


# Spatial dispersion modeling of air emissions from a farm using a Gaussian model

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## Abstract

Agricultural activities may cause significant air pollution at the local, regional, and global scales due to the uncontrolled release of pollutants into the environment. This study therefore provided model-based spatial estimates of ground-level concentrations of air emissions from Landmark University Farm. The emission inventory and meteorological parameters of the farm were used to execute a Gaussian dispersion model over a distance of 2 km. Elevated ground-level concentrations were recorded, which continued to decrease as the distances increased. These concentrations exceeded threshold limits stipulated by National Ambient Air Quality Standard. The study concluded that high levels of air emissions obtained in this study are indications of tendencies for possible violation of permissible limits at locations not too far from the University Farm.

## KEYWORDS

Emission factor, emission inventory, emission rate, Gaussian model, meteorology

## 1 | INTRODUCTION

All over the world, air pollution has emerged as one of the major health, environmental, economic, and social problems. Besides its adverse effects on the health of all living organisms, urban air pollution has profound regional and global impacts (Carbonell et al., 2013). Recently, urbanization, industrialization, and other anthropogenic activities have been found to be the major causes of air pollution (Hsu et al., 2010). Many cities in developing nations continue to experience significant increase in air pollution (Abiye et al., 2016; Assamoi & Liousse, 2010), possibly due to population increase. In Nigeria especially, upsurge in population, rural–urban migration, and various industrial expansions have resulted in the release of pollutants in various degrees to the environment (Li et al., 2014).

It has been reported that exposure to air pollutants can lead to multiple health conditions like respiratory infections, heart disease, and lung cancer (European Union, 2014). Other health issues that can be caused by air pollution may include difficulty in breathing, wheezing,

coughing, asthma, and aggravation of existing respiratory and cardiac conditions (WHO, 2018). Besides reproductive effects in animals, acid rain formation and temperature inversion, loss of lives, reduction in the efficiency of people to work as well as damage to cultural and historical monuments could be some of the economic effects of air pollution (Seinfeld & Pandis, 2006). Several other epidemiological and toxicological studies have reported both short-term and long-term adverse effects of exposure to air pollutants on human health and environments (Kampa & Castanas, 2008; Peacock et al., 2003; Peel et al., 2005).

Anthropogenic activities, especially agricultural systems, industrial facilities, energy production, transport systems, etc., may cause significant air pollution at the local, regional, and global scales. This can be from direct emissions of primary pollutants or by the formation of secondary harmful species from the primary ones. For example, it has been opined that great amount air pollution could be released from agricultural farms (Broucek & Cermak, 2015). In agricultural farms, particles can be discharged directly from different sources, like dust