*International Research Journal of Innovations in Engineering and Technology (IRJIET)*

**ISSN (online): 2581-3048**
**Volume 6, Issue 7, pp 288-291, July-2022**
https://doi.org/10.47001/IRJIET/2022.607060

# Assessing the Feasibility of Achieving Substantial Reduction of Under Five Mortality in India By 2030

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***Abstract* - This study uses annual time series data on under five mortality rate for India from 1960 to 2020 to predict future trends of U5MR over the period 2021 to 2030. Residuals and forecast evaluation criteria indicate that the applied model is stable in forecasting U5MR. The ANN (12, 12, 1) model projections indicate that U5MR will continue to decline throughout the out of sample period. Hence, we implore the Indian government to design child health policies that will reduce U5MR to levels below 25 deaths per 1000 live births and address various challenges existing in the rural areas and other disadvantaged communities across the country.**

***Keywords:*** ANN, Forecasting, U5MR

## I. INTRODUCTION

The introduction of sustainable development goals (SDGs) in September 2015 by all UN member states was a clear demonstration by all the Heads of States and governments together with Global partners that there is urgent need to solve all the challenges affecting people on this planet including ending all forms of poverty and hunger, encouraging peace and security, upholding human rights and attending to the major global health challenges (UN, 2016; UN, 2015). Global population health challenges include communicable and non-communicable diseases, maternal and child health mortalities, substance abuse, death from hazardous chemicals and road traffic accidents (UN, 2020; WHO, 19; UNICEF, 2019; UNICEF, 2019; UNICEF, 2018). In India under 5 mortality rate dropped from 83.1 deaths per 1000 live births in 2000 to 42.4 deaths per 1000 live births in 2017 whereas neonatal mortality rate (NMR) dropped from 38 deaths per 1000 live births to 23.5 deaths per 1000 live births (Thomson & Tevar, 2020). This study is being done in line with the Cape Town Global action plan and the Agenda 2030 for sustainable development to forecast future trends of under-five mortality rate for India a machine learning algorithm. The findings of the study will guide child health policy formation and implementation of effective strategies to substantially reduce under five mortality by 2030.

## II. LITERATURE REVIEW

A prospective, population-based research study carried out by Dhaded *et al*. (2020) to investigated neonatal deaths in rural Karnataka, India for the period 2014–2018.Study staff collected demographic and health care characteristics on eligible women enrolled with neonatal outcomes obtained at delivery and day 28. Cause of neonatal mortality at day 28 was assigned by algorithm using prospectively defend variables. Study results showed that infants who were preterm and low-birth weight remained at highest risk for 28-day neonatal mortality in India. A cross-sectional study by Biracyaza & Habimana (2019) investigated the significant predictors of infant mortality in Rwanda from 2011 to 2015. The survey used data from 2014/2015 Rwanda Demographic and Health Survey. Target population was women aged 15-49 years from sampled households. All 492 of the clusters selected were surveyed for 2014/2015 RDHS. STATA version 13 was used to analyze the statistical data. The study concluded that the significant predictors of IM were grouped into community, ecological, socio-economic and proximate factors and identified that each group consists of multifactor that influence the infant mortality rate. Mishra *et al.* (2019) gave a detailed presentation of how they used the ARIMA model to forecast infant mortality rates (2017 – 2025). The forecast of the sample period (1971 – 2016) showed accuracy by the selected ARIMA (2, 1, 1) model. The post-sample forecast with ARIMA (2, 1, 1) model showed a decreasing trend of infant mortality (2017 – 2025). The forecast infant mortality rate for 2025 in India is 15/1000 live births. A comparison of Pakistan's under-five mortality, neonatal mortality, and postnatal newborn care rates with those of other countries was done by Ahmed & Won (2017). Neonatal mortality rates and postnatal newborn care rates from the Demographic and Health Surveys (DHSs) of nine low- and middle-income countries (LMIC) from Asia and Africa were analyzed. The study results indicated that postnatal newborn care in Pakistan was higher compared with the rest of countries, yet its neonatal mortality remained the worst. In Zimbabwe, both mortality rates have been increasing, whereas the neonatal mortality rates in Nepal and Afghanistan remained unchanged.

## III. METHODOLOGY

The Artificial Neural Network (ANN) approach, which is flexible and capable of nonlinear modeling; will be applied in this study. The ANN is a data processing system consisting of a large number of highly interconnected processing elements in

 

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architecture inspired by the way biological nervous systems of the brain appear like. Since no explicit guidelines exist for the determination of the ANN structure, the study applies the popular ANN (12, 12, 1) model based on the hyperbolic tangent activation function. This paper applies the Artificial Neural Network (ANN) approach in predicting annual under five mortality rate for India.

**Data Issues**

This study is based on annual under five mortality rate in India for the period 1960– 2020. The out-of-sample forecast covers the period 2021– 2030. All the data employed in this research paper was gathered from the World Bank online database.

## IV. FINDINGS OF THE STUDY

ANN Model Summary

Table 1: ANN model summary

| | |
|---|---|
| Variable | X |
| Observations | 49 (After Adjusting Endpoints) |
| Neural Network Architecture: | |
| Input Layer Neurons | 12 |
| Hidden Layer Neurons | 12 |
| Output Layer Neurons | 1 |
| Activation Function | Hyperbolic Tangent Function |
| Back Propagation Learning | |
| Learning Rate | 0.005 |
| Momentum | 0.05 |
| Criteria: | |
| Error | 0.000311 |
| MSE | 0.164492 |
| MAE | 0.319432 |

Residual Analysis for the Applied Model

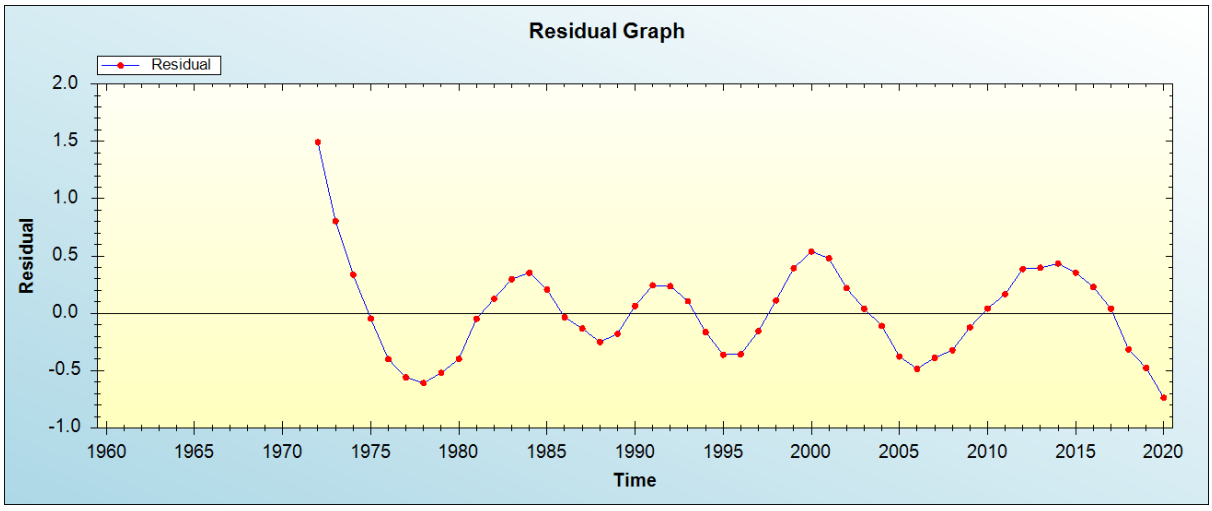


Figure 1: Residual analysis

 

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In-sample Forecast for X

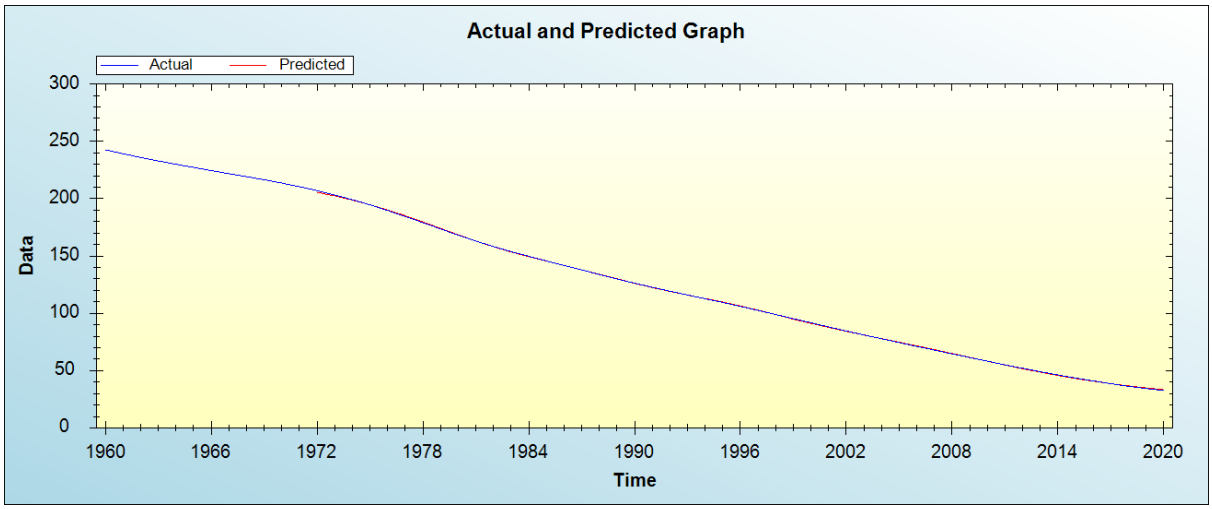


Figure 2: In-sample forecast for the X series

Out-of-Sample Forecast for X: Actual and Forecasted Graph

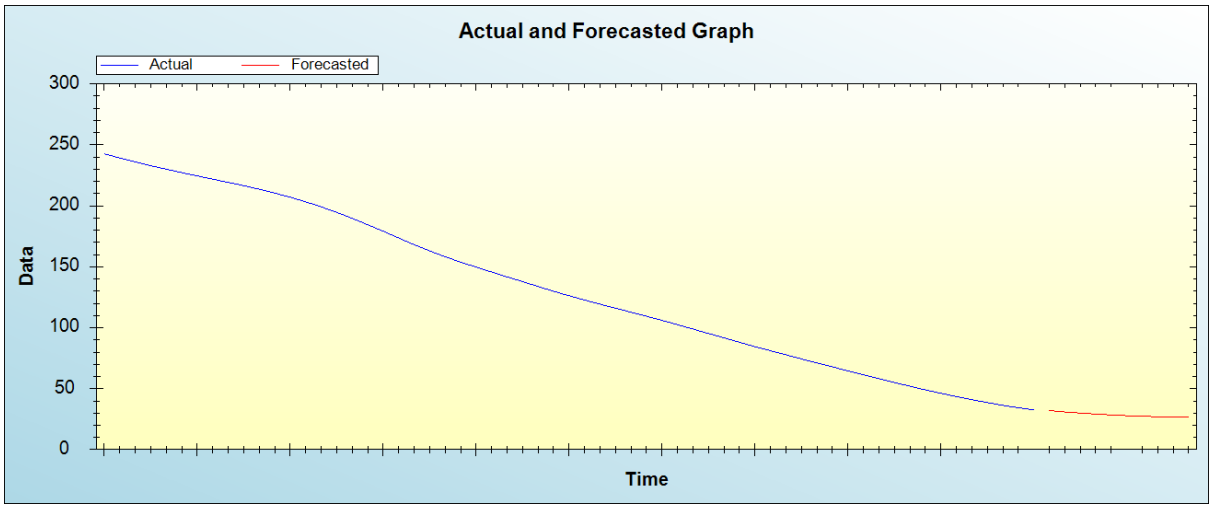


Figure 3: Out-of-sample forecast for X: actual and forecasted graph

Out-of-Sample Forecast for X: Forecasts only

Table 2: Tabulated out-of-sample forecasts

| | |
|---|---|
| 2021 | 32.0410 |
| 2022 | 30.9281 |
| 2023 | 30.0132 |
| 2024 | 29.1540 |
| 2025 | 28.4424 |
| 2026 | 27.8466 |
| 2027 | 27.3937 |
| 2028 | 27.0508 |
| 2029 | 26.7143 |
| 2030 | 26.4926 |

 

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The main results of the study are shown in table 1. It is clear that the model is stable as confirmed by evaluation criterion as well as the residual plot of the model shown in figure 1. It is projected that annual U5MR will continue to decline throughout the out of sample period.

## V. POLICY IMPLICATION & CONCLUSION

The Indian government reported a downward trend of under five mortality over the past decades as a result of the measures put by the authorities. However certain parts of the country still report high absolute numbers of under five deaths. Forecasting under five mortality rate will inform child health policies, decisions and allocation of resources. In this study we apply the multilayer perceptron to predict future trends of U5MR in India and the model projections revealed that U5MR will continue to decline throughout the out of sample period. Therefore, we encourage the Indian government to address all the various challenges faced by under five children in the rural areas and other disadvantaged communities.

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**Citation of this Article:**

Dr. Smartson. P. NYONI, Thabani NYONI, "Assessing the Feasibility of Achieving Substantial Reduction of Under Five Mortality in India By 2030 " Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 6, Issue 7, pp 288-291, July 2022. Article DOI https://doi.org/10.47001/IRJIET/2022.607060

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