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Willingness to Pay for Cleaning up Road Dust in Vientiane

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Abstract

This paper sets out to estimate residents' Willingness to Pay (WTP) for cleaning up road dust in urban areas of Vientiane, Laos. The analysis relies on the Contingent Valuation Method (CVM) and seeks to identify the factors affecting WTP. Based on a sample of 6,590 respondents, the results show a mean WTP of 7069 kip (USD0.86) per person per month. This amounts to 4.7% of residents' average monthly income. Education and income have a statistically positive impact on WTP. Conversely, the number of children in family has a statistically negative impact on WTP. These results offer information to policy makers dealing with the dust problem on urban roads in Vientiane.

Key words: Road dust; Contingent valuation method (CVM); Willingness to pay; Vientiane

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INTRODUCTION

Vientiane has an area of 3920 Km^2 and a population of 667,000 (density of 171 person/Km^2). It has the fastest growing economy and population in Laos. Average economic growth in the city was more than 10 % and population growth was about 5 % over the past 5 years (VC, 2009). This growth has accelerated public and private construction activities in city and is one of the most important causes of dust on urban roads.

There has also been a lack of law enforcement to regulate illegal dust production. Until now, Vientiane authorities and the Water and Environment Authority (WEA) have taken few actions to deal with the dust problem. The government has neglected the dust problem for two main reasons: a lack of funds for cleaning up dust on roads, and a lack of understanding of the costs of dust pollution for residents.

According to air quality monitoring conducted at three sites in Vientiane (ADB, 2006; Mukhopadhyay and Thomassin, 2010), Total Suspended Particulates (TSP) concentrations range from 82 to 296 $\mu g/m^3$. PM10 concentrations range between 40 and 179 $\mu g/m^3$ with an average of 87 $\mu g/m^3$. These levels exceed the WHO guideline (50 $\mu g/m^3$). SO_2 measurements range from 3 to 276 $\mu g/m^3$ and only 27.6 per cent of readings comply with the WHO guideline of 20 $\mu g/m^3$. These monitoring results show that Vientiane faces serious air pollution, especially in terms of PM10 which leads to serious health impacts.

The adverse health effects of respiratory "dust" on human health are well-documented (Inyang and Bae, 2006; Hong et al., 1999; Pope, 1995). Vientiane, the capital city of Laos faces a serious problem of road dust. The dust, which contains PM 10, has negative effects on the health of Vientiane residents and damages the city environment.

The Lao government has introduced some important policy and institutional measures to manage natural resource and environmental problems. The main legal structure regarding environmental pollution (dust) is stipulated in the Laos PRD Constitution (1996) and Environmental Protection Law (1999). However,

enforcement of the law is weak. In addition, there are numerous ministries and agencies involved in environmental management and this produces inefficient responses to road dust problems.

The costs and benefits of cleaning up road dust are not well understood. There are no studies of the impact of dust on health and the environment in Vientiane. Therefore, the main objective of this study is to estimate the willingness to pay (WTP) for cleaning up road dust in urban areas and to identify the factors affecting their WTP. This study employed an open-ended Contingent Value Method (CVM) (Hanemann, 1995; Alberini and Kahn, 2006; Takeuchi, 2000). Multiple-regression analysis is used to estimate the factors determining WTP.

This paper makes three contributions to the literature. This study is the first to analyse an environmental issue using the stated preference approach in Laos. Second, there are various developing country studies of the impact of air pollution that use the stated preferences approach (Alberini and Krupnic, 1998; Brajer et al., 2006; Carlsson and Johansson-Stenman, 2000; Carlsson and Johansson-Stenman, 2000; Dziegielewska Mendelsohn, 2005; Halvorsen, 1996; Hammitt and Zhou, 2006; Wang et. Al, 2006). However there are very few studies on air pollution in Less Developed Country (LDC) and most of those studies focus on air pollution from motor vehicles and industries. Thirdly, there are some studies which link dust problems and health (Chen et al., 2004; Hong et al.,1999 ; Inyang, 2006; Mohamed and Bassouni, 2007; Prospero, 1999). However, there are few studies on dust based air pollution even though dust based air pollution is a serious problem in many countries other than Laos.

1. QUESTIONNAIRE DESIGN AND SURVEY

The questionnaire designed for this study was based on some key sources (Alberini and Kahn, 2006; Bateman and Willis, 1999; Whittington, 2002), interviews with government agencies and focus group discussions. Before the formal survey, two pre-tests were conducted each with 20 respondents. Based on the feedback from the pre-tests, the questionnaire was revised accordingly. Interviews were limited to 20-30 minutes.

The questionnaire consisted of four parts: (1) WTP for cleaning up road dust in urban Vientiane; (2) the socio-economic characteristics; (3) number of vehicles and main forms of transportation used; and, (4) perceptions of the impacts of dust on health and the environment.

In the willingness to pay (WTP) part of the survey, respondents were asked their maximum WTP for reducing by 60 to 70 per cent the health problems from dust and for reducing by 60 to 70 per cent the environmental impacts of dust in the urban area of Vientiane over a 5 year period. An increase in the water supply bill was specified as the payment vehicle. Before asking the open-ended WTP question, the negative impacts of dust on health and the environment were explained. Second, details of a proposed project to clean up road dust in Vientiane were set out. Third, the impacts of the project on reducing health risks and improving the environment were described. Fourth, the details of the payment vehicle were provided. In addition, pictures of current dust problems were attached to the questionnaire and shown to respondents during the interview.

The survey was conduct from June to July 2009 in four districts of Vientiane. A total of 7625 responses were collected. The survey was carried out by students and lecturers from the Faculty of Economics and Business Management at the National University of Laos. Face-to-face interviews with the household head were used. The student and lecturer interviewers were trained before conducting the survey (Whittington, 2002).

2. SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS

The socio-economic characteristics of the respondents were investigated and are shown in table 1. About half of the respondents were female and about 30 per cent were single. The average age was around 34 years. On average, respondents had 13 years of education. About half were government officers. The average household size was four people, including one child. About 13 per cent of respondents had health problems, such as eye problems, sore throat, nose problems, lung / respiratory disease, heart disease, asthma, cold, and other diseases. Respondents had an average of two motorbikes and one car at home. More than 90 per cent of respondents considered dust to be a problem for their health and the environment of the city.

Table 1
Socio-Economic Characteristics of Respondents

Socio-economic condition	
Female (%)	47.0
Single (%)	29.4
Age (year)	34.8
Education (year)	13.5
Income (10000 kip)/month	15.4
Home locates near main road (%)	30
Main occupation (%)	
Government	47.6
Private	18.7
Retails/owner of business	20.6
Student	9.8
Other	3.3
Family and Children (number)	
Family	4.7
Children	0.7

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Socio-economic condition	
Having problem/disease (%)	
Eye	21.1
Throat	18.4
Breath	12.9
Nose	8
Cool	27
Fever	9.6
Heart	3.4
Other disease	6.1
Having vehicle (number)	
Bicycle	0.5
Motorbike	2.1
Car	0.7
Perception on the impact of dust (%)	
Serious impact on health	96.8
Serious impact on city environment	92.9

3. WILLINGNESS TO PAY

A total of 7625 questionnaires were collected. Of these, 6,590 questionnaires (86 per cent of the total sample) contained effective information. Out of the 6,590 total, 4951 (24.9 per cent) provided a zero WTP, and 4951 respondents (75.1 per cent) gave a positive WTP. The whole sample mean WTP to achieve 60 to 70 per cent reduced health problems and 60 to 70 per cent improvement in the urban environment from controlling the dust problem was 7069 kip (USD0.86) per person per month. This amounts to an average of 4.71 per cent of income per month. As shown in table 2, a WTP of 1000-5000 kip/person/month was the most frequently recorded bid range at 37.7 per cent. WTP of 6000-10000 kip/person/month is the second most popular bid range accounting for 15.3 per cent (Table 3).

There are 369,233 persons living in the urban area of Vientiane (VC, 2009). Assuming that the sample selected is representative of the population[3], the aggregate WTP of Vientiane residents is US$ 317,500 per month.

The main reasons given by respondents for being willing to pay for cleaning up the road dust was for the cleanliness of the city (45.5 per cent), for personal and family health (31.9 per cent) and to contribute to government (13 per cent) (Table 4). On the other hand, the main reasons for respondents giving zero WTP were: 42.6 per cent of zero WTP respondents said that dust was caused by trucks and construction activities and not themselves; 28.3 per cent indicated that it was the government's duty to clean up road dust in urban areas of Vientiane capital; and, 14 per cent mentioned that they did not have confidence that their money would be used to implement the project (Table 5).

The zero WTP respondents could fall into two categories: true zero WTP and protest bids (Wang et al., 2006). For the protest bids, respondents might have difficulty understanding the valuation questionnaire. However, it is difficult to separate the true zero WTP and protest bids and hence no protest bids were excluded.

There are some obstacles to the application of the CVM in Laos. Laos is a socialist country, which has been moving towards a more open market. Public goods are still seen to be the responsibility of government. Furthermore, households have little experience in public consultation and problem solving of the type involved in the CVM. The estimation of WTP for air pollution reductions in developing countries is relatively rare (Whittington, 2002). However, in comparison to studies in other developing countries, the mean WTP of this study is high. For example, the mean of WTP per household per year for 50% reduction of harmful substance in the air in Beijing was 0.7% of annual income (Wang et al., 2006). There are several potential explanations for the relatively high mean WTP. First, respondents may not have considered the time horizon of the payment (five years). Second, respondents may not have distinguished between personal and household payments. This survey focuses on individual payment. Thirdly, as in many developing countries, the salary of government officials in Laos is low and they have other (unofficial) sources of income to support their family. These respondents might not have revealed all the income they received.

Open-ended CVM questionnaires have been criticized (Arrow et al., 1993; Hanemann,1994) for giving lower mean WTP compared to dichotomous choice CVM questionnaires (Hausman, 1993). This type of questionnaire has the advantage of avoiding starting point and yea-saying bias (Carlsson and Johansson-Stenman, 2000). Because there are no studies concerning with residents' WTP for improving air quality in Laos, it is difficult to design a bid-vector for discrete choice questions or a scale and intervals for payment card questions.

[3]Comparing the sample socio-economic characteristics to the population is problematic in he Laos context because *there are no census data. While there is a Lao household expenditure and consumption census conducted every 5 years, it is not a true census in that there are only 8000 households surveyed across the whole country.*

Table 2
Mean WTP of Respondents (kip per person per month)

WTP						WTP/Income(%)
Mean	STDEV	Median	Mode	Minimum	Maximum	
Whole sample (N=6590)						
7069	11432	5000	0	0	150000	4.71
Positive WTP (N=4951)						
9410	12328	5000	5000	200	150000	5.8

Table 3
Range of WTP of Respondents

Willingness to pay (kip)	Number of interviewees	Percentage(%)
0	1639	24.9
<1000	478	7.3
1000-5000	2482	37.7
6000-10000	1006	15.3
11000-15000	267	4.1
16000-20000	364	5.5
21000-25000	59	0.9
26000-30000	107	1.6
31000-35000	16	0.2
36000-40000	19	0.3
41000-45000	8	0.1
46000-50000	97	1.5
51000-55000	3	0.0
56000>	45	0.7
Total	6590	100.0

Table 4
Reasons for Positive WTP

Reason for payment	Percent
Cleanness of city	45.5
Health of yourself and family member	31.9
Contribution to government	13.0
High indirect benefit from eliminate dust	6.7
Other reasons	2.9

Table 5
The Reasons for Zero WTP

Reasons not to pay	Percent
It is government's duty, not residence	28.3
It is responsibility of producer (trucks, construction activities)	42.6
Do not have money, other expenditure is high	10.5
Do not have confidence of using money and implementation of this project	14.2
Dust in street is not big problem	1.3
Other reasons	3.1

4. COMPARING CHARACTERISTICS OF ZERO AND POSITIVE WTP RESPONDENTS

A simple t-test was used to investigate the socio-economic determinants of the choice between a zero WTP and positive WTP (table 6). There are statistically significant differences between the two groups in term of sex, years of education, main occupation (Government, retail shop owner/ business owner, and student), income, proximity of home to the road, pre-existing health problems (number of illness), number of cars at home and perception of the impact of dust on health and environment. Positive WTP respondents had higher income, education, lower number of illnesses, and higher perception of the detrimental effects of road dust on health and environment than zero WTP residents.

Table 6
T-test for Socio-Economic Variables of Zero and Positive WTP

Socio-economic characters	Mean			STDEV		t-value	Significance
	WTP=0	WTP>0	Different	WTP=0	WTP>0		
Sex	0.49	0.46	0.02	0.50	0.50	1.74	0.08
Age	35.08	34.76	0.32	10.08	9.88	1.13	0.26
Status	0.30	0.29	0.01	0.46	0.46	0.41	0.69
Education	13.23	13.61	-0.39	2.97	3.20	-4.47	0.00
Main occupation							
Government	0.50	0.47	0.03	0.50	0.50	2.03	0.04
Private company	0.19	0.19	0.00	0.39	0.39	-0.05	0.96
Retails shop owner/business owner	0.18	0.21	-0.03	0.38	0.41	-3.12	0.00
Student	0.02	0.04	-0.02	0.14	0.19	-3.84	0.00
Income	12.99	16.23	-3.24	15.43	23.99	-6.33	0.00
Home locates near main road	0.28	0.31	-0.03	0.45	0.46	-2.30	0.02

To be continued

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Socio-economic characters	Mean			STDEV		t-value	Significance
	WTP=0	WTP>0	Different	WTP=0	WTP>0		
Number of person at home							
Family member	4.78	4.71	0.07	2.10	1.99	1.22	0.22
Children member	0.64	0.67	-0.03	0.84	0.88	-1.05	0.29
Having health problems (number of illness)	0.96	1.10	-0.14	1.08	1.10	-4.50	0.00
Number of car at home							
Bicycle	0.50	0.53	-0.02	0.86	0.86	-0.95	0.34
Motorbike	2.06	2.05	0.01	1.19	1.19	0.20	0.84
Car	0.68	0.71	-0.03	0.88	0.89	-1.34	0.18
Perception on							
Impact of dust on health	1.48	1.41	0.07	0.66	0.64	3.49	0.00
Impact of dust on environment	1.59	1.55	0.04	0.82	0.80	1.94	0.05

5. FACTORS AFFECTING WTP

In order to evaluate the influence of socio-economic characteristics on WTP, a multiple regression model was used. The definitions of variables used in the regression analysis are shown in table 7. The OLS (Ordinary Least Square) method was used to estimate the factors affecting the positive WTP bids. Multicollinearity in the independent variables was checked using a correlation matrix. The variables with correlations of less than 50% to other variables were chosen as independent variables in the regression. The results are shown in table 8. As expected, income has a statistically significant impact on WTP. In addition, some socio-economic characteristic variables also had effects on WTP. Marital status, education, retail shop owner/business owner, house located near main road, number of family members, having other diseases, and numbers of bicycles, motorbikes and cars at home had positive significant impacts on respondents' WTP. Respondents who had higher income and higher education had higher WTP. This result is consistent with other studies (Wang, 2006).

Three socio-economic variables; gender, number of children in family, and perception on the impact of dust on the environment had negative significant impacts on respondents' WTP. This indicates that residents who are female, single, and have a large number of children have lower WTP.

Table 7
Definitions of Regression Variables

Variables	Definition	Unit	Mean	Std.Dev.	Minimum	Maximum	Expected sign
Independent variable							
WTP	Willingness to pay	Kip	9408.3	12322.7	200	150000	NA
Dependent variables							
GEND	Gender	Female=1, other=0	0.5	0.5	0	1	?
AGEY	Number of year	Year	34.8	9.9	14	76	+
STAT	Statute of marries	Single=1, other=0	0.3	0.5	0	1	+
EDUC	Year of attending school	Year	13.6	3.2	0	18	+
Main occupation							
GOVE	Government officer	yes=1, other=0	0.5	0.5	0	1	+
RETA	Shop owner/business owner	yes=1, other=0	0.2	0.4	0	1	+
STUD	Student	yes=1, other=0	0.0	0.2	0	1	+
INCO	Income per month	10000 kip	16.2	24.0	1	535	+
MARO	House locates near main road	yes=1, other=0	0.3	0.5	0	1	+
Number of person and child at home							
FMUM	Family member	Person	4.7	2.0	1	13	+
CHIL	Child	Person	0.7	0.9	0	7	-
Health situation							
EYES	Eye problems	yes=1, other=0	0.2	0.4	0	1	+
THRO	Sore throat	yes=1, other=0	0.2	0.4	0	1	+
BREA	Lung/respiratory disease	yes=1, other=0	0.1	0.3	0	1	+

To be continued

Continued

Variables	Definition	Unit	Mean	Std.Dev.	Minimum	Maximum	Expected sign
NOSE	Nose problems	yes=1, other=0	0.1	0.3	0	1	+
COLD	Cole	yes=1, other=0	0.3	0.5	0	1	+
ASTH	Asthma	yes=1, other=0	0.1	0.3	0	1	+
HEAR	Heart disease	yes=1, other=0	0.0	0.2	0	1	+
ODIS	Other disease	yes=1, other=0	0.1	0.2	0	1	+
Number of vehicle at home							
CARH	Car	Number	0.3	0.4	0	1	+
BICLE	Bicycle	Number	0.0	0.1	0	1	+
MOTO	Motorbike	Number	0.7	0.5	0	1	+
Perception of serious dust problem on							
HEAL	Health	yes=1, other=0	0.3	0.5	0	1	+
ENVE	City environment	yes=1, other=0	0.9	0.3	0	1	+

Table 8
Factors Affecting WTP

Variables	Coefficient	t-statistic	P-value
GEND	-679.7	-1.87	0.06
AGEY	-10.1	-0.45	0.66
STAT	1094.1	2.27	0.02
EDUC	130.9	2.04	0.04
Main occupation			
GOVE	78.1	0.18	0.86
RETA	1008.3	1.94	0.05
STUD	1636.9	1.60	0.11
INCO	25.6	3.31	0.00
MARO	720.5	1.88	0.06
Number of person and child at home			
FMUM	328.3	3.35	0.00
CHIL	-492.8	-2.24	0.03
Health situation			
EYES	-667.9	-1.49	0.14
THRO	-350.6	-0.77	0.44
BREA	25.3	0.05	0.96
NOSE	-232.2	-0.35	0.73
COLD	-398.7	-0.99	0.32
ASTH	792.3	1.31	0.19
HEAR	776.0	0.81	0.42
ODIS	1957.3	2.17	0.03
Number of vehicle at home			
CARH	3418.7	3.13	0.00
BICLE	5113.2	2.64	0.01
MOTO	2176.5	2.07	0.04
Perception of serious dust problem on			
HEAL	-1068.1	-0.87	0.38
ENVE	-3482.5	-3.36	0.00
Constant	7749.0	4.39	0.00
Number of observation		4944	
Adjusted R^2		0.0178	
F-statistic		4.74	

CONCLUSION

The main objective of this paper was to estimate residents' Willingness to Pay (WTP) for the clean up of road dust in urban areas of Vientiane, Laos. The Contingent Valuation Method (CVM) was used and the factors affecting WTP were identified using regression analysis.

The WTP for cleaning up road dust in urban areas of Vientiane was 7069 kip (USD0.86) per person per month. This amounts to 4.71% of resident' income per month. The main reason for respondents' WTP was for the cleanliness of the city, improvement in health conditions and contribution to government. Respondents who have higher incomes and higher education had higher WTP. The results indicate that Vientiane residents will benefit from cleaning up road dust. This is useful information for government agencies to consider. It will help them understand the benefits of cleaning up road dust by taking action to enhance law enforcement stopping illegal causes of road dust in Vientiane.

In addition, there are very few studies of the valuation of public goods and bads in Laos. This study is an important step toward the wider use of CVM to evaluate non-market goods for Laos. However, this analysis and non-market valuation in general faces several challenges in Laotian application. First, biases relating to the use of monetary measures in an emerging market economy with a strong history of central planning may be difficult to resolve. Second, stratified random sampling techniques are difficult to implement in Vientiane where information about the population is available only at the broadest level of detail. Third, the use of alternatives to the open-ended CVM should be explored in further research. Dichotomous choice CVM or Choice Modeling might be appropriate for future studies.

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