Policy Research Journal
ISSN (E): 3006-7030 ISSN (P) : 3006-7022 Volume 4, Issue 3, 2026

STONE CRUSHING INDUSTRY IMPACT ON HUMAN HEALTH EXPENDITURES AND ENVIRONMENT: A CASE STUDY OF MALAKAND DISTRICT

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DOI:https://doi.org/10.5281/zenodo.21488712

Keywords

Article History
Received: 07 January 2026
Accepted: 17 March 2026
Published: 31 March 2026

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Abstract

This study reveals the considerable impact of stone crushing industry on human health and on the environment. Moreover the study also shows that how Stone Crushing Unit's workers and owners respond to health problems and what are the existing environmental health laws at both national and provincial basis. Primary data has been collected from 280 respondents in Malakand district and respondents were classified into two groups Controlled group and uncontrolled group (treatment group) and they were interviewed through pre-tested questionnaires. For empirical analyses a Propensity Score matching model has been estimated using Stata software to evaluate the environmental pollution based health cost. The result shows that average treatment expenditure is greater than 10261.14 rupees for those people who are living in a range of 500 meters with crush plants as compared to those who are out of 500 meters range. Moreover the result shows that the relation between the groups is significant. Direct exposure to stone crushing units the related diseases such as respiratory problem, asthma skin and depression in treatment group were high as compare with the controlled group. Study recommends some polices intervention unit and Strict and proper implementation of the existing PAKISTAN ENVIONMENTAL PROTECTION ACT, (PEPA) 1997 is need to be enforced to curb the environmental pollution generating by stone crushing unit and to make it sustainable.

INTRODUCTION

The era in which we are living cannot be imagining without the industry is like life without water. Most of the economic products are related to different sector like agriculture, industry and services. The industries include manufacturing, construction, gas, water, electricity and mining etc. The industry is the largest contributing sector

to the world GDP. Industry provides employment to the people around the globe. In US every year about US$ 1.3 trillion value of structures are built.

For a moment if we keep aside the positive output of the industry they are getting a big threat for the environment. Industrial activities lead to environmental issues like air pollution, water pollution and soil contamination (Sivacoumar, 2006; Gunkel et al., 2007; Mushtaq and Khan, 2010). Industrial workers especially in developing countries have always been facing problems of polluted environment and are regularly exposed to dust and particulate matter (Davidson et al., 2005; Solanki et al., 2014). This sector largely employs rural, migrant, and unskilled workers and often provides only seasonal employment between agricultural seasons. High turnover, exploitative management, and low socio-economic status with limited access to health care, education, and housing have resulted in lack of programs to address workers health and safety in this sector. Since workers also reside close to these units, environmental and occupational exposures coexist and increase vulnerability of all members of the community to health impacts (Sivacoumar et al., 2006).

The quarrying industry is considered an important industrial sector in Pakistan. The Stone crushing sector contributes 1 billion US$ per years and provide .5 million people employment in Pakistan (Ilyas and Rashed 2010). It has small-scale stone crushers in unorganized sector in different mountainous areas. These industries are mostly based on manual system and poor workers are working in these industries. Similarly these industries provide material for construction purposes like roads building and much more. Similarly, these industries provide employment to the poor people. This study aims to review the existing environmental laws both at national and provincial level related to stone crushing unit. Secondly study also aims to evaluate the impacts of stone crushing unit on human health and water in Malakand district. Thirdly study will find out that What kind of strategies and equipment are adopted by the owners and workers to work in a safe environment and minimize the health hazards?

Although stone crushing industry have economic benefits but there are some environmental costs of these industries as well. Exposure to dusty environment both at the work place and the radius of influence, there is a high chance of health risk like asthma, respiratory problems, headache, eye irritation, skin irritation, loss of hearing and backbone ache etc. In Malakand district of Khyber Pakhtunkhwa there are large numbers of stone crushing industries because of the geographical positioning. Most of the stone crushing is adjacent to population. Besides documenting the economic activity work has to been done in this area to unfold the health and environmental problems created by these industries. Therefore research is needed to find out the economic cost which these crushing units put through environment and human health damages. This would help improve the current rules and regulations besides help in advocacy for the people living in adjacent areas for improving their health protection practices.

LIMITATIONS OF THE STUDY

Since it a survey data ideally it should have a full presentation, but due time and resource constraints it was not done. Further health condition has to be measured; here we are asking self-reporting health problems. Many elements are not considered such as availability if health care institutions and other variables which can be affect health outcomes.

LITERATURE REVIEW

Study don't deny from the importance of the stone crushing industry but this study will emphasizes on bleak side of stone crushing business that how its effecting the environment such is air quality standards, water and crops. It's obvious that a low standard environment will definitely degrade the health of humans.

Sivacoumar et al., (2006) In India pulmonary test has been performed on the workers who are working in the quarrying industries. The result shows that due to dusty environment and absence of protective instruments the health of

the workers were found significantly lower than compare to the normal south Indian healthy man. Chauhan et al., (1998) Inhalation and ingestion of poor quality of air will make worsen the lung lesions. Furthermore nitrogen oxide in air probably increases the openness respiratory infections. Kamal et al., (2014) Toxic gases like Co, Co2 So2 and PM erupt from brick kilns and merge in the atmosphere. In result air quality become poor and it have significant adverse effects on plants animals and humans.

Campa and castanas, (2007) states that Volcanoes fire and many other natural sources release different kinds of pollutants in the environment but we human are the most responsible of environmental air pollution. By anthropogenic activities toxic chemical escape to the environment which degraded the air quality and in result human health effects through inhalation and ingestion. Brunekreef and Holgate, (2002) London fog in 1952 various numbers of studies shows that the effect of the air quality changes the human health. The mortality and hospital admissions were found higher due to high particulate pollutants in air.

Ozcelik, (2016) the oldest marble areas are exists in turkey. About 4000 years of natural stone production and was started at Marmara Island in Turkey. These areas are about 4000 years old, and the harvesting process of the natural stones was started at Marmara Island. There are 80 different types, about 400 different colours and designs. The objective of the study is to analyze the impact pollution on water can be generated in marble cutting industries in Turkey. To accomplish the objective the recorded concentration was compared to the standard of Turkey Environment Laws Controlling Environment Protection (TELCEP) for rock quarrying industries.

Chougule et al., (2017) the study concludes that the (PM2.5 and PM10) was found above the permissible level and the air quality parameter was significantly affected. The surrounding people are found suffering from different allergic problem like skin irritation and eye irritation etc. The productivity of surrounding was also adversely affected.

Olusegun et al., (2009) the study concludes that the granite quarry generates particulate matters during activity and it has severe health effects on workers and residents of the Surrounding. The study found that drilling point is the most hazardous point. Quarry companies should be mandated to adopt modern technology of dust strapping Such that a negligible quantity of dust escapes from the various operations at quarry site. Particulates release can be controlled with scrubbers, precipitators, and filters, which can be retrofitted to dust-stacks for pollutants removal from emission.

There are a lot of literatures available on the workers exposure to particulate matter on human but there is lack of study available about the impacts of adjacent population. But due to on growing population and decrease of land resource human are getting closer to industries. Study is needed to disclose the health impacts of stone crushing industry on the adjacent population as well. These industry provide the materials to the infrastructure purposes and cannot be ignored, however there is a need to do it r in a sustainable environment and development.

DISCRIPTION OF DATA AND METHODOLOGY

The study will be conducted in Malakand district of KPK. This district was formed in 1970 as a provincial administrated area. Malakand is considering as an administrative unit which has three tehsil and each tehsil has numbers of union councils. Collectively there are 82 union councils in three tehsils. The population of Malakand is 70295 and area is 952 kilometer square. The study will be carried out in the union councils of Thana Jadeed and Thana Banda Jaat.

MAP OF MALAKAND DISTRICT



Source: Google Map

For accomplishing objectives primary survey data has been collected from the households and from owners of stone crushers in Malakand district. Stone crushing industry have significant adverse impact on human health and environment. By environmental guide lines for stone crushers they should be 500m away from the educational, population and other religious areas. On the basis of stratified sampling to conduct this research we compare two groups. One group people who are living within in one km while the second group people will be those who are living out of one km. The people who living within a 500 meters diameter is considered Uncontrolled group (treatment group) while the other is out of 500 meter diameter so they are considered is a controlled group. Study assumed that problem is same within and out of the radius but some are taking treatments. The selection of the group is not on the basis of any discrimination like cultural, social and demographic characteristics. Second for the workplace environmental health impact focused interview will be done from the owners of the stone crushing units. In this study where the survey is carried out is famous for river bed mining. So this study to select the sample size we used sample size calculator we had 384 sample size of 720295 population but due to time constraint and ongoing covid situation the sample size was restricted to 280 (n=280). Different question are asked from the respondent like their demographic characteristic, socio economic characteristics. Similarly we asked questions regarding water. Similarly the study will insist on the existing environmental laws both at national and provincial level.

Treatment or uncontrolled population (within 500 meter)	**Number of respondents to be interviewed**	**Control group population (out of one 500 meter)**	**Number of respondent to be interviewed**
Population A	140	Population B	140
Total population	**Total respondents =140**	**Total population**	**Total respondents = 140**

To estimate the environmental pollution based health cost the study used a propensity score matching technique using Stata software to compare the environmental pollution based health cost between controlled group and uncontrolled group or treatment group.. Propensity score matching (PSM) is getting popular for adjusting nonrandomized experiments. PSM is known the best approach to estimate the casual effects. This approached is widely used in labor market policies (Caliendo and Kopeinig., 2008). Propensity score match practice has been carried out in Ethiopia to estimate the average treatment effects of the family conversation strategy on new born care practices, including institutional delivery, early postnatal and immediate breastfeeding. The results indicate that around 17 percent respondents had family conversation during their last pregnancy. The average treatment effects of 7,12,9 and 16 respectively were found for institutional delivery, early postnatal care, clean code care and thermal care of the new born ($P < 0.05$). The study analyzed that husband involvement is very important in newborn care practice (Altaye et al., 2018)

Study also reviewed the current status of the existing environmental and public health laws both at national and provincial level. Similarly primary data has been collected through pre tested questionnaires and two separate questionnaires were design for data collection process. One question was for general public while the other one was for the stone crusher owners. The questions from both general public and stone crush owners were based on both qualitative and quantitative questions. In questionnaire for general public we asked questions such as demographic analysis, use of protective instruments, diseases related to stone crushing industry, treatment type and about water quality etc. Similarly in the questionnaire for stone crush owners managers we as asked questions like demographic, number of workers, production, visit of Environmental Protection Agency EPA members, penalty record, and follow up of Standard Operating Procedures SOPs etc.

EMPERICAL ANALYSIS

For this we establish an equation,

$$y = a + \beta 1xi + \beta 2zi + \beta 3wi + \beta 4ri + d + ui$$

Where y is the environmental pollution based health expenditures xi is the health condition while zi is the socio- demographic characteristic. wi is variable for water for checking the water quality. Radius is also our variable in the equation that denote on 'ri'. Similarly d is a dummy variable and ui is the error term. To estimate the environmental pollution based health expenditure we will use the propensity score technique which is explained below.

Propensity score matching is a technique is an econometric technique in which researcher is make an artificial group against the treatment group for comparison. By using this technique the research is able to know the impact of an intervention.

$$p(x) = prob\,(D = 1 \mid x) = E(D \mid x)$$

We will assigning two groups one will be treated group while the other one will be control group. While D is binary variable for both control group and treatment group. When D=1 it will be treatment group when D= 0 it will be for control group.

ENVIRONMENTAL LAWS AND IMPLICATIONS

To review the first objective of the study is regarding existing environmental laws both national and provincial base are discussed. On 3 September 1997 and then senate of Pakistan on November 7, November passed the environmental protection act 1997. This act was applicable then after the approval from the president of Pakistan on 3rd December 1997. Purpose of establishing this act is conservation, protection, rehabilitation and improvement of the environment, for reduction and restricting pollution and encouraging of sustainable development. This act will applicable indiscriminately on all industries exist in Pakistan such as cement industry, stone crushing and marble, brick kilns steel mills and so on. The action on this act will be across whole Pakistan

and will come into force at once. There are different definitions set in 1997 act regarding different pollutions. Adverse environmental health impact is one in them which mean that diminishment or degrading or damaging to ecosystem. Adverse environmental effects are specified in regulations. Similarly definition of air pollution which mean that a substance which stays in the air and contaminate the ambient air quality such smoke, dust particles, electromagnetic, radiation, heat, fumes, exhaust gases hazardous substances. Inhalation or contacting with such substances of human or animal may have significant adverse health impact.

According to NWFP Environmental Protection Agency which is working under Pakistan Environmental Protection Act, 1997 the guidelines are established for stone crushing units in Khyber Pakhtunkhwa. In environmental guidelines the stone crushing units must be 500 meters away from public areas. They must ensure to make proper fencing green belts water sprinkling system. No working hours are allowed in evening and late night. During survey we noticed that no of the stone crushing unit have license for operating their business. License should be mandatory for every stone crushing unit. Beside this there is no proper method and tools are used for checking the air quality.

RESULTS AND DISCUSSIONS

We collected from stone crush owner manager and general public. We first interviewed the stone crush owners or managers and these had 10 in numbers. Similarly then we interviewed 140 respondent from controlled population and 140 respondent from treated or uncontrolled population. Both stone crush owners and general respondents were interview analysis. The aim of data collection from such respondents is to cover the 2nd and 3rd objectives of the study. Tables and brief discussion of each table is below.

Table 1: Demographic "Stone crushing unit's owners

Education status of the owner			
Education status	**Frequency**	**Percent**	**Cumulative percent**
Below primary	1	10.0	10.0
Below matriculation	2	20.0	30.0
Matriculated	1	10.0	40.0
Below or above intermediate	4	40.0	80.0
Graduated or above	2	20.0	100.0
Total	10	100.0	
Residential status of owner			
Residency	**Frequency**	**Percent**	**Cumulative Percent**
Urban	6	60.0	60.0
Rural	4	40.0	100.0
Total	10	100.0	
Age of the respondents			
Age	**Minimum**	**Maximum**	**Mean**
Total	24	58	41
Income status of the owner			
Income	**Minimum**	**Maximum**	**Mean**
Total	130000	170000	148500

The above table 1 shows that 10% respondent were below primary, 20% were below matriculation while 10% were matriculated. Similarly below or above intermediate and graduated or above were 40% and 20% respectively. The education status of the owners shows that most of the stone crush owners have low level of education which indicates that due to this there is a high potential of adverse environmental externalities and negative health impact for both workers and general public. The residential status of the stone crush owner shows that all 60% respondents were from urban areas and 40% were from rural areas. The age of the respondent show his experience. The more he experience the more will be aware the stone crush unit (Table 1).Age is a very important variable it show the experience of the respondent. The more a person is aged the more he will have experience in particular business. The minimum and maximum age of the stone crush owners is 24 and 58 years respectively. The average ages of the respondents were 41.The age of the respondent show his experience. The more he experience the more will be aware the stone crush unit. The income status of the stone crush owners shows that the average income of the respondent is 148500 and the minimum is one 130000 while maximum is 170000.

Table 2: Crush Plant distance away from public "In meters"

Distance away from Public			
Distance in meters	**Frequency**	**Percent**	**Cumulative Percent**
30	4	40.0	40.0
40	1	10.0	50.0
50	1	10.0	60.0
70	1	10.0	70.0
100	1	10.0	80.0
150	1	10.0	90.0
200	1	10.0	100.0
Total	10	100.0	

We asked the owner that by distance wise their crush units are how far away from restaurants, schools, office and shops etc. The distance was asked in meters. 30 meters were 40%, 40 meters were 10%. 50 meters were 10%, 70 meters were 10% 100 mete were 10% 150 and 200 meters were also 10%, 10% respectively (Table 2). According to the environmental guide lines the distance of the stone crushing must 500 meters away from the public and residential areas.

Table 3: Number of workers at stone crushing units

Numbers of workers in Stone crushing units			
Number of workers	**Frequency**	**Percent**	**Cumulative Percent**
3.00	3.00	40.0	40.0
4.00	4.00	10.0	50.0
5.00	5.00	20.0	70.0
6.00	6.00	30.0	100.0
Total	Total	100.0	

Table 3 represents the number of stone crushing workers in units. Percentages of 3 workers at different stone crushing units were 40%, 4 workers were 10% 5 workers were 20% and 6 workers were 30%.

Table 4: Knowledge about pollution and effect on health

Knowledge about pollution			
Knowledge about pollution	**Frequency**	**Percent**	**Cumulative Percent**
Yes	7	70.0	70.0
No	3	30.0	100.0
Total	10	100.0	
Degrading environment			
Degrading	**Frequency**	**Percent**	**Cumulative Percent**
Yes	8	80.0	80.0
No	2	20.0	100.0
Total	10	100.0	
Type of pollution creating by stone crushing industry			
Pollution type	**Frequency**	**Percent**	**Cumulative Percent**
Air	3	30.0	30.0
Noise	1	10.0	40.0
All kind	5	50.0	90.0
Not polluting environment	1	10.0	100.0
Total	10	100.0	
Health problems due to pollution			
Diseases	**Frequency**	**Percent**	**Cumulative Percent**
Respiratory problem	2	20.0	20.0
Almost all problem	7	70.0	90.0
No adverse impacts on human health	1	10.0	100.0
Total	10	100.0	
Residents suffering or not			
Yes/No	**Frequency**	**Percent**	**Cumulative Percent**
Yes	4	40.0	40.0
No	6	60.0	100.0
Total	10	100.0	

The table 5 covers the questions from stone crushing units from owners related to knowledge about pollution, degrading environment, types of pollution, diseases due to pollution and beside workers residents are suffering or not. The owners who know about pollution were 70% and those who don't have knowledge were 30%. Similarly 80% percent owners believes that stone crushing industry can pollute environment while 20% believes that environment is not degrading by stone crushing industry. On the question about what type of pollution is creating by stone

crushing industry owner's responses were different. 30% were believes that stone can create only air pollution and 10% agrees only noise pollution. Similarly 50% believes that stone crushing can creates all kinds of pollution. All kind of pollutions means that stone crushing can create noise pollution air pollution soil pollution and water pollution etc. Only 10% stone crushing units owner believes that stone crushing industry have no adverse impact on the environment. For diseases 20% believes that respiratory problem is possible because of stone crushing industry polluting environment. But 70% were agreeing that respiratory problem, asthma, skin and eyes problem stress and depression etc is because of stone crushing industry. There were only 10% owners who believe that stone crushing have adverse health impact on human. Likewise 40 percent believes that beside workers residents are affecting too while 60% were disagree.

Table 5: Provision of SOPs

Does EPA provide you Sops?			
Yes/No	**Frequency**	**Percent**	**Cumulative Percent**
Yes	5	50.0	50.0
No	5	50.0	100.0
Total	10	100.0	
Are you following them?			
Yes/No	**Frequency**	**Percent**	**Cumulative Percent**
Yes	6	60.0	60.0
No	4	40.0	100.0
Are you Following PPIs?			
Yes/No	**Frequency**	**Percent**	**Cumulative Percent**
Yes	5	50.0	50.0
No	5	50.0	100.0
What type of PPIs following			
PPI Type	**Frequency**	**Percent**	**Cumulative Percent**
Only Available of mask	2	20.0	20.0
Only Available of safety shoes	1	10.0	30.0
Availability some of them	3	30.0	60.0
Availability all of them	1	10.0	70.0
Not available any PPIs	3	30.0	100.0
Total	10	100.0	
Use of green belts			
Yes/No	**Frequency**	**Percent**	**Cumulative Percent**
Yes	2	20.0	20.0
No	8	80.0	100.0
Total	10	100.0	
Use of water sprinkles			
Yes/No	**Frequency**	**Percent**	**Cumulative Percent**
Yes	1	10.0	10.0
No	9	90.0	100.0

Total	10	100.0	

Source: *Survey data*

Table 5 covers the information regarding Standard operating procedures and personal protective instruments PPI. According to 50% stone crushing units owners confessed that Environmental protection agency provided them Sops and 50% owners denied from the provision of sops from environmental protection agency. Similarly 60 percent were said that they are following the sops while 40% were not following the sops. Likewise in the response about following ppi 50% were said that they have ppi while 50% stone crushing unit don't have ppi. There were only 20% stone crushing units who had only mask, safety shoes were 10% and 30% had some of the ppi at their unit for the workers protection. Only 10% stone crushing unit had complete set of ppi and 30% had not complete set of PPIs. Green belt were using by 20% stone crushing worker and 80% were not using green belts. Only 10% crush plant had water sprinkle system to reduce the dust eruption while 90% were have no water sprinkle system. It shows that personal protective instruments are about unavailable at most of the stone crushing unit. It means that workers healths are indeed in dangers. Similarly the use of green belt and water sprinkle is not up to the mark so dust can be flow away to adjacent population depending on the intensity and direction of the wind and in result it will have adverse impact on adjacent people beside workers.

Table 6: Penalization and penalty paid

Ever Penalized			
Yes/No	**Frequency**	**Percent**	**Cumulative Percent**
Yes	2	20.0	20.0
No	8	80.0	100.0
Total	10	100.0	
Kind of violation			
Violation	**Frequency**	**Percent**	**Cumulative Percent**
Air quality standard violation	1	10.0	10.0
No availability of ppi	1	10.0	20.0
Not penalized on any	8	80.0	100.0
Total	10	100.0	
Total penalty paid so far			
Penalty paid	**Frequency**	**Percent**	**Cumulative Percent**
0	8	80.0	80.0
30000	1	10.0	90.0
70000	1	10.0	100.0
Total	10	100.0	

Source: *Survey data*

Table 6 covers the question regarding penalty history of the stone crushing owners etc. The penalty history shows that how environmental protection agency keeps their check in balance on them. There were only 20% respondents who were penalized while 80% were not penalized since they start their business. 10% percent violation was due to air quality standard violation while 10% were on no availability of ppi. 10 percent were paid 30000 penalty and 10% were

paid 70000 while the rest 80% were none. The owners who were penalized claimed that their penalization was due to lack of knowledge. They agree that penalization is different on different offence**.** According to the Government of Pakistan Environmental protection agency there should be 104 readings taken in a year while twice in a week. No visit is recorded from environmental protection agency at any unit in last six months. Which means that the attention is the environmental protection agency is unacceptable.

Table 7: Complaint received from

Complaint received from adjacent business			
Complaints by	**Frequency**	**Percent**	**Cumulative Percent**
Restaurant	3	30.0	30.0
Schools	2	20.0	50.0
Companies offices	1	10.0	60.0
Petrol pumps or shops	1	10.0	70.0
No complains	3	30.0	100.0
Total	10	100.0	
Disputed happened with them			
Disputes	**Frequency**	**Percent**	**Cumulative Percent**
Usually	7	70.0	70.0
No disputes	3	30.0	100
Total	10	100.0	
EPA guide you to avoid violations			
Yes/No	**Frequency**	**Percent**	**Cumulative Percent**
Yes	7	70.0	70.0
No	3	30.0	100.0
Total	10	100.0	

Source: *Survey data*

Table 7 covers the questions we asked about complaint or disputes with closed businesses and adjacent populations. There were 30.0% complaints from restaurant, 20% from schools, 10% percent from closed companies and 10% were from petro pumps or shops. 30% stone crushing industry have claimed that they did not receive any complaint as they exist at a quite away range. There was 70% stone unit which said they have dispute on a usual basis. Some of them were sued by other businesses. There were 30% stone crushing units who don't have any disputes since their business start. Similarly 70% owners confessed that EPA taught them how to avoid violation and 30% said that they were not taught by EPA that how to avoid violations. It means that they are busy to maximize their profit due to non-seriousness of EPA.

Table 8: Accident, cost and type of injury

Accidents happened ever			
Yes/No	**Frequency**	**Percent**	**Cumulative Percent**
Yes	7	70.0	70.0
No	3	30.0	100.0
If yes paid cost of worker			
Yes/No	**Frequency**	**Percent**	**Cumulative Percent**
Yes	4	40.0	40.0
No	6	60.0	100.0
Total	10	100.0	
What kind of injury happened			
Type of injury	**Frequency**	**Percent**	**Cumulative Percent**
Hand or finger cut	3	30.0	30.0
Leg cut or fractures	2	20.0	50.0
Head fractures	1	10.0	60.0
Death	1	10.0	70.0
No injury record	3	30.0	100.0
Total	10	100.0	

Source: *Survey data*

The table 8 shows the record of accidents of the workers, financial support and type of injury happened in stone crushing units. At 70% stone crushing unit accident were happened while 30% were claimed that no accident has been recorded in their stone crushing units since they start their business. The accidents happened at stone crushing units 40% were said that they bear all the cost of the accident of workers while 60% were not facilitated in this regard. Different injuries were happened to the worker in which hand cut or fingers cut were 30%, leg cut or fractures were 20%, head fractures were 10% and one had a death record due fall of machine on worker. No injury record has been found at 30% stone crushing units.

Table 10: Respondent living or doing business away from stone crushing industry

Distance from stone crushing industry			
Above or Below 500 meter	**Frequency**	**Percent**	**Cumulative percent**
Below 500 meter	140	50.0	50.0
Above 500 meter	140	50.0	100.0
Total	280	100.0	

The table 11 shows that 50 respondents who were living below from stone crushing units while 50% were living beyond stone crushing units.

Table 11: Use and type of PPIs

Use of protective instruments			
Yes/No	**Frequency**	**Percent**	**Cumulative percent**
Yes	101	36.1	36.1
No	179	63.9	100.0
Total	280	100.0	
Type of PPIs use by respondents			
Type of PPIs	**Frequency**	**Percent**	**Cumulative percent**
Use of shoes	2	1.4	1.4
Use of Mask	94	33.6	35
Use of cover all	2	.7	35.7
Not using any PPI	181	64.3	100.0
Total	280	100.0	

Source: *Survey data*

Table 11 unfolds the information regarding use and type of PPIs to avoid the polluted environment. There were only 36.1% respondents who were using personal protective instruments and 63.9% were not using any type of protective instrument. The PPIs use by the respondents at stone crushing unit or other workers were only 0.7 person were those who have safety shoes, 33.6% were have masks .7% were use of cover all .7%and there are 64.3% respondent who don't have use of any PPIs.

Table 12: Employment, economic impact and impact on environment

Provision of employment			
Yes/No	**Frequency**	**Percent**	**Cumulative Percent**
Yes	255	91.1	91.1
No	24	8.9	100.0
Total	280	100.0	
Economic impacts on society			
Yes/No	**Frequency**	**Percent**	**Cumulative Percent**
Yes	255	91.1	91.1
No	24	8.6	100.0
Total	280	100.0	
Polluting environment			
Yes/No	**Frequency**	**Percent**	**Cumulative Percent**
Yes	262	93.6	93.6
No	18	6.4	100.0
Total	280	100.0	

Source: *Survey data*

The table 12 unfolds the information about employment, economic impact and adverse impact on human ears. According to the respondent 91.1% respondent believes that stone crushing industry employment to poor peoples and 8.9% were not agreed with provision of employment. Similarly 91.1% were believes that stone crushing industry have a positive economic impact on society while 8.6 were believes that there has no positive economic impact of stone crushing industry on society. In terms of polluting environment 93.6% were agree that stone crushing industry can pollute environment while the rest were disagree.

Table13: Disease faced last month and accidents

Diseases faced last month			
Name of disease	**Frequency**	**Percent**	**Cumulative Percent**
Asthma	28	10.0	10.0
Respiratory problem	73	26.1	36.1
Skin problems	21	7.5	43.6
Eye Irritation	10	3.6	47.1
Stress and depression	42	15.0	62.1
Almost all	14	5.0	67.1
No problem	66	23.6	90.7
Other health problem	26	9.3	100.0
Total	280	100.0	
Huge injury record			
Injury type	**Frequency**	**Percent**	**Cumulative Percent**
Hand or fingers cut	2	.7	.7
Any other physical injury	1	.4	1.1
leg or hand fracture(broke)	1	.4	1.4
No physical injury	276	98.6	100.0
Total	280	100.0	
Reason			
Yes/No	**Frequency**	**Percent**	**Cumulative Percent**
Yes	132	47.1	47.1
No	148	52.9	100

Source: *Survey data*

The table 13 shows the diseases faced by respondents in last month, huge injury faced and Reason. In the context of diseases face in last month asthma were 10%, respiratory problems were 26.1%, skin problem were7.5%, eye irritation were 3.6%, stress and depression were 15% and those who have all such problems 5.0%. Those who have other health problems were 9.3% which those who have no problems were 23.6%. Likewise in terms of huge injury record .07% were hand broke or fingers cut, .04 were other physical injuries and .04% were leg or hand broke injuries. 98.6% had no physical injury record. The people who had physical injury record were those who work in stone crushing industry. On the question regarding disease faced last month 47.1% were believes that it is because of stone crushing industry while 52.9% believes that their disease are not because of stone crushing industries.

Table 14: Days illness, work off and work satisfaction

Days illness			
Number of days	**Frequency**	**Percent**	**Cumulative Percent**
1-5	126	45.0	45.0
6-10	42	15.0	60.0
11-15	10	3.6	63.6
16-20	3	1.1	64.6
21-25	2	.7	65.4
Above 26	5	1.8	67.1
Not ill	92	32.9	100.0
Total	280	100.0	
Days off due to illness			
Days off	**Frequency**	**Percent**	**Cumulative Percent**
1-5	95	33.9	33.9
6-10	19	6.8	40.7
11-15	4	1.4	42.1
16-20	1	.4	42.5
21-25	1	.4	42.9
Above 25	4	1.4	44.3
Not off	156	55.7	100.0
Total	280	100.0	
Working performance due to illness			
Performance	**Frequency**	**Percent**	**Cumulative Percent**
Worsen	27	9.6	9.6
Poor	98	35.0	44.6
Satisfactory	50	17.9	62.5
As usual	105	37.5	100.0
Total	280	100.0	

Source: *Survey data*

Table 14: Represents the day's illness, days off from work and performance of the respondent. The day's illness is asked in ranges. From 1 to 5 were 45%, from 6 to 10 were 15%, from 11 to 15 were 3.6%, from 16 to 20 were 1.1%, from 21 to 25 were .07 and those who were above ill then 20 days were 1.8%. Similarly those who were not ill recorded 32.9%. Similarly those who missed their works or jobs from 1 to 5 were 33.9%. 6 to 10 were 6.8%, 11 to 15 were 1.4% and 16 to 20 and 21 to 25 both were .04% respectively. Those who were above 25 days off were 1.4% and those were not skipped their work due to illness were 55.7%. Similarly in the context of performance, worsen were 9.6%, poor were 35.0% satisfactory and as usual were 17.9% and 13.5% respectively.

Table 15: Treatment from doctor or self-medication

Treatment	**Frequency**	**Percent**	**Cumulative Percent**
Rely on self-medication	78	27.9	27.9
Going to specific Doctor	202	72.1	100

Total	280	100.0	
Doctor fee			
Minimum	**Maximum**	**Mean**	**Std. Error**
0	10000	680	68.86
Per day cost			
Minimum	**Maximum**	**Mean**	**Std. Error**
0	250	107	7.35

Source: *Survey data*

The table 16 shows the respondent the priority of choosing treatment. There was 27.9% respondent who said that they are relying on self-medication while 72.1% were going to specific doctor. The minimum doctor fee is recorded 0 while the maximum was 10000. The mean and standard error is 680 and 68.86 respectively. Similarly the minimum per day cost is also 0 while the maximum was 250. The mean and standard can 107 and 7.35 respectively.

Table 16: Diagnostic test, traveling source record and type of hospital

Diagnostic test or medication			
Tests/Medication	**Personal transport**	**Personal transport**	**Personal transport**
Only medication	76	27.1	27.1
Diagnostic test	6	4.2	31.3
Both	80	28.6	59.9
Non	118	40.1	100.0
Total	280	100.0	
Source use for going doctor			
Source	**Personal transport**	**Personal transport**	**Personal transport**
Personal transport	50	17.9	17.9
Local transport	88	31.4	49.3
Walk	24	8.6	57.9
Self-treatment or not visited	118	42.1	100.0
Total	280	100.0	
Type of hospital			
Type hospital	**Frequency**	**Percent**	**Cumulative Percent**
Government	20	7.1	7.1
Private	142	50.7	57.9
Not visited to any	64	22.9	80.7
Self-treatment	54	19.3	100.0
Total	280	100.0	

Source: *Survey data*

Table 16 shows the medical history of the respondents, traveling used for going and type of hospital. According to 27.1% who said that doctor prescribed them only medicines while 1.4% said that doctor recommended them diagnostic test. Similarly 28.6% were whom

doctors advised them medication and diagnostic tests. There are 42.8% respondents who said that their doctor didn't them medication or diagnostic tests or they were not visited. For visiting to doctor to doctor we ask respondent kind of source use for traveling. In them 17.9% used personal transportation, local transport were 31.4%while 8.6% percent were those who were visited on their feet. The rest 42.1% were either on self-treatment or not visited to the doctor. Similarly in the category of the hospital type there are 7.1% respondent were doing their treatment in private hospital while 50.7% respondents were doing their treatment in private hospitals. The rest 22.9% and 19.3% were not visited and self-treatment respectively

Table 17: water source for drinking and cooking, quality

Source of water for drinking cooking and washing etc			
Source of water	**Frequency**	**Percent**	**Cumulative Percent**
Well	240	85.7	85.7
Government water supply	35	12.5	98.2
River	3	1.1	99.3
Water filter plant	2	.7	100.0
Total	280	100.0	
Water quality			
Quality	**Frequency**	**Percent**	**Cumulative Percent**
Good	133	47.5	47.5
Normal	71	25.4	72.9
Bad	76	27.1	100.0
Total	280	100.0	
Disease because of poor water quality			
Diseases	**Frequency**	**Percent**	**Cumulative Percent**
Diarrhea	40	14.3	14.3
Cholera	16	5.7	20.0
Typhoid	26	9.3	29.3
Almost all	40	14.3	43.6
Hair fall	24	8.6	52.1
No problem	134	47.9	100.0
Total	280	100.0	
Reason stone crushing			
Yes/No	**Frequency**	**Percent**	**Cumulative Percent**
Yes	103	36.8	36.8
No	177	63.2	100.0
Total	280	100.0	

Table 17 covers the information regarding the source of the water use for drinking and cooking. Similarly the quality of water and if the water quality is bad so kind of diseases he or she faced. The one who used well water were 85.7%, government supply water were 12.5%, river were 1.1% and those who source of water is water filter plants were .07%. In the response the regarding water quality there 47.5% who told that there water is good. Normal was 25.4% respondents and bad ones were 27.1% respondents. Because of bad normal water quality

there were sever disease faced by respondents. Which includes diarrhea 14.3%, cholera 5.7%, typhoid 9.3% and those who had almost all problems were 14.3%. 8.6% respondent they have hair fall issue due to use of poor water quality. Similarly asking about the reason that is all the regarding problems are because of stone crushing industry. 36.8% were agreed that stone crushing is the reason while the rest were disagrees.

CROSS TABULATIONS

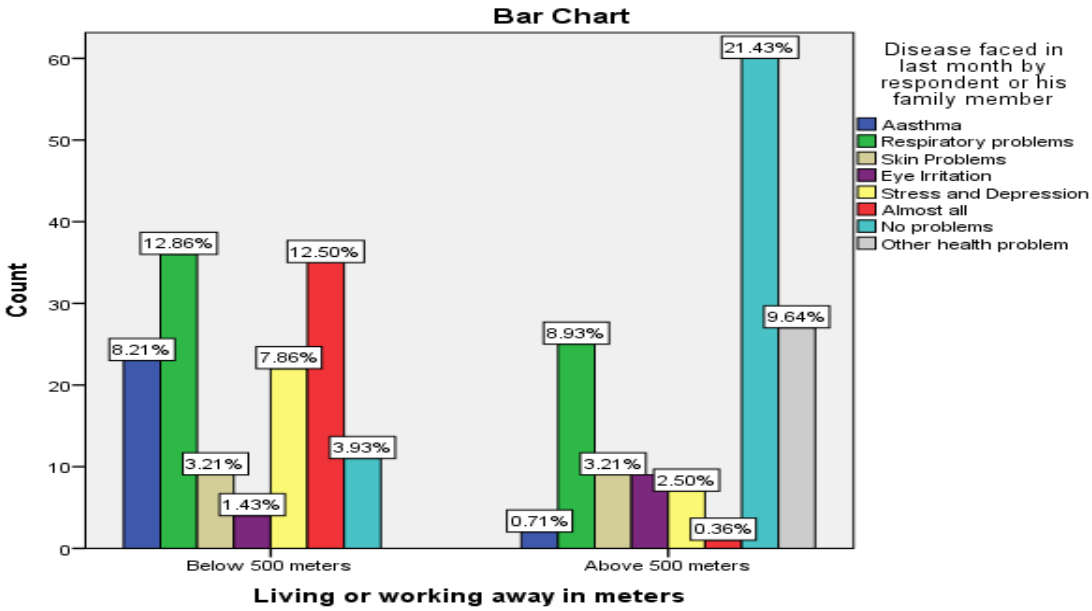

Figure 1: Cross Tabulation between Occupation and Disease Faced

That people who living below 500 meters are facing high diseases as compare with those who are living beyond 500 meter. Its means that as we are moving toword stone crushing units the potential of the disease are increasing in respondends or vice versa.Relationship between distance and diseases faced by the respondents faced in last month is significant. The chi square value is 122.2 while the degree of freedom is 7 and the Sig value is .000.

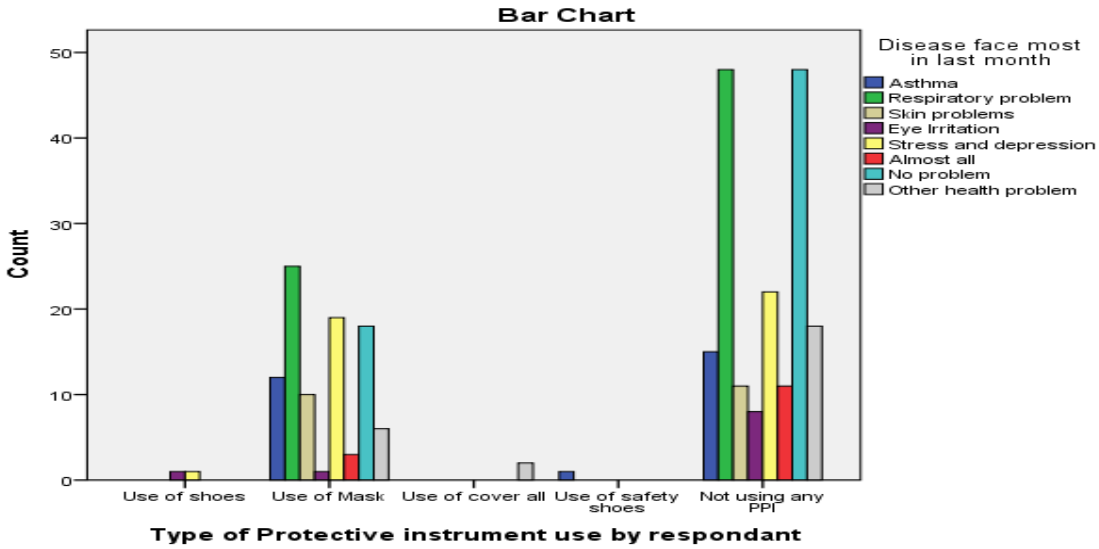

Figure 2: Cross tabulation between disease faced last month and use of ppi's

The figure 2 shows the relationship between use of PPIs by the respondent and the disease he she faced last month.The diseases are quite high in those who are not using PPIs as compare with those who are using PPIs. The relationship between the use of PPIs and disease faced in last month is significant. From the table we can see the Person chi-square value 54.9, degree of freedom value is 28 and the significant value is 0.002.

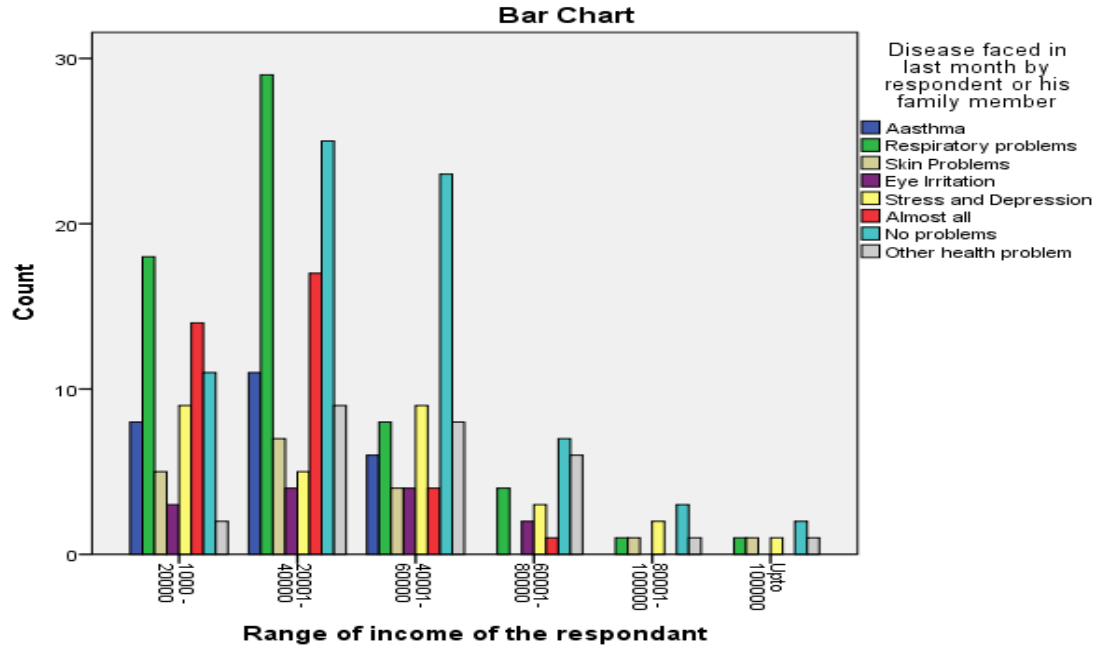

Figure 3: Cross tabulation between disease faced last month and income

Figure shows the relationship between the disease faced last month and income. It can be clearly seen that as the income increasing the disease faced in last month by the respondent are

decreasing or vice versa.The relationship between income of the respondent and disease faced last month is significant at 10%. The person chi-square value is 46, the df value is 35 while sig value 0.093.

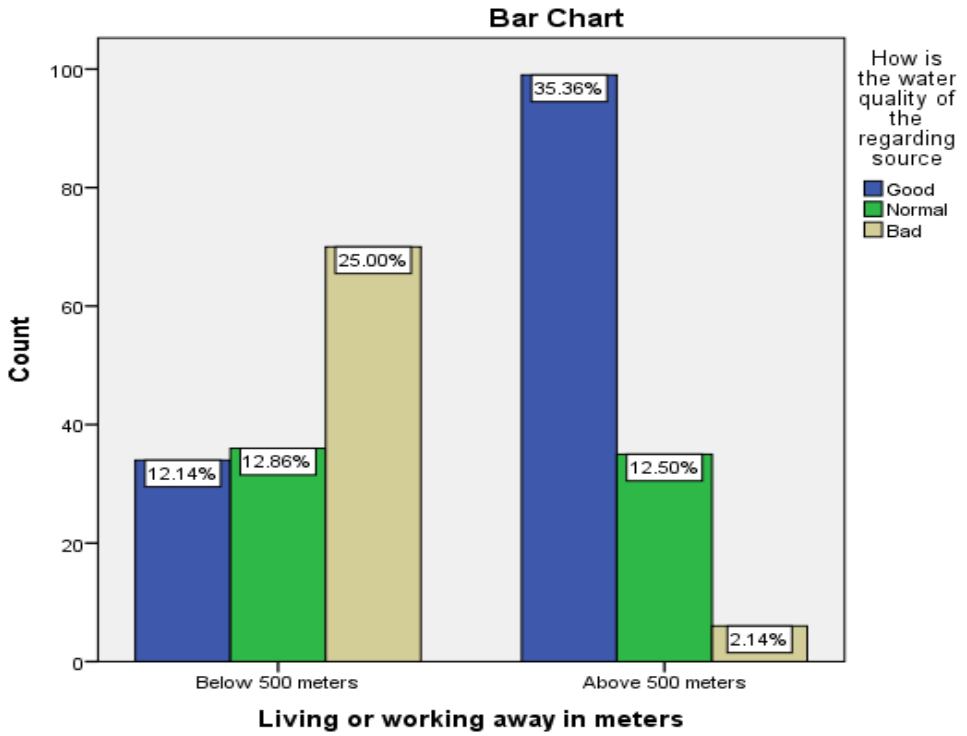

Figure 4: Cross tabulation between water quality and living or working in meters

Figure 4 shows the relationship between distance and water quality. The water quality is decreasing as we moved toward stone crushing industry and vice versa.The relationship the water quality and the distance is significant. The person chi square-value is 85.6, the df value is 2 and sig value is .000.

Propensity score matching

Table 18: Propensity score matching model and results

teffectspsmatch (total_envpol_exp) (distance_c age gender education hhs income residence water_qual >itydisease_faced_lastmon)	
	Treatment-effects estimation Number of obs = 277
	Estimator: propensity-score matching Matches: requested =1
	Outcome model : matching min = 1
	Treatment model: logit max =1

total_envpol_exp	AI Robust				
	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]
ATE distance _C (Above 500 Meters Distance vs Below 500 Meters Distance)	-10261.14	5143.972	-1.99	0.046	-20343.14 -179.1376

Below output table explained the summary of Propensity-Score Matching and the Average Treatment Effect ATE. The coefficient of ATE shows us the average treatment effect – 10261.14 rupees and another way we can explain the average treatment expenditure is greater than 10261.14 rupees for those people who are living in a range of 500 meters with crush plants as compared to those who are out of 500 meters range. This also tells us those people who belong to the controlled group his average treatment expenditure is less – 10261.14 rupees from those who belong to an uncontrolled group and statistically the results are significant at a 5 percent of significance level because the P-value is less than 0.05. The z – value also shows us the significance, here the z – value is -1.99 and calculated z - value in the table 0.023 which mean that calculated P = 0.023 < 0.05 which suggest that we reject the null hypothesis and accept the alternative hypothesis and the results also suggest that there is a significant difference between both groups.

CONCLUSION AND POLICY RECOMMENDATIONS

Study concluded that stone crushing business is like two sides of a coin the brighter one and bleak one. The brighter side shows how much stone crushing business is important for both local and national economy while the bleak side shows that stone crushing business is getting growing concerns for environment. Stone crushing business provides employment to the poor people but the safety standard which are the key to minimize the health hazards which are not up to the mark. Due to unavailability of the safety protocols and unhygienic environment create health concerns for the workers such is cardiovascular diseases, pulmonary diseases, skin problems, health problems, eye irritation and stress and depression. Huge injury cases such as leg or hand fractures and hand and feet loss even a death of the respondent is noticed in at many stone crushing unit due to absence of safety measures.

During survey we found that the people who are living in a diameter of 500 meter from stone crushing units are higher rate of disease as compare with those who are living beyond 500 meter. As we can see the diseases in figure 1 asthma is higher 8.21% in uncontrolled and 0.21% in controlled population, respiratory problems in uncontrolled is 12.86% while 8.93% in controlled population, skin problems is equal in both groups as it stand on 3.21%, eyes problems were observed higher in controlled population than uncontrolled population is 3.21% and 1.43% respectively. Similarly the disease stress and depression in uncontrolled is 7.86% and 2.50% in controlled, almost all problem is 12.50% in uncontrolled and 0.36% in uncontrolled. The percent of the respondent who have no problems is 3.93% in uncontrolled and 21.43% in controlled population. There is not a single respondent in uncontrolled population who is complained about other health problem while in the controlled population there are

9.64% respondents who had other health problems mostly are pregnant women's. As the basic environmental guide lines that stone crushing should be exist in a safe area. By using Chi-square value we proved that there is significant relationship between distance and disease faced in last month by respondents. Similarly the study witnessed of the water quality was not up to the mark in uncontrolled population as compare with the controlled population. Due to bad water quality respondent who bad water quality related disease such as diarrhea, cholera and typhoid are found higher than the treatment group as compare with the control group. Model results concluded that average treatment of the respondents who are living below the diameter of 500 meter has high level average treatment expenditures than those who living beyond. The average treatment expenditures are recorded -10261.14 which is statistically significant at 5 significant level.

The study suggests some polices for sustaining the stone crushing business.

- The study recommends that government needs to allocate them a land under section 4 and should be located in hilly areas or on a barren land and shift all the stone crush units there to make it sustainable. Government can handover them on lease as well.
- In the stone crushing unit it's a prior responsibility on the owner to provide the health to take care of their health.
- The environmental guideline must be strictly followed by the stone crushing units. If any stone crushing unit is found violation of the environmental guidelines their license should cancelled and sealed them on the spot.
- If government provides scrubbers to every stone crushing units which capture fine particulate matter which is more strengthen then cement and a bit expensive as well. So the government can generate benefits as well.

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