

# The relationship of motor vehicles and soil lead levels in Pingtung, Taiwan

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## Abstract

**Purpose:** Most of lead consumption is for the motor vehicles. The soil is polluted by leaded aviation fuel.

**Approach:** Using enrolled motor vehicles during 1995 – 2018. We approached the effect of lead emission on soil quality of Pingtung County that is known its agriculture in Taiwan.

**Results:** The enrolled motor vehicles was peak in 2011, The mean lead levels in soil was peak in 2013. The enrolled motor vehicles was correlated to the mean lead levels in soil significantly ( $r = 0.71$ ,  $p < 0.05$ ). Soil quality was not improved after the banned or reduced lead in gasoline product.

**Conclusions:** Decreasing motor vehicles could cause a lower contaminated lead level in soil. The soil should be protected by diminishing automobile emission.

**Keywords:** Lead; Moto Vehicles; Soil.

## 1. Introduction

More than three quarters of global lead consumption is for the manufacture of lead- acid batteries for motor vehicles (WHO 2019). The automobile emission is the exposure route through contaminated water, soil, and food (Attar 2019). High levels of lead intake adversely affect the functioning of the circulatory and nervous systems. (Meyer et al. 2008). The mean of automobiles was 750 per 1000 persons in 2019. Pingtung county had occupied the most density of automobiles more than 6 years since 2014.

Pingtung county is famous of agriculture in Taiwan. In order to prevent soil pollution from lead, the motor vehicles correlated to the soil lead levels need to be evaluated importantly.

## 2. Methods

Using the enrolled motor vehicles, and environmental soil quality information during 1995 – 2018 from Pingtung county government Taiwan. This study investigated the relationship of motor vehicles and soil lead levels. The correlation in the two groups were studied by spearman's regression analysis. Differences between various groups were evaluated using Student t-test. The level of significance was set at 0.05.

## 3. Results

The enrolled motor vehicles (980197) was peak in 2011, and declined to 911952 in 2018. The mean lead levels (35.88 mg / kg) in soil was peak in 2013, and declined to 21.55 mg / kg) in 2018. The enrolled motor vehicles were correlated to the mean lead levels in soil significantly ( $r = 0.71$ ,  $p < 0.05$ ) (table1).

The enrolled motor vehicles, and estimated means of lead in soil during 1995 – 2018 in Pingtung by year interval are seen in table2. The mean of motor vehicles in Pingtung county was 671293.4 during 1995 – 2000 which increased to 896441.8 during 2001 – 2018 (1.34 folds). The average lead level was 7.82 mg / kg during 1995 – 2000 which increased 22.22 mg / kg during 2001 – 2018 (2.84 folds). The increased rate of average lead level was significantly higher than the increased rate of average motor vehicles by year interval comparison ( $p < 0.05$ ).

Soil quality was not improved after the banned or reduced lead in gasoline product from 2000.

**Table 1:** Spearman's Correlation (R) Between the Enrolled Motor Vehicles, And Estimated Means of Lead in Soil, Pingtung, Taiwan (1995 – 2018)

Year	Enrolled Motor Vehicles (No.)	Means Of Lead in Soil (Mg /Kg)	R
1995	591907	7.15	0.71*
1996	637539	5.82	
1997	679919	7.70	
1999	713212	8.76	
2000	733890	9.67	
2001	756314	17.36	
2003	815265	20.07	
2008	932343	32.09	
2010	959702	19.10	
2011	980197	11.84	
2013	917102	35.88	
2015	898659	21.55	
2018	911952	19.90	

\*: R Value Significant at  $P < 0.05$

**Table 2:** Distribution in Enrolled Motor Vehicles, And Estimated Means of Lead in Soil, Pingtung, Taiwan (1995 – 2018)

Year	Enrolled Motor Vehicles (No.)	Means of Lead in Soil (Mg /Kg)
1995 – 2000	671293.4	7.82
2001 – 2018	896441.8	22.22*

\*: P Value Significant at  $< 0.05$

## 4. Discussion

Although the use of lead in certain products, such as gasoline, and paints has been globally banned or reduced since 2000, the average lead levels in soil were high still. The classification of gasoline according to The Chinese Petroleum Corporation (CPC), Taiwan, is leaded gasoline (the lead level in gasoline is higher than 1.1 g/L), the low – lead gasoline (the lead level in gasoline is during 0.013 g/L and 1.1 g/L), unleaded gasoline (the lead level in gasoline is lower than 0.013 g/L ), respectively. However, People recognized the unleaded gasoline was zero lead contained gasoline level. For the misunderstanding, they bought and enrolled motor vehicles after 2000 numerously. The results agreed soil lead level is a sensitive indicator that could be affected by automobile emission. The scale of motor vehicles reflected the high soil lead level logically.

## 5. Conclusion

Decreasing motor vehicles could cause a lower contaminated lead level in soil. The soil should be protected by diminishing automobile emission.

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