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Water and sanitation status of Bangladesh: Trends and prediction

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ABSTRACT

Improving global access to safe drinking water and hygienic sanitation is one of the least expensive and most effective means to improve public health and quality of life. Safe drinking water is a right and proper sanitation is a dignity of the citizen. To ensure sound human health and sustainable environmental condition good management of freshwater sources and access to safe water and safe sanitation are necessary. Though there is no lack of water sources, access to safe drinking water in Bangladesh is still not in optimum level. This puts the health of people at risk of diseases such as cholera, diarrhoea, dysentery, hepatitis A and typhoid. This study analyzes historical records of Bangladesh regarding access to safe drinking water and hygienic sanitation and make prediction with a view to achievement of sustainable development goals (SDG). Yearly data used in this study was collected from World Bank dataset. Trend analysis technique and Autoregressive Integrated Moving Average (ARIMA) models were used to forecast the future scenario of percentages of population with access to improved water and sanitation. This study exposes that percentage of people having access to safe drinking water and hygienic sanitation of Bangladesh follows a linear increasing trend. However, the rates of increasing need to be speeded up to reach SDG target by 2030. Forecasts from the trend models accompanied with ARIMA specifications reveal that in 2030, about 98% and 75% people of Bangladesh would have access to safe drinking water and hygienic sanitation respectively.

Keywords: Safe drinking water; hygienic sanitation; sustainable development goals; trend analysis; ARIMA model.

INTRODUCTION

Safe drinking water and sanitation are fundamental to an improved standard of living, including the protection of health and the environment, improved educational outcomes, greater convenience, dignity and gender equality. Poor and vulnerable populations have lower access to improved water and sanitation services and poorer associated behaviors. In contrast, improvement in water supply and sanitation has an important impact on a wide variety of infectious diseases, and could improve the quality of life of millions of children worldwide, and provide them a proper start in life. Safe drinking water and hygienic sanitation can reduce diarrhoeal disease, one of the foremost causes of child mortality. Thus, intervention on safe drinking water, sanitation and hygiene gives positive result to improve the public health (Brown *et al*., 2013; Tofail *et al.*, 2018; Wolf *et al.*, 2018; Freeman *et al.*, 2017). In order to ensure adequate standard of living with dignity and sound health, United Nations Human Rights Council recognize clean drinking water and sanitation as a human right (WHO and UNICEF, 2012).Access to safe drinking water and sanitation is among the targets of Millennium Development Goals (MDGs) and eventually, that is included in the Sustainable Development Goals (SDGs) (Mara and Evans, 2018; Hutton and Varughese, 2016; Hutton and Chase, 2016).

To meet the water and sanitation target related to SDG-6 by 2030, a large number of people around the world need access to safe drinking water and sanitation (Mara and Evans, 2018). In 2012, the joint water and sanitation monitoring program reported that according to 2010 estimates, population without access to safe drinking water had been reduced by 50%, and the world had met the MDG target, but these global estimates mask regional disparities and inequities in access between urban and rural populations. Sixteen percent of rural dwellers remain unserved, compared with 4% of urban dwellers (WHO and UNICEF, 2012). Globally, use of improved drinking water sources has increased from 76% in 1990 to 91% in 2015. On the other hand, use of improved sanitation has increased from 54% in 1990 to 68% in 2015 (WHO and UNICEF, 2015). In urban areas, 82% of urban dwellers have access to improved sanitation compared to 51% of rural dwellers. Open excretion practiced by population in the world declined from 24% in 1990 to 13% in 2015. However, 638 million people (9%) share their sanitation facility with another family or families (Blackett *et al*., 2014; Peal *et al.*, 2015).

In Bangladesh both government and non-government organizations are active to achieve target of SDGs associated to water and sanitation. However, arsenic contamination, ground water depletion, salinity, flood, drought and coastal climate are major constraints to ensure safe drinking water for 100% of her population (Abedin *et al*., 2014). Bangladesh has also made significant improvement in sanitation; open defecation has been reduced by 33 percent from 1990 to 2015 (WHO and UNICEF, 2015). Yet, the current rate of improved sanitation is 61 percent (World Bank, 2016). People with disabilities may not have poorer access to safe water and improved sanitation at the household level, but may have poorer quality of access within their households. Households including a person with a disability were more likely to share facilities with other households (Mactaggart *et al.*, 2018). This study assesses the achievement of water and sanitation related target of SDG-6. It is intended to determining the future scenario of them.

MATERIALS AND METHODS

This study is primarily based on a secondary data. The yearly dataset used in this study is freely available from the World Bank Data archive of Health, Nutrition and Population Data and Statistics category spanned from 1990 to 2014 (w.w.w.data.worldbank.org/topic/health).

The methodology involved trend analysis techniques to observe the trends in selected safe drinking water and hygienic sanitation indicators of Bangladesh and ARIMA forecasting to predict the future scenario of these health indicators.

TREND ANALYSIS AND FORECASTING

Safe Drinking water

The upper panel of Fig. 1 shows the observed and trend of access to safe drinking water in Bangladesh for the period 1990 to 2015. One can observe that a linearly increasing trend model fits the series. The fitted trend model with an ARIMA specification is given in equation (1) and (2). The diagnosis plot in Fig. 2 shows that the standardized residuals are within limit of3 and the autocorrelation functions (ACFs) are not statistically significant meaning that the fitted trend model and ARIMA specification is adequate. The six-year ahead forecast is displayed in lower panel of Fig. 1.1. It shows an increasing trend of safe drinking water in Bangladesh in the following years. The rate of increase is estimated as 0.76 indicating that every one year 0.76% of inhabitants would be added to population who has access to safe drinking water. In 2015, the percentage of population having access to safe drinking water is observed as 86.90 and it is predicted as 91.32 in 2021.

Trend Model:

$$Y_t = 67.57 + 0.76\,t \tag{1}$$

p-value:<0.01   <0.01

R^2: 0.9993

ARIMA model for residuals of the trend model:

$$\nabla e_t = 0.24\nabla e_{t-1} + 0.11\nabla e_{t-2} + 0.19\nabla e_{t-3} + \varepsilon_t \tag{2}$$
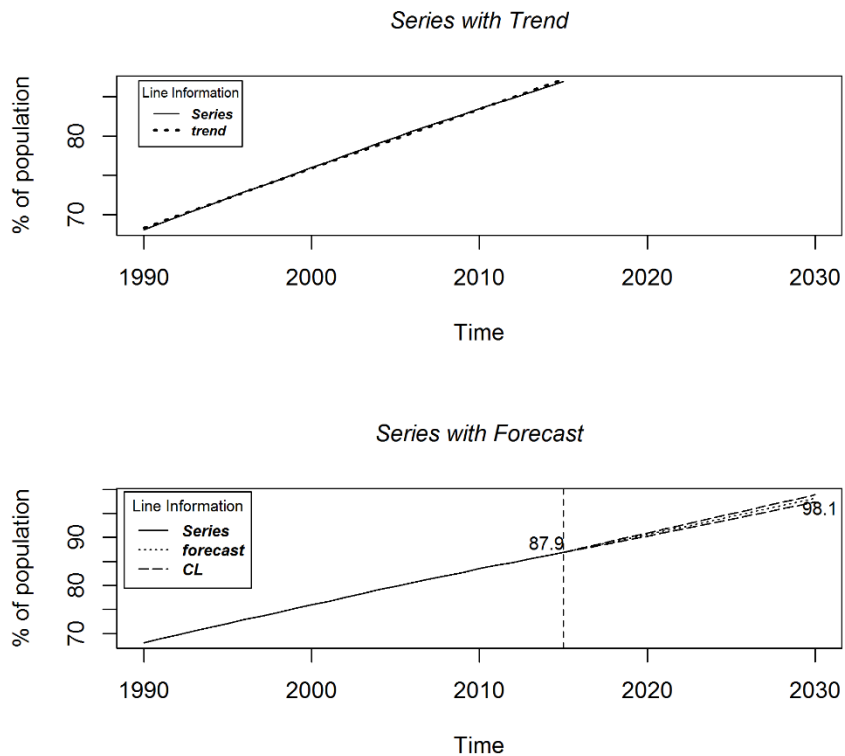
S.E: 0.19   0.20   0.20

Fig. 1: Trend and forecast of percentage of population in Bangladesh having access to safe drinking water.
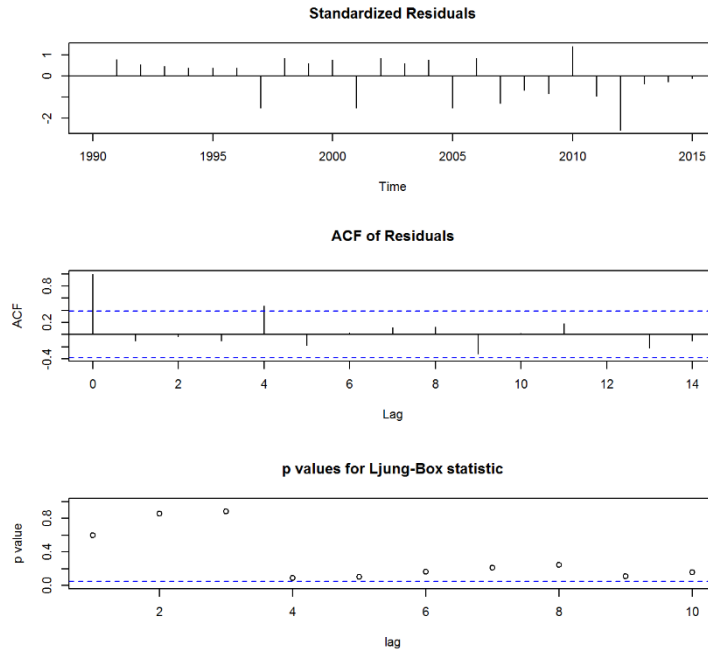
Fig. 2: Residual diagnosis of model for safe drinking water in Bangladesh

Hygienic sanitation

The upper panel of Fig. 3 shows the observed and trend of access to hygienic sanitation in Bangladesh for the period 1990 to 2015. Once again it is observed that a linearly increasing trend model fits the series. The fitted trend model with an ARIMA specification is given in equations (3) and (4). The estimated equations can be treated adequate since the diagnosis plot in Fig. 4 shows that standardized residuals are limited within 3and ACFs are not statistically significant. The six-year ahead forecast is displayed in lower panel of Fig. 3. It shows that the trend of hygienic sanitation in Bangladesh in the following years is increasing. The rate of increase is estimated as 1.049 meaning that in every one year access to hygienic sanitation will increase by 1.05%. The predicted percentage of population in Bangladesh having access to hygienic sanitation in 2021 is 66.32, while it was observed as 60.60 in 2015.

Trend Model:

$$Y_t \quad = \quad 33.73 + 1.05t \tag{3}$$
p-value: <0.01   <0.01
R^2: 0.9994

ARIMA model for residuals of the trend model:

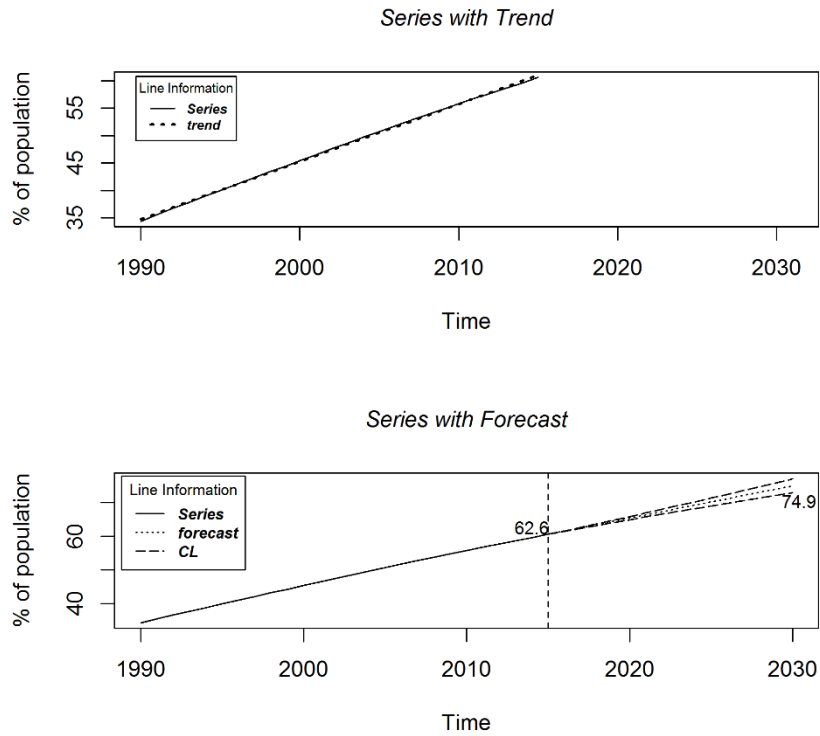$$\nabla^2 e_t = -0.76 \nabla^2 e_{t-1} + \varepsilon_t \tag{4}$$
S.E: 0.14

Series with Trend

Series with Forecast

Fig. 3: Trend and forecast of percentage of population in Bangladesh having access to hygienic sanitation.

Standardized Residuals

ACF of Residuals
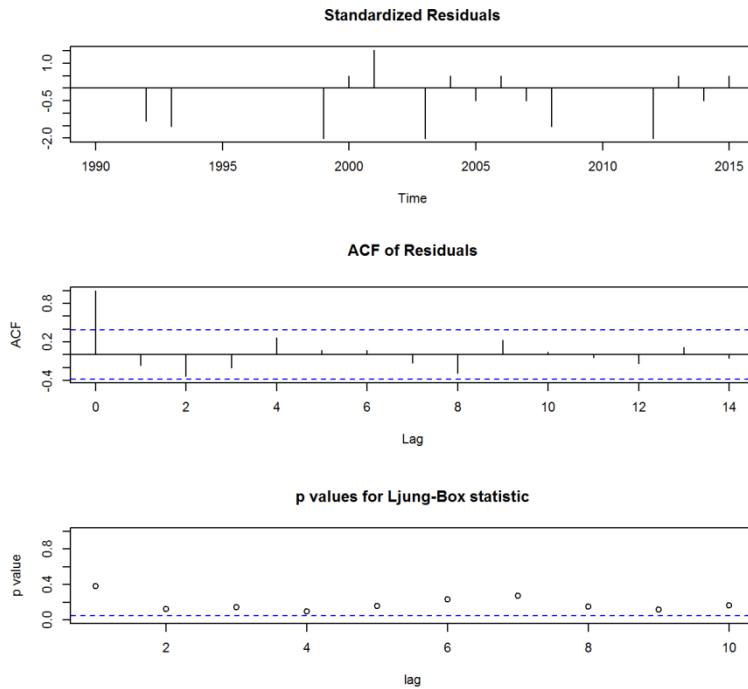
p values for Ljung-Box statistic

Fig. 4: Residual diagnosis of model for hygienic sanitation in Bangladesh

CONCLUSION

Being a developing country Bangladesh achieved noticeable improvement in the area of water and sanitation over past few decades. The study revealed that access to safe drinking water and hygienic sanitation rate shows growing trend in Bangladesh. The current trend and future prediction of these indicators considered in this study support satisfactory development and Bangladesh is on a track to reach national target. However, at present and in near future, a noticeable proportion of her people would be away from the coverage of these two basic public facilities. The rate of increase is not good enough to achieve related SDG targets by 2030. Drinking unsafe water and unhealthy sanitation are risk factors of various kinds of health hazards, specifically water-borne diseases. To meet sustainable development goals and thereby build a healthier, stronger, and decent society, effective policy implementation and continuous monitoring on this issue is necessary. This study is limited to national achievement in the area of water and sanitation. However, scenario of water and sanitation in rural area of Bangladesh may differ significantly from that in urban area. Evaluating trend with consideration of urban-rural disparity in these issues is an interesting topic of future study.

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