

# Forecasting Total Fertility Rate (TFR) In Somalia

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**Abstract - In this research paper, the ANN approach was applied to analyze TFR in Somalia. The employed annual data covers the period 1960-2018 and the out-of-sample period ranges over the period 2019-2030. The residuals and forecast evaluation criteria (Error, MSE and MAE) of the applied model indicate that the model is stable in forecasting TFR in Somalia. The results of the study indicate that annual total fertility rates in Somalia are likely to remain around 6 births per woman over the out-of-sample period. Therefore, the government of Somalia should focus on creating demand for sexual and reproductive health (SRH) services, address challenges encountered by adolescents and young adults when seeking family planning services and scale up women empowerment program activities.**

**Keywords:** ANN, Forecasting, Total fertility rate (TFR).

## I. INTRODUCTION

Somalia has been characterized by civil war and conflict which began in 1991 leaving the majority of the population without basic health services because of destruction of infrastructure and displacement of scores of people (WHO, 2013; Human rights watch, 2014). Access to health services such as SRH services has been limited with many women failing to access family planning services (WHO, 2013). High rates of sexual abuse of women and gender based violence has been reported in conflict zones such as Somalia (RHRCC, 2014). Rape has been reported as a weapon of war (Human rights watch, 2014; WHO, 2014). Somalia's fertility is regarded as one of the highest in the world and reported to be 6.7 births per woman (WHO, 2013; Gogineni, 2012). Furthermore, the country is regarded as one of the countries in the world with very high infant and child mortality rates. In 2020 the country reported an infant mortality rate of 62.8 infant deaths per 1000 live births and under five mortality rate of 104.6 deaths per 1000 live births (Worldometer, 2020). Based on qualitative study, Egeh et al (2019) investigated Somali Islamic religious leaders' views on birth spacing. Qualitative individual interviews were conducted with 17 Somali Islamic religious leaders aged 28–59 years and analyzed through content analysis. The study results indicated that according to the religious Islamic leaders, selected practice recommendations for contraceptive use is permitted in relation to birth spacing to promote the health of the mother and child. Based on cross-sectional survey, Kågesten et al (2017) described the characteristics of VYA (very young adolescents) aged 10-14 years in two humanitarian settings, focusing on transitions into puberty and access to SRH information. Their findings revealed that Parents/guardians were the most common source of SRH information in both sites, however VYA indicated that they would like more information from friends, siblings, teachers and health workers. Gure et al (2015) did a qualitative study to explore women's reproductive health knowledge and experiences. In 2014, the study conducted four focus group discussions with 21 married and unmarried women of reproductive age living in Mogadishu, Somalia. The findings of the study highlighted that misinformation, restrictive policies, mistrust of clinicians, and prohibitively expensive services shape women's experiences and health-seeking behaviors.

The aim of this study is to project TFR in Somalia using a machine learning approach. The results of the study are expected to highlight the likely fertility trends in Somalia in the out of sample period. This will guide policy, planning and allocation of resources for health, education and employment creation.

## II. 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 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 total fertility rates in Somalia.

**Data Issues**

This study is based on annual total fertility rate (births per woman) in Somalia for the period 1960 – 2018. The out-of-sample forecast covers the period 2019 – 2030. All the data employed in this research paper was gathered from the World Bank online database.

**III. FINDINGS OF THE STUDY**

**ANN Model Summary**

Table 1: ANN model summary

Variable	S
Observations	47 (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	0.073522
MSE	0.004271
MAE	0.054484

*Residual Analysis for the Applied Model*

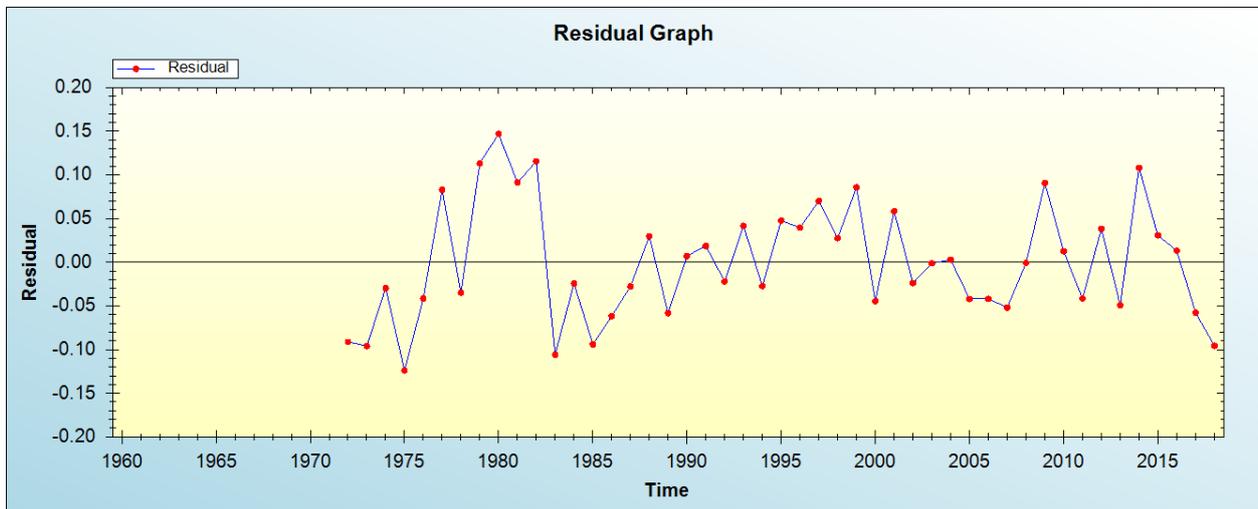


Figure 1: Residual analysis

*In-sample Forecast for S*

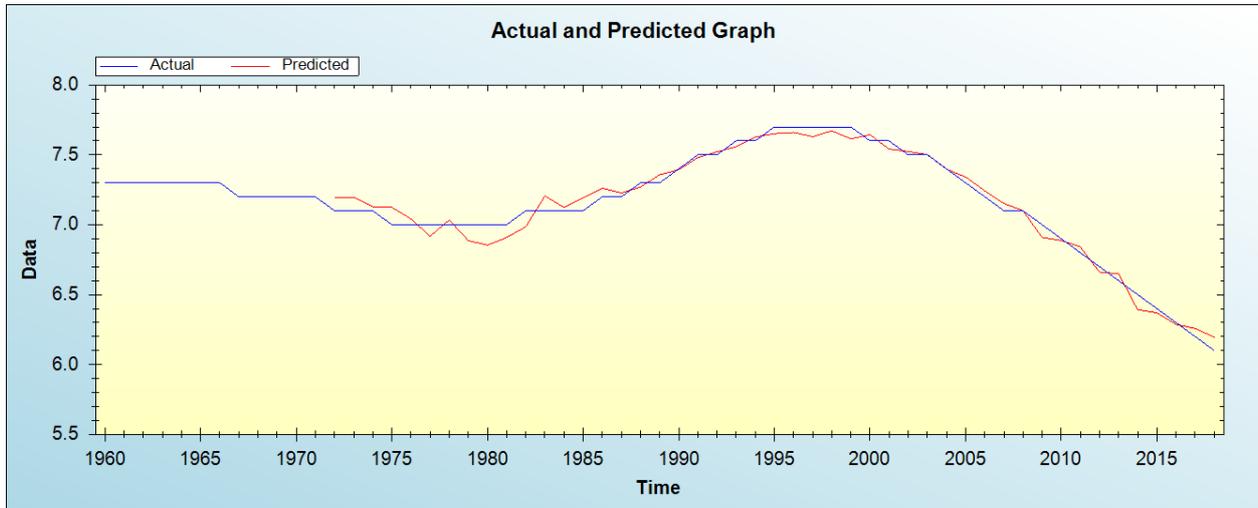


Figure 2: In-sample forecast for the S series

*Out-of-Sample Forecast for S: Actual and Forecasted Graph*

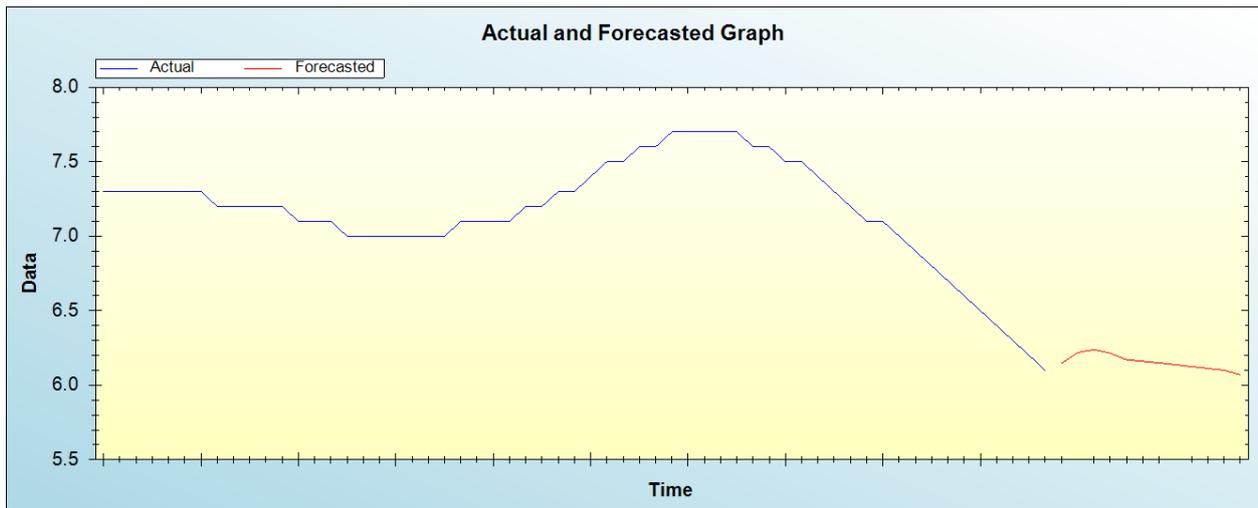


Figure 3: Out-of-sample forecast for S: actual and forecasted graph

*Out-of-Sample Forecast for E: Forecasts only*

Table 2: Tabulated out-of-sample forecasts

Year	Forecasts
2019	6.1468
2020	6.2195
2021	6.2399
2022	6.2146
2023	6.1714
2024	6.1608
2025	6.1497
2026	6.1376
2027	6.1254
2028	6.1128
2029	6.1002
2030	6.0698

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 total fertility rates in Somalia are likely to remain around 6 births per woman over the out-of-sample period.

#### IV. CONCLUSION & RECOMMENDATIONS

Somalia's total fertility rate is one of the highest in the world and this paper proposes to apply a machine learning approach to predict total fertility rate in Somalia. The findings revealed that annual total fertility rates in Somalia are likely to remain around 6 births per woman over the out-of-sample period. Therefore, the Somali government is encouraged to focus on creating demand for sexual and reproductive health (SRH) services, addressing challenges encountered by adolescents and young adults when seeking family planning services and scale up women empowerment program activities.

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