Sustainable Development in Water Quality Assessment: Data for Khadakwasla Dam, Pune

Mohnish M. Waikar and Parag Sadgir

Abstract The study represents data collection and analysis of the water quality index (WQI) and different parameters considered for calculating water quality index in Khadakwasla dam which is located in Pune district. The dam is major contributor of fresh water in Pune city, and thus, the analysis of the water in Khadakwasla dam is crucial as water for the urban and rural areas as well as for industries is supplied through canals of Khadakwasla dam. The data is acquired and analysed for the study of variation of water quality index, and results were obtained for the year 2011 to 2021. Data is tabulated, and graphs are plotted for better understanding the variation in the data. Precipitation data is also studied for the variation of quality of water and interrelation of precipitation and water quality can be seen from tables and graphs.

Keywords Water quality · Water quality index · Sustainable development · Data

1 Introduction

Khadakwasla dam is primary source of water in Pune district. Built in 1869 the dam has a capacity of 1.96 TMC (Thousand Million Cubic feet) and is in the downstream of Panshet and Varasgaon Dam. The deterioration of water quality is caused by a growing population, declining usable water resources, increasing rates of usage, global climate change, and a variety of other factors (Bora and Goswami 2017). These sources are, for the most part, made unfit for human eating and other human activity. The minimum needed flow within the river is not maintained at numerous locations due to dry season circumstances and limited releases from dams along the downstream river stretch during dry months. Water shortage is exacerbated by deteriorating water quality and a scarcity of supply, which puts the environment under

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stress (Shah and Joshi 2017). As a result, the efficient and effective management of water resources is becoming increasingly crucial (Arief Dhany Sutadian et al. 2016).

The water quality index is one way for determining the quality of river water (Ichwana et al. 2016). It has been proved to be an effective and practical tool for analysing water quality. This technique provides policymakers with a sense of the overall quality of water. The purpose of this study is to construct a WQI to analyse the quality of water of the Khadakwasla dam and its water quality status (Water Quality Index).

2 Water Quality Assessment

Water quality assessment differs with respect to fresh water and wastewater. Our study includes the fresh water that is to be supplied in Pune city and downstream, so the quality assessment of water is done with respect to freshwater study only. The water quality index (WQI) is an important tool to determine the drinking water quality in urban, rural and industrial area (Ichwana et al. 2016). WQI is described as an index that reflects the combined impact of several water quality characteristics that are taken into account and used to calculate the water quality index.

Factors considered in the calculation of water quality index

i. pH-If the pH of the water is too high or too low, sea creatures living in it will perish. The pH of water affects the stability and hazard of chemicals and heavy metals. Although most marine animals require a pH of 6.5 to 9.0, some may thrive in water with a pH higher than that (Gupta et al. 2017).
ii. Dissolved Oxygen-Dissolved oxygen is oxygen that has been dissolved in water. The greater the quantity of D.O. of water, the better the quality. The growth potential of aquatic organisms is lowered when dissolved oxygen is depleted (Lkr et al. 2020).
iii. Bio-Chemical Oxygen Demand-Bio-chemical oxygen demand generally known as BOD is one of the prominent parameters which reflects the quality of water by giving the oxygen demand required to disintegrate the amount of organic contaminants present in the water that is to be tested (Bora and Goswami 2017). This BOD is analogous to water quality and can be treated as same as it consumes oxygen from water, i.e. dissolved oxygen, and hence, if the oxygen level in water depletes, the aquatic life may disrupt.
iv. Chemical Oxygen Demand-The test is used to evaluate the amount of organic matter that can be oxidised in an acid solution by a powerful chemical oxidising agent (potassium dichromate). For describing water bodies, sewage, industrial pollutants and treatment plant effluents, it is a significant and quickly measurable characteristic (Prabhakar et al. 2018).
v. Nitrate-Nitrogen mixes with oxygen to generate NO3—when bacteria break down ammonia, urea, or proteins. This reduces the amount of dissolved oxygen

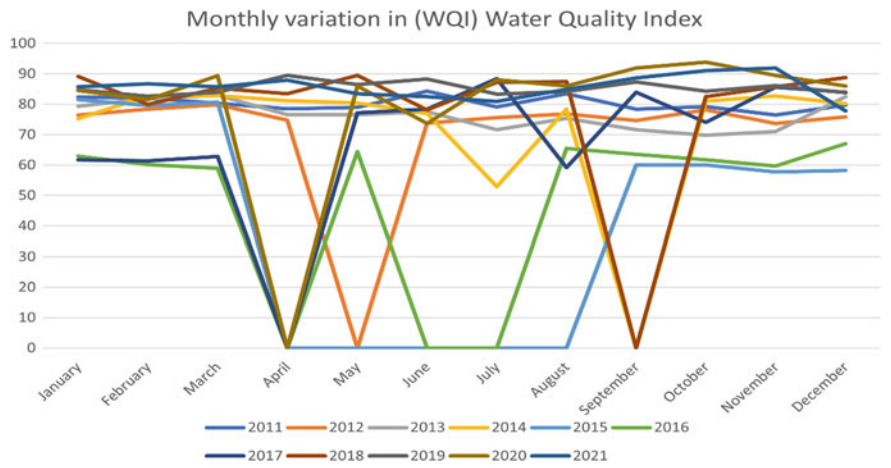

Fig. 1 Monthly variation in WQI

in the water, which can result in dead zones for any species that rely on oxygen to exist (Lkr et al. 2020).

vi. Faecal Coliform-Faecal coliform bacteria suggest that a stream has been contaminated with sewage and that other harmful organisms may be present (Fig. 1).

3 Methodology

1. Data collection

   The data for analysis of WQI is collected from Maharashtra Pollution Control Board (MPCB) website, and the information for the precipitation is collected from Maharashtra Rainfall and recording website, and then, the analysis is carried out.

2. Data processing

   Different metrics of the Khadakwasla Dam's data were observed, processed in excel sheets, and shown as graphs. For each year, monthly data is provided, which is then analysed, and a consolidated graph for the years 2011–2021 is shown.

Table 1 WQI classification and colour code

WQI	Quality classification	Remarks	Colour code
63-100	Good to Excellent	Non-Polluted	
50-63	Medium to Good	Non-Polluted	
38-50	Bad	Polluted	
38 and less	Bad to very Bad	Heavily Polluted	

The monthly study of precipitation data includes an analysis of how it relates to WQI.

3. Variation analysis

It has been noted that after the monsoon, the water quality improves due to the arrival of freshwater, but after winter, the water quality declines because in the summer, water contaminants become concentrated due to evaporation loss, and the oxygen level is found to be lower (Table 1).

Graphical representation of yearly data:
See Figs. 2 and 3.

4 Discussion

As we can see from the precipitation chart, due to decrease in rainfall in 2014, there is decrease in water quality, and in 2015, there is enough rainfall but due the rapid industrialisation, the discharged effluents from the factories, etc., have polluted the river making quality to moderate, and in 2016, the rainfall is once again reduced deteriorating the quality which is made up after the monsoon of 2016, and water quality once again increases as water input is consistent thereafter.

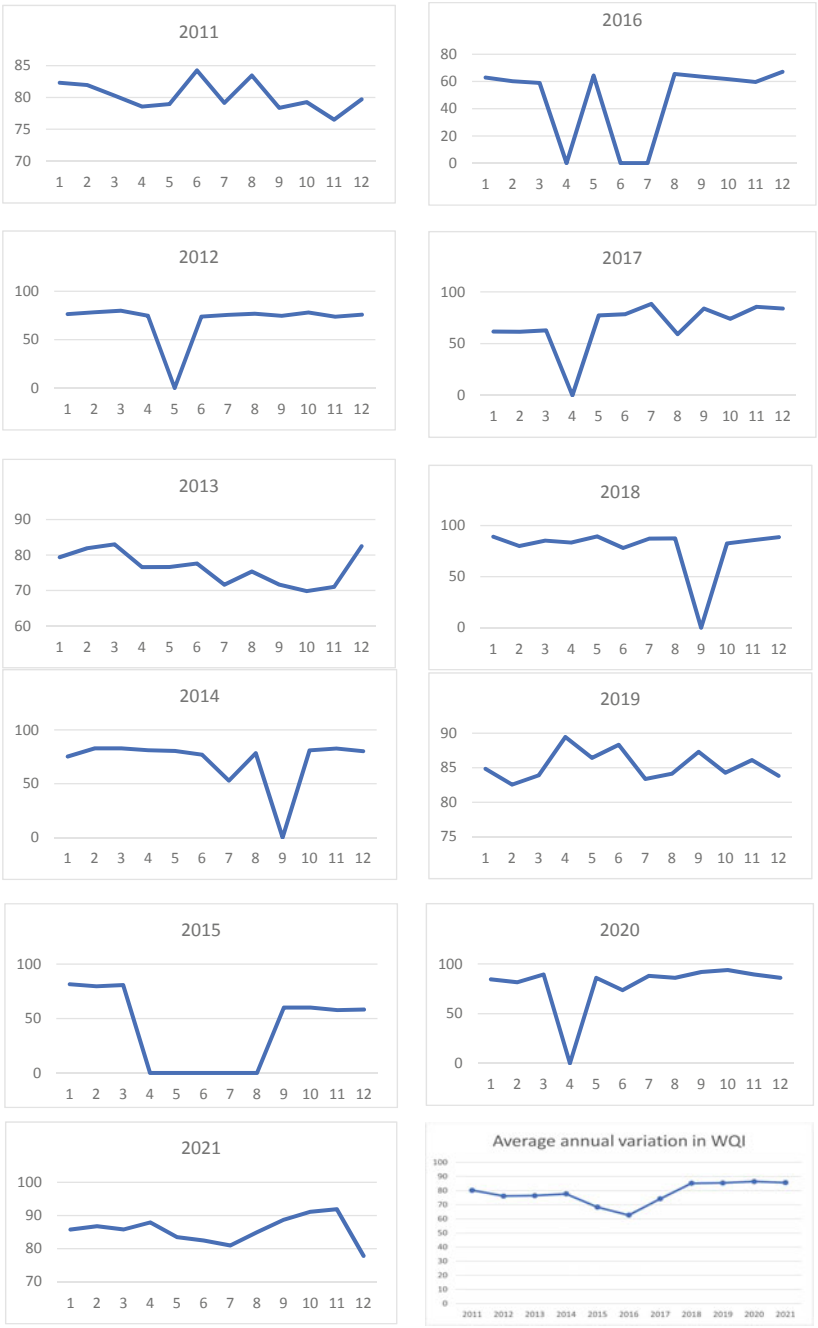

Fig. 2 Average annual variation in WQI

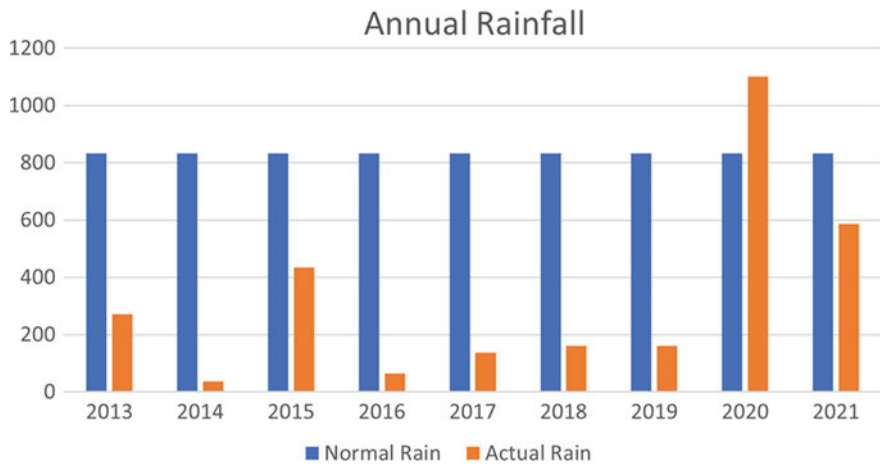

Fig. 3 Precipitation

5 Conclusion

As per the data analysis and plotting, it can be concluded that in the post-monsoon months up to November, the water quality index is apparently going towards the good end, i.e. the river is not polluted and due to addition of freshwater the dissolved oxygen level increases, resulting in reduction of BOD and COD values. Nitrate concentration also decreases due to addition of freshwater so less algal bloom and decrease in growth of aquatic plants is seen. The pH also balances in river water as rainwater is in the range of 5.5–6, but it can vary according to the air quality as sulphates and nitrates oxidise with water and form sulphuric and nitric acid, respectively, causing acid rain which reduces the pH affecting the quality of river water.

References

Arief Dhany Sutadian CP, Muttil N, Yilmaz A (2016) Authors' accepted version of the paper

Bora M, Goswami DC (2017) Water quality assessment in terms of water quality index (WQI): case study of the Kolong River, Assam, India. Appl Water Sci 7(6):3125–3135. https://doi.org/10.1007/s13201-016-0451-y

Gupta N, Pandey P, Hussain J (2017) Effect of physicochemical and biological parameters on the quality of river water of Narmada, Madhya Pradesh, India. Water Sci 31(1):11–23. https://doi.org/10.1016/j.wsj.2017.03.002

Ichwana I, Syahrul S, Nelly W (2016) Water quality index by using national sanitation foundation-water quality index (NSF-WQI) method at Krueng Tamiang Aceh, pp 110–117. https://doi.org/10.21063/ictis.2016.1019

Lkr A, Singh MR, Puro N (2020) Assessment of water quality status of Doyang River, Nagaland, India, using water quality index. Appl Water Sci 10(1):1–13. https://doi.org/10.1007/s13201-019-1133-3

Prabhakar VM, Patil AR, Swain KK, Mane BB, Nerkar MS, Kharat PC (2018) Assessment of water quality index of Indrayani River, Alandi, Pune, Maharashtra. Int J Sci Eng Technol Res 7(6):398–402

Shah KA, Joshi GS (2017) Evaluation of water quality index for River Sabarmati, Gujarat, India. Appl Water Sci 7(3):1349–1358. https://doi.org/10.1007/s13201-015-0318-7