AIR PARTICULATE POLLUTION IN KUALA LUMPUR - A STATISTICAL CONSIDERATION

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ABSTRACT

The 24-h average concentrations of inhalable (IPM) and total suspended particulate (TSP) matter collected at one site of Kuala Lumpur were studied.

Both IPM and TSP were highly correlated ($r = 0.81$) with a positive intercept on the TSP axis which clearly indicates that the IPM constitutes a portion of the TSP concentration.

The impact of meteorology parameters such as wind speed and rainfall on the particulate concentrations using a simple linear regression analysis are also discussed in this paper.

INTRODUCTION

The Federal City of Malaysia i.e Kuala Lumpur has undergone tremendous developments for the last 10 years. Its location which is right in the heart of the Klang Valley Region makes it an ideal reciepient of pollutants emitted within the region.

In addition, the city experiences low wind speed averaging between 0.5 m/s - 1.0 m/s throughout the year. There is certainly a pollution potential in this region due to poor dispersion of pollutants.

The present air quality monitoring station in Universiti Teknologi Malaysia (UTM) has been established as part of the National Ambient Air Quality Monitoring Network (NAAQMN). The main objective of this NAAQMN program was to quantity the level of the particulate pollution in major city areas throughout the country. Perhaps, the findings will serve as a guideline in the process of setting up the national ambient air quality standards.

This paper presents the summaries of the total suspended particulate (TSP) matter and inhalable particulate matter, IPM (particulate diameter equal or less than 10 micron) data collected at the U.T.M. station. As such, simple statistical procedures were used to analyse the data.

METHODOLOGY

Site Location.

The particulate data were gathered at the UTM air quality monitoring station located 4 km northeast of the Central Business District of Kuala Lumpur as shown in Figure 1. The city is surrounded by several industrial areas located at every corner. The Petaling Jaya industrial area is considered as the largest and the most important one in this region and is located about 10 km southwest of Kuala Lumpur. The existence of these industrial activities will certainly contribute significant amount of particulate pollution in the Klang Valley region.

Data Collection.

The 24 hr concentrations of the TSP and IPM were collected using a standard high volume air sampler (SAUV-1H) and a size-selective high volume air sampler (SAUV-10H) respectively. The TSP sampler collects almost any particle size of up to about 30 micron while the IPM sampler collects only particles with size equal or less than 10 micron in diameter. Both samplers were operated and calibrated at 1.13 m^3/min. The samplers were placed on the roof top of a four-storey building of about 15 meters high.

The particulates were collected once in four days using 8" x 10" glass fiber filters (Whatman-2000). The filters were calibrated and conditioned in an incubator for 24-hr before and after the sampling events. The average difference in weight of the sample filters were divided by the total volume of air sampled, to give the airborne particulate concentration presence in the air.

The meteorological parameters reported in this studies were taken from the nearest weather station located in Petaling Jaya, approximately 14 km southwest of the monitoring site.

RESULTS & DISCUSSION

The data presented in this paper were taken from Januari 1986 - April 1978 simple statistical analysis were used to analyze the data and are discussed below.

Frequency Distribution of Daily Particulate Concentrations.

The frequency distribution of the daily TSP and IPM are given in Figure 2 and 3 respectively. Most air pollution data have been found to have skewed distribution that can be presented as a log-normal distribution pattern. Both Figures 2 and 3 prove that daily particulate concentrations fit into a log-normal distribution. A smooth curve can be drawn and well fit in the frequency distribution histogram. The log-normality of this frequency distribution can easily be verified by plotting the percentile value on the log-probability paper.

TSP and IPM Relationship.

The relationship between the TSP and IPM were also studied. A linear regression analysis were applied to the data. Both TSP and IPM were found to have a good correlation coefficient (r = 0.81) with a positive intercept on the TSP axis (Figure 4). As mentioned before that the TSP sampler collects virtually almost any particle size in air which also includes the IPM. Therefore, the positive interception on the TSP axis reflects that there are some portion of the TSP concentration which is not accounted for by the IPM samplers i.e particulate concentration with size more than 10 micron in diameter. However, on average the IPM was found to constitute 75% (by weight) of the TSP in Kuala Lumpur.

Particulate Concentrations Vs. Meteorological Parameters.

Wind Speed.

Wind speed is said to be one of the most important meteorological parameters that can affect the dispersion of pollutants in Kuala Lumpur.[1,2] A statistical investigation of particulate concentration against local average wind speed were carried out and is illustrated in Figure 5 and 6. Both IPM and TSP have negative correlation coefficients of r = -0.33 and r = -0.36 against the wind term respectively. This means that there is a linear decrease of particulate concentrations with increasing wind speed. A similar assumption is being used in most diffusion models. In this respect, wind speed always act as a diluting agent once the pollutants are released into the atmosphere.

Rainfall.

Rainfall can play an important role in reducing the level of particulate concentration in the atmosphere. However, only the duration of rainfall has been found to have a better correlation in this respect.[2,3]

Both IPM (r = 0.04) and TSP (r = -0.07) correlate poorly with the amount of rainfall in each sampling day (Figures 7 & 8). While both IPM and TSP showed better correlation coefficients of r = -0.41 and r = -0.30 against the duration of rainfall respectively (Figures 9 & 10). This clearly indicate that reduced in particulate level in the atmosphere is not due to 'wash-out' effect by the rainfall but rather due to prolong wetness of the ground that hinder the reentrainment of particulate matter back to the air. However, further investigation is warranted to verify this statement.

CONCLUSION

An analysis of airborne particulate concentrations using simple statistical procedures has been presented in this paper. The particulate concentration in Kuala Lumpur was found to exhibit a log-normal distribution as similarly being found elsewhere. Based on a linear regression analysis, both IPM and TSP were very well correlated with each other. Meanwhile, the IPM and TSP were negatively correlated with the wind speed and the duration of rainfall terms. Finally, this study suggests that simple linear regression can be serve as an important tool in interpretating air pollution data.

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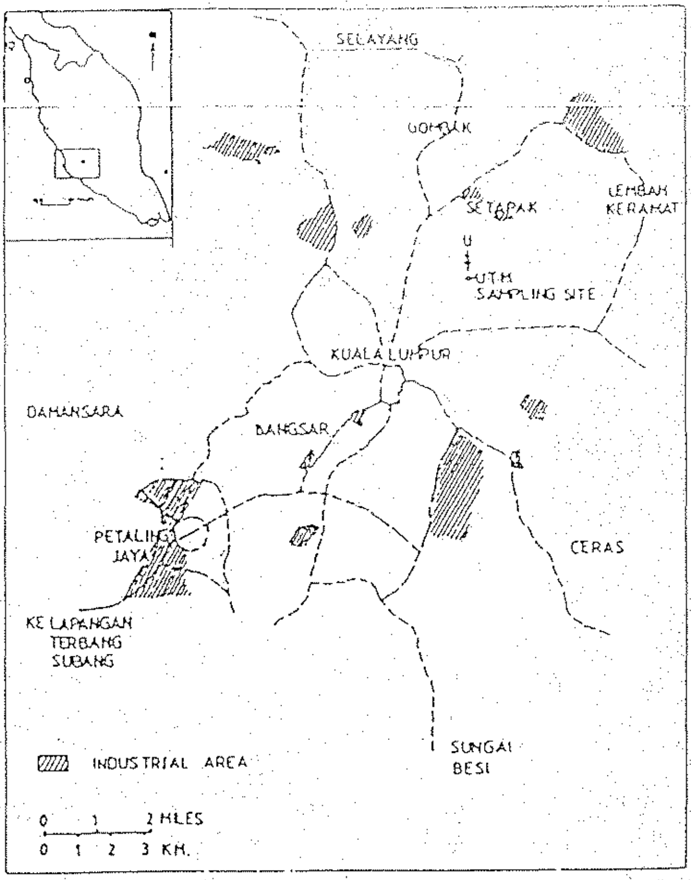

Figure 1 : Sampling Location

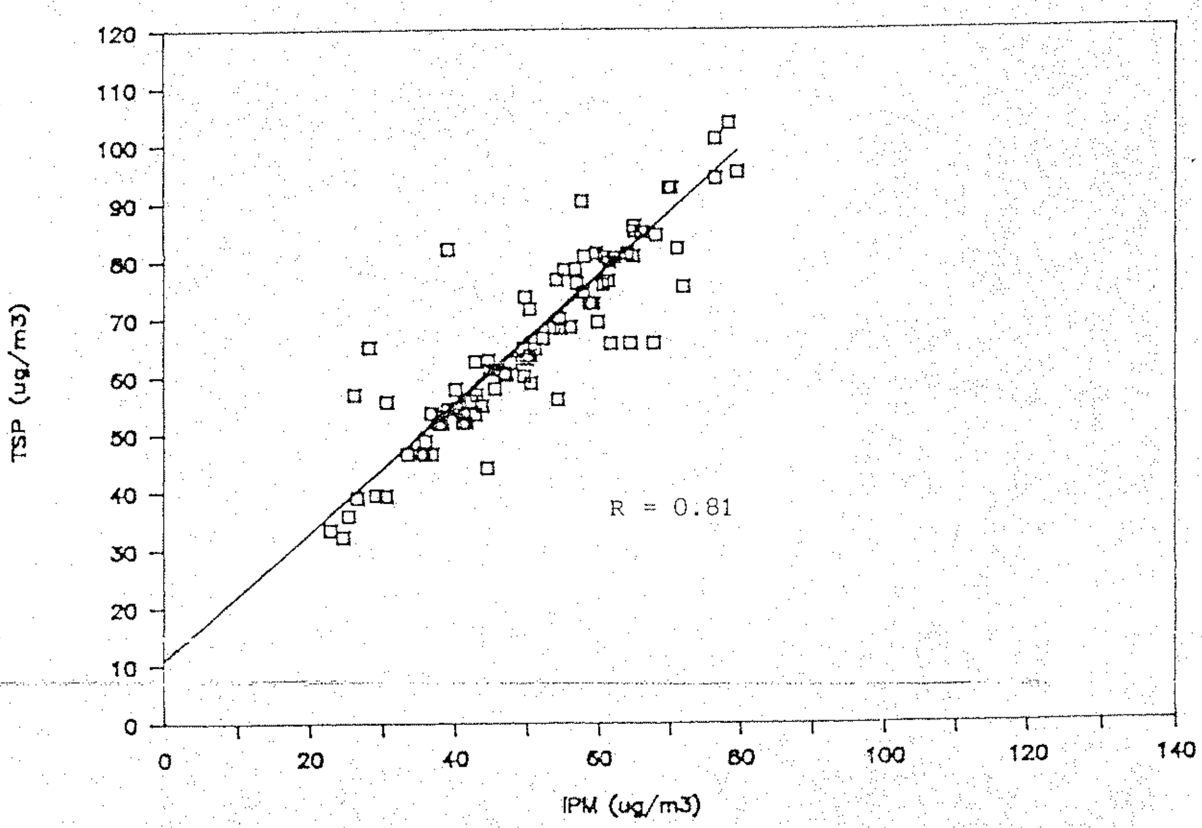

Figure 4 : TSP Vs. IPM

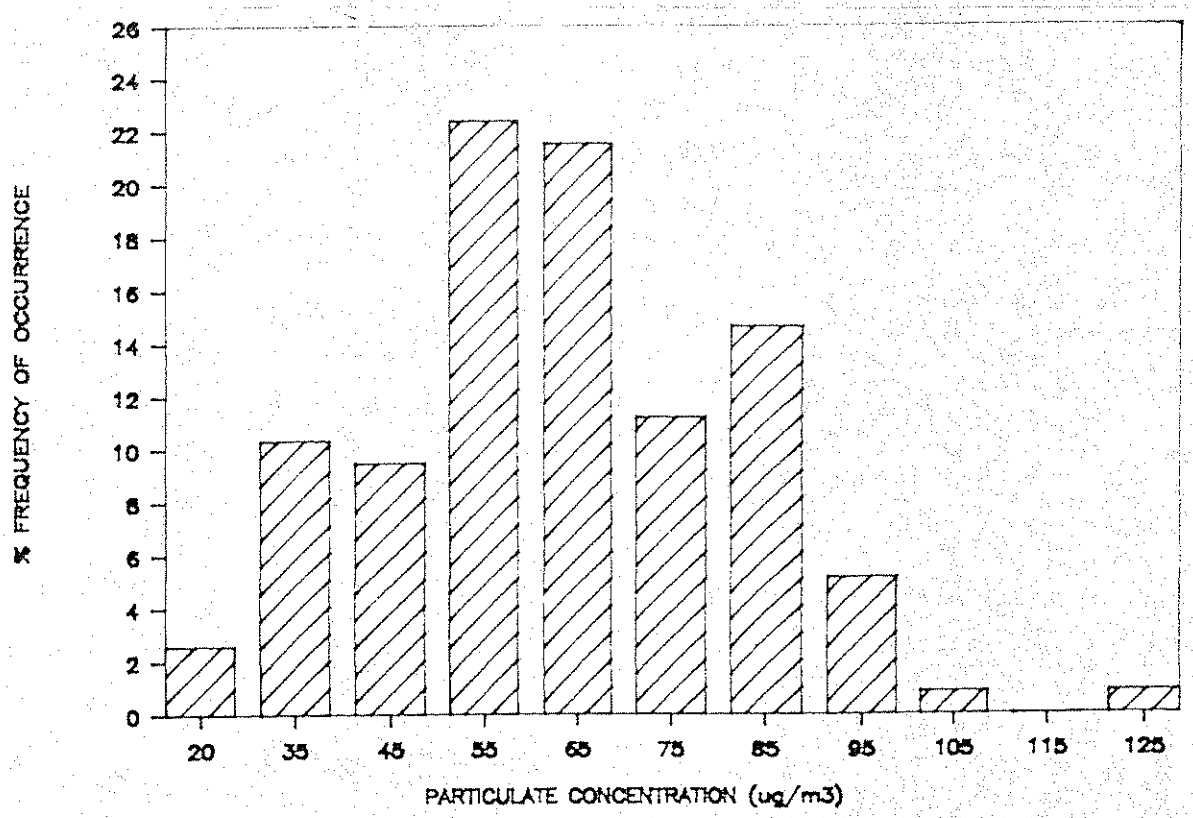

Figure 2 : TSP Histogram

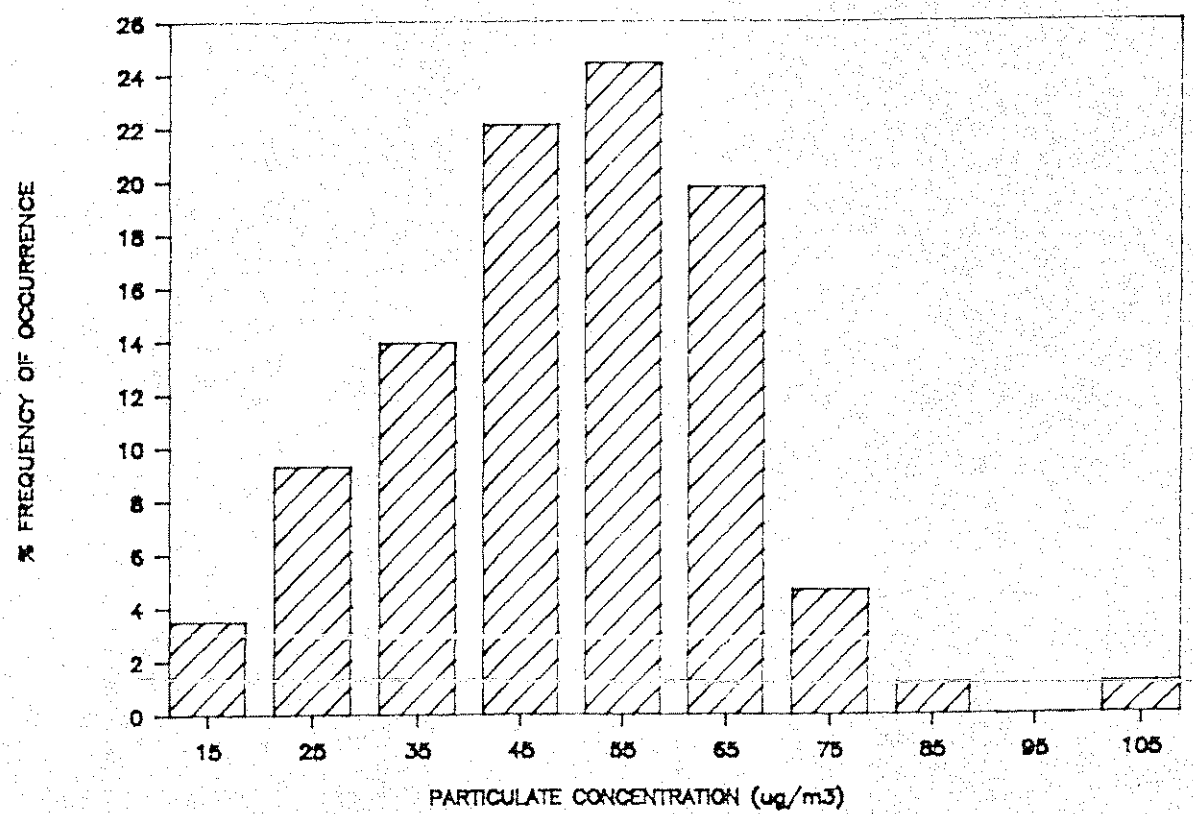

Figure 3 : IPM Histogram

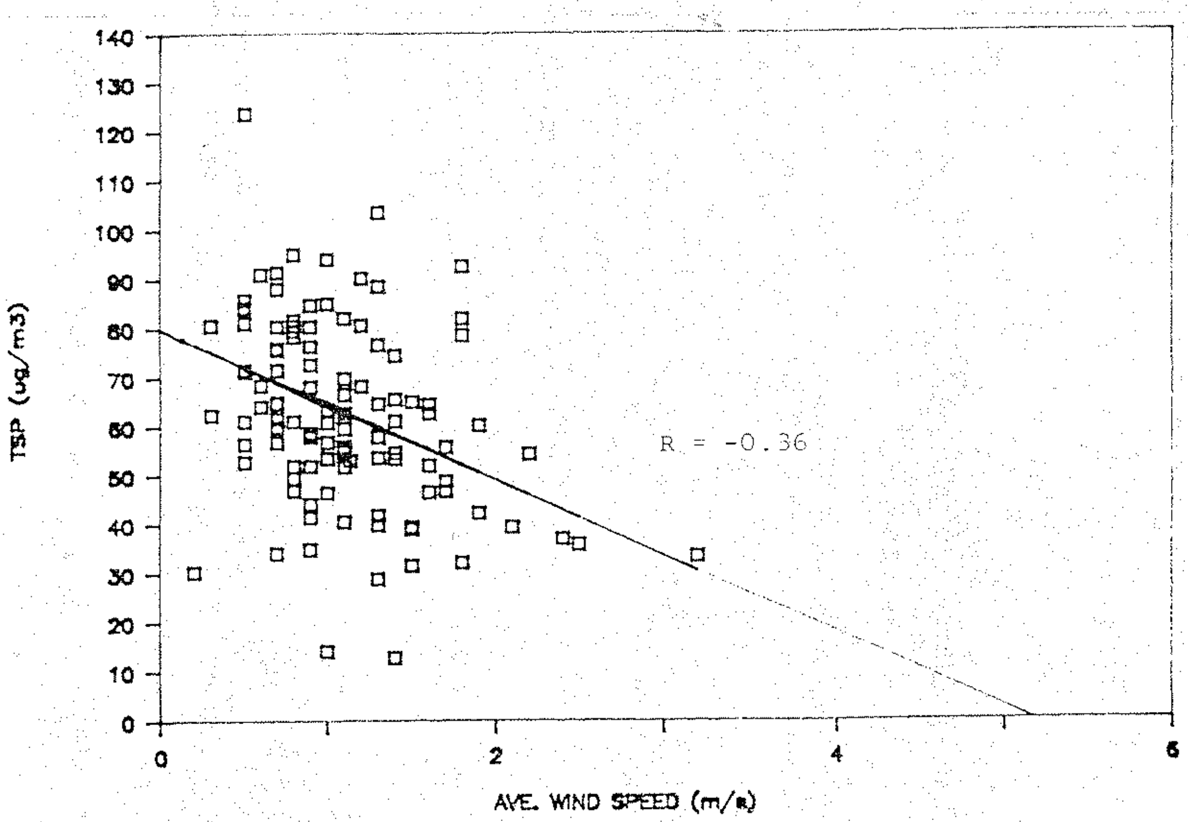

Figure 5 : TSP Vs. Wind Speed

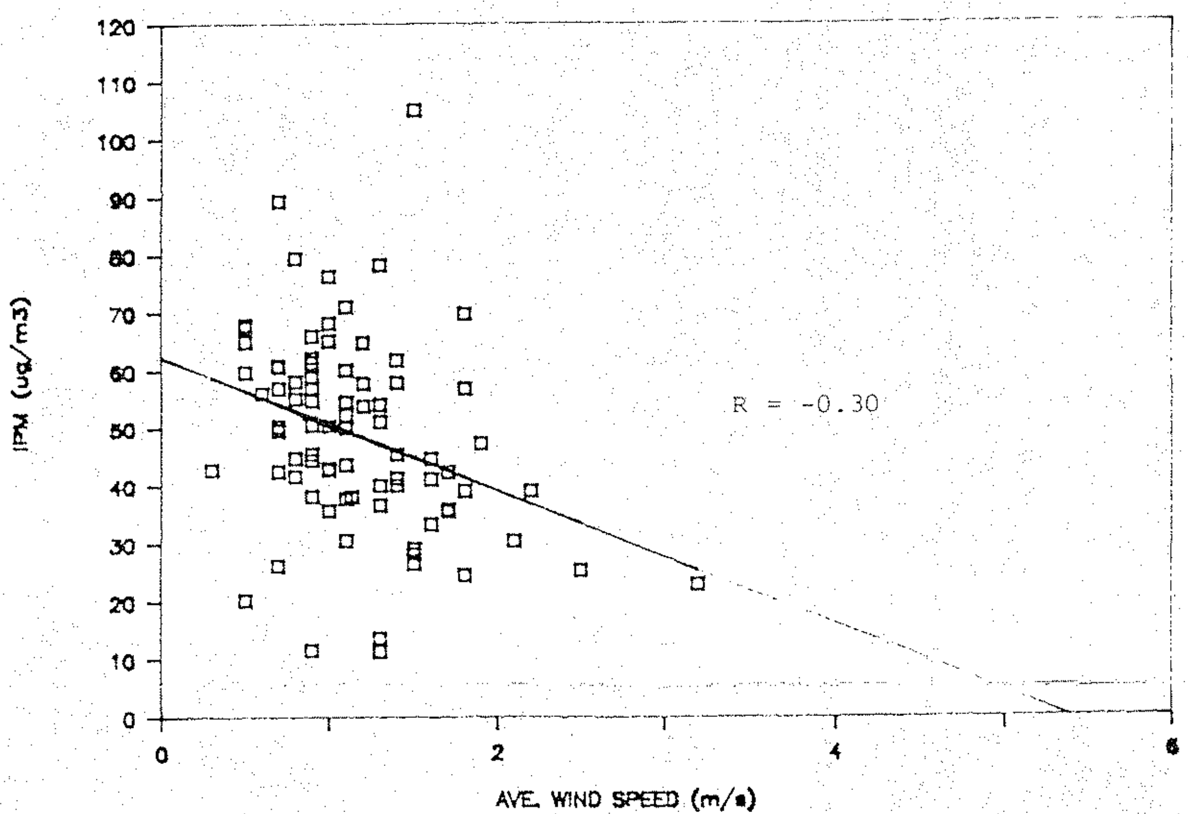

Figure 6 : IPM Vs. Wind Speed

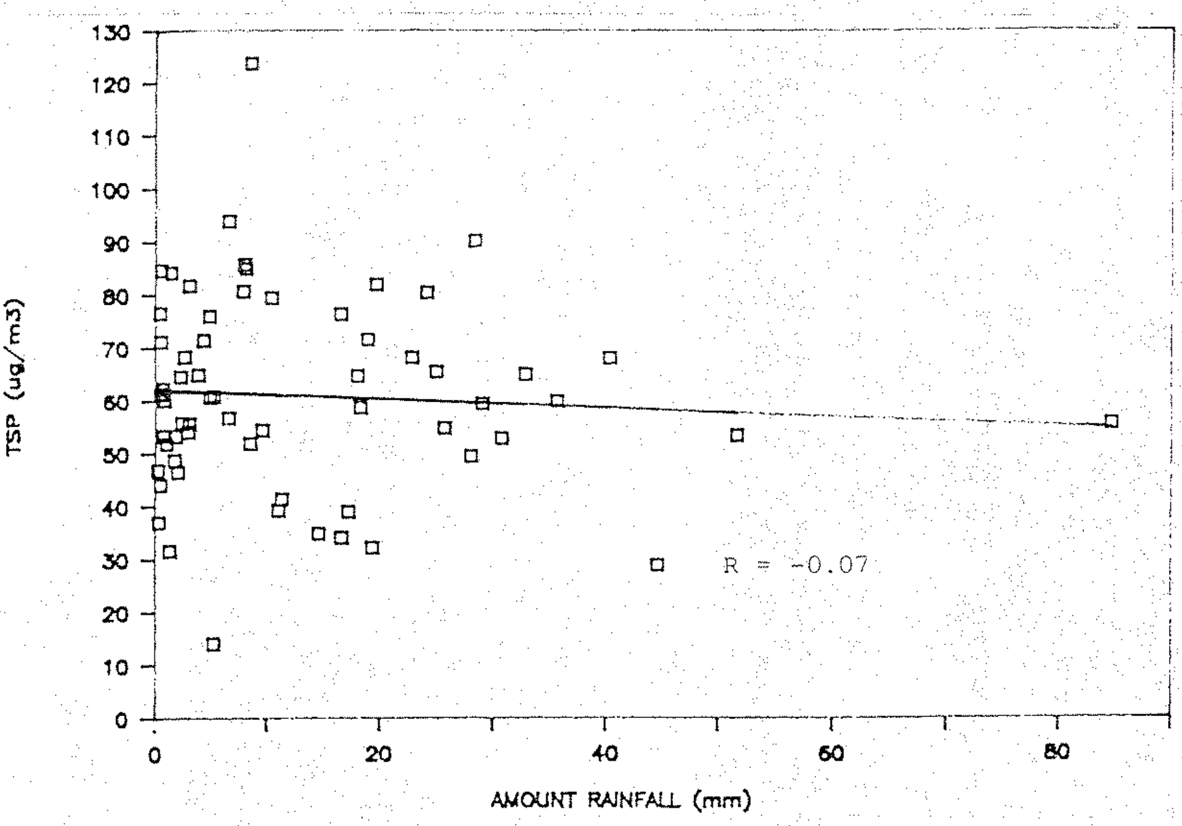

Figure 7 : TSP Vs. Amount of Rainfall

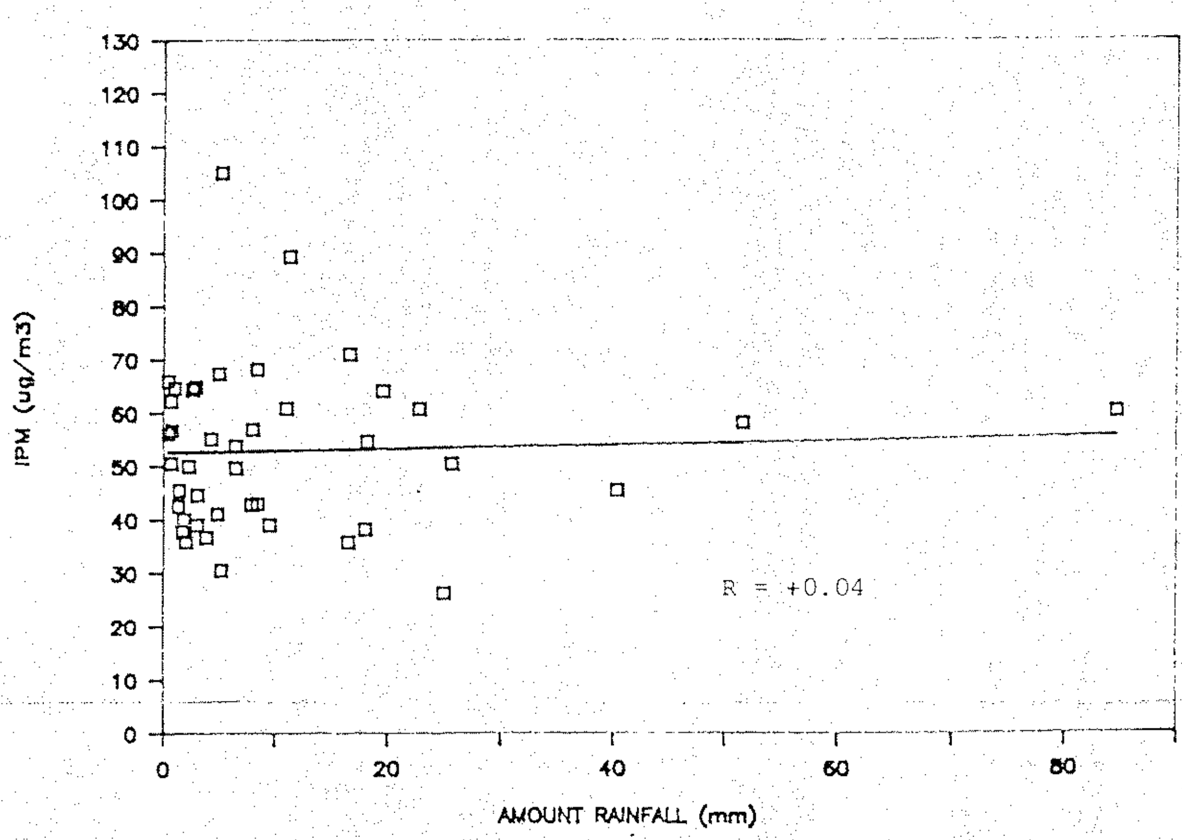

Figure 8 : IPM Vs. Amount of Rainfall

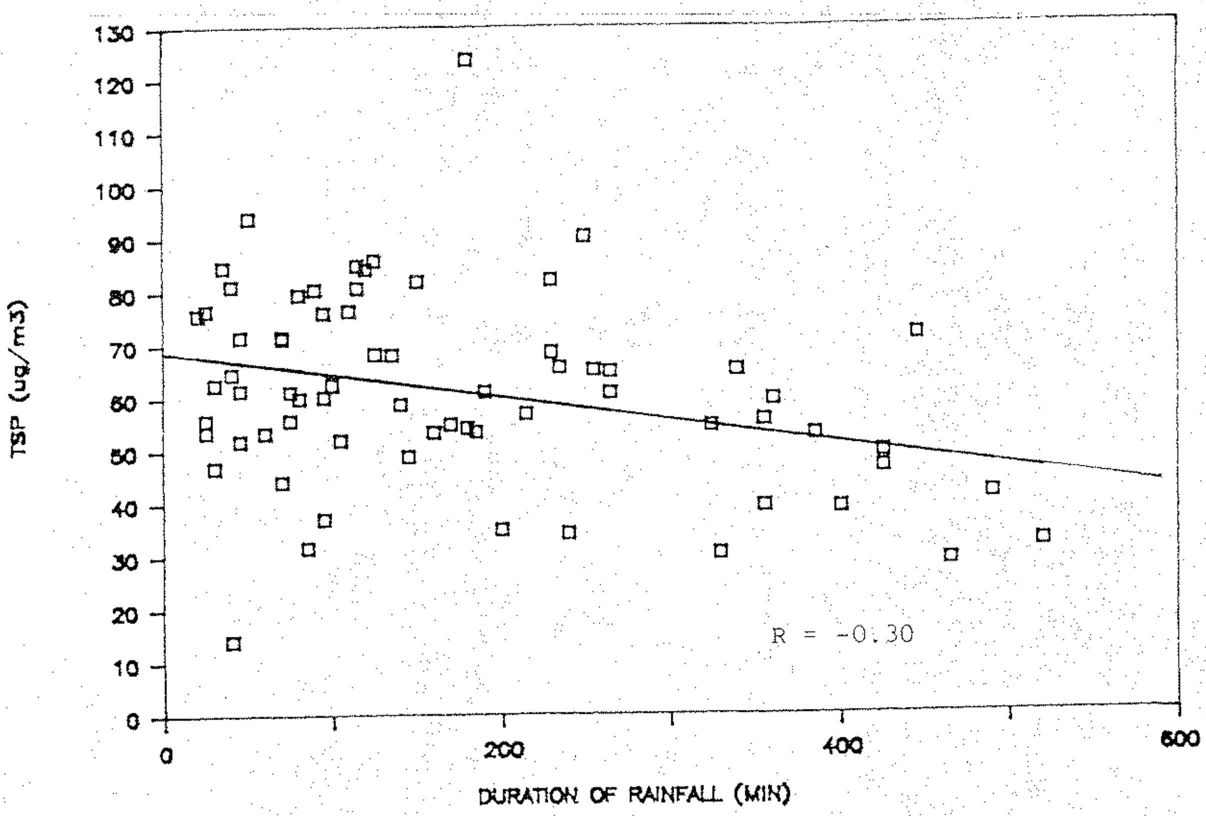

Figure 9 : TSP Vs. Duration of Rainfall

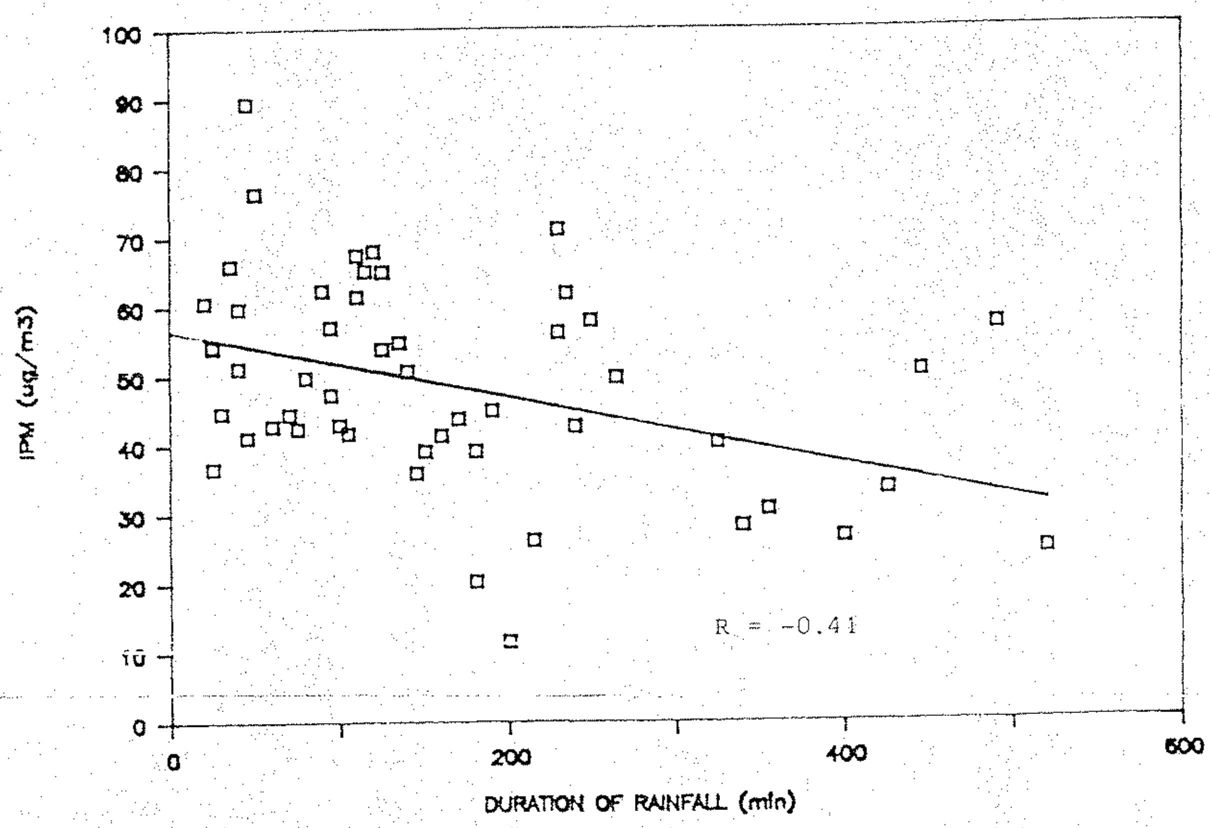

Figure 10 : IPM Vs. Duration of Rainfall