to identify possible diffusion in the context of Bangladesh. The model is chosen for forecasting ISO certification in Bangladesh due to its unique advantages. Unlike other forecasting methods like time series models and machine learning techniques, the GM (1,1) model is more suitable for the specific context and objectives of the research. Time series models require large volumes of historical data and assume data stationarity, which may not be available in developing economies like Bangladesh. Machine learning techniques, while offering flexibility and complexity, require extensive computational resources and expertise, which pose practical challenges in resource-constrained settings. The GM (1,1) model can handle limited data availability, accommodate irregular patterns, offer simplicity and interpretability, and ensure practical applicability in real-world forecasting tasks. The procedure includes the steps mentioned in Figure 4 (Zhou 2013):

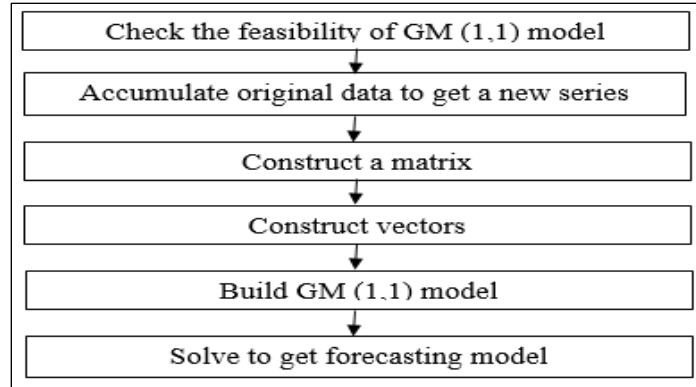


Figure 4. Steps of Grey (1, 1) model

The GM (1,1) model has been successfully applied in various fields, demonstrating its versatility and robustness across different domains.

#### 4. Data Collection and Analysis

ISO 9001, ISO 14001, ISO 45001, and ISO 22000 have been considered for this study. To forecast the future value, data regarding the number of certifications were collected from the ISO Survey issued for the period 2012–2021.

The following data analysis has been performed for the selected ISO standards:

- a) Relative Growth Rate (RGR) for the certification of ISO standards was calculated up to 2021 using the following equation (Sousa Lira et al., 2021):  

$$RGR = \ln(NC_1) - \ln(NC_0) / (t_1 - t_0)$$

Where,

RGR = Relative Growth Rate;  $NC_1$  = Number of certificates at the end time;  $NC_0$  = Number of certificates at the initial time;  $t_1$  = End time;  $t_0$  = Initial time.

- b) The industrial sectors with highest number of certification is ranked for each of the aforesaid ISO standards.
- c) Grey Forecasting Model GM (1,1) was employed to predict the diffusion of ISO standards for Bangladesh.
- d) Accuracy level is checked to evaluate the performance of the forecasting model.

#### 5. Results and Discussion

This section describes the overall findings of the research including the analyses of Relative Growth Rate (RGR), ranking of main industrial sectors for adopting ISO standards and prediction of future diffusion.

##### 5.1 Relative Growth Rate (RGR)

Relative Growth Rate (RGR) assessed the trends and trajectories of ISO certification adoption in Bangladesh.

The relative growth rate of ISO 9001 in Bangladesh shows a varied pattern of growth and decline. Starting in 2013, there is a minimal growth rate of 0.02. Adoption increased significantly in 2014 and 2015, with a growth rate of 0.27. However, in 2016, there is a decline with a growth rate of 0.04, which continues in 2017. In 2018, there is a slight rebound with a growth rate of 0.12, indicating a modest increase in ISO 9001 adoption. This positive trend continues in 2019. However, in 2020, growth rate -0.12, indicates a decrease or slower growth in ISO 9001 adoption. Despite this decline, the growth rate significantly rebounds in 2021 with a value of 0.28, suggesting a substantial increase in certifications and a positive trend in ISO 9001 adoption (Figure 5).

The relative growth rate of ISO 14001 in Bangladesh shows a generally positive trend, indicating an increase in the adoption of ISO 14001 certification for environmental management. There is a relatively high growth rate of 0.38 in 2013, which continues in 2014 with a growth rate of 0.03, albeit at a slower pace compared to the previous year. In 2015, the growth rate rises to 0.54, indicating a substantial increase in the adoption. In 2016-2019, the growth rates remain positive but show a slight decrease. However, Adoption growth rebounded in 2021, despite challenging circumstances.

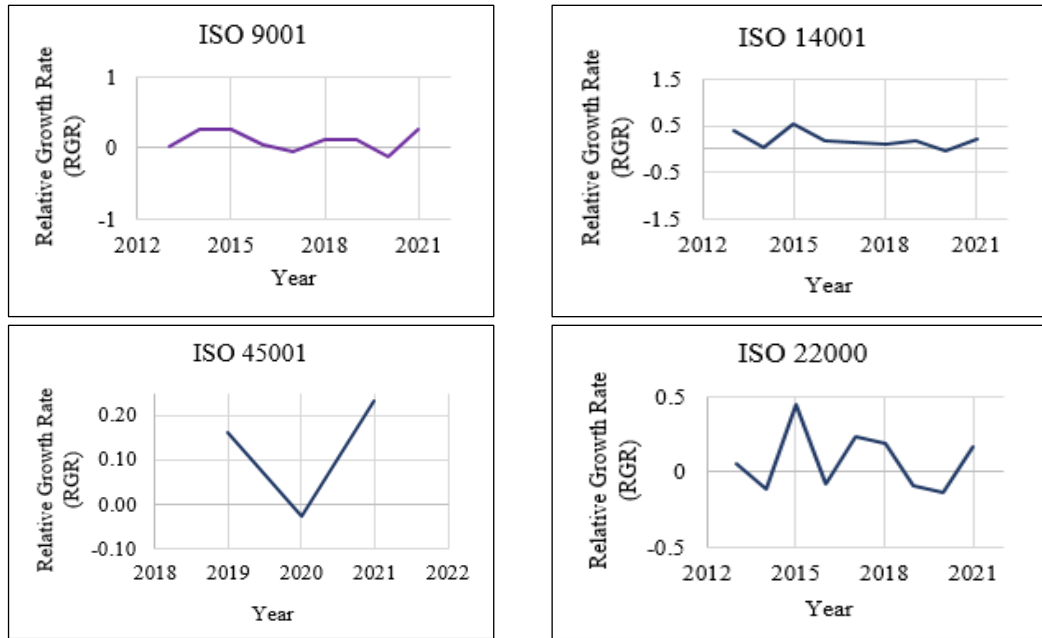


Figure 5. Relative Growth Rate (RGR) of ISO certifications in Bangladesh

ISO 22000 adoption in Bangladesh fluctuates between growth and decline. The modest growth rate (0.06) in 2013 indicates a slight increase in ISO 22000 certifications. However, in 2014, there is a decline with a growth rate of -0.12. In 2015, the growth rate significantly rebounds with a value of 0.45 a slight decline is observed with a growth rate of -0.08. However, the growth rate rebounds again in 2017 with a value of 0.23 albeit there is another decline with slower growth. In 2021, the growth rate picks up again with a value of 0.16 indicating a modest increase.

The relative growth rate of ISO 45001 in Bangladesh represents a mixed pattern with alternating periods of growth and decline. In 2019, there was a positive growth rate of 0.16, suggesting an increase in certifications. However, a slight decline with negative growth rate is observed in 2020. In 2021, the growth rate indicates a substantial increase in the adoption of ISO 45001 certification with a growth rate of 0.23. This indicates a positive focus on improving occupational health and safety practices in organizations.

The fluctuations in the growth rates of ISO standards adoption in Bangladesh can be attributed to several influencing factors. Economic conditions play a crucial role; periods of economic growth typically led to increased industrial activity and greater emphasis on quality and compliance, driving ISO certifications. Conversely, economic downturns can result in reduced investment in such initiatives. Government policies also significantly impact these growth rates. Supportive policies, incentives, and awareness campaigns can boost adoption, whereas bureaucratic obstacles and lack of enforcement may impede progress. Industry-specific challenges such as technological advancements, availability of skilled labour and competitiveness also impact growth rates. For instance, sectors like textiles and garments, which face intense global competition, may exhibit higher adoption rates due to international quality assurance demands. Addressing these factors through strategic planning and targeted interventions can help stabilize and enhance the growth trajectory of ISO standards in Bangladesh.

## 5.2 Ranking of Main Industrial Sectors

The ranking of the main industrial sectors offers a comprehensive overview of ISO certification trends across Bangladesh's main industrial sectors, laying the groundwork for future research. It also serves as a reference point for understanding the distribution of certifications within the country's industrial landscape, its implications for economic development, sectoral competitiveness, and market positioning. The industrial sectors with highest number of certifications in Bangladesh for above mentioned ISO standards are ranked as follows in Table 3 and Table 4:

Table 3. Industrial sectors with highest ISO certification in 2021

| <b>ISO Standard</b> | <b>Rank</b>                                     | <b>Sector</b>   | <b>No. of certificates</b> | <b>%</b> |
|---------------------|---|---|----------------------------|----------|
| ISO 9001            | 1   | Textiles and textile products   | 79                         | 10.55    |
|                     | 2   | Wholesale & retail trade, repairs of motor vehicles, motorcycles & personal & household goods | 54                         | 7.21     |
|                     | 3   | Electrical and optical equipment  | 47                         | 6.28     |
| ISO 14001           | 1   | Textiles and textile products   | 82                         | 32.80    |
|                     | 2   | Electrical and optical equipment  | 19                         | 7.60     |
|                     | 3   | Rubber and Plastic Products   | 11                         | 4.40     |
|                     |   | Wholesale & retail trade, repairs of motor vehicles, motorcycles & personal & household goods | 11                         | 4.40     |
| ISO 45001           | 1   | Textiles and textile products   | 31                         | 22.63    |
|                     | 2   | Construction  | 11                         | 8.03     |
|                     |   | Wholesale & retail trade, repairs of motor vehicles, motorcycles & personal & household goods | 11                         | 8.03     |
|                     | 3   | Electrical and optical equipment  | 9                          | 6.57     |
| ISO 22000           | These standards do not contain data on sectors. |   |                            |          |

### 5.3 Prospects of ISO Certifications

Figure 6. illustrates the plot between observed and forecasted values of the number of certificates. The results depict positive growth of ISO certification for Bangladesh in upcoming years.

Table 4. Forecast of ISO certification for Bangladesh

| <b>Year</b> | <b>ISO 9001</b> | <b>ISO 14001</b> | <b>ISO 45001</b> | <b>ISO 22000</b> |
|-------------|-----------------|------------------|------------------|------------------|
| 2022        | 675             | 262              | 171              | 37               |
| 2023        | 730             | 303              | 273              | 40               |
| 2024        | 789             | 350              | 436              | 43               |
| 2025        | 853             | 404              | 695              | 46               |
| 2026        | 922             | 467              | 1108             | 50               |
| 2027        | 998             | 540              | 1766             | 54               |
| 2028        | 1079            | 624              | 2815             | 58               |
| 2029        | 1166            | 722              | 4488             | 62               |
| 2030        | 1261            | 834              | 7156             | 66               |



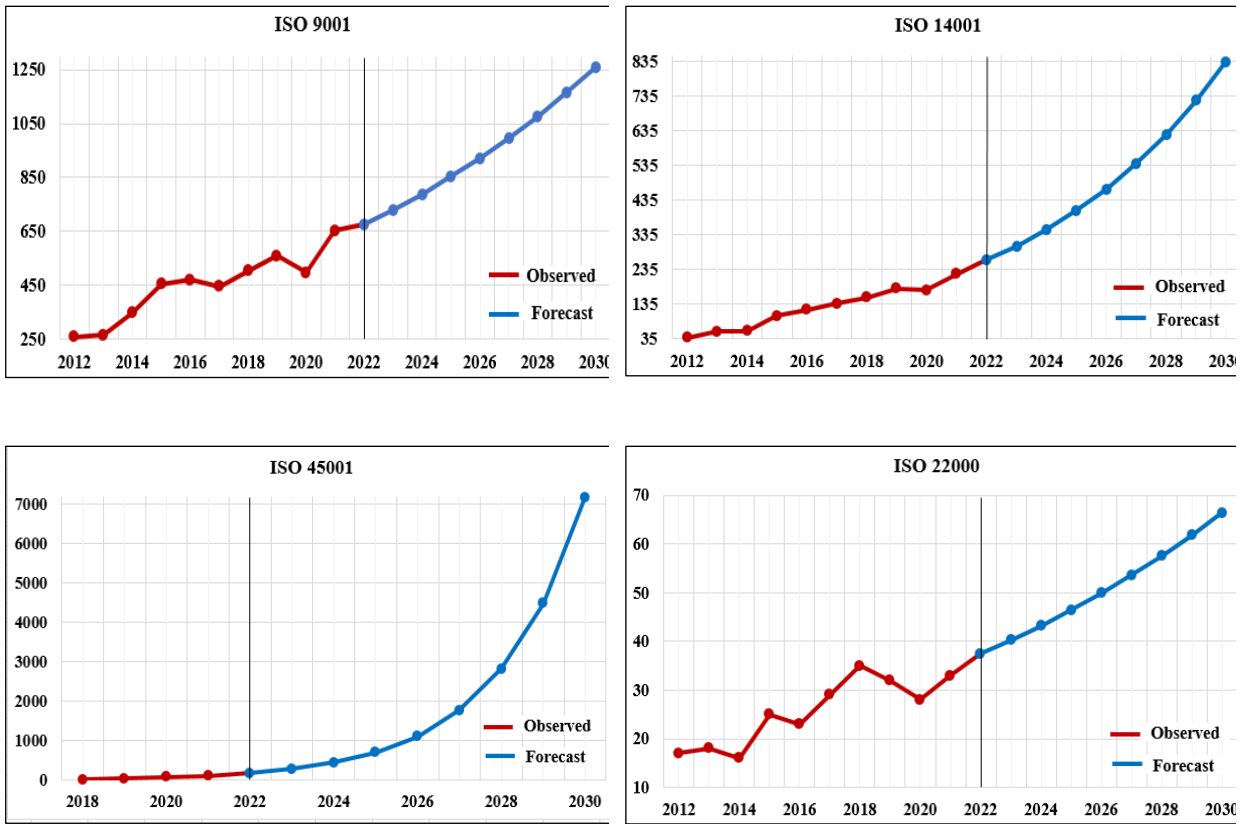


Figure 6. The observed and forecasted values of ISO certifications in Bangladesh

### 5.4 Performance of Forecast Model

Table 5. depicts the accuracy tests of the prediction (Song et al. 2020).

Table 5. Accuracy Test of Prediction

| Description                    | ISO 9001  | ISO 14001 | ISO 45001 | ISO 22000 |
|--------------------------------|-----------|-----------|-----------|-----------|
| MAPE                           | 9.44%     | 12.17%    | 5.20%     | 12.56%    |
| Forecasting Power              | Excellent | Good      | Excellent | Good      |
| Relative Deviation in sequence | -0.02     | -0.05     | 0.01      | -0.03     |
| Accuracy                       | 90.56%    | 87.83%    | 94.80%    | 87.44%    |

From Table 5, it is evident that the mean absolute percentage error (MAPE) is satisfactory, so the fitting is in good condition. Moreover, the relative deviation in sequence for each standard is  $\leq 0.01$ , which is a high level of accuracy. It can be concluded that the GM (1,1) model is effective.

### 5.5 Opportunities of ISO Certifications in Bangladesh

ISO certification in Bangladesh can significantly expand the country's export market opportunities by enhancing the credibility of Bangladeshi products and services in the global market. For example, in the garment industry, ISO certifications like ISO 9001 and ISO 14001 can enhance market access. As global consumers prioritize quality and sustainability, ISO certification can help Bangladeshi companies compete and thrive in the global marketplace. ISO certification serves as a platform for stimulating creativity and innovation within Bangladeshi industries. This process-driven approach often sparks innovation as companies seek more efficient, sustainable methods. Implementation of ISO standards promotes an organized approach to raising productivity and quality.

## **5.6 Stakeholder Implications of the study**

The study highlights that aligning with ISO standards boost trade competitiveness, attract foreign investments, simplify compliance with international trade agreements, and enhance Bangladesh's global economy integration. It implies that ISO standards can enhance legal frameworks, foster economic growth, and guarantee quality and safety in all industries.

This study also highlights the potential of ISO standards in driving educational excellence and research innovation in the academic sector. It suggests that collaborations of these standards with Bangladeshi academic bodies can ensure more robust and credible outcomes in research by preparing students for the global job market.

## **6. Conclusion**

Implementation of ISO standards helps organizations in strengthening sustainability and competitiveness to international markets. It's a way to measure progress and the tangible benefits like improved quality, operational efficiency, customer satisfaction etc. that these standards bring to organizations worldwide. So, evaluating the growth of ISO standards implementation is vital for future improvements to meet the evolving needs of businesses and their stakeholders. Recognizing the significance of ISO standards, this study examined the prospective growth of popular ISO standards in the context of Bangladesh. Further research is needed on the impact of ISO standards on various industries, emerging trends, and the challenges in implementing ISO standards in the country. Collaboration among businesses, academia, government agencies, and relevant organizations is crucial to facilitate ISO implementation. ISO certification can be expedited by implementing policies like financial incentives for SMEs, comprehensive training programs, regulatory alignment, industry-specific support, public awareness campaigns, consulting services, recognition programs, and continuous monitoring and improvement. Financial incentives can reduce certification costs, training programs educate businesses about ISO standards, and government procurement processes should align with ISO certifications. Public awareness campaigns, consulting services, recognition programs, and continuous monitoring can help businesses achieve and maintain ISO certifications. Policy suggestions emphasize government support for ISO certification and compliance procedures, while academics play a vital role in promoting an innovative and compliant culture.

### **6.1 Theoretical Implications**

This study offers empirical insights into the future diffusion of ISO standards in Bangladesh, a developing economy with its unique socio-economic context. Application of the Grey Forecasting Model GM (1,1) not only provides a practical forecasting tool but also advances theoretical understanding of standards adoption and diffusion dynamics in emerging markets. The findings shed light on the factors influencing ISO certifications in Bangladesh and the relevance of Grey System Theory as a theoretical framework.

### **6.2 Practical Implications**

The study provides insights for stakeholders like businesses, policymakers, and industry associations on the future trajectory of ISO certifications. It will help anticipate market trends, identify strategic opportunities, and allocate resources effectively. It emphasizes the importance of management practices and environmental sustainability initiatives for competitiveness and market access. Policymakers can use these insights for promoting standards adoption and economic development. The study also offers valuable guidance for Bangladeshi industries integrating sustainability principles into their operations, highlighting the importance of ISO standards in building trust and societal expectations in the industry.

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