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Air Quality Characterization for the city of Nablus, Palestine

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Abstract—The city of Nablus is considered as one of the largest cities in the West Bank, Palestine. The topography of the city, combined with multiple sources of air pollution creates a potential air quality problem that might affect the human health. Preliminary measurements of indoor and outdoor air quality using an optical particle counter showed elevated concentrations of particulate matters. Studies in the United States, Brazil, and Germany have related higher levels of particulates to increased risk of respiratory, cardiovascular, and cancer-related deaths, as well as pneumonia, lung function loss, hospital admissions, and asthma. Some investigations have pointed toward particle sizes smaller than $2.5 \mu\text{m}$ ($\text{PM}_{2.5}$) as a major contributor to elevated death rates in polluted cities. This research aims at investigating the presence of air quality problems, especially elevated concentrations of $\text{PM}_{2.5}$ in the city of Nablus, Palestine, and to link these pollutants to potential sources. This research will help to understand the nature of air pollutants and their main sources in the city of Nablus, in order to provide decision makers with knowledge to choose proper regulatory decisions that can help to alleviate the problem. Implementing these decisions can enhance the health situation and hence improve the socio-economic conditions of the people living in the city of Nablus

Keywords—component; air quality; pollution; particulate matter; Nablus; Palesstine

I. INTRODUCTION

Air pollution is the introduction of foreign matter (that includes particulates, biological molecules, or other harmful materials) into the atmosphere, possibly causing adverse effects to humans and the built and natural environment. Air pollution is of public health concern in three scales: micro (indoor air quality), meso (ambient air quality), and macro (global effects). [1]

Air pollution is considered as one of the main pollution problems around the world. Most countries consider this problem a threat to national health and enforce strict regulations, among other solutions, with an objective mitigate its negative impacts as much as possible.

Air pollutants may be originated from either natural or anthropogenic sources. The pollutants originated from anthropogenic sources can be in three physical forms: gas, liquid, and solid. Solid air pollutants (also called Particulate matter, PM) are of major health concern. Studies in the United States, Brazil, and Germany have related higher levels of particulates to increased risk of respiratory, cardiovascular, and cancer-related deaths, as well as pneumonia, lung function loss, hospital admissions, and asthma. Some investigations have

pointed toward particle sizes smaller than $2.5 \mu\text{m}$ as a major contributor to elevated death rates in polluted cities. [1],[2]

In Palestine, the main sources of air pollution are: various means of transportation, the heavy dust from quarries and stone cutting industry, smoke rising from chimneys of factories, and dust from seasonal dust storms.

The purpose of this research is to investigate the presence of elevated concentrations of particulate air pollutants in the city of Nablus, Palestine, and linked these pollutants to potential sources.

II. THE CITY OF NABLUS

The city of Nablus is a major city in the northern part of the West Bank, Palestine (Figure 1). In 2007, the population of Nablus governorate was about 320,000, about 125,000 of them were living in the city of Nablus [3]. The city is located in a valley between two mountains: Ebal to the north and Jerzjim to the south, with an altitude ranging from 550 m to about 900 m

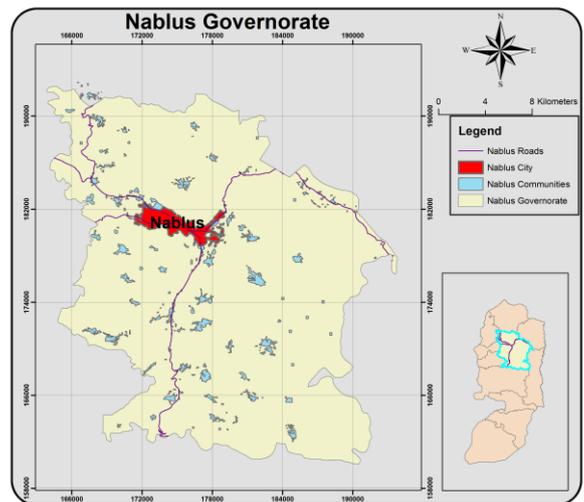


Figure 1. Location of the city of Nablus

above mean sea level. The location of the city gives it a Mediterranean climate of hot dry summers and cool, rainy winters. The hottest months in Nablus are July and August with the average high being 28.9°C . The coldest month is January with average low 3.9°C .

The topography of the city of Nablus, combined with multiple sources of air pollution creates a potential air quality

problem that might affect the human health. Preliminary measurements of indoor and outdoor air quality using an optical particle counter showed elevated concentrations of particulate matters. Figure 2 shows preliminary results of air sampling in one indoor and one outdoor location in the city of Nablus. The sampling was performed for $PM_{2.5}$ (particulate matter smaller than 2.5 microns), particulate matter smaller than 10 microns (PM_{10}), and total suspended solids (TSP). As shown in Figure 2, in both of the indoor and the outdoor locations the concentrations of $PM_{2.5}$ and PM_{10} exceeded the IMEP (integrated metropolitan environmental policy) annual standard.

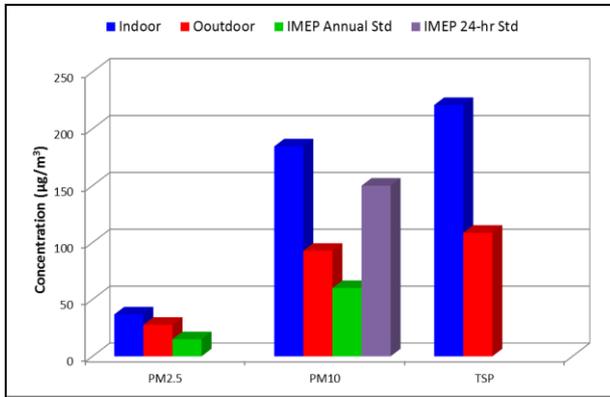


Figure 2. Nablus Indoor (An-Najah) vs. Outdoor (Al Qasr Hotel) Particulate Matter (2 min grab samples). Data courtesy of Dr. Randall Martin, Utah State University

III. POSSIBLE SOURCES OF PARTICULATE MATTER

There are four possible sources of particulate air pollutants in the city of Nablus: transportation, quarries and stone cutting industry, industrial activities, and seasonal dust storms.

A. Transportation

Despite the strategic importance of the transportation sector in modern societies, it is considered a major source of air pollution and a colossal energy consumer [4]. In Palestine, transportation sector consumes more than 60% of total consumed energy, where the average age of privately owned automobiles is 16.5 years [5]. These numbers indicate that there is a large number of old cars that consumes more fuel and emits more pollutants.

Due to the fact that the city of Nablus is considered the center of the northern part of the West Bank, The streets of the city are witnessing considerable traffic. For instance, the average daily traffic in Faisal Street was estimated in 2006 to be around 27,400 vehicle/day with peak hour traffic of 2,200 vehicle/hour [4]. This heavy traffic contributes to the problem of air pollution.

B. Quarries and stone cutting industry

There are more than 31 quarries and stone cutting facilities in Nablus district, producing more than 40,400 tons/year of solid waste [6]. Quarries and stone cutting industries release

large quantities of particulate matter and dust into the atmosphere. Most of these facilities lack necessary air filtration systems for collection of dust and particulate matter.

C. Industrial activities to the west

Due to the fact that the West Bank is still under Israeli occupation, there is an environmental impact of that occupation. Israeli authorities have relocated some of its polluting factories from Israel to the West Bank. For instance, Geshuri Industries, a pesticides and fertilizers factory originally located in Kfar Saba, was closed down for pollution violations and relocated to an area adjacent to Tulkarm, west of the city of Nablus [7]. This factory and others located in Israeli settlements could contribute to the air pollution problem in the city of Nablus.

D. Seasonal dust storms

Dust storms are among the most severe environmental problems in the Middle East. In Palestine, dust storms occur mainly in spring season [8]. Air pollution and increase of respiratory diseases are among the environmental impacts of dust storms. Other impacts include: reduction of visibility, increased traffic accidents, reduction of soil fertility, and limited solar radiation [8]. Figure 3 shows the city of Nablus during one of these dust storms.



Figure 3. An overview of the city of Nablus during a dust storm. Picture taken at noon on 2/3/2014

IV. FUTURE WORK

After characterizing the air quality of the city of Nablus, the research will try to answer the following research questions:

1. Is there a $PM_{2.5}$ problem in Nablus? is it homogeneous spatially?
2. What are the main sources of $PM_{2.5}$?
3. What is the main composition of $PM_{2.5}$?

4. Is there a difference between the indoor and ambient concentrations of PM_{2.5}?

To answer these questions, air samples will be taken from different locations in the city in different times.

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