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The Willingness of Residents to Pay for Improving Air Quality

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ABSTRACT

Air pollution has become one of the major emerging issues of the 21st century. It is a serious problem for almost every developing country. Due to the rapid increase in population and industrialization, the problem of air pollution has become more serious. Various environmentalists and scientists have conducted a variety of studies and surveys to know about the current situation and further how to deal with these situations. Therefore, this paper aims to analyze the willingness of people living in the Southern region of Lahore to pay for improving the air quality. Statistical Package for Social Sciences software (version 20.0) was applied to determine the relationship between willingness to pay and powerful factors. A short time later stepwise, a linear regression model was built to determine the amount of positive Willingness to pay and to predict the mean value of Willingness to pay. The frequency and percentage of each variable were also determined through SPSS. The results revealed that out of 400 questionnaires filled by the citizens 82% of the citizens of southern Lahore showed positive response as they were in favor of Willingness to pay for improved air quality which shows their deep concern about the rising issue. And only 18% were not ready for Willingness to pay for improved air quality, the only reason for this negative response was the unawareness among the citizens. This shows that more awareness is required to create more knowledge among the citizens of Southern Lahore that bad air quality has so many depressing impacts on their health and well-being.

INTRODUCTION

Air pollution has become one of the major emerging issues of the 21st century. It is a serious problem for almost every developing country. Due to the rapid increase in population and industrialization, the problem of air pollution has become more serious. According to WHO (2016), Air pollution has been the reason for the death of about 6.5 million people annually around the world. About 40-80% of air pollution in developing countries is due to vehicular emissions. Almost 88% of this ambient air pollution results from low and middle-income countries. Particulate Matter (PM), hydrocarbons, carbon mono oxide (CO), and nitrogen oxides (NO_x) are major sources of air pollution. Particulate matter (PM2.5 and PM10) is particularly responsible for various respiratory and cardiovascular diseases as well as cancer (Hamid, et al., 2019).

Overpopulation has effect air quality in many ways; a major concern is the increasing use of transportation linked to overpopulation. Vehicles emit a lot of particulate matter (PM 10 and 2.5) as well as SO, NO, and CO that pollutes the air. In the developing countries especially the increase in urbanization and its traffic is contributing a lot to the levels of air pollution. Air pollution has deleterious effects on human health. Air contaminants like airborne particulate matter (PM), ozone (O_3), volatile organic compounds (VOCs), and CO, NO_x, and sulfur dioxide (SO_2) are considered as the primary pollutants emitted directly from the burning of fossil fuels (Clarke, et al., 2014).

Asia is severely affected by air pollution. According to the World Air Quality report (2019), South Asian cities are the most polluted in the world. India, Pakistan, and Bangladesh have been

the most affected countries. People living in these countries are facing severe health risks due to air contamination (Ali & Athar, 2008).

In Pakistan, over-population is causing an increase in urbanization, industrialization, energy consumption, and transportation. The urge for more urban areas is causing severe air quality issues in developing countries. The lack of air monitoring and management systems is giving rise to poor traffic, poor planning, and poor maintenance of vehicles. The currently existing cities of Pakistan are expanding leading to the increased fuel consumption, power generation, and residual heating. Industrialization is also one of the major sources of air pollution (Filippini & Martínez-Cruz, 2016).

Ali et. al. (2015) reported that the infrastructure of Lahore consists of about 1244.41 Km^2 of metaled roads. Due to this much heavy traffic, the city is facing severe air quality problems and the number of people suffering from respiratory diseases has been increased (Bonzini, et al., 2010). A study performed in Lahore by Hamid., *et* al. in 2009, reported that elevated levels of TSP, CO, and NO along major intersections of road have adverse impacts mainly due to increasing traffic load. This indicates a severe need for adaptation of air quality management strategies and programs for improving the quality of ambient air (Liu, et al., 2018).

Willingness to Pay (WTP) for clean air is considered an important parameter for the trade-off between environmental laws and economic growth. WTP is an act in which people are asked either they're willing to pay for a product. It is mostly used in the field of economics so that, an average price should be developed by the company in the market for a product. Several researchers have started to apply the WTP principle in an environment for obtaining clean air and water. Many kinds of research of WTP related to clean air have been made around the world as in United Stated, Bangkok, China, some Northern European countries, and in Pakistan as well. Due to increased world economics, the problem of air pollution has become a more concerning issue. China constitutes about 17% of the annual deaths due to air pollution in the world. Different researches have been performed to observe the relationship between economics and the environment. Research conducted by Kumar in India showed that health status is affected by the WTP (Akhtar, et al., 2017). A research carried out in Lahore by S. Akhtar et; al. showed that people are willing to pay for improving the air quality. There are several ways for performing WTP such as the Contingent Valuation Method (CVM). In this method, the consumer is supplied with hypothetical chances to buy items (Desauziers, 2004). The main objective of this research is to analyze the willingness of people living in the Southern region of Lahore to pay for improving the air quality.

METHODS

Study Area Description

The capital of Punjab is found 31.55°N, 74.36°E, and is a socially rich, socially different, and most well-off city of Pakistan. Which contributes $58.14 billion to the GDP every year. Southern Lahore considers as a real part of the low-pay settlement with the high populace thickness space of Lahore Pakistan. This locale of Lahore is quite possibly the most recent assembled zones. Aside from present green belts, high population demonstrates the high number of transport. The southern piece of the city, specifically, is seeing a dangerous development with different lodging plans building up their essence in the once ignored piece of Lahore; giving enormous freedoms to benefiting reasonable yet luxurious private facilities

The significant offenders in decaying the air nature of southern Lahore territory are businesses, cars, and progressing development task new societies and projects factories since 2010. The significant poisons in the space were NO_x, SO_x, $PM_{2.5}$, and all were surpassing National Ambient Air Quality Standards (NAAQS), because of high population thickness, and the quantity of individuals who are presented to air contamination is very enormous. As air contamination causes genuine monetary misfortune henceforth interest in contamination control advances is expanding while the public tension on nearby government is mounting to make quick alleviation moves to get serious toxin levels. This huge degradation of air quality is likewise presenting inescapable health impacts on the occupants. Henceforth the region has been decided for the valuation of family WTP for improved air quality.

Questionnaire and study plan

The investigation was based on a close and personal review of randomly chose 400 families. Respondents were needed to react to an altered pretested survey. The study was directed in March 2021. The survey was separated into 3 segments. Area

I comprised of inquiries concerning socioeconomics including sex, age, month-to-month pay, marital status, number of family individuals, calling. Segment II involved respondent's abstract views about the air nature of their space and their respiratory wellbeing. While the last segment contained the unexpected valuation question. As is notable. There are a few estimates that could be taken to improve the degree of air quality in southern, Lahore. Among potential measures are; the establishment of exhaust systems on all gas vehicles constructed in 1990 and later, the formation of non-traffic territories, the elaboration of gas without lead, the utilization of green transports, improved street foundation, and so forth As referenced before, the utilizations of these actions cause an expense which straightforwardly or by implication will be paid by us. This installment could be through: costlier vehicles expanded fuel (gas and diesel) costs and public vehicle charges. Assume the specialists introduced a program that would diminish the degree of barometrical tainting by half.

Statistical analysis

SPSS 20.0 was applied to determine the relationship between WTP and powerful factors. After starting statistical analysis, linear regression was utilized to recognize the factors that impact the respondent's official decision on WTP. A short time later stepwise, a linear regression model was built to determine the amount of positive WTP and to predict the mean value of WTP. The frequency and percentage of each variable were also determined through SPSS.

RESULTS AND DISCUSSION

A survey was conducted among the citizens of southern Lahore to know about the levels of air and noise pollution, with its effect on the citizens and their willingness to pay (WTP) for better air and noise conditions in the area under study i.e. table (4.1). The population of the study included 210 males (52.2%) and 190 females (47.8%) which is a total of 400 people. The targeted population was people that were directly exposed to air and noise pollution. The area covered in southern Lahore included busy roads, factories, hospitals, shops, and residential areas.

Table 1. Demographic Information of Respondents

Characteristics	Frequency	Percentages %	Mean ±S. D
Gender			
Male	210	52.2	1.49 ± .500
Female	190	47.8	
Age			
15 to 20	109	27.0	
21 to 25	141	37.3	2.24 ± .978
26 to 30	91	23.0	
30 above	59	13.8	
Education			
Secondary	70	18.0	
Undergraduate	148	36.5	2.40 ± .920
Graduate	140	33.3	
Postgraduate	42	12.3	
Occupation			
Student	171	42.8	2.06 ± .995
Housewife	59	15.0	
Employed	147	36.3	
Unemployed	23	6.0	
Marital status			
Single	217	53.8	
Married	142	36.5	
Divorced	25	6.0	1.62± .820
Widowed	11	2.3	
Separated	5	1.5	

Number of household members			
2 to 4 members	96	24.8	
5 to 7 members	211	51.7	2.02±.767
8 to 11 members	78	20.0	
more than 11	15	3.5	
Monthly Income			
less than 35000	51	11.5	
36000-65000	87	20.5	2.91±1.043
66000-85000	112	26.2	
86000 and above	150	39.8	
Common Disease			
Pollen Allergy	101	26.3	
Bronchitis	62	14.5	
Asthma	117	28.3	
Some other disease related to the atmospheric contamination	33	8.3	2.86±1.450
None	87	22.8	

The age of 109 (27%) people in the survey were between 15 to 20, 141 (37.3%) ranged from 21 to 25 years, 91 (23%) people were between 26 to 30 and the rest 59 (13.8%) people were above 30 years old. Among the citizens, about 42.8% were students, and their education level varied from secondary to post-graduation. Among these 42.8% students, 18% students were from secondary level, 36.5% were undergraduate, 33.3% were graduate and 12.3 were postgraduate. Among the rest of the population, 15% were housewives, 36.3% were employed and only 6% were unemployed.

Moreover, about 53.8% of citizens of southern Lahore were single while 36.5% were married the rest were divorced, widowed, and separated. Out of these people, 53.8% had families with 5-7 members, 24.8% had 2-4 members, 20.0% had 8 to 11 members, and 3.5% people had more than 11 family members. The average number of family members per household was 2.02. The monthly income of household among 11.5% people was >35000 Rs, 20.5% people had income ranging 36000 – 65000, 26.2% had about 66000-85000 and 39.8% had income 86000 and above. This shows nearly half of the population was male and another half female, among them majority were being in their 20s having a good education, more family members and good monthly income. Furthermore, people experienced different diseases due to air pollution, among them about 14.5% had bronchitis, 26.3% had pollen allergy, 28.3% suffered asthma, and 8.3% people had issues while there were 22.8% who according to them were not affected by it.

Table 2. People WTP for improved air quality in the southern Lahore

Variable	Frequency	Percentage (%)
Are you WTP for the improvement in Lahore's air quality?		
Yes	329	82.8
No	71	18.3
WTP per month		
1000 to 5000	315	78.3
5000 to 10,000	64	16.5
5000 to 10,000	21	5.3

Moreover, out of the total 400 respondents, 329 showed positive responses for WTP for improved air quality in Lahore. This makes a positive response of 82.8%. Out of these 329 people, only 21.8% of people were willing to pay Rupees 5000-10000 for improved air quality whereas 78.3% said they will pay 1000-5000 for better air quality. The positive response towards WTP in dealing with atmospheric conditions can be because about 43.8% of people think that every citizen can contribute towards it individually and 25.8% think decontamination commissions can play a role. It can also be because to majority people leaving a better environment to future generation was important while to only 1.5% of people leaving behind a better environment was not a concern at all.

While on the other hand, the negative response can be due to the people (30.5%) who say that it's the responsibility of the government to deal with these severe atmospheric conditions. When asked if the government has given attention to atmospheric conditions in their respective areas only 12.5% of people authorities were paying attention to the problem. The basic reason for not contributing a higher amount for the better environment while having a high monthly income can be because maintaining a lifestyle is more important at present than investing in managing the environmental conditions, lack of awareness regarding the effects of these issues or the fact that how hard it is to support the high number of family members as most of the respondents had with that income they earn monthly due to the economic status of the country.

The *t-test* regression model further helps in explaining the effect of independent variable on the dependent variable. And for this reason, the linear regression model was run on the data obtained from the questionnaire conducted under the study area to find out the relationship of independent variable with dependent factor which was positive WTP. The independent variables include education, gender, age, no. of household members, monthly income, air pollution, and the diseases people suffer from. The statistical analysis showed that [table-3] as the monthly income increases the willingness to pay for improved air quality also increases. Further, the analysis showed a negative relation of positive with the no. of household members and positive relationship with the air pollution, monthly income, and the diseases the citizens and their families suffer from. With the increase of atmospheric diseases, the citizens were more willing to pay for improved air quality. The results were similar to another study conducted in Mexico City, it was observed that the respondents that are aware of the bad air quality and its consequences on the environment were more willing to pay for its improvement as compared to the un-awarded citizens which pay only a slight notice to its improvement. The results were positive to an extent because citizens who were not even quite educated were aware of the bad air quality and were ready for WTP Phenomenon. Another key factor, which was similar between both the studies was that the citizens that were either suffering from the impacts of bad air quality or one of their family member were suffering from asthma or various respiratory illnesses showed more consideration towards WTP for improved air quality than the citizens with fewer impacts. The household income was also a major factor in contributing to WTP for improved air quality because citizens with lower income were less likely to pay or pay very little as compared to the citizens with high income (Ali, et al., 2015).

Another similar study was conducted in China, according to which it was observed that the residents of the city were ready for WTP for

improved air quality, as they were quite aware of the consequences because of massive news on the televisions and internet. Similar things were faced by the residents under the current study, they were aware because of hearing the impacts on the newspapers, televisions, internet, and different brochures distributed by the government and private sectors. The citizens of China were also in favor of utilizing public transport more often as compared to using their private vehicles for daily uses. Moreover, it was also observed that that the average WTP for self-protection after information disclosure was significantly higher than that before information disclosure.

Table 3. Linear regression model of positivity of WTP

Variables	Coefficient	S. E
Gender	-.007	.038
Age	-.041	.028
Do you think that Lahore (your area) is suffering from some environmental problems?	.012	.027
Air Pollution	.000	.022
Marital status	.025	.025
Monthly Income	.005	.018
Number of household members	-.009	.029
Education	.010	.030
Disease you and your family suffer from?	.056	.020

Determinant amount of WTP

For the study of environmental valuation, regression models are used. The Stepwise regression model was performed using SPSS 20.0 for determining the amount respondents that are willing to pay. The independent's variables having a significant impact on the positive WTP included disease citizens and their family suffers from, if yes then which environmental problem is the most vulnerable, what degree of importance do you place on the problem of air pollution compared to other problems such as delinquency, unemployment, inflation, and water contamination and not with the monthly as it was included in the explanatory table. The explanatory variables in stepwise regression are not directly affecting the dependent variables but are somehow linked systematically with variables that are affecting the dependent variable.

Table 4. Stepwise Linear Regression Model

Model	Explanatory variables	Coefficient	SE	T	Sig
1	(Constant)	1.108	.063	18.399	.000
	Disease you and your family suffer from?	.057	.017	3.002	.004
2	(Constant)	1.019	.076	13.813	.000
	Disease you and your family suffer from?	.052	.016	2.798	.006
	If yes then which environmental problem is the most vulnerable?	.064	.032	2.113	.035
3	(Constant)	1.125	.084	13.496	.000
	Disease you and your family suffer from?	.063	.013	3.287	.001
	If yes then which environmental problem is the most vulnerable?	.091	.031	2.831	.005
	What degree of importance do you place on the problem of air pollution compared to other problems such as delinquency, unemployment, inflation and water contamination?	-.090	.035	-2.675	.008

CONCLUSION

This survey conducted included those questions that help to measure the citizen's WTP for air quality improvement. In southern Lahore unique variety of appealing results for WTP for improved air quality was observed. Moreover, out of 400 questionnaires that were filled by the citizens 82% of the citizens of southern Lahore showed positive response as they were in favor of WTP for improved air quality which shows their deep concern about the rising issue. And only 18% were not ready for WTP for improved air quality, the only reason for this negative response was the unawareness among the citizens. According to them, it is the duty of the government to pay for clean air and not theirs. Furthermore, the household income and symptoms of respiratory illnesses and opinions on current air quality governed citizen's decision to pay.

The results further showed that age, gender, and family size were not interlinked with the positive response of WTP for improved air quality. Therefore, it can be concluded that unlike most of the developing countries Pakistan is also suffering from environmental pollution and its intense impacts on human beings but the people of Pakistan are well aware of these impacts and are already facing the consequences as most of the people are suffering from respiratory illnesses like bronchitis, asthma, wheezing, cough and chest congestion. This leads to a higher level of people were WTP for improved air quality. Furthermore, these results provided important evidence for researchers and decision-makers to mitigate better air pollution control projects and strict enforcement of environmental laws for keeping the level of pollutants low in the air. More researchers are required to divert their attention on this rising issue as it is the basic need of the hour to provide the citizens with the best and economical air quality control projects that lessen the increasing health diseases.

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