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Machine Learning Approach in Forecasting Adolescent Fertility for Somalia

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***Abstract* - This study employs annual time series data on adolescent fertility rate for Somalia from 1960 to 2020 to predict future trends of adolescent fertility rate over the period 2021 to 2030. The forecast evaluation criteria of the applied model indicate that the ANN (12, 12, 1) model is stable in forecasting adolescent fertility rate. The neural network model projections revealed that adolescent fertility is expected to rise and also remain very high throughout the out of sample period. Therefore, we encourage authorities in Somalia to strictly enforce laws that safeguard sexual and reproductive health rights of women and girls, promote girl child education, fund empowerment programs for youths and provide accessible and affordable quality adolescent health care services.**

Keywords: ANN, Forecasting, adolescent fertility rate.

I. INTRODUCTION

The adolescence stage is a challenging phase for many teenagers as it is defined by many physiological and psychological changes. If these changes are not managed very well, adolescents end up indulging in unprotected premarital sex which exposes them to STIs, HIV, unintended pregnancy and unsafe abortions. Many adolescent girls in low-middle income countries lack adequate knowledge on sexual and reproductive health information and rights ((Braeken & Rondinelli, 2012; Kennedy *et al.* 2011; Crawford *et al.* 2009; Wilson *et al.* 1994). The main causes of teen pregnancy are peer pressure, religious beliefs, hunger, civil conflict, economic crisis and poverty leading to "gold rush" in illegal mining communities that promote commercial sex-work. Teenage pregnancy brings adverse sexual and reproductive health outcomes to the mother, baby and family as a whole. Maternal and child morbidity and mortality occur as a result of pregnancy complications such as eclampsia, pre-eclampsia, mental stress, sepsis, preterm labor and low birth weight (Kassa *et al.* 2019; Kassa *et al.* 2018; WHO, 2015). The 1994 International Conference on Population and development held in Egypt was organized by UNFPA to advance gender equality and women empowerment (UN, 1995). The agenda was to initiate the motion on addressing sexual and reproductive health issues for every individual or couple. Every individual has a right to choose a partner of his/her own, decide the number, birth spacing and timing of the births. Ending sexual abuse and violence against women is a huge step towards protecting women's rights. According to the Agenda 2030 for sustainable development, all UN member countries should demonstrate commitment towards eliminating harmful cultural practices and end child marriages as outlined in SDG-5(UN, 2020; UNICEF, 2019; WHO, 2019; UNICEF, 2018; UN, 2016; UN, 2015). Strategies to achieve this should be implemented as quickly as possible before 2030. In addition, governments should set aside resources to promote girl child education especially in low-middle income countries as a way to delay age at marriage and preparing them for better jobs for them to earn a living to take care of their children.

In line with Agenda 2030 for sustainable development, this paper utilizes a machine learning algorithm to forecast future trends of adolescent fertility for Somalia. The findings of this study are envisioned to depict the future burden of adolescent births in this country. This will enable review of current policies and legal instruments to make sure that they meet international standards in order to protect women's sexual and reproductive health rights.

II. LITERATURE REVIEW

Author (s)	Topic	Objectives	Methodology	Main Findings
Ahinkorah et al. (2022)	Prevention of Adolescent Pregnancy in Anglophone Sub-Saharan Africa: A	to identify and review national policies on the prevention of adolescent	Systematic review	Most policies acknowledged the importance of coordination and collaboration

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	Scoping Review of National Policies	pregnancy in Anglophone sub-Saharan Africa		among public and private actors. All policies had objectives that addressed adolescent pregnancy but none were measurable or included timeframes
Noori et al. (2022)	The Effect of Adolescent Pregnancy on Child Mortality in 46 Low- and Middle-Income Countries	To examine the association between maternal age and stillbirths, and neonatal mortality rate (NNMR), infant mortality rate (IMR) and under- 5 mortality rate	analyzed Demographic and Health Surveys data from 2004 to 2018 in sub- Saharan Africa (SSA) and South Asia, on firstborn children of mothers 25 years old or younger	Adolescent pregnancy is associated with dramatically worse child survival and mitigated by health-seeking behavior, likely reflecting a combination of biological and social factors
Worku et al. ((2021)	Prevalence and associated factors of adolescent pregnancy (15–19 years) in East Africa: a multilevel analysis	To investigate the prevalence and associated factors of adolescent pregnancy in Eastern Africa.	multilevel binary logistic regression analysis was fitted to identify the significantly associated factors of adolescent pregnancy	Age, contraceptive utilization, marital status, working status, household wealth status, community-level contraceptive utilization, age at initiation of sex, media exposure, educational level and relation to the household head were associated with adolescent pregnancy
Yakubu & Salisu (2018)	Determinants of adolescent pregnancy in sub-Saharan Africa: a systematic review	to identify factors influencing adolescent pregnancies in sub-Saharan Africa in order to design appropriate intervention program	Mixed methods study: Qualitative and cross-sectional studies intended to assess factors influencing adolescent pregnancies as the primary outcome variable in sub-Saharan Africa	High levels of adolescent pregnancies in Sub-Saharan Africa is attributable to multiple factors. Our study, however, categorized these factors into three major themes; sociocultural and economic, individual, and health service

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				related factors as influencing adolescent pregnancies
Kassa et al. (2018)	Prevalence and determinants of adolescent pregnancy in Africa: a systematic review and Meta-analysis	to estimate the prevalence and sociodemographic determinant factors of adolescent pregnancy using the available published and unpublished studies carried out in African countries	systematic review and meta-analysis of published and unpublished studies in Africa	Overall, nearly one-fifth of adolescents become pregnant in Africa. Several sociodemographic factors like residence, marital status, educational status of adolescents, their mother's and father's, and parent to adolescent SRH communication were associated with adolescent pregnancy

III. METHODOLOGY

The Artificial Neural Network (ANN) approach, which is flexible and capable of nonlinear modelling; 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 adolescent fertility for Somalia.

Data Issues

This study is based on annual adolescent fertility rate in Somalia 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	S
Observations	
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:	

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Error	0.013865
MSE	0.850407
MAE	0.689912

Residual Analysis for the Applied Model

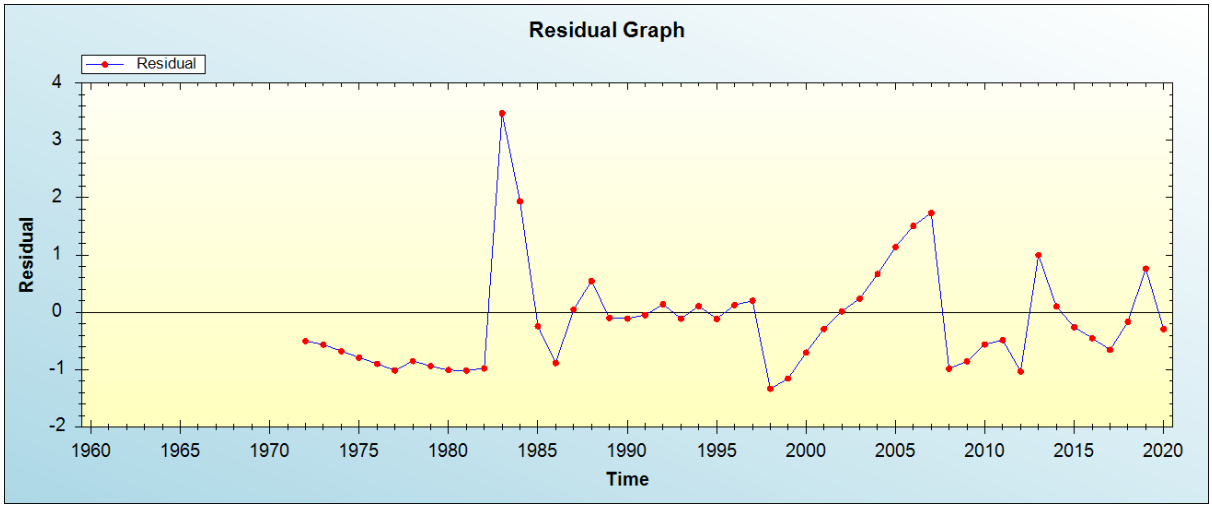

Figure 1: Residual analysis

In-sample Forecast for S

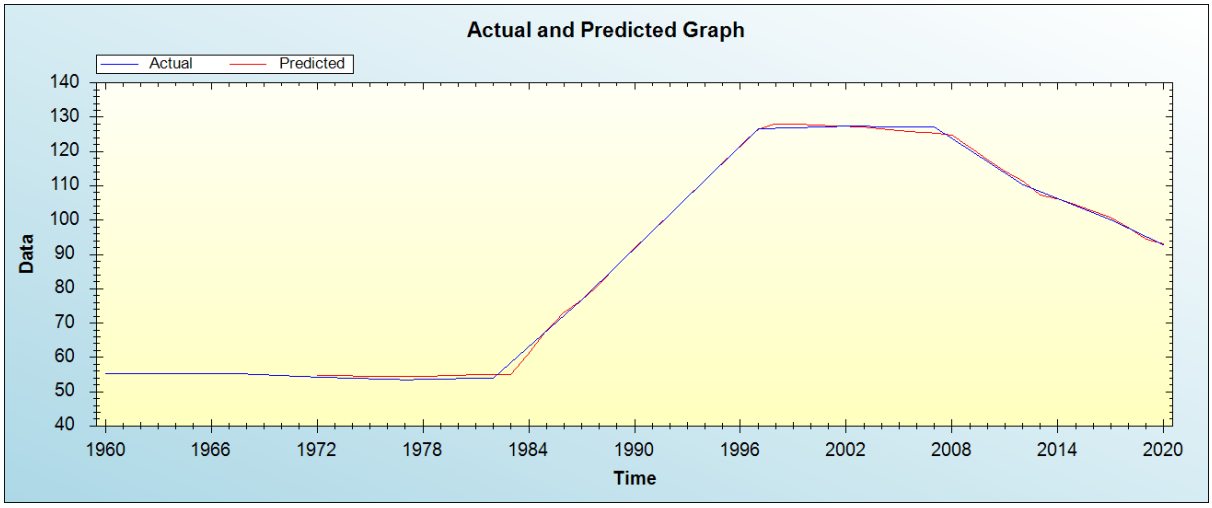

Figure 2: In-sample forecast for the S series

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

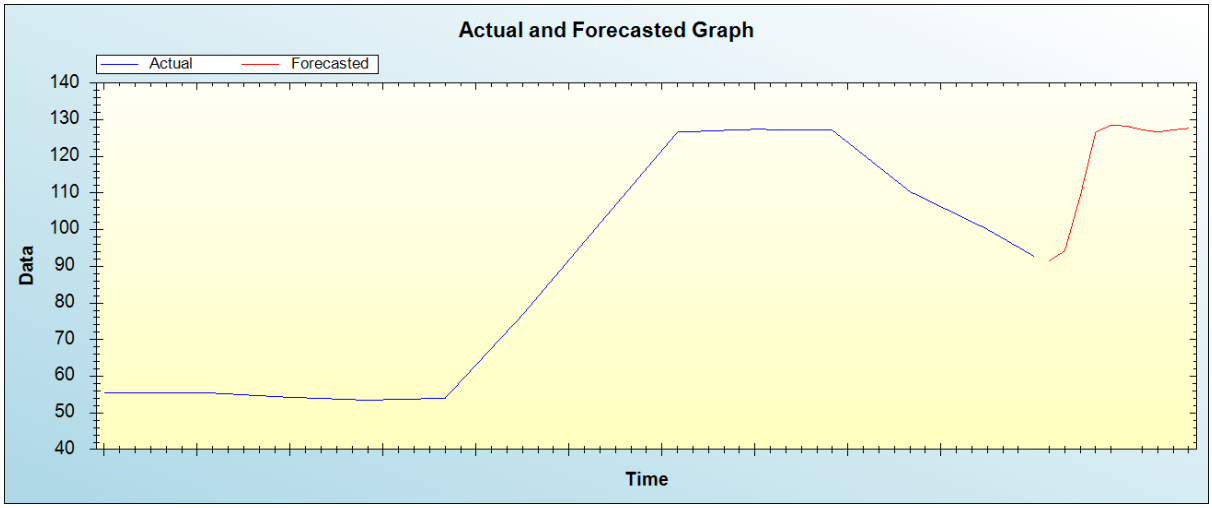

Figure 3: Out-of-sample forecast for S: actual and forecasted graph

Out-of-Sample Forecast for S: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasted adolescent fertility rate
2021	91.5091
2022	94.2160
2023	109.1923
2024	126.6511
2025	128.5530
2026	128.2312
2027	127.2411
2028	126.6260
2029	127.2256
2030	127.6216

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 adolescent fertility rate is expected to increase and remain very high throughout the out of sample period.

V. POLICY IMPLICATION & CONCLUSION

Adolescent fertility in Somalia remains very high despite huge efforts to reduce teenage pregnancy and child births. There was a decline in adolescent fertility from 127 births per 1000 women aged 15-19 years in 2007 to 92 births per 1000 women aged 15-19 years in 2020. This study applied an artificial neural network approach to forecast future trends of adolescent fertility for Somalia. The ANN (12, 12, 1) model projections revealed that adolescent fertility will likely increase and remain very high throughout the out of sample period. Therefore, we encourage the Somali government to strictly enforce laws that safeguard sexual and reproductive health rights of women and girls, promote girl child education, fund empowerment programs for youths and provide accessible and affordable quality adolescent health care services.

REFERENCES

[1] UNICEF (2019). Levels and trends in child mortality: report 2019. Estimates developed by the UN Inter-agency Group for child mortality estimation. New York: UNICEF.

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Volume 7, Issue 2, pp 355-360, February-2023
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[2] Kassa G. M., Arowojolu AO., Odukogbe A. A., and Yalew A. W (2018). Prevalence and determinants of adolescent pregnancy in Africa: a systematic review and Meta-analysis. Reprod Health. 2018; 15:195.
[3] Kassa G. M., Arowojolu A.O., Odukogbe A-TA., and Yalew AW (2019). Trends and determinants of teenage childbearing in Ethiopia: evidence from the 2000 to 2016 demographic and health surveys. Ital JPediatr. 45:153, pp 20-24.
[4] World Health Organization (2015). Adolescent pregnancy situation in South-East Asia region. WHO Regional Office for South-East Asia.
[5] Kennedy E., Gray N., Azzopardi P., & Creati M (2011). Adolescent fertility and family planning in East Asia and the Pacific: a review of DHS reports. Reprod Health. 2011; 8:11.
[6] Crawford T.V., McGrowder DA., & Crawford A (2009). Access to contraception by minors in Jamaica: a public health concern. N Am J Med Sci, 1(5):247–55.
[7] Braeken D., & Rondinelli I (2012). Sexual and reproductive health needs of young people: matching needs with systems. Int J Gynaecol Obstet, 119(Suppl 1):S60–3.
[8] Wilson S., Daniel S., Pearson J., Hopton C., & Madeley R (1994). An evaluation of a new teenage clinic and its impact on teenage conceptions in Nottingham from 1986 to 1992. Contraception, 50(1):77–86.
[9] United Nations. (2015). transforming our world: The 2030 agenda for sustainable development, A/RES/70/1. New York: UN General Assembly.
[10] UN (2020) sustainable development goals. https://www.un.org/sustainabl development/development-agenda
[11] UNICEF (2018). Every Child alive. New York: UNICEF
[12] World Health Organization (WHO) (2019). SDG 3: Ensure healthy lives and promote wellbeing for all at all ages.
[13] United Nations (2016). Transforming our world: The 2030 agenda for sustainable development.
[14] United Nations (1995). United Nations International Conference on Population and Development, Cairo 5-13 September, 1994. Programme of Action. New York: United Nations, Department for Economic and Social Information and Policy Analysis.

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