STONE CRUSHING INDUSTRY IMPACTS ON HUMAN HEALTH EXPENDITURES AND ENVIRONMENT: A CASE SUDY OF MALAKAND DISTRICT

By

Syed Yawar Ali

PIDE2018FMPHILENV19

Supervisor

Dr Mahmood Khalid

PIDE School of Public Policy

Pakistan Institute of Development Economics Islamabad

2021

Pakistan Institute of Development Economics, Islamabad

PIDE School of Public Policy

CERTIFICATE

This is to certify that this thesis entitled: **"Stone Crushing Industry Impact on Human Health Expenditures and Environment: A Case Study of Malakand District"** submitted by **Syed Yawar Ali** accepted in its present form by the School of Public Policy, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree in Master of Philosophy in Environmental Economics.

Supervisor:

Dr. Mahmood Khalid,
Senior Research Economist,
Pakistan Institute of Development Economics,
(PIDE) Islamabad.

External Examiner:

Dr. Abdul Saboor
Chairman
Department of Economics
Arid Agriculture University
Rawalpindi.

Head,
PIDE School of Public Policy:

Dr. Hafsa Hina,
Assistant Professor/HOD
Pakistan Institute of Development Economics,
(PIDE) Islamabad.

ACKNOWKEDGEMENT

I would like to take this opportunity to first and foremost thank Allah for being my strength and guide in the writing of this thesis. Without him, I would not have wisdom or the physical ability to do so.

I express my gratitude to my thesis advisor Dr Mahmood Khalid for devoting much time to reading my work over and over again. His special interest, knowledge and guidance enhanced my motivation during this project. Special thanks to my best friend Waqar Younas for his support during this journey.

The most important thanks deserve my parents they supported me unconditionally throughout my education career. Their support, encouragement and care have always enhanced my level of confidence during this project.

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 relationship 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 interventions 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.

Contents

Chapter 1

INTRODUCTION

1.1 Introduction

We are living in industrial era and the character of industry is so important in today world. Most of the economic products are related to different sector like agriculture, industry and services. Industries include manufacturing, construction, gas, water, electricity and mining etc. Every 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. The stone crushing industry provide raw materials which use in the construction activities and is consider is the most beneficiary as infrastructure is the big of the consumer of mining and produces inputs for construction industry.

Current generation is living in the time of stunning technological wizardry. But unfortunately not everyone is using it. Due to political and economic instabilities and social unawareness environmental health hazards exist as an externality. The developed countries are on the track of technological use while the developing countries are destitute because of poor policies and lack of awareness. The advance technologies are environmental friendly and they keep the environment sustainable, less time consuming and even more efficient. On the other side because of the low per capita income, and poor laws and lack of awareness the developing countries are yet to adapt the advance and technological supremacy. Adaptation of rusted and old mechanism of technologies leads to disturb the balance of the biodiversity through different kinds of pollutions.

The phenomenon of the environmental pollution is that whenever the impurities contained by the atmosphere that are harmful for human being also to adhere remedial action for minimizing pollution (Rajeshwar et al., 1997)

We can't deny from the importance of industries but as these industries provide different economic benefits but on the other side they are also 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).

Stone crushing industries are mostly manually operated in subcontinent. Due to manual job many poor people are working in these small labor intensive industries (Aslam et al., 1992).A stone crusher machine converts large piece of stones into small pieces. Stone crushing is an important component of the construction industry. The stone crushing industry can be installed with moderate investment often with limited regulatory control. The units produced crushed stone that is used as raw material for various construction activities including building and roads etc. Many stone crushing operations tend to be located relatively near populated areas or on the highways to avoid high transportation costs. This can result in dust associated health problems in addition to automobile pollution problems along the highways (Sivacoumar and Thanasekaran, 2001).

The occupational hazards at the quarrying sites poses a high possibility of health hazard to the workers as well, since inhalation of particles rich in free silica for long periods of time may cause silicosis. Due to exposure of heavy dust concentration there is a high possibility of severe diseases (Zenz et al., 1994).

Similarly this sector largely employs rural, migrants, and unskilled workers and often provides only seasonal employment between agricultural seasons. High turnover, exploitative managements, 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).

Besides creating adverse environmental externalities of stone crushing industry have a good contribution to national economy. It has been estimated that per year stone crushing business is contributing 1 billion US$ to GDP and providing employment to 0.5 million people. In Pakistan a market in Sargodha name Pull 111 is known for the largest stone crushing market in south Asia (Ilyas and Rashid 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 materials for construction purposes like roads building and much more. Besides providing materials these industries also provide employment to the poor people. Different stages of stone crushing process involve drilling and blasting of rocks, transportation of the raw material, crushing, screening, size classification, material handling, storage operations and transportation of final product. Suspended particulate matter emits from the mining industries and merged in the air in result the air quality get worsen (Csavina et al., 2012; Titi et al., 2015).

Likewise area around the stone crushing is constantly polluted by dust that spreads in the atmosphere, thus causing damage to the environment and the health of resident's lives nearby. The residents of the area and specifically the labors working suffer from various diseases such as

skin allergy, throat and lungs diseases due to living and inhaling in the polluted air by stone crushing operations. Although laws addressing environmental problems specifically for labor health protection exist; however its effective functioning is what seems to be absent (Ilyas and Rashid 2010).

In Pakistan mechanism of stone crushing machines are old rustic due financial deficiencies. All the machines are labor intensive and poor people are working in it without using self protective instrument. According to dawn news report due to inhaling of silica particles damage the lungs tissues which further leads to lung cancer if no proper treatment taken on time. This industry has proved no less deadly for labors in Khyber Pakhtunkhwa and FATA. Poor enforcement of regulations might be the big concern. In 2015 only 16 out of 82 stone crushing units were found properly licensed in Punjab (Dawn News 11/1/2015).

Pakistan Environmental protection agency (Pakistan-EPA) has a very poor approach in this regard to restrict the environmental pollution creating by industries. Moreover to estimate the result with reality that is resulting under nutrition and high infant mortality (Azizullah et al., 2011)

1.2 Problem statement

Stone crushing industries play a vital role in infrastructure development and infrastructure leads to higher economic growth. However it is a moderate economic enterprise and it provides employment to mainly unskilled people across the poorer regions of Pakistan. At one side there are economic benefits of stone crushing business but at the flip side 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 be 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 to improve the current rules and regulations besides help in advocacy for the people living in adjacent areas for improving their health protection practices.

1.3 Research questions of the study

What are the state of environmental laws and public health laws which govern the stone crushing industries and efficacy in terms of minimizing the environmental health hazard?

People who are living adjacent where the environmental hazard is happening how the people keep their self safe and what the health cost?

What kind of Strategies and Equipment adopted by the owners and workers to work in a safe environment to minimize health hazards?

1.4 Objectives of the study

In the present study the following objectives would be explored:

1. Review the existing environmental and public health laws both at national and provincial level related to stone crushing business.
2. Evaluate stone crushing industry impact on human health and water in Malakand district.
3. To determine that how workers and owners of the stone crushing units respond to health problems.

1.5 Research gap

In Pakistan very less studies are available to disclose the impacts of stone crushing industry impact on surrounding resident public health. Most of the literatures are available on the workers exposure to the dusty environment. So study is needed to unfold the environmental based pollution adjacent population. The area selected for the research is famous for quarrying industries. But very less empirical research is done to find out the true economic cost and benefit of these for sustainable development.

1.6 Significance of the study

The study will highlight related health problems from the direct and indirect exposure to the dusty environment both for the workers and the population adjacent to the stone crushing units. Also the study will help to design economic policies on how to keep sustain these industries that it could minimize the environmental and health hazards also to delivers the inputs for construction goods and provide employment as well. Further we will understand whether people are aware of this hazard and why don't they leave that place. What are constraints for the employers in adopting the better technology? Finally this study will also explore the channels of environmental health hazard channel?

1.7 Organization of the study

This study is consists of 6 chapters. First chapter is based on introduction, research objectives, research questions, and research gap. The 2nd chapter discussed the literature review that what the previous studies says about stone crushing units. Chapter 3rd explains data description and methodology. Environmental laws and its implications for stone crushing units are discussed in chapter 4. Chapter 5th and chapter 6th deal with results and discussion and conclusion and policy recommendation respectively.

Chapter 2

LITERATURE REVIEW

2.1 Literature review

Though the stone crushing industry contribute to a country GDP but due to inattentiveness of related institutions and poor mechanism of machines it is getting a big concern for the environment and human health in developing countries. A lot of studies are available on the depletion of environment by stone crushing industry.

2.2 Stone Crushing industry impacts of environment

In the figure we can see that how stone crushing industries pollute the environment in different ways. According to different articles a fine dust is erupts from stone during crushing time. This fine dust is called particulate matter. This particulate matter reduces the air quality; reduce the productivity of surrounding crops, water contamination and creating noise which is harmful for the adjacent population. Human who live at the close range to crushing units their health also get affected.

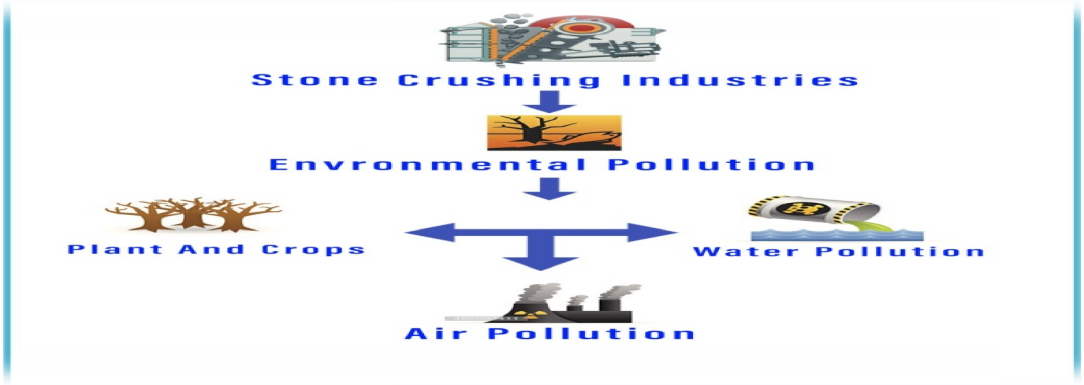

Figure 1: **Stone Crushing industry impacts on environment**

In literature review study explores the impacts of stone crushing business through a complete channel that how stone crushing business depleting the environment and effecting the human health.

2.3 Air pollution and its impacts on human health

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 for 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.

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.

Riediker et al., (2004) Carbon mono oxide increases the hemoglobin level and in result it reduces the ability to transfer oxygen. The reduction in ability of transferring oxygen affects different organs. The organs which are more oxygen consuming like brain and heart are affected more

severely. Which lead slow reflexes and confusion? Systematic inflammatory is persuading by changing in particulate matter and affecting blood coagulation.

Huang and Ghio, (2006) Different diseases like blood pressure and anaemia are caused by heavy metal pollution (specifically mercury and arsenic).

Raizenne et al., (1996) the analysis of 24 communities has been carried out in united state and Canada. The study found the bronchitic problems in kids to be associated with sulfate. The study also found that strong particle acidity was found in these communities which were associated with decrements in measure of lungs function test.

2.4 Stone Crushing industries impacts on human health

Subhasis et al., (2018) About 400,000 people are dying every year due to severe respiratory problems which are caused by different environmental pollution emanating from quarrying, sandblasting and emission of dangerous chemicals. Most workers who are working in the quarrying industry have silicosis (lungs disease) due to inhalation of high concentration of dust particles and that dust particles contain silica. The size of the dust particles is about 0.3 to 3 micron. Similarly the heavy truck loaders adds to the dust problems which make the surrounding environment more fragile for human health and in result it lead it to the acute respiratory diseases to be permanent and sometime it become reason of death. While the unhealthy habit of people smoking make it more vulnerable to the silicosis. According to the primary survey conducted in 2016, 17 states the about 70% people have a habit of smoking cigarette, bidi and gangas that have to increase the risk of silicosis and some other respiratory problems (i.e. pneumoconiosis).

Chougule et al., (2017) the study concludes that the (PM2.5 and PM10) in the vicinity of stone crushing units 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 crops and vegetations was also adversely affected.

Olusegun et al., (2009) 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.

The production of stone crushing's and gravels are the main reason of dust formation. This dust formation is a big threat for the workers who are working in these industries. The workers exposed to particulate matter of these industries are at high danger with sign of asthma, irritation in nose bronchitic and lung problems. The possibility of control nasal disease has measured from zero to hundreds as inhalable particulate matter (IPM). By mouth and nose human inhale these air borne particles. Kan, (2009) the dust of quarrying and stone crushing are made up of micro particles like silica and sand. According to (IARC 1997) whenever human come in contact with these micro particles are the main reason of occupational illness, silicosis, lung cancer, inhaling crystalline silica directly affects to immune system infection, cardiovascular and non harmful renal sickness.

Gamma et al., (2011) marble production has a great contribution to the Damietta city. After the experimental observation founds that the level of dust concentration at different sites was recorded above the allowable level. The study says that there is a great risk of environment

deterioration. Due to dusty environment the health of the worker can be in danger as well as the adjacent residents. Study recommending that industries should follow up the standard operating procedures to keep the environment sustains.

Ilyas and Rashid, (2010) in this paper 221 workers interviewed through questionnaires which are working in the stone cutting industries. The results show that the stone crushing industries have significant adverse effect on environment and workers. Numbers of health problems were found in the worker like asthma, skin irritation, back bone ache, headache and noise hearing issue etc. The study concludes that personal protective instrument were using by very few number of workers which lead them to expose the dusty environment. So the suggests that the use of personal protective instrument at work place can significantly minimize the risk of health problems.

Musa et al., (2016) during work time only six percent workers were using PPE while the rest of 94 had never use PPE. And in result the health of many workers are affected by the dusty environment. Due to illiteracy it's their compulsion do work in these industries and they have no other choice of employment. The responsibility comes on owner to provide them PPE at work place. Similarly the wages of the workers are below then the wages fixed by government for unskilled workers.

Sivacoumar et al., (2006) pulmonary test was performed to check the respiratory function of the workers. The study result shows that ambient air concentration is varied at different place. Beside it the study also found that Suspended Particulate Matter is high at different point from the permissible level. Pulmonary test shows that the workers health found poor as compare with

healthy south Indian males. Because the presence of high silica in the atmosphere around in the stone crushing sites which affect the health of the labors and surrounding peoples?

2.5 Stone Crushing Industries impacts on plant and vegetation

This section explores the impact of the stone crushing business at plants and vegetation. Studies has been done to show that how stone crushing business depleting the growth of the plants and other vegetations which are at close range to stone crushing units.

Sayara et al., (2016) engagement of different plants are studied by number of authors. Particulate matter of the stone crushing industries whenever places on the leaves and on the crops which can disturb the natural process of photosynthesis and chlorophyll. So the productivity of such plants and crops can be drop in future.

Supe and Gawande, (2013) Crushing sites generate dust which degrades the quality of atmosphere and the surrounding environment. As research founds that humans are exposed to heavy dust particles similarly plants and land is also exposed to heavy dust pollution. The pigmentation process became poor whenever a fine dust is placed on the leaves. The physical and chemical properties of plants tissues can be changed by heavy dust pollution, because plants body cells always rely on chemical properties of dust particles, chemical like led, iron, compounds of calcium etc. A thick layer is always found on the grass around at crushing sites. After experimental work this study found that most of the leaves were dusty and due to that the growth of these leave is became poor.

Alves et al., (2008); Ahmad et al., (2005) They concludes that the stone crushing industry produces high concentrations of particulate matters which adversely affected the surrounding of different food species and other vegetations. Also it does reduce the annual productivity of these

plants. It is highly recommend that green belts are needed to keep the particulate matter in control in a specified area. The change in environmental conditions is strongly correlated physical behaviors.

Rahul, (2013) The plants and crops which are located near to industrial areas and close to road have a high possibility of absorbing dust and other pollutant parties. The study was investigated to find out the impacts of stone crusher on Butea monospermous (Lam) which is nearly located to the stone crushing industrial area. The sampling activity has been done in different sites. A 100m to 300m distance was taken from the stone crushing site in east. Similarly 100m to 300m and 100m to 500m was taken in north and south sites respectively all the distances were taken from the stone crushing sites. Changes ware observed of plants chlorophyll process and caroteniod content were investigated in Butea monosperma. The study found that there were negative impacts on the photosynthetic pigments.

2.6 Stone Crushing industries impacts on water

This section explores the impact of stone crushing business that how stone crushing operation reduce the air quality and what are possible polluted water diseases. Whenever the dust particles get mixed with water in result the water get contaminate. Due to huge and continues vibration of machine which shake the underground plate the earth which also disturb the water stillness.

Sheikh et al., (2011) the study unfolds that the mean minimum and maximum values are found above the permissible level. Due to exposes to dust pollutant most of the workers were endure in different health problems like respiratory problem, asthma, skin problems, eye irritation and hearing loss. The study also found that the dust emission contaminate the water and air quality. The study reflects that the regulatory measurements are necessary protect the environment.

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 and 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. The assessment of water quality was carried out at different sites. The water qualities were classified into two periods. Post and after quarrying activities the quarrying activities were started from 2000 to 2013. After inspection the study found that natural stone water can be a source of contamination as a result of liquid of inadequate solid and liquid waste disposal.

From the literature we found that stone crushing industry is a big concern for environment and human health. Stone crushing industries has deteriorating the water quality and vegetation quality and quantity. Despite the technological supremacy the developed countries are overcome on such issues. While the developing nations are yet to overcome on such concerns due to limited resources. Poor workers who have no other choice of employment they are working in these industries. Working in dusty environment they face different health problem. Similarly the surrounding vegetation also suffers and reduced the annual yield. Water is a precious gift from Allah and adjacent lakes and rivers also effects from these industries.

2.7 Summary of the previous studies

The literature review shows the impact of stone crushing units on human health and on environment. Stone crushing industry caused different kind of health related disease in stone crushing workers and people who are living adjacent to the stone crushing industries. Stone

crushing units which are at closed range to the populations or publics are unsafe from the adverse externalities of stone crushing activities. Besides affecting human crops and water quality is also not up to the mark. From the literature it is obvious that stone crushing unit stone crushing industry have negative environmental externalities no human health and environment. From the literature it we concluded that the impact of the stone crushing industry on the adjacent population is completely ignored. Beside this availability of literature on impacts of stone crushing activities is also very drastic. Similarly from the literature we observed that some of the literatures argue that immediate banning is the solution to avoid negative externalities creating by stone crushing industry.

2.8 Research gap

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. 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 industries provide the materials for the infrastructure purposes and that cannot be ignored, however there is a need to do it in a sustainable environment and development. In Pakistan very less studies are available to disclose the impacts of stone crushing industry on surrounding resident public health. Most of the literatures are available on the workers exposure to the dusty environment. So study is needed to unfold the environmental based pollution adjacent population. The area selected for the research is famous for quarrying industries. But very less empirical research is done to find out the true economic cost and benefit of these for sustainable development.

Chapter 3

DATA DISCRIPTIONS AND METHODOLOGY

3.1 Study Design

In this chapter we discussed about the study design and study framework. Data is collected for this study with the help of pre-tested questionnaires. Sampling methods and estimation methodology is also explained below.

3.2 Study Area

The study was conducted in Malakand district of Khyber Pakhtunkhwa. This district was formed in 1970 as a provincial administrated area. It was known as Malakand protected area before its formation. Geographically district Malakand is located at a very important point because it is act as a gateway of lower dir, Bajaur and Bunair etc. Malakand pass connects Mardan with swat and Bunair and dir etc which is adjacent to Dargai. The swat river flow down toward in charsadda and then it falls in River Kabul. 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 district is 720,295 and area is 952 kilometer square.

MAP OF MALAKAND DISTRICT

Source: Google map

3.3 Data description

For accomplishing objectives primary survey data have 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. According to environmental guide lines for stone crushers they should be 500 meters away from the educational, population and other religious areas. To conduct this research we compared two groups. One group people who are living within in 500 meters while the second group people will be those who are living out of 500 meters. The people who living within a 500 meters radius is considered Uncontrolled group (treatment group) while the other is out of 500 meter radius 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 has done from the owners of the stone crushing units. Different questions were

asked from the respondents like their demographic characteristic, socio economic characteristics etc. Similarly we have asked different questions about water quality.

3.4 Sampling structure

There are two types of stone crushing one is power mining and the other is called river bed mining. In power mining they extract the stones through blasting in mountains. While in river bed they are extracting the stones from the river for further crushing. To avoid transportation cost most of the stone crushing units are adjacent to river swat which is also close to population. In Malakand district most of the stone crushing units are on the strips of river swat and due to the rapid growth in population the contact between the human and industry is getting closer.

Total area of the Malakand district is 952 kilo-meters square. As we have 82 union councils and in three tehsil can be seen in annexure and there are 20 registered stone crushing units in these union councils. List of Stone crushing units can be seen in annexure. According to Khyber Pakhtunkhwa Economic Zone Development and management Company the total Population of Malakand district is 720295 which comprised of 51% of male and 49% of females.

150 respondent has been interviewed by using simple random sampling technique to find out the socio economic and health effects of the workers in Sargodha (Musa., et al 2016).

To determine the impact of the stone crushing industry on workers and environment date has been collected from 300 respondents in India (Sheikh., et al 2011).

In this study where the survey is carried out is famous for river bed mining. In the light of previous study sampling design and using 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) considering the time and financial constraints. Data from two hundred

eighty people from treated and controlled area has been collected through questionnaires. 140 respondents were interviewed from those UCs where stone crushing units were exist while 140 respondents were interviewed from those UCs where the stone units are not exists. The selection was based on same cultural and demographic characteristics .On the basis of these groups we concluded that how does the environmental based pollution of stone crushing industry increases the health cost of the uncontrolled population or not. Choosing the controlled group and treated group is done through stratified sampling.

Treatment population (within 500 meters)	**Number of respondents to be interviewed**	**Control group population (out of 500 meters)**	**Number of respondent to be interviewed**
Pop A	140	Pop B	140
Total population	**Total respondents =140**	**Total population**	**Total respondents = 140**

On the basis of stratified sampling we have made two groups one was a treatment group named Pop A group who are living within the radius of 500 meter and interview 140 respondents similarly the second group Pop B was considered out of the radius 500 meter and 140 respondents had been selected in that group. The selection of the respondents of both the group was on the basis of simple random sampling techniques. So collectively we had select 280 respondents.

3.5 Conceptual background of the study

Researchers were focused on economic, social and environmental impact of gravel industry in the regions of North Africa and Middle East specifically Palestine. A case study for efficient use

of energy, water, and natural stone during production process and minimizing the waste and improve efficiency (Hanieh., et al 2013).

Conceptual framework of the study elucidate that at one side stone crushing business creating economic benefit like creating employment opportunities and providing raw materials for infrastructure development but at the flip side it create negative environment externalities which have adverse impact on human health and on environment in the surrounding. Due to direct exposure to the dust particles beside workers the adjacent residents are also exposed to different health related issues such as respiratory problem, skin problem, eye irritation and stress and depression etc. The environmental impacts of stone crushing industries such as air, water, noise and soil pollution make fragile the surrounding environment.

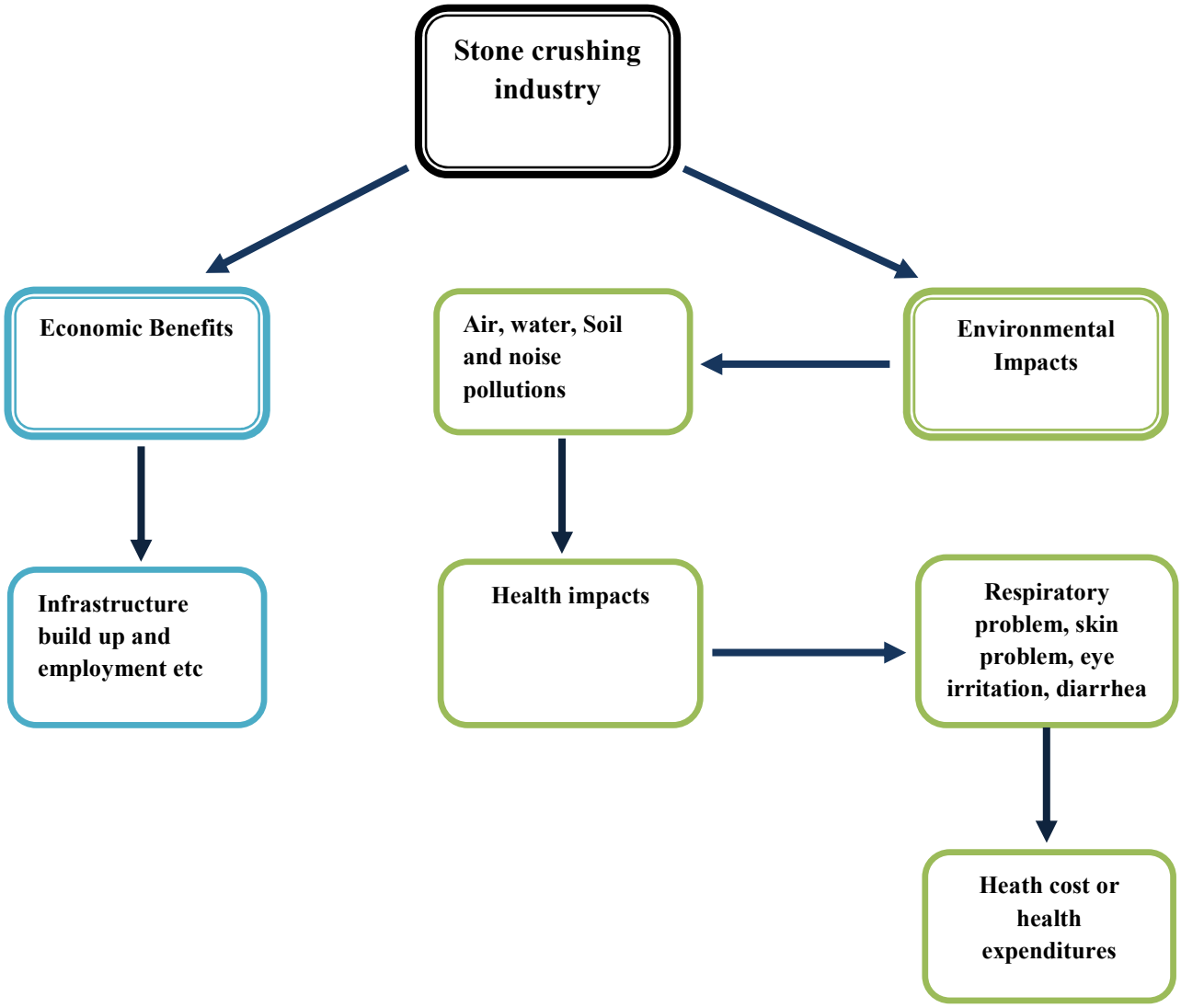

Figure 2: **Stone Crushing industry impacts on environment and economy**

3.6 Methodology

To find out the environmental pollution base expenditures we have used the propensity score Model. Through propensity score technique we are able to know that how the environmental pollution base health expenditure is significantly increasing due to the pollution of stone crushing units

3.7 ECONOMETRICS MODELING

3.7.1 Propensity score

The general equation we have,

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

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 we will check that how is 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 used the propensity score technique which is explained below.

Propensity score is an econometric estimation technique which is basically used for the comparison between control group and treatment group. After estimation we will be able to know that do the environmental pollution health based cost is increasing of the uncontrolled group or not.

To estimate the general equation we used the propensity score technique.

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.

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

As we assigned two groups one is a treatment group while the other one is controlled group. D is binary variable for both controlled group and treatment group. When D = 1 it is used for the treatment group when D = 0 it is used for control group.

3.8 Variable Description

In the below table it is shows that what is the dependent variable and what are the independent variables or explanatory variable and on what bases we took these variables.

Dependent variables	**Construction**
Health cost	Health cost is a vector variable in which includes all medical expenditures of the control and uncontrolled respondents.
Explanatory variables	**Construction**
Age	Age is the independent variable of the respondents. Which is measured in years?
Age 2	Age 2 of those respondents whose immune system is be decrease after specific time e.g. after 50 years
Education	Education is the number of schooling of the respondents. This is counted in years.
Gender	Gender is also independent variable. Its shows us that the respondents is male or female.
Income	It is the respondent monthly income which is counted in rupees.
Working hour	Its represent the number of hours working by labor in a day.
Visiting to doctor	This represents that how many time the respondent visit to the doctor.
Distance or radius	Distance shows that at what distance the respondent is living from stone crushing industry.

Protective instrument	This shows us that do the respondents using the protective instrument or not.
Medical condition	We asked about the medical condition from the respondents that how is their medical conditions and what are related health problems like asthma, skin irritation, shortness of breath, respiratory problems and coughing etc.
Water	Water quality of the area that is it effecting or not. Taste and impurities etc.

Chapter 4

ENVIRONMENTAL LAWS AND IMPLICATIONS

4.1 Environmental laws and its implications on national and provincial basis

This chapter discusses the existing environmental laws both at nation and provincial basis related to stone crushing business.

4.2 International and national environmental guide lines for stone crushing units

The aim of this chapter is to revise the environmental laws at national and provincial bases its will cover our first objective.

Human rely on natural resources and the extraction of the natural resource as at continuous pace across the globe. The methods used for the extraction of natural resources are very poor which have a significant potential of degrading the environment and adverse impact on human health. Different methods are used for extraction of different resources but most of the methods used for the extractions are not environmental friendly or either the use of them is not appropriate. For extraction of natural resources there are different institutions or department across the globe to monitor the process of extracting the natural resources to reduce the deterioration of the resource.

Growth in population leads to increase different demands of human. Crush stone is one in them for building infrastructures such as houses, hospitals and roads and so on. Crush stone use in different infrastructures can be extract by two ways one river bed and other one is power mining as this study area is famous for river bed mining so the study has emphasized on river bed mining. Those days were gone when people extract the stone and sand by using their own hands and load them on donkeys or horses etc and sell them on the road. Now the game is changed people extract the stone by using bulldozer etc and load the stones on dumpers and trucks etc to

carry them to the stone crushing units. In stone crushing units these stones further crushed by stone crushing machines. In developed countries the advance stone crushing machines already replaced the ancient stone crushing machines which are one core reason of environmental degradation. Replacement of machines will encourage and lead the stone crushing industry to sustainability but due to limited resources and financial constraints in developing countries can't replace the old ones with new ones.

Environmental Protection Agency (EPA) US, Office of air quality planning and standards and emission inventory branch is responsible for controlling the air pollution standard for industrial activities. Entropy environmentalists were made and conducted a test procedure for the measurement of particulate matter (PM10) emissions. This test program was carried out under the supervision of Environmental Protection Agency (EPA-US) special team call Emission measurement branch. Entropy environmentalist concluded that emission of the wet test series of both crushers were low as compare with dry test series of the crushers. This emission testing approach is an adaptation of the conventional "Roof Monitoring" technique for fugitive emission testing (Richard and Kirk, 1992)

Fine fugitive dust erupts during stone crushing activities which create a big concern for the both unit's workers and adjacent population by way of causing respiratory and other health problems. Beside such problems dust reduces the visibility and drops the growth of the surrounding vegetation. To eradicate these emissions Central Pollution Control Board of India is already presented the allowed emission limits and notified the guidelines in 1989 under environmental protection act 1986. Which emphasize that how to reduce the harmful effect of different type of pollution like water, air and soil etc? Multi pronged strategies has been adopted by the Indian

government in the form of regulations, laws and other measure to prevent and abate pollution (Manash., 2014).

4.3 Suggested pollution control measures for stone crushing units

Protocol drafted for the pollution control measure by Central environmental authority CEA of Sari lanka resulted the reduction in the noise level and slight reduction in the Suspended particulate matter is found after the implementation of pollution control measures. Control measures for the reduction of noise can be use at similar industries while there improvement need in dust emission protocols are given below in table (Weerakhody et al, 2016).

The following pollution control measure is used to curb the health hazards and environmental impacts.

Table 1*:* Pollution control protocols

Impact	**Implemented pollution control measure**
Dust emission	▪ Enclosed Screen and conveyer belts ▪ Covered the jaw crusher ▪ Sealed all holes in the room ▪ Wind barriers implemented using cement blocks asbestos sheets ▪ Construction of fencing around the unit ▪ Water spray system with nozzles at jaw crusher ▪ Establish circular duct lines, centrifugal fans, wet scrubber units, recirculation tanks, over headed water sprinkle system
Noise pollution	▪ Enclosing the crushing points ▪ Sound absorbing materials were used in constructing wind barriers.
Destruction of habitat for the fauna and flora species as well as biodiversity reduction due to vegetation of clearing sites	▪ Need to install the plant on a barren land or agro forestry techniques can also be adopt
Contamination of ground water due to use of oil from the maintenance of machines	▪ Regular check and balance of machine as required to avoid the oil drops on land. ▪ Provision of spill mitigation equipment such as double

	wall tanks or diking storage tanks
Creation of noise pollution for the adjacent population	▪ Technology need to encourage which

4.4 Pakistan environmental protection Act, (PEPA) 1997

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 pollution. 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 and water sprinkling system. No working hours are allowed in evening and late night.

During field survey i observed that most of the stone crushing units are exist in the middle of the public areas like restaurants offices and educational institution. No single stone crushing unit found beyond 500 meter from residential and public areas. The protocols sit for minimizing the occupational and regional hazard are completely ignored by Stone crushing unit's owner. Similarly during survey I got enlightened that most of the stone crushing units are working in evening and in night times and noise of the crusher can be hear up to 3 kilometers. We noticed that no proper fencing or boundary walls and installation of green were observed. It means that at many stone crusher units there is ignorance from the stone crusher owner and the concern institution as well.

Stone crushing units are not allowed to operate in residential areas within 500 meters as per the orders of the Honorable Supreme Court of India in the civil appeal (Pollution control board controlling pollution from stone crushing unit).

Due to the existence of the stone crusher unit's at close range to public areas conflicts were noticed. Complaints are recorded from restaurants companies and educational institutions. Poor labors who are working and living in the restaurant to feed their families have mentally tortured due to noisy environment and same like the other resident as well.

During survey we noticed that many workers don't have the Personal Protective Instrument to avoid huge health injury and other health related problems. Pictures added of the stone crush workers at stone crushing unit were completely without use of PPI.

Stone crusher workers can face physical injury and work days off due to slipping from height, accident inside and outside in traffics and heavy physical works (Safety and health in stone crushing units).

List of stone crushing units regarding issuing of Environmental Protection Order can be seen in annexure. Environmental Protection Orders are issued to different stone crushing units in Malakand district.

4.5 Licensing for stone crushing industry

Out of ten stone crush unit only one stone crush unit had no objection certificate while the rest were operating without issuing of No objection certificate. Any person who wants to install a crush plant should apply for the license first. Without valid license authority act no one has the right to install a crush plant. No license will be allowed to those who are not maintaining the safe distance from the public areas like mosque, schools, restaurants, shop or crops etc.

4.6 Responsibility of the license

Responsibility of the license is for cleaning the premises of the surrounding stone crushing areas, provision of safety equipments; provisions of personal protective instrument like mask, shoes, gloves and urinals for workers. During survey it was noticed that the availability of Personal Protective Instruments at most stone crushing unit they don't had for the workers. Due to unavailability of the PPI huge injury cases are noticed.

4.7 Air quality standards and Control

Environmental protection agency (Pak-EPA) drafted different standards for different pollutant which are Sulphur dioxide, Oxides of nitrogen, O3, Suspended particulate matter (SPM), respirable particulate matters PM10 and PM2.5, lead and carbon monoxide. To check the

standards their must 2 readings in a week for 24 hours on uniform intervals. Minimum 104 readings should be taken out in year. During the survey we noticed that the visit from Environmental Protection Agency no visit has been observed in last 6 months to 12 months. So the lack of the inattentiveness from the institution is also a big concern.

Stone crushing business is a very important industrial sector which is contributing in national GDP. For making this industry more sustainable laws and regulations are already available but the point is that the implementation of such laws and regulations is very weak. The prior responsibility comes here on the Environmental Protection Agency that how they allowed them to operate in public areas and without having NOCs. Similarly despite not having a safe distance they are still operating their business. It is clearly mentioned in the bill for the installation of stone crusher that a person cannot operate or install a plant with having NOCs. If a crushed plant is already installed he must apply for the license. Due to inattentiveness of the monitoring institution it encourages the stone crush owner to operate their activities openly and ignoring SOPs. Stone crush owner needed to be educated in this regard that stone crushing activity create adverse environmental externalities inside and outside the units. They need to be educated about the use of SOPs as we noticed during the survey that stone crush owner do not have sufficient level of knowledge. They knew that it create negative environmental externalities but don't have knowledge about how to mitigates such externalities. Similarly in a unit it's a prior responsibility on owner that he will provide the safety measure to protect them from inhaling the dust (Landrigan et al., 2002).

4.8 Conclusion

This chapter concludes that environment and human health is very important inside and outside of the industry. Stone crushing business is a small scale enterprise in developing countries but it is a source of employment of poor people and beneficiary for domestic and national economy. Due to lack of resource developing countries are yet to adopt the advance machines to curb the pollution creating by stone crushing industry. Anyhow the environmental guidelines can insist the adverse environmental externalities if followed properly. Similarly education can play as a key role for stone crush owner to restrict adverse environmental hazards from stone crushing units. The follow up of environmental guidelines is very important for sustainability.

CHAPTER 5

RESULTS AND DISCUSSION

5.1 Results and discussion

This chapter provides results from descriptive analysis and econometric techniques of the study and is divided into two sections, in the first section we will discuss analysis of the data we collected from the stone crushing unit's owners. Data has been collected from stone crushing unit's managers or owners. Due to COVID-19 constraint only ten stone crushing unit's owners were interviewed. In the second section we will discuss the results of the data we collected from general population. These had 140 respondents from control population and 140 from treated population. Again ideally the sample size would have been more but due to COVID-19 constraint these were limited to this numbers. The respondents were interviewed in the two Union council "Thana khaas"and "Thana bandajaat"of Malakand district.

For data collection from stone crushing owners and for general public (classified into controlled and uncontrolled) we organized two separate questionnaires for both. First we interviewed stone crushing unit owners to collect the information's regarding stone crushing unit in a detailed questionnaire. Questions asked in the questionnaire are based on socio economics characteristics, Production capacity of the product, knowledge about pollution and health impact on human, use of PPI, penalty history, conflicts with communities and how they responds to the health hazards of their workers. To accomplish our 3rd objective such information from stone crushing unit owner was necessary and which is collected through questionnaires. Then we discussed the results which we collected by using propensity score matching.

Similarly to achieve the 2nd objective we collected the information from general public though a separate questionnaire. We interviewed the general public through pre-tested and detailed questionnaire. Questionnaire is based on the questions related to demographic profile of the respondent, distance away from stone crushing unit, use of protective instrument, disease history, days of illness, treatment history, water quality and diseases related to water.

5.2 Descriptive analysis of Stone crushing unit's owner responses

Previous studies did not interviewed stone crushing unit's owners so this study will cover the information from stone crushing owners. Interviews from stone crushing owners actually give us idea of their own perspectives, that what are their perceptions about the concerns for the environment and industry impacts on human health by stone crushing industry and the contribution to economy. To get the fundamental information we used the descriptive analysis of the data. Without results the descriptive analysis of data provides us the simple interpretation of data and the questions of the respective data were based on both quantitative and qualitative. Information taking from the stone crushing units owners is very important. It will cover our third objective that how stone crushing owners provides a safe environment for the workers in stone crushing units and how they minimize the environmental externalities which are serious concerns for general public.

5.2.1 Demographic Analyses of Stone Crush Owners

Table 2: 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

Source: *Survey data*

The above table 2 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 2).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.

Ages of the respondents were recorded from 21 to 58 years old considering all stone crushing units workers (Harvath and hegedus, 1994).

5.2.2 Distance from Population

Table 3: 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	

Source: *Survey data*

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 3). According to the environmental guide lines the distance of the stone crushing must 500 meters away from the public and residential areas.

5.2.3 Number of Workers at Stone Crushing Units:

Table 4: 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	

Source: *Survey data*

Table 4 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%.

5.2.4 Per day production of the units

Table 5: Per day production of the units in feet

Per day production in of the units in feet			
Production quantity (feet)	**Frequency**	**Percent**	**Cumulative Percent**
2000.00	4	40.0	40.0
2500.00	5	50.0	90.0
3000.00	1	10.0	100.0
Total	10	100.0	

Source: *Survey data*

Table 5 shows the per day production of the units. Production 2000 feet is 40%, 2500 feet were 50% and 3000 were 10%. Per day production in feet in these stone crushing units are between 2000 feet and 3000 feet.

5.2.5 Knowledge about Pollution and Effects on Resident's Health

Table 6: 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 6 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 have knowledge 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 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% don were disagree.

5.2.6 Use of Standard Operating Procedures (SOPs)

Table 7: 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 7 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 ppi. 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.

5.2.7 Penalty History

Table 8: 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 8 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.

5.2.8 Complaint and Dispute History

Table 9: 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 9 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.

5.2.9 Major Morbidity History

Table 10: Accident, cost and type of injury

Accident 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 10 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.

The data from the stone crushing unit owners shows that most of the stone crushing units are adjacent to the population or public areas. They are earning handsome amount of money and providing the material for the infrastructure building purposes. Beside it provide the employment opportunity for the poor people of Malakand district. The status of using PPIs and following sops at most stone crushing was very poor. I personally did not witnessed of the availability of complete set of PPI at many stone crushing unit accept shoes for protection. Similarly the green belts practice and water sprinkling system was about nil which can decrease the potential of the dust impact on the surrounding areas. Attention from the environmental protection was also poor. Only two units were charged on different offence. They should have visit two times in a week and should carry out all the procedure to keep their eyes on them. Similarly most of the stone crushing units were found in a conflict with local business specially restaurant as they exist very closed to them. Most of the other local business especially restaurants even filed cases against them. Ever the accident happened with worker at stone crushing unit according to the workers they don't get pay for it. According to the data collected from stone crushing owners we end up that almost all stone crushing units have very poor response to provide a safe environment for the poor workers.

5.3 Descriptive Statistics of General Public of Controlled and Uncontrolled Groups

5.3.1 Demographic profile of respondents

Table 11: Demographic analysis of the respondent

Gender of the respondent			
Gender	**Frequency**	**Percent**	**Cumulative Percent**
Male	225	80.4	80.4
Female	55	19.6	100
Total	280	100	

Education status of the respondent			
Level of education	**Frequency**	**Percent**	**Cumulative percent**
Below Primary	11	3.9	3.9
Below Middle	20	7.1	11.1
Below Matriculation	9	3.2	14.3
Matriculation	48	17.1	31.4
Intermediate	34	12.1	43.6
Below Graduation	37	13.2	56.8
Graduation	86	30.7	87.5
Above Graduation	09	3.2	90.7
Illiterate	26	9.3	100
Total	280	100	
Marital Status of the respondents			
Marital Status	**Frequency**	**Percent**	**Cumulative Percent**
Married	192	68.6	68.6
Unmarried	88	31.4	100
Total	280	100	
Occupation status of the respondent			
Occupation status	**Frequency**	**Percent**	**Cumulative percent**
Business owner	21	7.5	7.5
Managers of shops	8	2.9	10.4
Student	22	7.9	18.2
Trader	48	17.1	35.4
Farmer	1	.4	35.7
Housewife	5	1.8	37.5
Teacher	66	23.6	61.1
Worker	72	25.7	86.8
Government employee	12	4.3	91.1
Retired servant	5	1.8	92.9
Stone crush plant worker	20	7.1	100
Total	280	100.0	
Age of the respondents			
Minimum	**Mean**	**Maximum**	**Standard error**
16	32.8857	70	.65764
Income status			
Range of income	**Frequency**	**Percent**	**Cumulative percent**
1000-20000	70	25	25
20001-40000	107	38.2	63.2
40001-60000	66	23.6	86.8

60001-80000	23	8.2	95
80001-100000	8	2.9	97.9
Above 100000	6	2.1	100
Total	280	100	

Source: *Survey data*

Collection of the data from 280 respondents both controlled and uncontrolled population will cover our second objective relate to stone crushing industry impacts on human health and environment. The demographic characteristics of the respondents can be seen in table 10 tables. This will provide us the fundamental information of the data.In this survey we interviewed 280 respondents in which 80.4% were male and 19.6 were females. Data has been collected from them on the basis of their own perspectives and willing. As we know education is very important in every aspects of life. If a person from any occupation is educated he will try keeping himself from pollution and taking good care of his own health. This will enable us to accomplish our 2nd objective. Education status of the respondents states that 3.9 percent people were below primary level while 7.1 percent above primary but below middle. 3.2 percent have done their middle level education but they were below matriculation. Similarly 17.1 percent people have done just their matriculation. Intermediate and below graduation were 12.1 and 12.2 percents respectively. Likewise 30.2 percent out of 100 percent were graduated while 3.2 percent respondents were above graduation level. 26 out of 280 people were illiterates which is equal 9.3 percent. Similarly in the next table we can see the marital status of the respondents. 89.6 percent respondents have their own house while the rest is living in rent based houses which is equal of 10.4 percent. In the very next table we can see the occupation status of the respondents. 7.5 percent were business owner, 2.9 percent were managers of stores or other business, 7.9 percent were students, 17.1 percent were traders, 0.4 percent were farmer, 1.8 percent were house waives, 23.6 were teachers, 25.5 percent were workers who are working in restaurants and in other shops etc.

Similarly government respondents were 4.3 percent; retired servants were 1.8 percent and 7.1 percent workers were interviewed from different stone crushing units. In the table of age of the respondent 16 was the minimum age of the respondents and maximum age was 70. In the next table which represent the income status of the respondent in ranges. 25 percent respondent income were between 1000 and 20000, 38.2 percent and 23.6 percent respondent income were between 20001 to 40000 and 40001 to 60000 respectively. Likewise 23 respondent's income was between 60001 to 80000 which are equal of 8.2 percent. Similarly the respondents whose income were between 80001 and 10000 were 8 which are equal of 2.9 percent while those who have higher income than 100000 were 6 which are equal of 2.1 percent.

5.3.2 Distance from Stone Crushing Industry

Table 12: 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 12 shows that 50 respondents who were living below from stone crushing units while 50% were living beyond stone crushing units. During the survey most of the stone crushing are on close range to schools, restaurants and offices etc. All of them insist me to convey our voice to the concerns institution that either these stone crushing unit should be shift or they should keep their under follow up strict rules and regulations. Due to heavy noise i witnessed that a school at close range was getting disturb for the environment for the educational activities. The school administration told me that it would be better if could rotate their working hours.

5.3.3 Use Protective Instruments (PPIs)

Table 13: 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 13 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.

It is the prime responsibility of the owner to provide safety protocol to the worker to minimize the potential health hazards. Occupation health and safety administration and adhere through administration as guideline of international organization of health and safety (Landrigan et al., 2002

5.3.4 Stone Crushing Industry Perception

Table 14: 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 14 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.

5.3.5 Disease and Accidents History of the Workers

Table15: 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 15 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.

Our study results are agrees with the previous studies stone crushing industry contaminate the surrounding environment whenever the allowed limits are surpassed then people are directly exposed to the dusty environment and face related health diseases such respiratory, skin, eye irritation problems etc (Chougule., et al 2017).

5.3.6 Day's Illness

Table 16: 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 16: 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.

5.3.7 Treatment Status

Table 17: *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 17 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.

5.3.8 Medical or Diagnostic Tests Records and Hospitalization

Table 18: 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 18 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. This study results are agrees with the previous in India a pulmonary test function has been performed on the stone crush workers. The results are claimed that stone the health of the workers are comparatively weaker than the normal south Indian workers (Sivacoumar., et al 2006). Our study further contributes that beside workers stone crushing have also adverse impacts on resident healths and they face related health diseases to stone crushing units.

5.3.9 Water quality and types

Table 19: 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 19 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. Our results contributes that the water quality further lead water related health diseases as the previous studies did not elevate water related disease. Study unfold water related health diseases that as the water quality drop the respondent are faced water related diseases such as diarrhea, cholera and typhoid etc.

5.4 Cross tabulation between variable

5.4.1 Cross Tabulation between distance and diseases

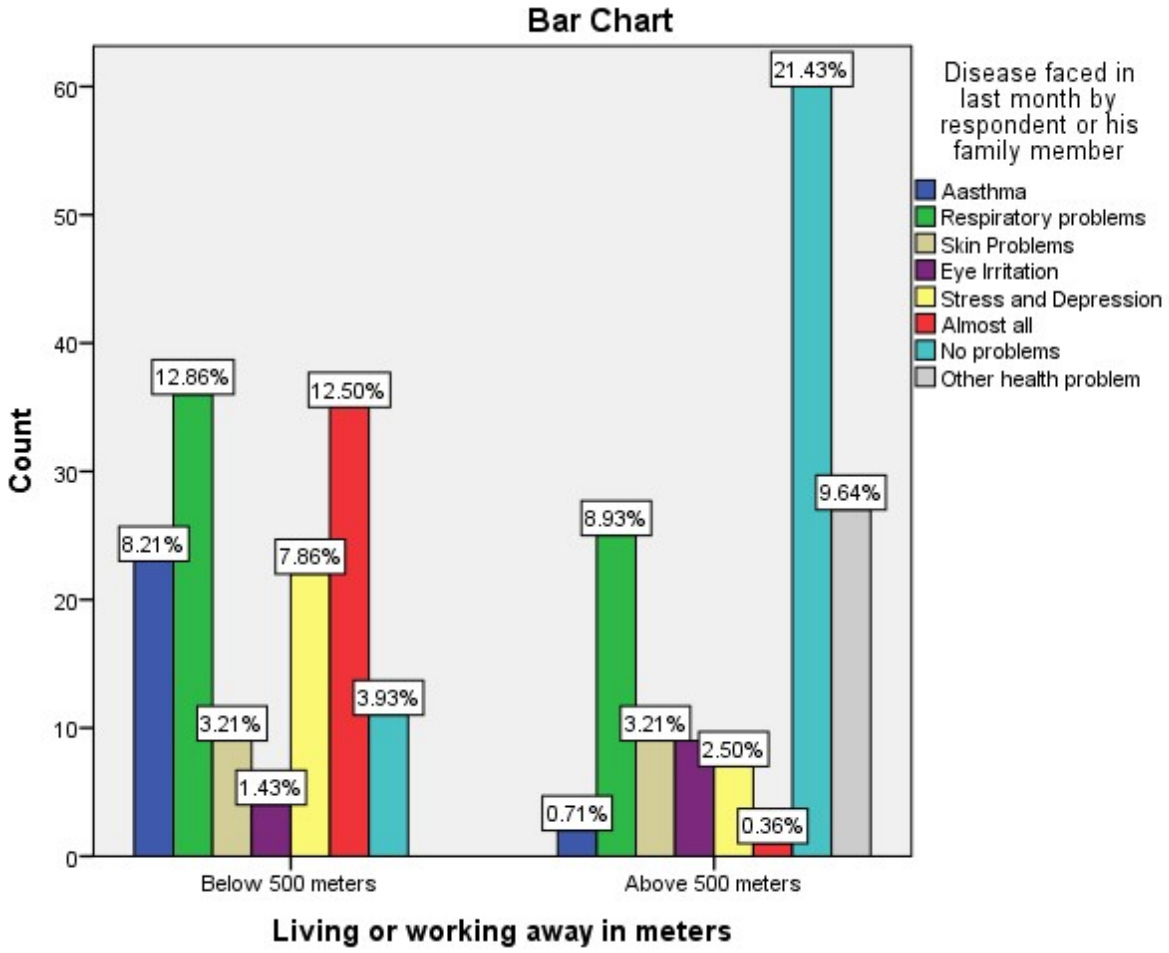

Figure 3: Cross Tabulation Between Distance and Diseases

The above figure show the relationship between distance away from the stone crushing units and diseases faced in last month. The figure clearly shows 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.

5.4.2 Cross Tabulation between occupation and disease faced

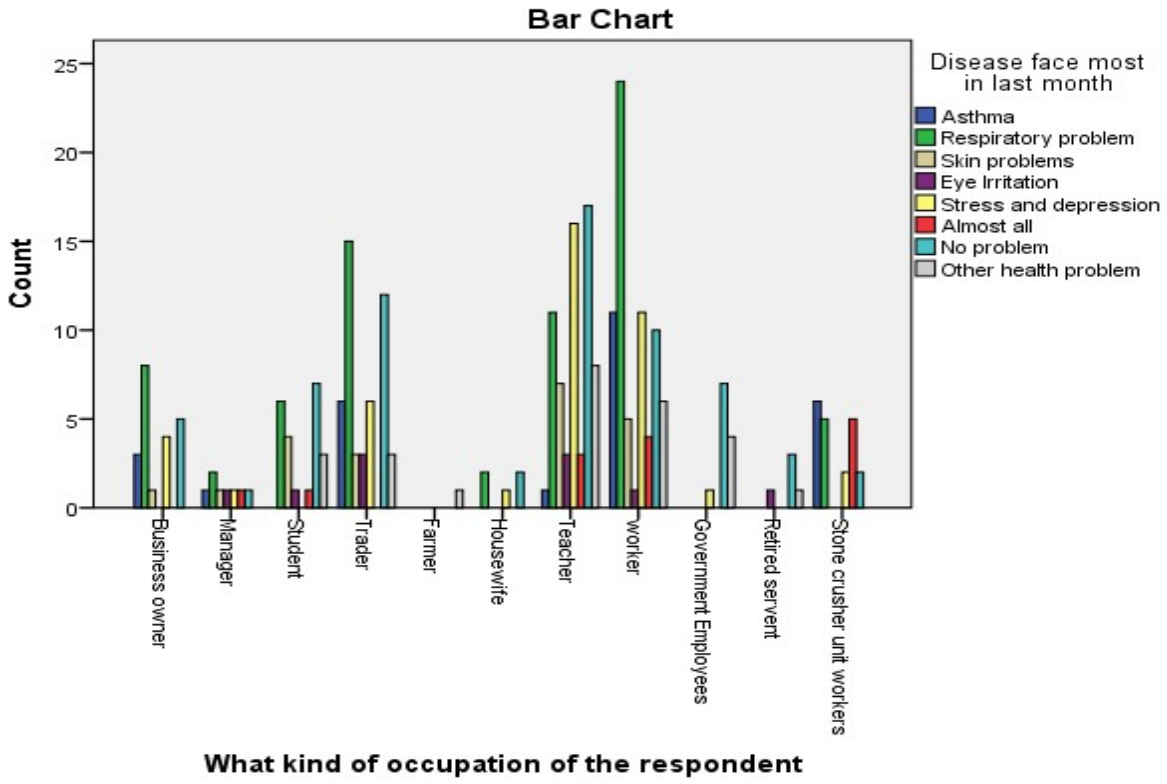

Figure 4: Cross Tabulation between Occupation and Disease Faced

The figure show the relationship between occupation of the respondent and disease faced in last month. On vertical axis we can see the diseases faced by respondents and on horizontal axis we can see the occupation of the respondents. The relationship between occupation and disease faced last is significant. The person chi square value is 118.03, the degree of free is 70 and the significant value is 0.000.

5.4.3 Cross Tabulation between Use of PPIs and disease faced

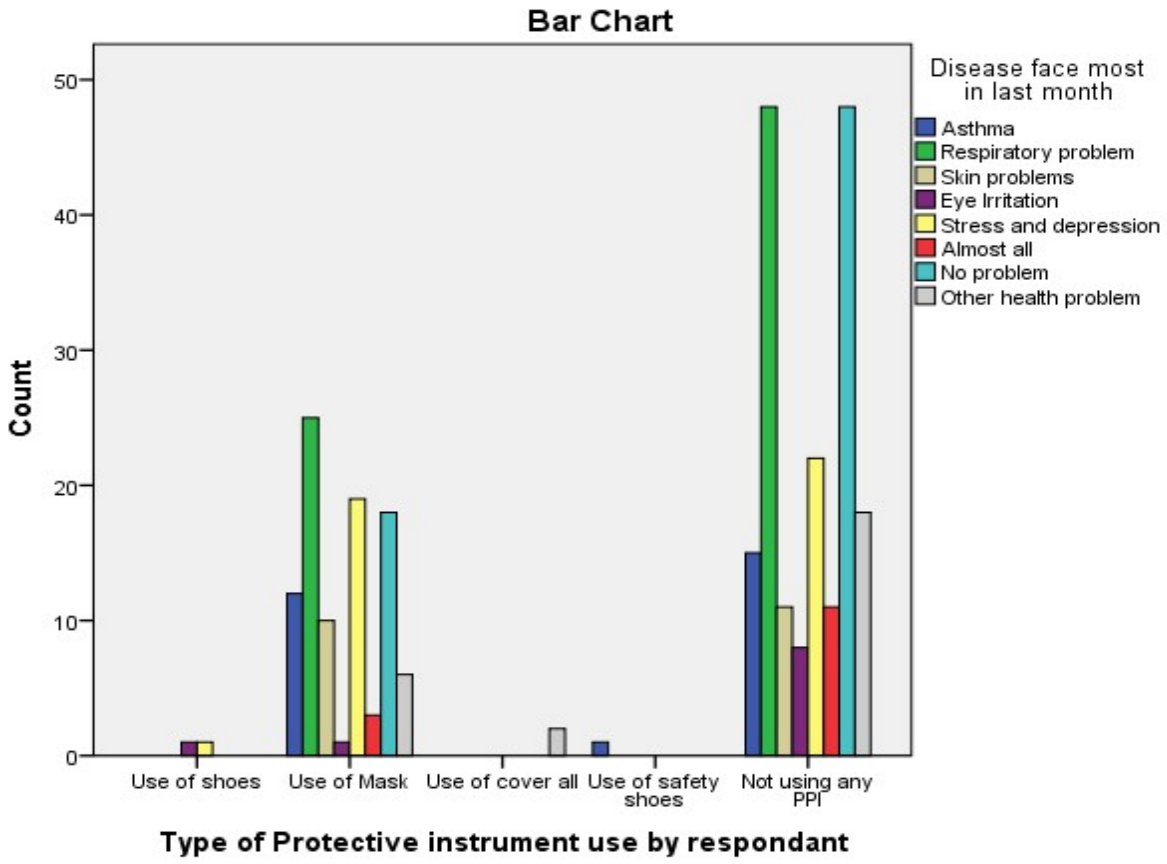

Figure 5: Cross tabulation between disease faced last month and use of ppi's

The figure 5 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.

4.4.4 Cross Tabulation between Income and Disease Faced

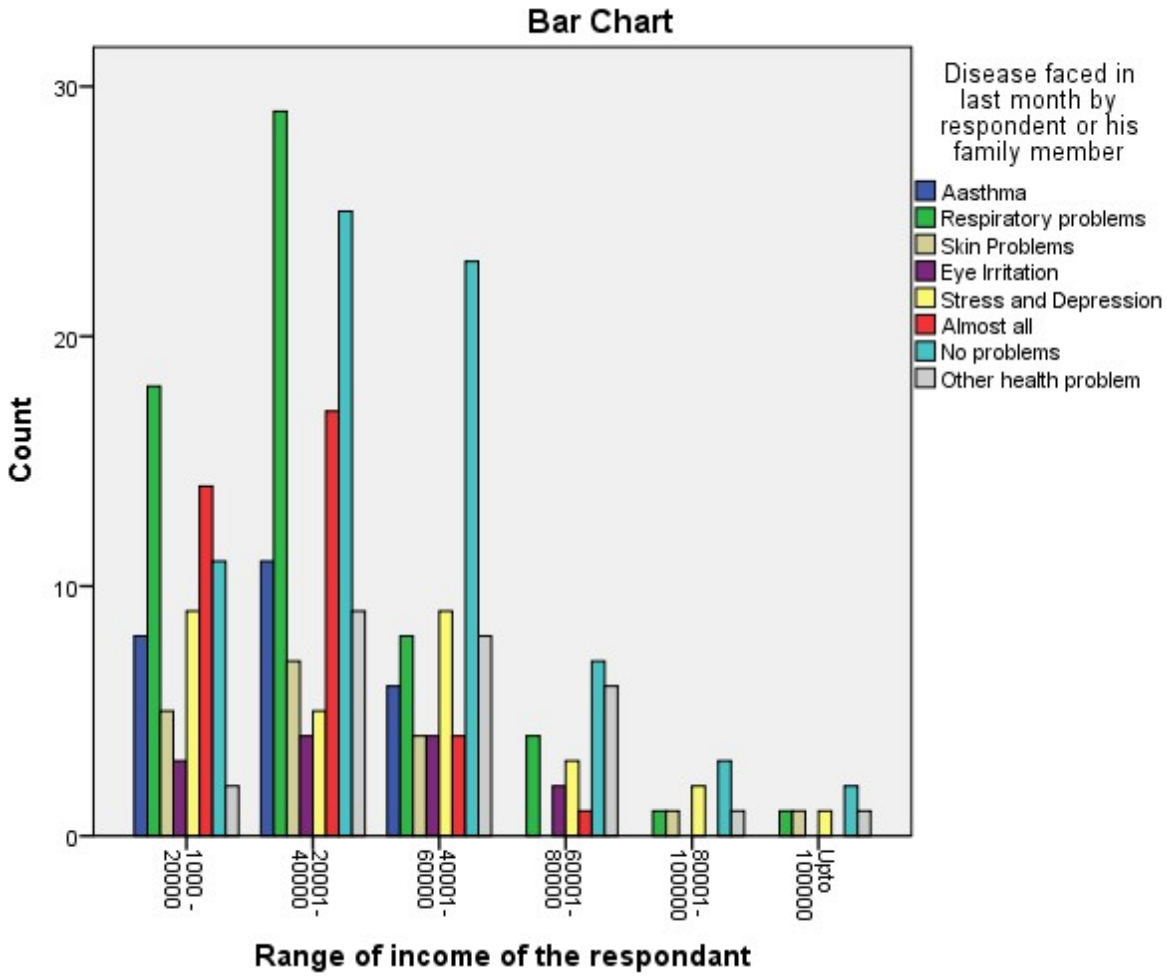

Figure 6: Cross tabulation between disease faced last month and income

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.

5.4.5 Cross Tabulation between Total Cost and Distance

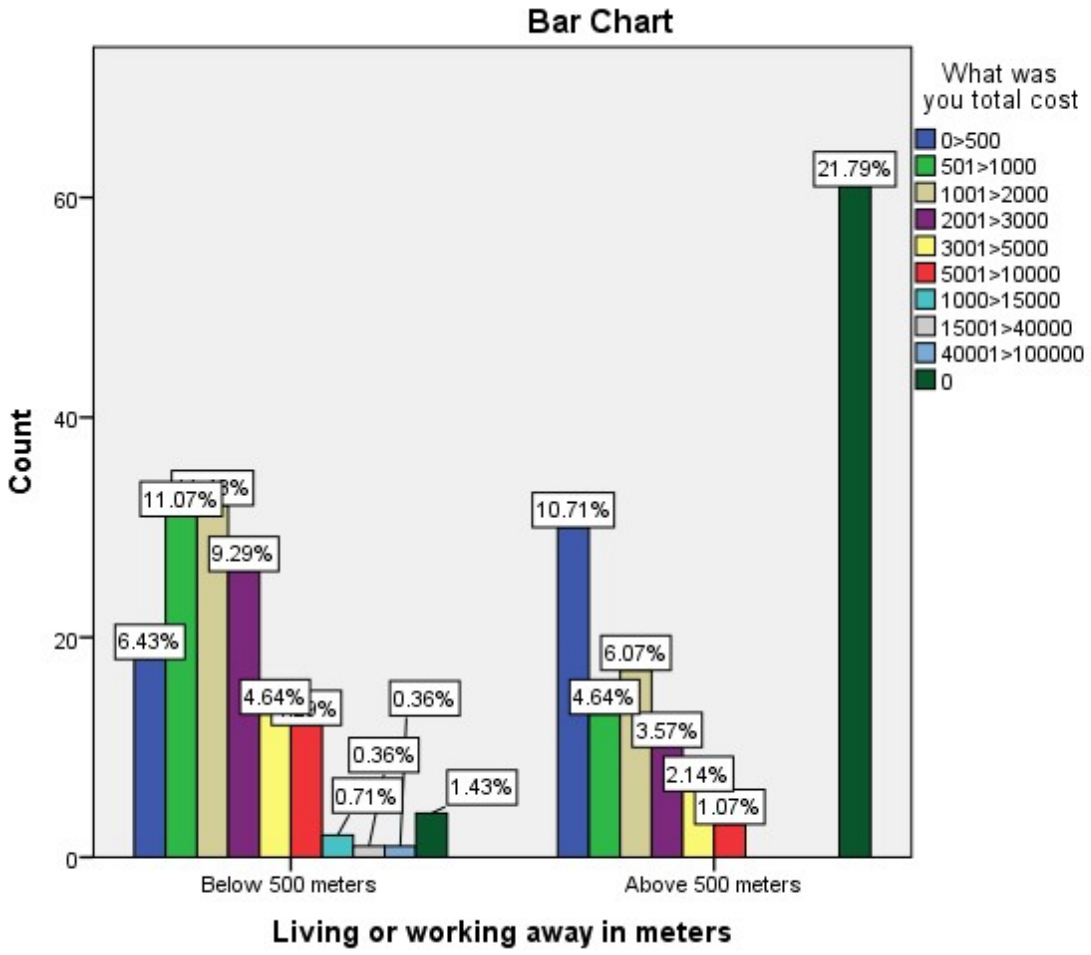

***Figure 7*:** Cross tabulation between Total cost and distance away from units in meters

The figure 7 shows the relationship between total cost and distance. The costs of the respondent who are living below 500 meters are high then those who are living beyond 500 meters. The relation between the total cost he or she paid for his treatment and distance is significant. The person chi-square value is 84, the value of df and sig is .000. Means that those who living or working adjacent to stone crushing units have high total cost than those who are beyond 500 meters.

5.4.6 Cross Tab between Total Cost and Reason is Stone Crushing

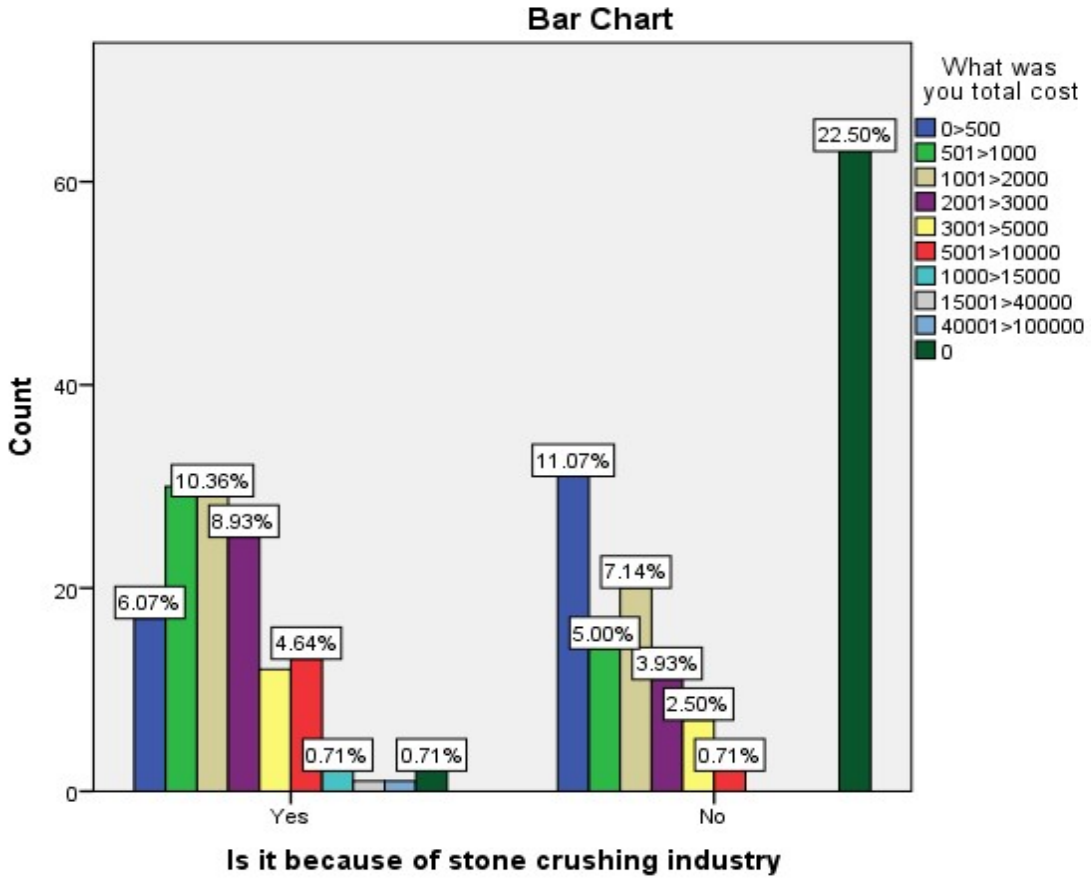

***Figure 8*:** Cross tabulation between total cost and due to stone crushing units

The figure 8 shows the relationship between what was total cost of his treatment and is all his expenses are because of stone crushing industry. Those who are agree that their all the expenses they paid are due to stone crushing industry are higher than those who are not agrees. The relationship between both variable is significant as we can see in the table. The chi square-value is 86.9 and degree of freedom is 9 while sig value is .000.

5.4.7 Cross Tabulation between water and distance

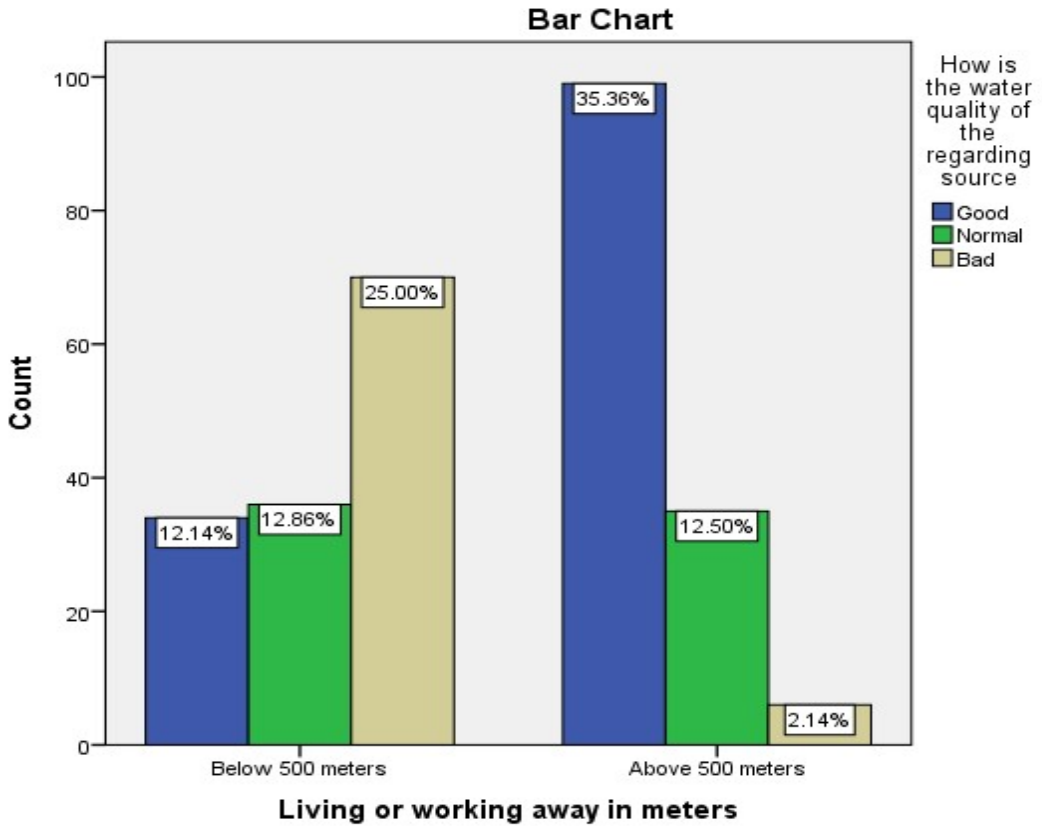

***Figure* 9:** Cross tabulation between water quality and living or working in meters

Figure 9 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.

5.4.8 Cross Tabulation between Water Quality and Water Related Diseases

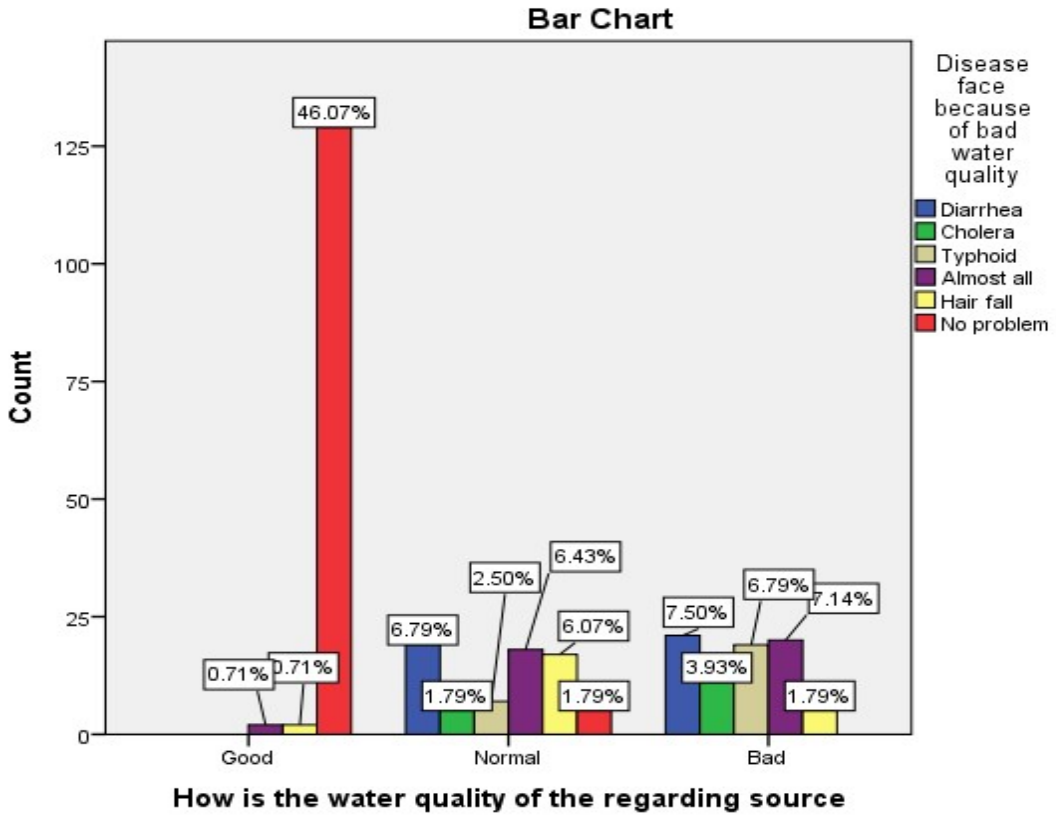

Figure 10: Cross tabulation between disease face water related disease and water quality

The figure 10 shows the relationship between water related diseases with water quality. The diseases can be seen in percentage on top of the bars. The relation between the water related diseases because of water quality are higher in normal and bad water than good water quality. The person chi-square value is 271.6; the degree of freedom value is 10 while the sig value .000. Those who have good water quality have low water related disease as compare with those have normal and bad water qualities.

5.5 Econometric analysis

To estimate the environmental pollution based health expenditure we use the propensity score matching technique. The data we collected from public including 140 respondents from

controlled and 140 respondents from uncontrolled population. This model will enable us that environmental pollution based health expenditure is higher in uncontrolled as compare with controlled group or not.

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)

Comparative analysis has been carried between stone crushing workers and non stone crushing workers under using chi square method. The result indicates on age income and dust pollution, number of diseases, symptoms and work days loss due to pollution are significant (Hafiza sadaf hafeez, 2018)

Table 21: 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

Interpretation

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.

5.6 Conclusion

The conclusion of the Descriptive analysis shows that stone crushing business provides raw material in the vicinity for infrastructure development. Our results are agrees with the previous studies results that stone crushing business have adverse impacts on the human health and surrounding environment. Similarly the study contribute the role the concern institution is very important to minimize the health hazards and environmental depletion. Previous study did not show the intervention the concern institution for monitoring their operations. Our study claimed that beside use of poor quality significantly the human health quality in terms of diagnosing water related diseases. Beside as no study has reported the empirical results. Present study Empirical results shows that stone the environmental pollution based health expenditures are higher in the people who are living close to stone crushing units than those who are living away at radius of influence.

Chapter 6

CONCLUSION AND POLICY RECOMENDATION

Study wind up 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. The spike in population demands for more infrastructure development. Due to limited resources stone crushing business also provide employment to the poor people and most of the poor people are working in this industry. Unemployment is also getting a big concern in developing countries due to speedy growth in population which force the people to work in unwilling industries and stone crushing industry is one in them. Due to poor approach and illiterate administration staff leads this industry for adverse human health impacts and for environment.

Stone crushing business is a small scale business which can be easy to install. In developing countries stone crushing business is main occupation in the hilly areas and the areas where rivers exists and operations are manually. Pakistan is one in developing countries where the stone crushing business practiced is carried out. Countries across the globe are depending on natural resources. Unnecessary use and overexploitation of natural resources will create concerns for human health and environment.

Although the 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. The prior responsibility comes on the owner to provide the safety measure to avoid such problems.

We reviewed the existing environmental and public health laws which is the first objective of this study. The study emphasizes that why and how the environmental public health laws can be enforced both at national and provincial level. Similarly the 2nd objective regarding how stone crush owner and worker at stone crushing unit responds to health concerns. Beside stone crushing workers the health of general population is also important and for environment as well. So the 3rd objective reveals about stone crushing industry impacts on human health and environment.

We discuss the first objective "Review the existing environmental and public health laws both at national and provincial level related to stone crushing business" in chapter 4. Similarly by the help of collecting data we accomplish our 2nd and 3rd objectives impacts of stone crushing business on human health and environment & how workers and owner responds to health problem at stone crush units. Descriptive analysis of the data and empirical evaluations are discussed 5th chapter.

Pulmonary test function has been performed on stone crush workers and the result were shows that due to dusty environment and absence of protective instruments the health of the of the workers are significantly lower the health of the normal south Indian male (Sivacoumar et al, 2006)

PM 10 and PM2.5 exceeds from the permissible level which leads to drop the air quality in vicinity. In result the surrounding people are exposed to different allergic problem such as skin

irritation and eye irritation etc. Similarly due to loud noise which is completely unbearable create disturbance for the surrounding peoples. Beside this the productivity of the surroundings are also effected (Chougule et al, 2017)

Previous studies mostly argue that health impact of the stone crushing unit is only limited to stone crush unit workers. Present study reveals that beside stone crush workers adjacent people are also directly expose to the pollution of stone crushing industry. People who are living 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. The result agrees with the previous studies that stone crushing industry have significant adverse impact human health it drop human health and will definitely drop the productivity.

Present study favor to the previous studies that due to loud and bearable noise 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 controlled population who is complained about other health problem while in the uncontrolled population there are 9.64% respondent who had other problems mostly they 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.

Assessment of the water quality is carried out on different site at Marmara Island in turkey. Post and after quarrying activities the quarrying activities were started from 2000 to 2013. They researcher concluded that natural stone water can be a source of contamination as a result of inadequate solid and liquid waste disposal (Ozcelik, 2016).

Previous studies reveal that beside health problems stone crushing industry have adverse impact on water quality as well. In this regard we asked different respondent about their water quality they use for drinking and cooking purposes. Our results agree with the previous study stone crushing industry have significant adverse impacts the water quality. Study also reveals that the water quality was not up to the mark in uncontrolled population as compare with the controlled population. Respondent of the uncontrolled population complained about bad water quality. They claimed that due to stone crushing activities at close range contaminate the water of the surrounding population. Limited studies are available to expose the diseases due to bad water quality. Result of present study also contributes that due to bad water quality people were complained about diseases like diarrhea and cholera etc.

Chi square test has been performed to carry out the comparative analysis between stone crushing workers and non stone crushing workers. Results shows that direct exposure to pollution there is a significant work days due illness was observed. High correlation is also observed that due to prolonged hour's consequently greater exposure to the dust particles. Comparatively the work day loss was noticed high in stone crushing unit workers then non stone crushing unit workers (Hafiza., 2018).

Primary data has been collected and medical record from the stone crush workers to monitor the the health of the stone crush workers in five quarries. ANOVA and least significant difference

has been performed to determine the results. Results were shows that Suspended Particulate Matter in the selected quarries were lies between 26.03±1.36mg/m3 and 11.03±1.52mg/m3. SPM levels declined significantly ($p>0.05$) with distance from the Drilling and crushing locations at each of the quarry sites. At 25metres away from the quarry sites, mean SPM Levels reduced drastically to 4.85±0.20mg/m3 and 3.67±0.40mg/m3.

Current study agrees with the previous study that stone crushing industry generate the particulate matter which creates big concern for the environment and human health. Moreover by the help of empirical analysis the environmental pollution based health expenditures of the respondent also increases. Through empirical analysis underperforming the propensity technique we analyzed that respondents from the uncontrolled population their environmental pollution based health cost is higher than the respondents in controlled population. As they are directly expose to the stone crushing units and are facing concern diseases. From the results we concluded that average treatment of the respondent 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. similarly the z-value also shows us the significance which stands on 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.

6.1 Policy recommendation

This study suggest some policies to the concern institutions

- Banning stone crushing industry is not the solution even stone crusher units owner admit that it degrade the environment and it have adverse health impacts on general public. 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.

- Provision of safe and clean working environment can increase the productivity of the labors. In the stone crushing unit it's a prior responsibility on the owner to provide the health to take care of their health. Beside this government intervention in terms of technology advancement in this regard to curb the pollutions.
- Proper wind barrier walls should be constructed and proper water sprinkling system should encourage curbing the eruption of the dust. Proper enclosure of machines and installing mist sprayers at different points will even more helpful in the reduction of air pollution. The importance of mist spraying can make a big difference.
- 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.

6.4 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. According to these limitations, future researcher should keep these issues into account for better performance and results.

2 References

Altaye, D. E., Karim, A. M., Betemariam, W., Zemichael, N. F., Shigute, T., & Scheelbeek, P. (2018). Effects of family conversation on health care practices in Ethiopia: a propensity score matched analysis. *BMC pregnancy and childbirth*, *18*(1), 43-52.

Brunekreef, B., & Holgate, S. T. (2002). Air pollution and health.

Caliendo, M., & Kopeinig, S. (2008). Some practical guidance for the implementation of propensity score matching. *Journal of economic surveys*, *22*(1), 31-72.

Chaturvedi, R. K., Prasad, S., Rana, S., Obaidullah, S. M., Pandey, V., & Singh, H. (2013).

Chougule, A. C., Chougule, P. A., & Kumbhoje, C. K. (2017). Effect of stone crusher on Khan,

Chauhan, I. S., & Chauhan, A. (1998). *Environmental Degradation: Socio-economic Consequences*.

Devlin, R. B. (2004). Particulate matter exposure in cars is associated with cardiovascular effects in healthy young men.

Effect of dust load on the leaf attributes of the tree species growing along the roadside. *Environmental monistoring and assessment*, *185*(1), 383-391.

Environmental guidelines for stone crushing units

Hafiza sadaf hafeez, (2018) Pakistan institute of development economics.

Huang, Y. C. T., & Ghio, A. J. (2006). Vascular effects of ambient pollutant particles and metals.

Ilyas, M., & Rasheed, F. (2010). Health and environment related issues in stone crushing in

Ibrahim, W. H. W., Marinie, E., Yunus, J., Asra, N., & Sukor, K. M. (2018, February). Air quality assessment on human well-being in the vicinity of quarry site.

Kampa, M., & Castanas, E. (2008). Human health effects of air pollution. *Environmental pollution*, *151*(2), 362-367.

Khan, M. W., Ali, Y., De Felice, F., Salman, A., & Petrillo, A. (2019). Impact of brick kilns industry on environment and human health in Pakistan. *Science of The Total Environment*, *678*, 383-389.

Kamal, A., Malik, R. N., Martellini, T., & Cincinelli, A. (2014). Cancer risk evaluation of brick kiln workers exposed to dust bound PAHs in Punjab province (Pakistan). *Science of the Total Environment*.

Kan, H. (2009). Environment and health in China: challenges and opportunities.

Khan, A. S. (20). *NEQS for Ambient Air.* islamabad: pak-EPA.

Landrigan, P. J., Schechter, C. B., Lipton, J. M., Fahs, M. C., & Schwartz, J. (2002). Environmental pollutants and disease in American children: estimates of morbidity, mortality, and costs for lead poisoning, asthma, cancer, and developmental disabilities. *Environmental health perspectives*, *110*(7), 721-728.

Das, M. (2014). A study on the implementation of legislative provisions for pollution control in the stone crushing industry of barak valley, Assam: A case study. *ZENITH International Journal of Multidisciplinary Research*, *4*(8), 95-104.

M. M., Nawaz, R., Ehsan, N., Ahmad, S., Nawaz, M. W., & Nawaz, M. H. Health Hazards and Socioeconomic Effects of Stone Crushing Industry on Its Workers: A Case Study of Sargodha, Pakistan.

Olusegun, O., Adeniyi, A., & Adeola, G. T. (2009). Impact of granite quarrying on the health of workers and nearby residents in Abeokuta Ogun State, Nigeria. *Ethiopian Journal of Environmental studies and management*,

Pakistan. *South Asia Network of Economic Research Institutes.*

Peter, C., Alozie, M. C., & Azubuine, C. E. (2018). Stone Quarrying Impact on Air Soil Water in Ebonyi State, Nigeria J Pollution Eff Cont.

Riediker, M., Cascio, W. E., Griggs, T. R., Herbst, M. C., Bromberg, P. A., Neas, L., ... &

Raizenne, M., Neas, L. M., Damokosh, A. I., Dockery, D. W., Spengler, J. D., Koutrakis, &

Sayara. T., Hamdan, Y., & Basheer-Salimia, R. (2016). Impact of Air Pollution from Quarrying and Stone Cutting Industries on Agriculture and Plant Biodiversity.

Sheikh, A., Rana, S. V. S., & Pal, A. (2011). Environmental health assessment of stone crushers in and around Jhansi, UP, India. *Journal of Ecophysiology and Occupational Health*, *11*(1-2), 107-115.

Semple, S., Green, D. A., McAlpine, G., Cowie, H., & Seaton, A. (2008). Exposure to particulate matter on an Indian stone-crushing site. *Occupational and environmental medicine*, *65*(5), 300-305.

Sivacoumar, R., Jayabalou, R., Swarnalatha, S., & Balakrishnan, K. (2006). Particulate matter from stone crushing industry: size distribution and health effects.

Speizer, F. E. (1996). Health effects of acid aerosols on North American children: pulmonary function.

Weerakkodya, A. P., Weerasingheb, T. K., Gamagea, N. S., Dilrukshib, R. P. P. M., & Weerasingheb, K. G. N. H. Effectiveness of Environmental Pollution Control Measure Implemented In Stone Crushing Sites Located At Kaduwela Municipality, Sri Lanka.

Annexure

Two different questionnaires for stone crushing unit owners and for general public can be seen below.

Stone crushing industry impacts on human health expenditures and environment: A case study of Malakand district

QUESTIONNAIRE

<table>
<tr><td>Questionnaire Number</td><td colspan="2">Gender</td><td colspan="2">Age</td></tr>
<tr><td></td><td>Male</td><td>Female</td><td colspan="2"></td></tr>
<tr><td>Level of education</td><td colspan="2"></td><td>Religion</td><td></td></tr>
<tr><td colspan="5">Any specific skill learned regarding to your job?
Answer: ……..?</td></tr>
<tr><td colspan="2">Marital</td><td>Number of family members</td><td colspan="2">Your monthly income ?</td></tr>
<tr><td>Married</td><td>Unmarried</td><td rowspan="2"></td><td colspan="2" rowspan="2"></td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="3">Question: In what kind of home you are living?
Answer: Clay made ◯ Concrete made ◯</td><td colspan="2">Residence
Rural | Urban</td></tr>
<tr><td colspan="5">Question: Do you have your own house or on monthly rent paying? If on lease then how much you are paying for it monthly?
Answer:</td></tr>
<tr><td colspan="5">What you use for going to industry or office (car, bicycle, local transport or any other source)? If yes then what is the monthly cost of the regarding source?
Answer:</td></tr>
<tr><td colspan="5">Question: Your kids are studying in private school or in public school?
Answer: (A) If they are in private school their monthly school fees plus transport fees etc ……?
(B) If they are in Government School their monthly school fees and transport fees etc..?</td></tr>
<tr><td rowspan="2">Other expenses</td><td>Telephone bills</td><td>Internet Bills</td><td>Electricity bills</td><td>TV bills</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>

Question from managers or owner

1) Number of workers …… 2) Type of plant ……..

3) Per day production …… 4) Truck sales per day……

5) Truck carrying capacity ……. 6) Per truck price……..

7) Knowledge about pollution Yes/No 8) Polluting environment Yes/No

9) Type of pollution creating ……. 10) what happens to human health when air quality reduce…….

…….…….....

11) Besides workers residents also effected…. 12) Is there any failure in any failures of EPA……

…… 13) Did they provides you SOPs Yes/No

14) What kinds of SOPs you following……15) Are you following them Yes/No

…… 16) PPI's following Yes/No

17) Type of PPI's you following……..

18) Green belt using Yes/No 17) Number of time EPA visit last month……

19) Ever they penalized you……. 20) Number of times EPA penalized you ……

21) On what violation …….. 22) Penalty you paid last month ……

23) Penalty you paid so far…….. 24) Charging penalty on different offence……

25) Method use for violation……..

26) Warned you or penalized on first violation……

27) Complains from the residents or restaurants……

28) Number of times they complaint about ……

29) Dispute happened with them Yes/No 30) Penalization was due lack of knowledge Yes/No

31) EPA taught you how to avoid the violation Yes/No

32) Complaint regarding EPA's ……..... 33) Ever paid environment tax……

34) Any accident happened Yes/No 35) Took him and bear him all his expenses Yes/No

36) The total cost you bearded for him .....

Stone crushing industry impacts on human health expenditures and environment: A case study of Malakand district

QUESTIONNAIRE

Questionnaire Number	Gender		Age	
	Male	Female		
Level of education			Religion	

Any specific skill learned regarding to your job?

Answer: ……..?

Marital		Number of family members	Your monthly income ?
Married	Unmarried		

Question: In what kind of home you are living?	Residence	
Answer: Clay made ◯ Concrete made ◯	Rural	Urban

Question: Do you have your own house or on monthly rent paying? If on lease then how much you are paying for it monthly?

Answer:

What you use for going to industry or office (car, bicycle, local transport or any other source)? If yes then what is the monthly cost of the regarding source?
Answer:

Question: Your kids are studying in private school or in public school?

Answer: (A) If they are in private school their monthly school fees plus transport fees etc ……?

(B) If they are in Government School their monthly school fees and transport fees etc..?

Other expenses	Telephone bills	Internet Bills	Electricity bills	TV bills

2) Whats your Occupation

Owner ◯ Manager ◯ Student ◯ Trader ◯ Farmer ◯ Housewife ◯

Teacher ◯ Worker ◯ Government employee ◯ Retire servant ◯ other ◯

3) Experience in months / years ☐

4) Job Criteria fulfillment Yes ◯ No ◯

5) Accommodates by company Yes ◯ No ◯

6) If stone crusher worker, joining reason

No other choice of employment ◯ other reason ◯

7) Use of personal protective instruments (PPE's) Yes ◯ No ◯

8) If yes then do you use the following PPE?

Use of gloves ◯ Use of mask ◯ Use of working dress ◯ Use if cover all ◯

Use of safety shoes ◯ Use of helmet working ◯ Practice Training in job ◯

9) Equipment maintenance Yes ◯ No ◯

10) Distance away from stone crushing unit (in meters) ☐

11) Stone crushing industry provide employment Yes ◯ No ◯

12) Any family worker working in stone crushing industry Yes ◯ No ◯

13) Knowledge about general pollution Air pollution ◯ Water pollution ◯

Soil pollution ◯ Noise pollution ◯ knew about all ◯ Don't know ◯

14) Stone crushing industry economic impacts on society Yes ◯ No ◯

15) Employment is necessary despite health is degrading Yes ◯ No ◯

16) Does environment pollute by stone crushing industry Yes ◯ No ◯

17) Disease because of water pollution Diarrhea ◯ Cholera ◯ Typhoid ◯

Almost all ◯ Don't know about any ◯

18) Stone crusher machine can damage human ears Yes ◯ No ◯

19) Which of the disease you faced last month? Asthma ◯ Respiratory problem ◯

Skin problem ◯ Eye irritation ◯ Stress and depression ◯ Almost all ◯ No problem ◯

20) Disease face most

Asthma ◯ Respiratory problem ◯ Skin problem ◯ Eye irritation ◯

Stress and depression ◯ Almost all ◯ No problem ◯

21) Is it because of stone crushing industry? Yes ◯ No ◯

22) Number of days you were ill in last month ☐

23) Days off because of illness ☐

24) Working performance after illness Worsen ◯ Poor ◯ Satisfactory ◯ As usual ◯

25) Type of treatment you followed for illness Rely on Self-medication ◯ Specific doctor ◯

26) If rely on self-medication what was your per day cost ☐

27) If visited to doctor what was the doctor fee? ☐

28) What doctor recommended you?

Only Medication ◯ laboratory tests ◯ Both ◯ Non ◯

29) What type of transport you were used for going to doctor

Personal transport ◯ Local transport ◯ Walking ◯

30) Was you hospitalized Yes ◯ No ◯

31) How many days you were hospitalized ☐

32) The hospital where you hospitalized was Government hospital ◯ Private ◯

33) Any care taker visited with you. If yes then who

Family member ◯ Friend ◯ Alone ◯

34) Expenses you paid for the care taker ☐

35) Your total cost was 1) 0……..500 ◯ 2) 500…….1000 ◯

3)1000…..2000 ◯ 4) 2000….3000 ◯ 5) 3000…..5000 ◯ 6) 5000….. 10000… ◯

36) Any death happened in your family last month Yes ◯ No ◯

37) Reason of his/her death was ……..?

38) Your water source for drinking and cooking Well ◯ Government Supply ◯ River ◯

39) How is the water quality Good ◯ Normal ◯ Bad ◯

40) If water quality is bad, which disease you faced last month

Diarrhea ◯ Cholera ◯ Typhoid ◯ Almost all ◯ Non ◯

41) If your water quality is normal or bad is it because of stone crushing industry

Yes ◯ No ◯

42) Your comments about stone crushing industry? Any Suggestion…

……

…….?

Thank you

Village Councils neighborhoods Councils List of district Malakand and Tehsil

S.No	Tehsil baizai	Neighborhoods	S.No	
1)	Ghari Hazrat Khel	(Thana)	42)	Qulangai
2)	Baba Khel/Ali Khel	(Thana)	43)	Loya Agra
3)	Dhanda	(Thana)	44)	Kama Agra
4)	Chapai maizara	(Thana)	45)	Inzergai
5)	Muslim Abad/Khadim Abad	(Thana)	46)	Khanorai
6)	Nul gunyar	(Thana)	47)	Dheri / Siai Patay
7)	Hibat Gram	(Thana)	48)	Totai
8)	Jalala	(Thana)	49)	Kot
9)	Bazid Khel	(Thana)	50)	Maina
10)	Palai Shakot	(Palai)	51)	Mungai
11)	Sher Khana/Zoor Mandai	(Palai)		Tehsil Dargai
12)	Bazdara Bala & Payeen	(Palai)	52)	Dargai patak jaban
13)	Khan Palo	(Aladhand)	53)	Village Dargai
14)	Said Abad	(Aladhand)	54)	Petaw
15)	Baro	(Aladhand)	55)	Qaldara
16	Cheshti Baba	(Aladhand)	56)	Khakai
17)	Fazal Abad	(Aladhand)	57)	Dargai Bazar
18	Amandara	(Aladhand)	58)	Dobandai
	Tehsil	Batkhela	59)	Wartair

	Neighborhoods		
19)	Bala Batkhela (Batkhela)	60)	Ghari Usman Khel
20	Pir Khusshal Baba (Batkhela)	61)	Anar Tangai
21)	New Batkhela (Batkhela)	62)	Sidra juwar
22)	Din Abad (Batkhela)	63)	Meherdai
23	Ibrahim Khel (Batkhela)	64)	Wazir Abad
24)	Maday Khel (Batkhela)	65)	Sharif Abad
25)pp	Saman Abad (Batkhela)	66)	Palaw Naw
26)	Akbar Abad (Batkhela)	67)	Narai Oba
27)	Maizara (Batkhela)	68)	Haryan Kot
28)	Noor Muhamma Khel (Batkhela)	69)	Purana Sakhakot
29)	Mucha Khel (Batkhela)	70)	Sakhakot Bazar
30)	Kotkay (Batkhela)	71)	Khan Garai
31)	Malakand (Malakand)	72)	Arab Dhanda
32)	Piran (Malakand)	73)	Ghwando Bala & Payeen
33)	Jalal Kot (Malakand)	74)	Kharkai Dherai
34)	Bara Atya Dheri	75)	Alifi kalay
35)	Koza Atya Dheri	76)	Latifi
36)	Julagram	77)	Ghani Dherai
37)	Mubark Khel	78)	Koper Khass
38)	Ismail Khel	79)	Muhammad Patai
39)	Matkanai	80)	Badraga
40)	Pirkhel	81)	Ghawar kalay

41)	Mekhband	82)	Khushal Garah

2.1 ENVIRONMENTAL PROTECTION AGENCY REGIONAL OFFICE SWAT

Current status of Crush Plants in District Malakand

S.No	Unit Name and Address of the Unit	Status of the Unit
1.	Adil Power Crush Plant, Pir Khail, Tehsil Batkhela, District Malakand.	EPO Issued
2.	Azan Crush Plant, Thana Bypass, District Malakand.	EPO Issued
3.	Azan Crush Plant, Trai, Tehsil Batkhela, District Malakand.	EPO Issued
4.	Bilal crush plant, pull choki, Tehsil Batkhela, District Malakand.	EPO Issued
5.	Fazal Builder Stone Crush Plant, Totakan, Tehsil Batkhela, District Malakand.	EPO Issued
6.	Foji Crush Plant, Pir Khail Tehsil Batkhela, District Malakand.	EPO Issued
7.	Friends Crush Plant, Jalawanan, District Malakand.	EPO Issued
8.	Gull Faraz Crush Plant, Pull Chocki, District Malakand.	EPO Issued

9.	**Hanif Crush Plant, Tehsil Batkhela, District Malakand.**	**EPO Issued**
10.	**Itehad Crush Plant, Pull Chocki, District Malakand.**	**Referred to EPT**
11.	**Madina Crush Plant, Pull Chocki, District Malakand.**	**EPO Issued**
12.	**Malakand Crush Plant, Thana Bypass, District Malakand.**	**EPO Issued**
13.	**MaShaAllah M-A-B Crush Plant, Pali, Tehsil Batkhela, District Malakand.**	**EPO Issued**
14.	**Master Crush Plant, Pali, Tehsil Batkhela, District Malakand.**	**EPO Issued**
15.	**New Fine Stone Crush Plant, Pali, Tehsil Batkhela, District Malakand.**	**EPO Issued**
16.	**New Khyber Crush Plant, Pali, Tehsil Batkhela, District Malakand.**	**EPO Issued**
17.	**Summer Crush Plant, Agra, Tehsil Batkhela, District Malakand.**	**EPO Issued**
18.	**Swat Crush Plant, Pull Chocki, District Malakand.**	**Referred to EPT**
19.	**Syed Bacha Crush Plant, Agra, Tehsil Batkhela, District Malakand.**	**EPO Issued**

20.	**Zaman Crush Plant, Trai, Tehsil Batkhela, District Malakand.**	**EPO Issued**

3 Interviews from workers managers and restaurant workers