Health and Economic Implication of Solid Waste Dumpsites: A Case Study Hazar Khwani Peshawar

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This study evaluates the economic burden of diseases associated to the inappropriate disposal of solid waste at dumpsite located at the Hazar Khwani, Peshawar provincial headquarters of Khyber Pakhtunkhwa Province of Pakistan. A sample of 200 respondents was selected from 5% of the total population residing in the target area. Our sample selection is based on two-stage sampling technique. The sample data was regressed with the help of Tobit & Poisson models for estimation of mitigation costs and work days lost. Results suggest an inverse and significant association between the distances and work days lost and mitigation costs, respectively. Annualized monetary benefit of adoption of scientific and modern techniques of landfill management to the locals ranges from 186,612,897.66 PKR to192,559,787.244 PKR especially for residents living within the proximity of 4km of the dumpsite. Therefore, the study recommends adoption of alternate solid waste management solutions, such as composting or sanitary landfill and providing the populace of the target area comprising of residential facilities at a considerable distance from the dumpsite.

***Keywords**:* Municipal solid waste; dumpsite; environmental economics; cost of illness

Waste also referred to as rubbish or garbage is the by-product of the human economic activities. There are different types of wastes, such as sold, liquid or gaseous. The solid wastes have adverse impact on the environment as well as public health and are major source of water, land and air contamination. Solid Waste Management (SWM) is a much bigger problem of developing economies as compared to developed nations. The South Asian region, specifically Pakistan is no different from the rest of the world and is faced with the challenge of providing scientific SWM solution to its population. The lack of awareness and implementation of existing faulty framework also adds to the problem of defective SWM.

The civic facilities managers of major cities in Pakistan in-spite of serious and continuous efforts are unable to cope with the menace of municipal waste management. The road sides and empty open areas overflow with filthy unhygienic heaps of wastes portraying a sorry state of affair all over the country. This uncollected waste is one of the causes of environmental degradation, is a source of many life threatening diseases and impinges huge economic cost onto the general public. The waste management is the center of attention of the municipal authorities around the globe because of increased pollution which leads to environmental hazards and economic costs due to non-existent or inappropriate wastes management. The term waste management covers the collection, segregation, handling and disposal of wastes in an environment- friendly manner (Khan, 2006; Khan et al., 2012; Mahar et al., 2007).

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The waste disposal technology has evolved into engineered sanitary landfills, recycling industry, composting, incineration and recently a valuable source for energy production transformed from simple waste disposing-off. In the today's world, the wastes are considered as useful renewable resources which can be reused as compost (fertilizers) and incineration (Waste to Energy). (Visvanathan et al., 2004; Masood, 2013). The existing SWM strategy of Pakistan is not sufficient to handle the solid waste issue as 51-96% of the waste generated remains uncollected (Mahar et al., 2007). In Pakistan, the SWM system adopted is unsanitary landfills and open dumps which are an open threat to the society's environment and health. It works as a breeding ground for many disease vectors, causes odor pest, defaces cities and also contributes to community's air, water and land pollution. The open burning practice of solid waste emits toxic gases which are not only harmful for the society's health and environment but it also adds to groundwater contamination.

Environmental Economists try to explain the economic loss to the society because of inaction of the concerned authorities regarding environmental problems by valuing the resources. Environmental goods can be valued either by using the revealed preference or the stated preference approaches. The former approach is based on actual choices whereas the latter approach is based on hypothetical choices. One of the developed and widely used revealed preference methods for valuing environmental changes is the Cost of Illness (COI) which analyzes the total costs incurred by a society due to a specific disease or health condition. An estimate of costs is often valuable, when planning, decision-making, and regulatory development is to be considered thoroughly. As such, the benefits of avoiding illness can be provided by having efficient estimates. Various studies have proved that economic cost of illness to the people living near dumpsite is much higher than to those living in a cleaner environment (Folefack, 2008). Therefore, the aim of this paper is also to estimate the costs of illness of the residents residing near the Hazar Khwani dump site, Peshawar, which is the largest in-operation dumping ground.

The rest of the paper is structured as follows. Next section reviews the relevant literature on SWM and COI approach, followed by a description of the research context. This is followed by a discussion of materials and methods utilized in the paper. We then present and discuss the results. In the end, we offer our conclusions based on this empirical study.

Literature Review

Economic growth is the result of economic activity due to which wastes of all types are being generated manifold. As a result the alarming problems of air, water and land pollution arise which contribute in damaging the environment and public health through noise pollution, bad smell prevailing in the atmosphere, congested towns, improper waste disposal, highly crowded traffic, and tensions. Environmental degradation is the damage to the environment as a result of destruction of resources such as air, water and soil; the exploitation associated with ecosystems and the loss of wildlife. Environmental degradation was declared officially as one of the ten global threats in 1998 by the United Nations. Moreover, academia has consistently advocated the adoption of sustainable business practices in order to reduce negative impacts of economic activity on the environment (Atiq and Karatas-Ozkan, 2013).

The sustainability of the landfilling system has become a global challenge due to increased environmental and public health concerns (Visvanathan and Glawe, 2006). Environmental degradation attributed to insufficient waste disposal can be articulated by ground and surface water and soil contamination through direct waste contact or leachate, air pollution by burning of wastes, dispersing of diseases by different vectors like insects and rodents, or unrestrained methane discharge by anaerobic decomposition of waste. A pilot study in Kenya was conducted by UNEP (2007), which linked environmental pollution to public health. A medical assessment of the children and adolescents living and schooling near the dumpsite indicated a high incidence of diseases such as respiratory, abnormalities in the red blood cells and high level of blood lead, as a result of exposure to the metal pollutants as revealed by the soil samples.

Cropper et al., (2004) attempted to measure the monetary value households place on preventing malaria in Tigray, Ethiopia using COI approach and the Willingness to pay (WTP). The value of preventing malaria with vaccines is about 36 USD per household per year or about 15 percent of imputed annual household income which is about two or three times the expected household cost of illness which was calculated through the COI method. The WTP estimates for adopting preventive measure, i.e. the bed-net were 6 USD per bed-net; only one-third of the population of a 200-person village would sleep under bed-nets. Similarly, EPA with the help of Craun and Associates, Inc. (2007) conducted a research on the burden of disease associated with waterborne outbreaks. Monetary burden of infectious Waterborne Outbreaks in Drinking Water, in the period 1971 to 2000, was estimated to be $201,716,000 using the COI approach including both, direct and indirect costs. Several sensitivity analyses were also run, for evaluating key assumptions that are used to develop the burden estimates and influence of model input parameters on these estimates.

For Cameroon, (Folefack, 2008) estimated the costs of illness of the resident of living around Nkolfoulou dumping site by employing the COI approach. The paper revealed that living near the dumping site are two times more exposed to various diseases due to living in a polluted area. The annual costs were estimated to be 607,310 FCFA1 per year per person (about 926 Euros/year/person). The researcher recommended alternative disposal technologies, such as, composting to be adopted for reducing the burden of diseases. For Bangladesh, (Chowdhry and Imran, 2010) investigated the morbidity costs associated with the reduction in air pollution in Dhaka using COI approach. The annual savings for Dhaka's population was estimated to be Taka 2.39 billion or USD 34.09 while per person estimated calculated were Taka 131.37 (USD 1.88) and Taka 150.49, respectively, from reductions in lost earnings and medical expenditure.

Self-reported occurrences of major chronic diseases among the residents of rural Vietnam were examined by (Minh et al., 2012). They analyzed the household financial burden associated with these diseases. The disastrous health expenditure among the households having at least one member with a chronic disease was estimated to be 14.6 and 7.6%, respectively. The percentage of experiencing terrible health expenditure among the household with non-communicable patients were in the range of 2.3-3.2 times greater than that of other households. The study indicated that the household financial burdens caused by chronic diseases in Vietnam are substantial and instantaneous mitigation measures are needed. Similarly, the COI approach was also used by (Seyler et al., 2013) for examining direct and indirect costs incurred by household living in slums of Chennai. The empirical results showed that the poorer section of slum dwellers suffered more from catastrophic illness despite of having free public health services in the region. Policies enhancing the resilience of poor households against illness costs are the need of the time.

Research Context – Hazar Khwani, Peshawar

Peshawar lies between 33° 44' and 34° 15' north latitude and 71° 22' and 71° 42' east longitude covering an area of 1257 sq. km. According to a UNFPA report, the city's population has crossed 2.5 million[1]. District Peshawar is the provincial capital of KP consisting of 92 union councils.

For adminstrative purpose the City District Government is divided in to four towns i.e. Town I, II, III, IV and cantonment. Town I and III comprises of the urban areas whereas Town II and IV comprises of the rural areas.The Cantonment, Hayatabad and Regi Lalmah are also included in the city's urban areas. The Municipal Corporation (MC) is responsible for managing the solid waste of urban areas, the Peshawar Development authority (PDA) is responsible for the management of Hayatabad and Regi Lalmah, Cantontment is being independenly supervised by the Cantonment Development authority (CDA) whereas there is no local authority assigned for the managing the solid waste problem for the rural areas (Khan, 2006; Pak-EPA/OECC, 2007)

Peshawar Municipal Corporation is still utilizing old fashioned and discarded waste management techniques of open dumping and burning. There are two dumping sites on the outskirts of the city which have also become a part of the city due to population explosion and city extension. These dumpsite situated at Hazar Khwani and Lundi Akhune Ahmed employ the same techniques or open dumping and burning or burying along the roadsides(Khan, 2006).

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[1]Article published in Express Tribune: "**Bane or boon: Urbanization, displacement pushes Peshawar's population over 2.5m**" Posted By Irfan.Shaikh On Nov 5, 2013

The dumpsite at Hazar Khwani is located at Ring Road about 7 km from the city center. The problems addressed by the study are; the inappropriate waste disposal methods and costs evaluation of ill-planned and mismanaged waste. Dumping, burning and burying of wastes in open spaces though reduce the quantities of wastes are no more a desirable waste management solution. Resultantly, it impacts the health of the residents in adjacent localities through spreading skin and respiratory tract infections, stomach and chest related problems, malaria, dengue and other chronic diseases, psychological disorders, gastrointestinal problems, and allergies. It is also worth mentioning that these dumping sites have a very high economic and social cost not yet estimated (Salam, 2010; UNEP, 2007)

Methods

In order to achieve the objectives of the study, data was collected through in person interviews. A structured questionnaire was administered by three trained enumerators from the targeted respondent households, living within the 4km radius of the Hazar Khwani Dumpsite All the wastes, whether aerobic or anaerobic, generated are placed and disposed-off at the open dumping ground. The economic consequences of living around this waste dump and its impact on the labor market performances of individuals due to loss in productivity and work days lost are measured through a cross-sectional household survey. Before conducting the final survey, questionnaire were pre-tested for checking the reliability and validity and the econometric specification.

The study collected health and medical expenditure data from the household as a primary source. The research adopted multistage sampling procedure following the sampling technique 0f (Gupta, 2006). The purposive sampling was used in the first stage and Union Council 37 (Hazar Khwani-I) of Town VI was identified as a sample unit for data collection. The second stage involved stratifying the households in the area according to the residential proximity from the open dump which included Afridi Ghari, Chamkani, Jameel Chowk and Dir. Colony.

The sample size consists of 200 households from the Union council 37-Hazar Khwani I of Peshawar district. The sample constitutes 5% of households, out of the total 4,236 residential properties within four-kilometer radius of the dumpsite. Data collection was carried out for one month, i.e. November, 2013, only due to time limitation.

Theoretical Framework

Waste, as defined by economic theory, is a negative externality. The consumer and industrial activities produce wastes with a negative impact on environment. There is a general consensus among economists that the markets fail to account for the economic costs of the resources depletion due to environmental degradation. The water, air, land and soil pollution costs the economy dearly. The current and potential losses such as damaged health, lower productivity, depleted natural resources and the reduced enjoyment of nature are outcome of the harmful human economic activities. Environmental economics aims at quantifying these losses and to provide the world with a foundation to reduce them in the most appropriate way and to compare the cost of environmental damage to the mitigation cost. Similarly, during the 1950's Neoclassical economists also made significant contributions to environmental theories, and recognized it as the root cause of many economic externalities. (Gordon, 1954; Balasubramanian and Birundha, 2012)

In order to analyze the economic impact of an environmental bad on public health, two types of information are needed; the identification of physical health impacts of the exposure and evaluation of the monetary health cost associated with it (Freeman, 2003). Thus the aim of the study is to estimates the economic costs based on a dose-response model for quantifying the physical impact and cost evaluation thereof. Cost of illness is defined as lost productivity due to sickness plus the cost of medical care resulting from sickness. (Freeman, 1993)

The theoretical model that is being employed is the simplified version of the health production function (Freeman, 1993) as used by (Gupta, 2006; Chowdhry and Imran, 2010; Adhikari, 2012), to estimate the optimal choice of medical expenditure.

The basic individual health production function can be written as

$$H = H(Q, M, X) \tag{1}$$

Where, H represents the number of work days lost referring to the health status of the individual which is positively related to the level exposure to pollution (*Q*); and negatively related to the mitigation activities (*M*) carried out by the individual; and X includes the vector of individual's health characteristics.

The utility function (U) of an individual is defined as

$$U = U(C, L, H(Q, M, X), Q) \tag{2}$$

C is consumption of other commodities; L is leisure and His health status and Q representing the level of pollution.

The individual allocates his non-labor income (Y); wage rate (w); the income earned from work such that the sum of these two components gives the total income of an individual (T-L-H) and the price per unit of mitigating activity (PM).

The budget constraint for an individual is expressed as

$$Y + w(T-L-H) = C+PMM \tag{3}$$

Here, *w* is the wage rate, while price of *M* are given by *PM*, respectively, and the price of aggregate consumption is normalized to one. The individual maximizes *U* by choosing *C*, *L and M,* subject to budget constraint (3).

The demand for mitigating activities for an individual can be written as:

$$M = M(PM, H, Q, X, Z) \tag{4}$$

Where;
Given the pollution level (Q), prices of mitigating activities (PM), wage rate (w), income (Y), and other exogenous variables (X), individuals maximize (1) with respect to X, M, and L given the budget constraint (3). By solving the following problem,

$$Max\ G = U(X, L, H, Q) + \lambda[Y + w(T-L-H)-X-PM\ M] \tag{5}$$

Where, λ represents the Lagrange multiplier
The first order conditions of the optimization problem yields the following demand functions for mitigating activities (PM), which depend on prices, wage rate (w), non-labor income (Y), level of pollution (Q), and the vector of individual characteristics (X).

The cost of illness (COI) can be derived as the sum of individual's COI as the sum of lost earnings due to workdays lost and medical cost to the concerned individual as follows:

$$COI = w\, {dQ}/{dH} + P_M\, {dM}/{dQ} \tag{6}$$

Econometric Specification of the Model

The study aims to quantify the health costs associated with the inappropriate waste management. Therefore, both the functions namely; health production and demand for mitigating activities functions are being employed for cost assessments and evaluations using Poisson and Tobit Regression models. is to be estimated. (Gupta, 2006; Chowdery and Imran 2010; Adhikari, 2012)
The Poisson regression model estimates the household health production function as:

$$Hit = E(Hit) + Uit = \lambda it + U_{it}$$

$$\ln \lambda it = \beta 1\ 1n\ Xit + U_{it}$$

According to this modelλ_{it} is the mean value of the number of sick days, β_1 is the vector of regression coefficients, and X_{it} is the vector of independent variables.

The Tobit model is used to estimate the demand function for mitigating activities is specified as:

$M^*it = Xit\, \beta_2 + U_{it}$

M^*_{it} is a latent variable with

$M^*it = Mit$ if $M_{it}>0$

$M^*it = 0$ if $M_{it} \leq 0$ Where, β_2 is the regression coefficients vector and $X_{it}$is the independent variables vector.

The two estimated reduced form equations of the health production function and the demand for mitigation activities are:

$$H = \alpha_1 + \alpha_2 ODR + \alpha_3 PRC + \alpha_4 DST + \alpha_5 Age + \alpha_6 Age^2 + \alpha_7 GND + \alpha_8 EDU + \alpha_9 MRST + \alpha_{10} AWR + \alpha_{11} ILLSUF + \alpha_{12} LogPCI + \mu \tag{7}$$

$$M = \beta_1 + \beta_2 ODR + \beta_3 PRC + \beta_4 DST + \beta_5 Age + \beta_6 Age^2 + \beta_7 GND + \beta_8 EDU + \beta_9 MRST + \beta_{10} AWR + \beta_{11} ILLSUF + \beta_{12} LogPCI + \varpi \tag{8}$$

μ and ώ are the stochastic error terms

The explanation of the *dependent variables* used in the equation is as follows:
Work Lost Days (H): H represents the number of workdays lost per person per month due to diseases associated with living in a polluted area.

Mitigating Activities (M): include expenses incurred as a result of living in a polluted area related diseases. These expenditures include costs of medicines, doctor's fees, diagnostic tests, hospitalization, travel to doctor's clinic, etc., per person/month.

The explanation of the *independent variables* that affect the health production function and mitigating activities is as follows:

ODR: the odor nuisance that people report due to living around a dumpsite. It is expected to have a negative sign as we move away from the dumpsite.

PRC: it is a dummy variable which takes the value 1 if the local authorities bury/burn the garbage; 0 otherwise.

DST: the total distance of 4km was taken from the dumpsite as a proxy for the exposure to the adverse health and environmental impacts. As the distance increase so does the cost on illness decreases, it is expected to have a negative sign.

Age: Age of the individual. Till a point it is negative because living in a polluted environment may affect the children adversely; for the middle age people it is expected to have a positive sign whereas for old age people it is expected to have negative sign again.

Age2: The age square of the age of the individual is taken for capturing any non-linear relation between age and sickness.

GND: it is a dummy variable which takes the value 1 if the individual is male; 0 otherwise.

EDU: the education of the individual is taken in years to capture the level of understanding of the respondent about the harmful health effects of living around a dumping site. It is assumed that the higher the level of education, the more respondent is aware of the harmful effects of living in the polluted area.

MRST: is a dummy variable which takes the value 1 if the individual is married; 0 otherwise. The marital status of the individual is expected to have an impact on the costs of the household because if the individual is married, he/she would be more concerned about the hygiene of his family as compared to a single person.

HHtype: is a dummy variable which takes the value 1 if the individual is the owner of the house; 0 otherwise.

AWR: is a dummy variable which takes the value 1 if the individual is aware about the adverse health impacts of the dumpsite; 0 otherwise. It is expected that if the costs of mitigating activities will be less if the individual is aware.

ILLSUFF: is a dummy variable which takes the value 0 for the stomach/chest/eye/skin infections; 1 for the malaria/dengue/flu & fever and 2 for chronic illness.

Results and Discussion

The descriptive analysis and the regression analysis are reported in this section. The estimated Tobit equations for the demand for mitigating activities are explained in Table 2, while in the Poisson, and Negative Binomial Regressions are estimated for the dose response function are explained in Table 3 and 4.

For estimating the effects of pollution variables and the individual characteristics on the mitigation costs incurred by the household, mitigation costs were taken as the dependent variable. As it is a discrete variable, it violates the linearity assumption of the least squares, therefore Tobit regression is being employed for getting better results. Whereas the dose response function is being estimated by employing the Poisson and Negative Binomial regression models s the dependent variable, i.e., number of work days lost due to living in a dirty environment. However, there are two separate tables for estimating the number of work days lost with distance and odor. The rationale for estimating them separately was that odor and distance were not giving significant results when computed together because of multicollinearity between them.

Table 1
Summary Variables

Variable Code	Variable Type	Variable Definition and Measurement
Age	Continuous	Age of the respondents
EDU	Continuous	Education in years of the respondents
MRST	Dummy	Marital Status of the respondent; if married=1; otherwise= 0
GND	Dummy	Gender of the respondent, for male=1& for female=0
LogPCI	Continuous	The log of the per capita income of the household per month
HHtype	Dummy	Tenure of dwelling: Owner=1; otherwise =0
DST	Continuous	Distance from the dumpsite from 1km to 4km
ODR	Dummy	Annoyed by the odor nuisance; if yes=1; 0 otherwise
AWR	Dummy	Living near a dumpsite is harmful: If aware=1; otherwise = 0
PRC	Dummy	Disposal practice by government: Burning/burying=1; 0 otherwise
M	Continuous	The household per month costs on all the mitigating activities, i. medication costs, laboratory costs, dr.'s fee and the travel costs in the la one month
H	Discrete	The number of work days lost due to illness in the last one month
ILLSUF	Dummy	The illness suffered due to living near a dumpsite; 0=infections, 1= fevers 2= chronic illness.

Descriptive Statistics

HHCOST: The average mitigation cost is estimated to be Rs. 569/- due to living near a dumpsite.
SKDYS: The total work days lost on average is estimated to be 1.91. The maximum number of sick days reported by respondents was 45 whereas the minimum number of sick days was 0.

ODR: it is a dummy variable which takes the value of 1 if the respondent is annoyed by the odor nuisance; 0 otherwise. Almost 70% respondents were annoyed because of the odor nuisance. The remaining 30% did not complaint about the odor nuisance because they lived at a considerable distance from the dumpsite, i.e. more than 4km.

PRC: it is a dummy variable which takes the value 1 for the burning/burying disposal practice adopted by the local authorities; 0 otherwise. Almost 76% respondents reported that burning/burying of solid waste is being practiced by the local authorities for waste disposal. 24% responded that the local authorities were not adopting any practice and the heaps of waste could be seen lying on the streets, in the *nallas* and causing adverse health effects.

Age: the average age of the respondents was 22; minimum age was 0(which means less than one year) and the maximum age was 94.

GND: it is a dummy variable which takes the value 1, fi the respondent is male; 0 otherwise. 54% of the respondents were male while the remaining 46% were females.

EDU: the respondents' education level was measured in years. The average education level of the respondents was reported to be 4 years.

MRST: it was also a dummy variable, if the respondent was married; it took the value of 1; 0 otherwise. 40% of the respondents were married while the remaining 60% were unmarried.

HHtype: it was also a dummy variable, which take the value 1 of the respondent is the owner of the house; 0 otherwise. It can be seen that almost 59% of the respondents were owners.

AWR: it is also a dummy variable, if the respondent is aware about the harmful health effects of living in a residential proximity to a dumpsite, it takes the value 1; 0 otherwise. It is found that about 70% of the respondents were aware that living in a dirty environment is harmful for them.
ILLSUF: it is a dummy variable which takes the value of 0, 1 and 2. 0 for those who were suffering from chest, intestinal, skin or eye infections; 1 for those who were suffering from malaria, dengue or flu & fever; and 2 for those who were suffering from any chronic illness like cancer, hypertension, diabetes, etc. Only 12% of the respondents have reported malaria, dengue; and flu & fever whereas the other 88% suffered from infections and chronic illness.

Table 2
Descriptive Statistics

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
M	1782	569.3732	4215.25	0	137300
H	1782	1.916386	5.159475	0	45
Odr	1782	0.70651	0.455489	0	1
Prc	1782	0.767677	0.422433	0	1
Dst	1782	0.936027	1.235064	0	4
Age	1782	22.74411	17.45001	0	94
age2	1782	821.6263	1147.325	0	8836

Gnd	1782	0.546577	0.497966	0	1
Edu	1782	4.62514	5.241372	0	18
Mrst	1782	0.404602	0.490953	0	1
Hhtype	1782	0.590909	0.491804	0	1
Awr	1782	0.704265	0.456501	0	1
Illsuf	1782	0.122335	0.391753	0	2

Interpretation of Table 2- Tobit Regression

The parameter estimates from the reduced form equation of mitigation cost are presented in table 2. The significant and negative coefficient of distance (DST) measured in kilometers, which was used as a proxy for the pollution variable, indicates a monthly reduction in the mitigation costs by Rs. 1258/- after moving away from the dumpsite. Similarly, the burning practice (PRC) adopted has a negative relationship with the household cost on mitigating activities, which implies that the cost of people living at a distance of 4km or more is PKR. 321/-, less than those who live within the 2km or less radius of the dumpsite. The pollution variable, odor (ODR) as reported by 70% of the respondents was troubling odor nuisance, so their mitigation costs increases although it is statistically insignificant. The socio-economic variables such as gender (GND), education (EDU), marital status (MRTS) have positive signs, as expected, but insignificant. The coefficient of age is negative and that of age^2 is positive. Both the coefficients are significant at 1% and 5% levels, respectively. The coefficient of LogPCI is positive and significant which means that as the level of income increases so does the mitigation cost of the respondent. It can be seen that the coefficients for household type is negative and significant, whereas the awareness level of the respondent is insignificant and have an inverse relation with the mitigating costs.

Table 3

Tobit regression

Dependent Variable: Mitigation Costs per month (value in PKR.)	**Tobit Regression**			
Independent Variables	**Coef.**	**Std. Err.**	**t**	**P>|t|**
Odr	1219.152	904.3548	1.35	0.178
Dst	-1258.752	350.0837	-3.6	0***
Prc	-321.895	877.8417	-0.37	0.714
Age	-224.441	106.8938	-2.1	0.036**
age2	4.112592	1.221448	3.37	0.001***
Gnd	362.1657	721.4553	0.5	0.616
Edu	77.47083	83.64961	0.93	0.355
Logpci	2475.868	1158.195	2.14	0.033**
Mrst	1258.311	1219.219	1.03	0.302
Hhtype	-1985.656	725.6559	-2.74	0.006***
Awr	-655.1911	1337.137	-0.49	0.624
Illsuf				
1	12023.64	1028.436	11.69	0***
2	18694.42	1693.95	11.04	0***
_cons	-17907.32	4042.116	-4.43	0***
/sigma	9531.808	379.8036		
log likelihood	-3993.5546			
LR chi2(13)	338.20(0.00)			

No. of obs.	1782 (1438-Left Censored)	344-Uncensored Right Censored	0-

**and *indicate significance at 1% and 5% levels.

Poisson and Negative Binomial for distance and Work Days lost

Table 3 shows the estimates of the reduced form of health production function due to work days lost. The pollution variable, distance (DST) measured in kilometers is negative; as me move away from the dumpsite the expected work days lost decreases. If the distance is increased, expected work days lost is decreased 2.8% (100*0.028). The coefficient of burning practice adopted (PRC) is positive and significant at 1 percent, showing an increase in the sick days due to the emissions of the burning of wastes makes the state of health of the people residing near the dumpsite more vulnerable. As the emissions from the burning of wastes increases, the expected number of work days lost increases by 20%. The socio-economic indicators of the respondents' show that age, education (EDU), gender (GND) and marital status (MRTS) have their expected signs but some of them, such as age and gender are only statistically significant at 1% and 10%, respectively. The LogPCI of the respondents is statistically significant and is negatively influencing the days of illness. This implies that the more the respondent is exposed to the pollution originating by the dumpsite; the probability of the work days lost is increased positively by more than 100% and is highly significant. However, results from the same table shows that the awareness level (AWR) doesn't have any insignificant impact on the work days lost and do not have the expect sign either.

The negative binomial estimates do not show any statistical significance with all the variables. In fact the signs of the coefficients are also changed from those of Poisson regression estimates. Only the coefficient of the illness suffered (ILLSUF) by the respondents' is significant and has the expected sign, which implies that due to living in a polluted area the probability of expected work days lost increases by more than 100%.

Table 4

Poisson and Negative Binomial for distance and Work Days lost

Dependent Variable (work days lost in last one month)	Poisson				Negative Binomial			
Independent Variables	**Coef.**	**Std. Err.**	**z**	**P>z**	**Coef.**	**Std. Err.**	**z**	**P>z**
Prc	0.19996	0.042836	4.67	0***	-0.01869	0.200351	-0.09	0.926
Dst	-0.02853	0.015342	-1.86	0.063*	-0.03872	0.065278	-0.59	0.553
Age	0.01341	0.004947	2.71	0.007***	0.025342	0.026916	0.94	0.346
age2	-3.10E-05	5.48E-05	-0.57	0.572	-0.00011	0.000335	-0.32	0.752
Gnd	0.065513	0.036656	1.79	0.074*	0.151513	0.167029	0.91	0.364
Edu	0.001928	0.003951	0.49	0.626	-0.00744	0.020469	-0.36	0.716
Mrst	0.004965	0.054707	0.09	0.928	-0.03706	0.28724	-0.13	0.897
Awr	-0.03514	0.06617	-0.53	0.595	-0.14531	0.300306	-0.48	0.628
Illsuf	1.231553	0.022883	53.82	0***	1.45841	0.209996	6.94	0***
Logpci	-0.24721	0.056242	-4.4	0***	-0.20071	0.280796	-0.71	0.475
_cons	0.660062	0.195953	3.37	0.001	0.474439	1.00608	0.47	0.637
/lnalpha					2.305808	0.065126		
Alpha					10.03228	0.653358		
Log likelihood	-5527.9065				-2204.9183			

Chi2(10)	2889.6(0.00)	100.65(0.00)
No. of obs.	1782	1782

***, ** and * indicate significance at 1%, 5% and 10% levels.
Hausman test does not reject the random effects.

Poisson and Binomial for Odor and Work Days lost

Table 4 shows that the coefficient of odor nuisance (ODR) is positive and significant at 1% level, as expected. The probability of the expected work days lost, who were troubled by the odor nuisance is almost 18 %. As the workers work in an unhealthy environment, so, it positively affects their hours of work. However, results from the same table shows that 1 unit increase in the burning practice adopted by the municipality will increase the probability of work days lost by 19% and is highly significant. The respondents' characteristic shows that age, education, gender and marital status have the expected signs but only age is statistically significant at 1%. The awareness level of the participants is negatively affecting the potential of working hours but does not explain any significant impact. The log of per capita income (LogPCI) of the respondents is statistically significant and is negatively influencing the days of illness. This implies that the more the respondent is ill, the less the income would be generated and the probability of the sick days increases positively by more than 100% at 1% significance level.

However, the results interpreted from the negative binomial regression of the dose response estimations does not show any significant relationship with the pollution variables, respondent's characteristics as well as the respondents' per capita income and awareness levels; except for the illness suffered by the respondents due to living in a polluted area which is highly significant.

Welfare Gains

The COI estimates provided in this study are lower bounds estimates as they exclude the Aversive expenses by the people living in a polluted area. The total benefits to a person should include the benefits from avoiding the number of sick days due to illness and saving mitigation costs. To calculate the benefits in monetary terms from living at a distance more than 4km, the marginal effects from the Tobit regression, given the coefficient of distance multiplied by the probability of the mitigation costs considering only the positive values (Gupta, 2006; Naveen, 2012).

Tobit Regression Results for Distance and Odor

For Distance

The distance was taken as the main variable in the study for measuring the mitigation costs and the work days lost.

Saving from reduced mitigation costs per year = β * Pr (MC>0) * 365/30

Therefore, the estimated annual welfare gain to a representative individual in the sample is PKR. 15,305.7 /-, per annum due to living at a distance more than 4km from the dumpsite. So the estimated annual reduction in the mitigation costs for the entire employed population of the Union council[2] will be PKR. 192,559,787.244 (US$ 1,816,601.77)[3]

For Odor

The other main independent variable that influence the mitigation costs and the work days lost was Odor.

Saving from reduced mitigation costs per year = β * Pr (MC>0) * 365/30

Therefore, the estimated annual welfare gain to a representative individual in the sample is PKR. 14,833.016 /-, per annum due to living at a distance more than 4km from the dumpsite. So the estimated annual reduction in the mitigation costs for the entire employed population of the Union council will be PKR. 186,612,987.66(US$ 1,760,499.88)

[2]Households in UC 37 are 4326; average family size is 11, therefore, the population of UC-37, Hazar Khwani-I, Town VI is 46, 596

[3] The exchange rate used is USD=106 PKR.

Poisson Regression Results for Distance and Odor

For Distance

Similarly, the number of work days lost due to living around a dumpsite, computed from the Poisson regression will be as follows:

Restricted days per annum = $\alpha * e^{\sum \alpha X} * 365 / 30$; where, α is the coefficient of distance and $e^{\Sigma\alpha X}$ is the predicted value of the Poisson regression.

The results of Poisson regression estimates shows that as the distance increases the work days lost decreases by 0.029. Whereas the annual restricted days saved for increasing the distance for more than 4km will be 0.353. The average per day wage rate of the sample was PKR. 848. As 27%[4] of the population in the area is employed, so the estimated annual benefit for saving the sick days would be PKR. 3,766,022.917 (US$ 35,528.52)

For Odor

Similarly, the number of work days lost due to living around a dumpsite, computed from the Poisson regression will be as follows:

Restricted days per annum = $\alpha * e^{\sum \alpha X} * 365 / 30$; where, α is the coefficient of distance and $e^{\Sigma\alpha X}$ is the predicted value of the Poisson regression.

The results of Poisson regression estimates shows that as the distance increases the work days lost decreases by 0.18. Whereas the annual restricted days saved by increasing the distance for more than 4km will be 2.19. The average per day wage rate of the sample was PKR. 848. As 27% of the population in the area is employed, so the estimated annual benefit for saving the sick days of the employed population would be PKR. 23,364,278.15 (US$ 220,417.72)

Conclusion

Both, Tobit and Poisson regressions shows that distance has a negative relationship with the mitigation costs and the work days lost, respectively which substantiate our main hypothesis that the cost of illness of the people living near the dumpsite is higher than that living far from it. The health status of the people living in the residential proximity of the dumping site is vulnerable and needs to be taken seriously by the local authorities. The annual health benefits from having an alternate waste disposal system, e.g. composting will save up to PKR. 186,612,897.66 to 192,559,787.244. Government should adopt an alternate waste disposal method, such as composting Hence; we recommend the adoption of modern techniques of managing landfill in order to reduce the adverse health effects and odor nuisance originating from the dumpsite.

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[4] 27% employed population is 12,580.92

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