

Neural and Mathematical Predicting Models for Particulate Matter Impact on Human Health in Oman

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Abstract: - The recorded reports of the World Health Organization (WHO) show that a total of 4.2 million death cases is due to exposure to PM_{2.5} particulate matter. This paper aims to analyze and examine the impact of particulates (PM_{2.5} and PM₁₀) on human health in Oman. Also, it proposed neural and mathematical prediction models for predicting predict the future levels of particulate matter (PM_{2.5} and PM₁₀) and its influence on human health. The paper performs a critical comparative study of proposed models, which is evident that the proposed models were fast, cheap, and accurate. The first model is based on Linear regression that obtained results of the coefficient of determination $R^2=0.7604$, mean square error (MSE=0.0673), and root mean square error (RMSE=0.2595). The second model is based on non-linear regression polynomial that achieved excellent results of (R^2) value of 0.9394 and (MSE) value of 0.0209 and (RMSE) value of 0.1447. The Neural model is more accurate in predicting the experimental results, which is obtained the highest achievements of MSE value =0.0064, correlation rate (R) =0.994, and NMSE =0.01392. The work confirmed that the Arab countries and Oman in a good and moderate situation based AQI indicator and did not reach the degree of danger of pollutants.

Key-Words: - Environment Impact, Outdoor Air Pollution, Neural Networks, particulate matter, Simulation models.

1 Introduction

The concentration of particulate matter (PM) is the most popular air pollutant that affects short term and long term health [1]. The report of the World Health Organization (WHO) shows that the rate of outdoor pollution in developing countries is dramatically increased and will up to 8%. The PM_{2.5} particulate matter is a significant cause of premature mortality, with an average of 4.2 million death cases. The PM_{2.5} particulate matter causes many diseases such as respiratory, cardiovascular, and cancers. Figure 1 presents the level of PM_{2.5} in Oman, which indicates that Onam in Moderate situation [2]. The main sources of air pollution include several resources like energy production (Oil and gas), transportation, and industry, which contribute to increasing the emission rate of pollutants and molecules [3]. Figure 2 presents the sources of air pollution and their relationship with other factors. The main air pollutants include particulate matter, ozone, nitrogen oxides, sulfur oxides, and carbon components, which is reported by World Health Organization (WHO). These pollutants are impacting human health in short-term and long-term effects. The effects of short-term

diseases include cardiovascular, respiratory, cardiovascular, and atherosclerotic diseases.

And, Long-term increased the autism spectrum in children, decreased fetal growth, and low birth weight. Also, elderly patients suffering from various pathological effects like skin and lung cancer, asthma, chronic diseases, and Alzheimer's disease, helping to increase mortality [4]. Increased industrial activity, vehicle emission contribute significantly exacerbated the air pollution problem in some areas of the Sultanate, such as Muscat, Duqm, and Sohar. High temperature and desertification also contribute to high levels of harmful dust, such as PM₁₀. Industrial activity in Sohar contributed to the increased risk of air pollution, especially sulfur dioxide from oil refineries [5].

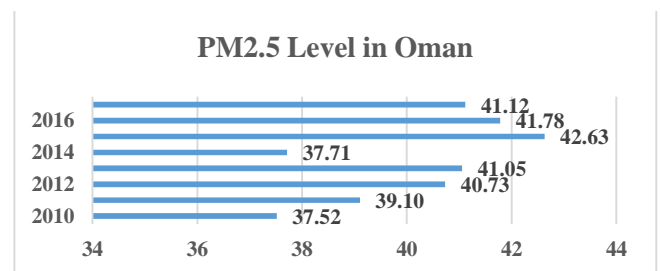


Fig 1. The PM_{2.5} level in Oman

- [12] National Weather Service, "Air Quality Index," 2019. [Online]. Available: <https://www.weather.gov/safety/airquality-aqindex>.
- [13] S. H. M. E. M. S. N. H. A. S. S. S. W. a. W. A. Rahman, "A long term study on characterization and source apportionment of particulate pollution in Klang Valley, Kuala Lumpur," *Aerosol and Air Quality Research*, pp. 2291-2304, 2015.
- [14] R. K. S. A. H. M. I. a. W. H. Atkinson, "Epidemiological time series studies of PM_{2.5} and daily mortality and hospital admissions: a systematic review and meta-analysis," *Thorax*, pp. 660-665, 2014.
- [15] World Health Organization, "Effects of air pollution on children's health and development: a review of the evidence (No. EUR/05/5046027)," Copenhagen: WHO Regional Office for Europe, 2005.
- [16] C. M. G. M. A. R. N. B. J. L. G. D. C. P. P. J. a. A.-M. I. Maesano, ". Impacts on human mortality due to reductions in PM₁₀ concentrations through different traffic scenarios in Paris, France," *Science of The Total Environment*, p. p.134257, 2020.
- [17] A. G. I. B. G. S. E. C. C. B. D. C. D. S. B. F. E. P. M. a. A. R. Franzetti, "Plant-microorganisms interaction promotes removal of air pollutants in Milan (Italy) urban area," *Journal of Hazardous Materials*, 2019.
- [18] M. F. L. M. B. Y. J. C. A. C. W. a. X. J. Li, "Short-term exposure to ambient fine particulate matter increases hospitalizations and mortality in COPD: a systematic review and meta-analysis," *Chest*, pp. 447-458, 2016.
- [19] Ministry of Environment and Claimant affairs, "Department of Monitoring Air pollution and Noise," Ministry of Environment and Claimant affairs, Muscat, 2019.
- [20] S. Abdul-Wahab, "Effect of Air Pollution on Atmospheric Corrosion of Engineering Metals," *Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management*, pp. 274-285, 2004.
- [21] O. S. O. A.-R. K. K. A. a. A.-Z. H. Abdalla, "Modelling an aquifer's response to a remedial action in Wadi Suq, Oman," *WIT Transactions on Ecology and the Environment*, pp. 355-363, 2007.
- [22] S. Abdul-Wahab, "Monitoring of air pollution in the atmosphere around Oman Liquid Natural Gas (OLNG) plant," *Journal of Environmental Science and Health*, pp. 559-570, 2005.
- [23] A. a. Z. A. Al-Wahaibi, "Air pollution and health indicators in a rapidly developing industrial port in the Sultanate of Oman.," 2013.
- [24] D. a. Y. J. Saini, "Environmental Scrutinizing System based on Soft Computing Technique," *International Journal of Computer Applications*, p. 62(13), 2013.
- [25] World Health Organization, "Air pollution," 18 12 2019. [Online]. Available: <https://www.who.int/airpollution/en/>.
- [26] University of Utah, "Frequently asked Questions about Wintertime PM_{2.5} Pollution in Utah's Salt Lake Valley," 18 12 2019. [Online]. Available: <http://home.chpc.utah.edu/~u0453210/PM2.5/PM2.5.html>