ENVIRONMENTAL IMPACTS OF STANDARD OF LIVING: A CASE STUDY OF DISTRICT MARDAN, KHYBER PAKHTUNKHWA

BY

ASMA SAEED

M.Phil Environmental Economics

Session: 2012-14

SUPERVISED BY

DR. ANWAR HUSSAIN

Department of Environmental Economics

Pakistan Institute of Development Economics (PIDE)

Islamabad

Dedicated to my Parents, brother and sisters for whom I did it.

Acknowledgement

First of all my thanks and praises are for Allah Almighty, the most Merciful, the only Creator and the Beneficent who blessed me with thoughts, health, talented teachers and golden opportunity to complete my research in time from such a well reputed institution PIDE, Islamabad.

I would like to express my deepest gratitude to my Supervisor, Dr. Anwer Hussain, for his excellent guidance, caring, patience, and providing me with an excellent atmosphere for doing research. I would like to thank Dr. Rehana Siddiqui, Head of the department of Environmental Economics, who gave me fruitful ideas and supported my research. I would also like to thank Mehreen Zaid Ullah, Ph.D Scholar at PIDE who as a good friend was always willing to help and give her best suggestions in the fulfillment of this research. I am really very grateful to all my friends for their guidance, help and motivation.

I would also like to thank my parents, sisters, and sweet brother. They always supported me and encouraged me with their best wishes. My research would not have been possible without the help of my family and my supervisor.

TABLE OF CONTENTS Page No

CHAPTER NO 4 RESULTS AND DICUSSION

CHAPTER NO 5 CONCLUSION AND RECOMMENDATIONS

List of Tables **Page No**

List of Figures **Page No**

ABSTRACT

Household income plays an important role in the improvement of the standard of living. However as the standard of living of the household improves, it also causes environmental degradation. This study investigatesthe environmental impacts of living standard of the households in District Mardan. The impact of other factors such as household size, location of the household (urban or rural) and education of the households is also estimated. The study used primary data of 267 households collected through the questionnaire. The questionnaire consists of the information relevant to the households direct energy consumption and different socio-demographic information. The results are estimated through regression model. Findings show that household income is significant factor in increasing CO_2 emissions in District Mardan. A positive relationship is also found between household size, education and CO_2 emissions. Findings also reveal that EKC is valid in case of rural areas but not in urban areas because of the carbon intensive consumption activities of urban households. Hence an effective policy formulation stressing on public awareness programs, incentives of tax reductions, and better public transport network is conducive to the reduction of CO_2 emissions in the selected District.

CHAPTER 1
INTRODUCTION

1.1 Statement of the Problem

The standard of the living is the degree of wealth available to an individual or family with which they can satisfy their wants/consumption of goods and services necessary for well-being. There are many factors that influence the standard of living of an individual or family. Generally the standard of living is indicated by household's income level. The higher the income, the higher is the standard of living because people will be able to buy more goods and services (Perry, 2013).

Improvement in the standard of living always remained the priority of the governments. It is also well known fact that improvement in the standard of living of the people is associated with environmental concerns in various ways (Chik, Rahim, Radam, & Shamsudin, 2013). With the increase in the income of the people, the preferences for environmental quality also increase. But, with increase in income, the consumption of the people also increase which further causes environmental degradation. As income goes up, the usage of vehicles, refrigerators, air conditioners and other fuel items and electrical appliances increases, which ultimately adds to the carbon dioxide emission in the economy (Majid, Moeinzadeh, & Tifwa, 2014). Similarly, as the food expenditures increases, the solid wastes also tend to increase (Z.-H. Feng, Zou, & Wei, 2011) . The high standard of living that accompanies the increased production and consumption of goods is the major cause of pollution and environmental degradation.

The standard of living of Pakistanis has been significantly improved during the past years as claimed by the Pakistan Social and Living Standards Measurement (PSLM) survey (Kiani, 2005). This is also evident from the fact that the GDP per capita increased from US $631 in the year 2004 to US $1024 in the year 2010 (World Bank, 2014).

On the other hand the mean estimated annual cost of environmental and natural resource damage in Pakistan is about 365 billion Rs. per year or 6 percent of GDP. The highest cost is from inadequate water supply, sanitation and hygiene (Rs. 112 billion) followed by agricultural soil degradation (Rs. 70 billion) and indoor air pollution (Rs. 67 billion). Urban air pollution (particulate matter) adds another Rs. 65 billion. The estimated cost of lead exposure is about Rs. 45 billion. Rangeland degradation and deforestation cost are the lowest at about 7 billion Rs. in total (World Bank, 2006). Also, the per capita emissions have been increased from 0.84 metric tons per capita in the year 2004 to 0.93 metric tons per capita in the year 2010 (World Bank, 2014).

1.2 Study Area and Justification

District Mardan represent a typical district in Pakistan. Studying this District may give better generalization of situation in Pakistan. In 2013, about 98% of the households in district Mardan were using electricity for lighting without having much rural urban variation. The usage of gas/oil for lighting in rural and urban areas is 1% and 2% respectively. Similarly, the usage of gas as fuel in urban and rural areas of district Mardan during 2013 is 92% and 18% respectively while wood/charcoal usage was 7% and 56% respectively (Government of Pakistan, 2014). Apart from these selected items, the household are also using other sources of energy in their day to day life which may have environmental concerns. In Khyber Pakhtunkhwa the per capita consumption of gas in year 2010 was 1422 Cubic Meters but has grew to 2494 cubic meters in the year 2013 (Government of Khyber Pakhtunkhwa, 2014). In the year 2006-07, 65% of the household used gas/oil for cooking in urban areas of District Mardan (Government of Pakistan, 2007) while in the year 2012-13, it increased to 92% (Government of Pakistan, 2014). Similarly in rural areas, 9% of the household used gas/oil for cooking in the year 2006-07 (Government of Pakistan, 2007) , increasing to 18% in the year 2012-13 (Government of Pakistan, 2014) which definitely would have implication for environmental degradation alongside its positive impact. In District Mardan, the total population of registered motor vehicles was 115814 in the year 2012 (Government of Khyber Pakhtunkhwa, 2014) while this was 98576 in the year 2011 (Government of Khyber Pakhtunkhwa, 2012). Apart from these the population of the District also increased significantly over the years, which will also put pressure on the household consumption and will also be alarming for environmental degradation.

1.3 Research Questions

This study is designed to answer the questions;

1. Does standard of living degrade environment in rural-urban areas of District Mardan?
2. Does non-income factors influence carbon dioxide emissions in District Mardan?

1.4 Objectives of the Study

The main objectives of the study are the following:

1. To show the environmental impacts of the standard of living in rural and urban areas of district Mardan.
2. To estimate the impact of non-income factors on carbon dioxide emissions at household level in rural and urban areas of District Mardan.

1.5 Hypotheses of the Study

This study is based on the hypotheses that:

1. As income of the household increases, the CO_2 emissions also increase.
2. The non-income factors such as household size and urban location has a direct relationship with CO_2 emissions while rural location and the education have an inverse relationship with CO_2 emissions of the household.

1.6 Organization of the Study

The study is organized as follows:

The introduction of the study consisting statement of the problem, description of the study area, contribution of the present study, research questions, objectives and hypotheses is discussed in chapter 1. The relevant literature is reviewed in second 2. The data and methodology is given in chapter 3. Next to this is the discussion of estimation and results in chapter 4 while conclusion and recommendations is given in chapter 5.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter provides the review of previous studies regarding the environmental impacts of the standard of living, model used in the study, economic growth and environment. The environmental impact of energy consumption is also reviewed. This is given in the following section.

2.2 Review of Previous Studies

Looking over the past studies done, it is observed that most of the studies estimated the relationship between environmental degradation and economic growth and also, they estimated environmental Kuznets Curve in various parts of the world.

2.2.1 Studies on Standard Of Living and Environment

Lenzen, Jesper Munksgaard, and Smed (2000) estimated the environmental impacts of the household lifestyle and consumption. They followed the methodology of (Munksgaard, Pedersen, & Wien, 2000) to analyze the relationship between the variables. The household income, urbanization, age of the main income provider and type of the house were found to be strongly influencing factors of CO_2 emissions. While education, number of adult and number and age of children are found to be less important in explaining the household CO_2 emissions.

K. Feng, Hubacek, and Guan (2009) used the IPAT model to examine the impact of population, affluence and technology on CO_2 emissions for China. They found that growth in population, affluence and industrial development all have an important role in increasing CO_2 emissions. Their study also confirmed that affluence is the main factor that leads to an increasing level of CO_2 emissions.

Yan and Minjun (2009) estimated the impact of household consumption on CO2 emissions in rural and urban areas of China. Their estimation is based on household living expenditure data over the period 1995 to 2004 and input model. The findings showed that the increase in income and consumption caused an increase in per capita CO_2 emissions from 1995-2004. The results also showed that lifestyle change and household living expenditures are the important factors which contributes to higher CO_2 emissions in China.

Druckman and Jackson (2009) conducted a study which examines the carbon footprint of UK households. They carried out their analysis by using a quasi-multi-regional input-output (QMRIO) model and household expenditures data for the period 1990 to 2004. Their finding is that increasing lifestyle needs are important factors in increasing household CO_2 emissions.

Baiocchi, Minx, and Hubacek (2010) conducted a study on UK in which they studied the environmental impacts of social factors and consumer behavior. They used the regression approach, input output and geodemographic consumer segmentation data. The results showed that lifestyles and other sociodemographic variables are important in explaining carbon emissions associated to household's consumption.

Li and Wang (2010a) used a consumption approach to examine the nexus between income and household CO_2 emissions with reference to China's rural urban areas through a household survey data. They analyzed the household's lifestyle pattern and CO_2 emissions, the inequality of carbon in china and to estimate the income elasticity of individual CO_2 emissions. The results indicated that the inequality of carbon emissions is mainly caused by the income level. The education and age of the head of the household, family size and geographic are also the major factors that significantly affect the relationship between household income and CO_2 emissions. The family size negatively affects the relationship between household income and CO_2 emissions while the age and education positively affect them.

Zhuang, Jiang, and Zhao (2011) studied the household emissions with reference to Shijiazhuang city China. The life cycle assessment method is used to investigate the emissions and its influencing factors caused by the improvement in the standard of living and transportation. The IPAT model is also used for further investigation of the influencing factors of the household emissions. They concluded that household income is a significant factor in increasing the household CO_2 emissions. With the increase in income the usage of personal transportation is also increased which ultimately caused the household emissions. They also found that improvement in the technology leads to a reduction in emissions.

Chik et al. (2013) conducted a study which examines the environmental impacts of standard of living in rural urban areas of Malaysia. To analyze the impact of the household consumption CO_2 emissions results were estimated with hybrid input output model. According to their estimations a positive relationship exists between household income, consumption and CO_2 emissions. They also found that the impact of urban households on CO_2 emissions is higher than the rural households mainly because ease of access to the facilities such as good career opportunities and higher level of education in urban areas.

Irfany (2014) used the analysis of input output and the global trade analysis project environmental account to examine the environmental impacts of affluence from the household's perspective with reference to Indonesia. He used the regression model and the household expenditure survey over the period 2005-2009 to investigate the household CO_2 emissions and the factors leading to higher CO_2 emissions. The results of the study showed that the major factor contributing to higher CO_2 emissions is the increasing household expenditure level. The factors including large family size, urbanization, high level of education, female and older headed households also results in higher household CO_2 emissions.

2.2.2 Household Energy Consumption and Environmental Degradation

Zheng, Wang, Glaeser, and Kahn (2010b) investigated the environmental impacts of urbanization with reference to china. Using the household energy consumption and the relevant emissions factors data the results were estimated through regression model. The findings of their study revealed that increases in income and urbanization have a positive impact on household CO_2 emissions.

Gupta (2011) studied the environmental impacts of the standard of living and energy consumption with reference to Kolkata India. Using the online carbon calculator the results of the study showed that a middle income household in Kolkata has a carbon footprint almost equal to the world average, where as a high income household has a carbon footprint nearly half of that of an average US citizen and nearly equal to an average UK citizen.

Zhao and Cui (2013) analyzed the carbon footprint of household consumption with reference to Tianjin. The time frame of 2007 was taken. The household energy consumption data and input-output method was used for the estimation of the results. They find out that the major driver of the carbon footprint is the increased household energy consumption with the improving living standard and economic development both in urban and rural areas of Tianjin.

Kavi Kumar and Viswanathan (2013) studied the household pollution income relationship (local and global) for both urban and rural areas of India. The unit record data of fuel consumption for the period 2004-05 was used. The study comes to the conclusion that the EKC hypothesis is valid in case of rural households while a monotonically decreasing pollution income relation founded in case of urban households. They also concluded that global pollution is monotonically increasing among both urban and rural households.

Nair (2013) conducted a research in which he studied the carbon footprint of household for a small town Chhattisgarh, India. He used the carbon footprint calculator and the household energy data to carry out the estimations. The households were classified into two groups on the basis of their income high income group and lower income group. Three major usage of energy consumption were in their study namely electricity, liquefied petroleum gas (LPG) and transportation. The study comes to the conclusion that there is a positive relationship between income and household CO_2 emissions from all the sources of energy consumption.

Pachauri (2004) studied the variation in total energy requirements across households for India. He used regression analysis and household survey data for the period 1993-1994. The conclusion of the study showed that household income is a significant variable in explaining variation in energy across household. Apart from income, other variables such age of the head of the household and dwelling size are positively related while education of the head of the household and household size is negatively related to the requirement of energy of the household.

Barrett, Birch, Baiocchi, Minx, and Wiedmann (2006) studied the relationship between household energy consumption and environmental degradation for UK households. REAP model is used to investigate the environmental impacts of consumption. Regression model is also used to analyze the influencing factors of CO_2 emissions. They concluded that environmental degradation increases with the increase in household consumption. A positive and significant relationship is found between household's income, area of the household and CO_2 emissions. While higher level of education results in lowering households CO_2 emissions.

Druckman and Jackson (2008) analyzed the relationship between household energy consumption, associated carbon emissions and income with reference to UK. Their estimation based on local area resource analysis (LARA) model. They used household expenditures data over the period 2004-05.The conclusion of the study revealed that income is a significant factor in explaining the household energy consumption and the associated carbon emissions. The household composition, location of the household (rural or urban area), the type of dwelling and tenure are also important factors in explaining the emissions.

(Kerkhof, Nonhebel, & Moll, 2009) The environmental impact of household expenditure was investigated by carrying out the input-output analysis. The result of the study revealed that increasing household expenditure results in increasing environmental degradation.

Z.-H. Feng et al. (2011) conducted a study to investigate the nexus between household energy consumption and the related CO_2 emissions in rural urban areas of China. They used the grey model and secondary data for the period 2004 to 2008 to compare the pattern of energy consumption for urban rural households and the resulting differences in energy consumption and CO_2 emissions. It is revealed from the conclusion of the study that the urban households direct energy consumption is different from that of the rural households. In urban areas the direct energy consumption and CO_2 emissions are higher than the rural areas. The results further showed that the indirect energy consumption and the CO_2 emissions values of urban households are greater than the direct energy consumption.

Wu, Liu, and Tang (2012) conducted a study on the disregarded villages of Lijiang City, China which examines the impact of household energy consumption on environment. Their study is based on multiple linear regression model and primary data of sociodemographic variables. They estimated that household size, income, age and education significantly affect the energy consumption of the household and the related CO_2 emissions.

K. Feng, Hubacek, Sun, and Liu (2014) conducted a research which study the environmental impacts of consumption in the four major cities of china namely Beijing, Tianjin, Shanghai and Chongqing. A consumption based approach was used to investigate the major drivers of CO_2 emissions. According to their study the increase in consumption caused an increase in CO_2 emissions. Urbanization and the increase in income were confirmed as the major drivers of the increase in consumption and the related CO_2 emissions.

Majid et al. (2014) conducted a research which examines the households CO_2 emissions in rural urban areas of Iskandar Malaysia. They analyzed the relationship between income and emissions through collecting primary household's energy consumption data. A geo demographic segmentation was used to classify the households on the basis of their residential status. The results of the study demonstrates a strong correlation between income and and CO_2 emissions meaning that with the increase in households income their CO_2 also increased.

Kubota, Surahman, and Higashi (2014) conducted a study which examines the environmental impacts of household's energy consumption with reference to Indonesia. The study is based on primary survey data of the energy consumption and different household's characteristics. According to their study it was observed that the household income and family size are the two main contributors to higher energy consumption and their related carbon emissions.

2.2.3 Economic Growth and Environment at Global Level

The environmental impacts of North American Free Trade Agreement (NAFTA) were examined by employing regression analysis and random effect models in order to analyze the relationship between urban air pollution and economic growth. They concluded that economic growth results in increase pollution (Grossman & Krueger, 1991). The idea of environmental Kuznets curve was first presented by them.

Hung and Shaw (2004) conducted a study to investigate the relationship between income and pollution with reference to Taiwan. The panel data and a two-equation simultaneous model were used to estimate the existence of EKC hypothesis between per capita income and air pollution. The study showed that there is an inverted U-shaped relationship between them that confirmed the existence of EKC hypothesis between NO_2 and CO.

Kumar and Viswanathan (2004) conducted a research which study the household Environmental Kuznets Curve (EKC) for both urban and rural areas of India. They used the household expenditure data of major cooking fuels and household characteristics data for the year 1983, 1993 to 94 and 1999 to 2000. The cooking fuel is classified into two groups' dirty fuel and clean fuel. Regression model is applied for the estimation of the Engel curve for aggregate clean and dirty fuel. Further the relationship between income and pollution is also estimated to find the validity of EKC in their study. The results of the study showed that the EKC exists in rural areas of the study period while in urban areas the hypothesis exists only in 1980s.

Cialani (2007) estimated the environmental impacts of economic growth for Italy. The ordinary least square method, Index Decomposition Analysis (IDA) and secondary time series data over the period 1861-2002 were used to examine the existence of EKC. The conclusion of the study revealed that there is a positive relationship between economic growth and CO_2 emissions and the inverted U shape of EKC do not exist in case of Italy.

Vanneman (2008) studied the relationship between economic growth and environment at household level with reference to India. A dynamic optimization model and household data with directly measured indoor air quality was used for the estimation of the results. The conclusion of the study showed that the level of pollution decreases monotonically with the increase in the level of income.

Deluna Jr (2008) conducted a study on 43 Asian countries which examines the anthropogenic carbon dioxide emissions for the period 1980 to 2004. The study used the Dietz and Rosa's stochastic model (1997) and secondary time series data (1980-2004) to examine the environmental impacts of population, affluence and energy efficiency and to test the existence of EKC hypothesis. The conclusion of the study showed that the amount of carbon dioxide emissions increased with increases in population and GDP per capita, and decreased with increasing energy efficiency. The conclusion also revealed that EKC hypothesis is valid in the case of Asian economy.

Asafu-Adjaye (2008) investigate the relationship between economic growth and environmental quality for Pacific island countries for the first time. They used secondary time series data, graphical and polynomial regression models to estimate the existence of EKC between economic growth and pollution. The study comes to the conclusion that the EKC hypothesis exists in the case of Kiribati, New Caledonia, PNG, and the Solomon Islands while it does not exist in the case of Fiji and French Polynesia.

Omisakin (2009) conducted a study that examines the impact of economic growth on environmental quality with reference to Nigeria. He has the annual time series data for the period 1970-2005 to analyze the existence of EKC hypothesis. The study comes to the conclusion that there is no casual or long run relationship between them and also the hypothesis of EKC do not exists in case of Nigeria.

Ni, Lu, Lan, Gao, and Pan (2010) estimated the relationship between economic growth and environmental quality with reference to china was estimated using the EKC model and panel data (1989-2004). They concluded that there are four types of curve trend; upward, downward, EKC, and inverted EKC. Their results also showed that the indicators of surface water mostly support the EKC, while ambient air and near-shore water's indicators do not support it.

Shaw, Pang, Lin, and Hung (2010) investigated the relationship between economic development and air pollution (SO_2, NOX and TSP) with reference to mainland china. They used the simultaneity model and panel data (1992 to 2001) in order to examine the EKC hypothesis. The results of the study showed that EKC hypothesis confirmed by SO_2 and TSP while it do not confirmed in the case of NO_X.

U. F. Akpan and Chuku (2011) conducted the study which examines the impact of economic growth on environmental degradation for Nigeria. They used annual time series data (1960-2008) and autoregressive distributive lag model (ARDL) to estimate the existence of EKC hypothesis. They find out that the GDP per capita and CO_2 emissions relationship can be explained with N-shaped relationship and the Environmental Kuznets Curve do not exist in the case of Nigeria.

Ubaidillah (2011) estimated the relationship between carbon monoxide emissions, economic growth and number of vehicles for United Kingdom using time series model based on the model of (Dinda, 2004)and(De Bruyn, van den Bergh, & Opschoor, 1998). He used the time series data for the period 1970-2008. The conclusion of the study revealed that rise in income is significant and positive for increase in carbon monoxide emissions and results in shifting from buses towards passenger's cars due to improvements in the standard of living.

Cole, Elliott, and Zhang (2011) studied the relationship between economic growth and environmental degradation in terms of industrial pollution for China. They collected the data from 112 cities. The study covered the period 2001-2004. They analyzed six industrial water and air pollution indicators. Their findings revealed that with the increases in economic growth the environmental degradation also increases in terms of industrial water and air pollution indicators.

Odhiambo (2011) investigated the relationship between economic growth and CO_2 with specific reference to South Africa by using newly developed ARDL-Bounds test and annual time series data (1970-2007). The conclusion of the study revealed that there is a distinct unidirectional causal flow from economic growth to carbon emissions and energy consumption Granger-causes both carbon emissions and economic growth in South Africa.

Wu et al. (2012) analyzed the relationship between economic growth and environmental degradation at different income level through employing panel and non panel data approaches (1970-2008). The results of the study showed that there is no interaction between CO_2 emissions and income.

Shahiduzzaman and Alam (2012) conducted a research which study the environmental impacts of national income with reference to Australia. Auto regressive distributed lag (ARDL) model and time series data for the period 1961 to 2009 is used to investigate the long run relationship and the EKC between income and CO_2 emissions. They concluded that there is a long run relationship between CO_2 emissions and GDP. The study also confirmed that the hypothesis of the EKC is valid in case of Australia.

G. E. Akpan and Akpan (2012) investigated the environmental impacts of economic growth and electricity consumption with reference to Nigerian. The study used secondary time series data and the study was conducted for the period 1970-2008. A multivariate vector error correction model is used to analyze the long run and short run relationship between economic growth, electricity consumption and environmental degradation. The results confirmed the long run relationship between them. With the increase in real income the carbon emissions also increased during the long run. While a negative relationship found between electricity consumption and carbon emissions. The results also showed that the hypothesis of the environmental Kuznets curve (EKC) does not exists in Nigeria.

Omay (2013) studied the environmental impacts of income with specific reference to Turkey. She used the time series data over the period 1980 to 2007 and regression spline approach in order to examine the existence of EKC hypothesis. She concluded that an N-shaped relationship exists between economic growth and CO_2 emission that do not support the hypothesis of Environmental Kuznets Curve in Turkey.

Lu et al. (2013) conducted a study which examines the environmental impacts of energy consumption for Beijing China. The study is conducted for the period 1996 to 2010. The environmental impacts are studied in terms of the different energy consumption namely electricity, gas , oil and coal by the different sectors of the economy such as household, transportation, construction, industry, agriculture and service sector. The results showed that the major contributor of emissions caused by different energy sources is oil and coal. They also showed that industry is the most energy intensive sector which emits more emissions among the other sectors of the economy.

Das, Srinivasan, and Sharfuddin (2013) estimated the environmental impacts of growth in population and fuel consumption for the four countries United States , India, Japan and China. They used the panel data for the period 1970 to 2008 and fixed effect model for the estimation. The conclusion of the study revealed that the major contributor of CO_2 emission is the consumption of fuel in all of the four countries while the impact of population growth is less on emissions comparatively to fuel consumption.

Mrabet, Achairi, and Ellouze (2013) studied the impact of economic growth on CO_2 emissions with specific reference to Tunisian. They used the VAR model from the period 1980-2009 in order to analyze the two way relationship between them. The study concluded that there is a bidirectional relationship and CO_2 emissions increases monotonically with the increase in economic growth.

Bozdağlıoğlu and Çakır (2013) examined the environmental impacts of economic growth for Turkey by using annual data (1960 to 2011), the granger causality test and co-integration test approaches. The result of the study showed that environmental degradation decreases with the increase in economic growth. However it increases with further increases in economic growth. So the EKC hypothesis does not confirm for Turkey.

Uddin (2014) carried out a study in which they analyzed the long run relationship between economic growth and environmental degradation for SAARC countries. They used the time series data covering the period 1972 to 2012. Results were estimated with cointegration and vector error correction model. The results of the study confirmed a long run relationship between economic growth and CO_2 emissions.

Seriño and Klasen (2015) used the input out analysis and household expenditure data from the period 2000-2006 to estimate the household CO_2 emissions for Philippine. The results of the regression model showed a nonlinear relationship between income and CO_2 emissions. The other characteristics of the household such as female headed households, higher level of education and urbanization results in higher household CO_2 emissions. While the age of the household members and family size nonlinearly effect the CO_2 emissions.

2.2.4 Economic Growth and Environment With Reference To Pakistan

Chaudhuri and Pfaff (2002) conducted a research with reference to Pakistan. They examined the impact of economic growth on the environment through fuel use decisions of the household. The investigation is based on the Pakistan integrated household survey (PIHS) data and the household production model to analyze the relationship between indoor air pollution and income. The conclusion of the study revealed that there exist an inverted U-shaped relationship between indoor air pollution and income reflecting the Environmental Kuznets Curve (EKC).

Nasir and Rehman (2011) estimated the environmental Kuznets curve (EKC to analyze the relationship between carbon emissions, income, energy consumption and foreign trade with reference to Pakistan. They used time series data for the period 1972 to 2008. Results were estimated with the Johansen method of Co integration. The study comes to the conclusion that EKC exists in the long run but not in the short run in case of Pakistan. They also found a positive relationship between CO_2 emissions, energy consumption and foreign trade.

Ahmed and Long (2012) estimated the environmental Kuznets curve (EKC) to analyze the relationship between economic growth, pollution, trade liberalization and population density by using auto regressive distributive lag (ARDL) model and time series data over the period 1971-2008 with reference to Pakistan. They concluded that EKC is valid in both short run and long run for Pakistan. The relationship between pollution and economic growth was founded an inverted U-shaped while the contribution of trade to the environment is positive and that of the population is negative in Pakistan.

Shahid, Maryam, and RABBI (2014) assessed the long run relationship between environmental degradation and economic growth for Pakistan over the period 1972 to 2011. Their estimation based on the auto regressive distributive lag model (ARDL) to examine the existence of environmental Kuznets curve hypothesis (EKC). They find out that EKC hypothesis is valid in case of Pakistan.

Kaleem (2014) studied the environmental impacts of economic growth and energy consumption with reference to Pakistan. He used secondary time series data for the period 1972 to 2011, Autoregressive Distributed Lag (ARDL), Granger Causality and Error Correction Mechanism for the estimation of the results. The conclusion of the study revealed that energy consumption results in increasing both the economic growth and carbon dioxide emissions.

2.3 Summary of Previous Studies

The literature focused on the linkage of environmental degradation (carbon emissions) with economic growth, population increase and transportation. Further there are studies which investigate the economic growth and energy consumption from the household perspective. The literature also point out the studies which relates the environmental degradation with social factors, consumer behavior and consumption of the household.

2.4 Contribution of the Present Study

In the past attempts have been made to link environmental degradation (carbon dioxide emission) with economic growth. This study adds to literature through estimating the environmental impacts of the standard of living in rural urban areas using emissions factors and household level data in district Mardan.

CHAPTER 3

DATA AND METHODOLGY

3.1 Introduction

This chapter includes the theoretical background, sampling design, sample size and econometric model used to achieve the targeted objectives.

3.2 Theoretical Background

Economic growth is a broad discipline in literature and many theories explain its underpinnings. Kuznets (1955) analyzed the relationship between economic growth and income inequality and concluded that there exists an inverted U-shaped relationship between them. Grossman and Krueger (1991) examined the environmental impacts of North American Free Trade Agreement (NAFTA) in order to analyze the relationship between urban air pollution and economic growth. They found an inverted U-shaped relationship between economic growth and pollution. They realized resemblance of this U-shaped relationship to Kuznets's inverted U-shaped between income inequality and economic development, and named it as environmental Kuznets's curve (EKC). So the idea of environmental Kuznets curve was first presented by them.

Later on other studies have also discussed the relationship between pollution and economic development and come to the conclusion that there exists an inverted U-shaped relationship between them (Grossman & Krueger, 1994), (Shafik &

Bandyopadhyay, 1992) and (Panayotou, 1993). However all of this existing literature has largely presented the macro foundation of the EKC. (Andreoni & Levinson, 2001) and (Pfaff, Chaudhuri, & Nye, 2004) have provided the micro foundation of EKC for the first time in their studies. They argued that the inverted U-shaped relationship can also result at household level pollution. This study also evaluates the validity of EKC at household level.

This study used the following theoretical framework which is presented by (Andreoni & Levinson, 2001).

Consider an economy where there is only one person. Any solution will be Pareto efficient because the economy consists of one person and with one person there prevails no externality. The individual obtains utility from the consumption C of a private good and a bad pollution P. The preferences of the individual can be written as follows:

$$U = U(C, P) \qquad (3.1)$$

Where $U_c > 0$ and $U_p < 0$

It is also assumed that pollution is generated as a result of consumption. If the individual take an environmental effort and spend some resources on it, he can clean the pollution which is produces as a result of their consumption. The pollution can be written as follows:

$$P = P(C, E) \qquad (3.2)$$

The endowment M of resources is limited and can be spent on C and E. For simplicity it is assumed that that the cost of C and E equal to 1. Thus the resource constraint is $C + E = M$.

Let us take a simple example:

$$U = C - ZP \qquad (3.3)$$

$$P = C - C^{\alpha} E^{\beta} \qquad (3.4)$$

Utility is linear in C and P and Z > 0 is constant marginal disutility of pollution in equation 3 and pollution in equation 4 has two parts, the first part is C which present gross pollution before abatement and second term presents abatement.

Beginning with Z=1, Z here is the marginal disutility due to pollution.

Putting Z=1 in Equation 3.3 as follows:

$$U = C - (1)P$$

$$U = C - P \qquad (3.3)$$

Substituting Equation (3.4) into Equation (3.3):

$$U = C - C - C^{\alpha} E^{\beta}$$

$$U = C^{\alpha} E^{\beta}$$

Subject to

$$M = C + E$$

Setting the Langrangian expression:

$$L = C^{\alpha} E^{\beta} + \lambda (M - C - E)$$

$$L = C^{\alpha} E^{\beta} + \lambda(M - C - E)$$

$$\frac{\partial L}{\partial C} = \alpha C^{\alpha-1} E^{\beta} - \lambda = 0$$

$$\lambda = \alpha C^{\alpha-1} E^{\beta} \qquad \text{(A)}$$

$$\frac{\partial L}{\partial E} = \beta C^{\alpha} E^{\beta-1} - \lambda = 0$$

$$\lambda = \beta C^{\alpha} E^{\beta-1} \qquad \text{(B)}$$

$$\frac{\partial L}{\partial \lambda} = M - C - E = 0$$

$$M = C + E \qquad \text{(c)}$$

Dividing Equation (A) by Equation (B):

$$\frac{\lambda}{\lambda} = \frac{\alpha C^{\alpha-1} E^{\beta}}{\beta C^{\alpha} E^{\beta-1}}$$

$$1 = \frac{\alpha E}{\beta C}$$

By cross multiplication:

$$\beta C = \alpha E$$

$$E = \frac{\beta}{\alpha} C \quad \text{(D)}$$

$$C = \frac{\alpha}{\beta} E \quad \text{(E)}$$

Putting Equation (D) into constraint Function:

$$M = C + E$$

$$M = C + \frac{\beta}{\alpha} C$$

By taking L.C.M

$$M = \frac{\alpha C + \beta C}{\alpha}$$

$$M = \frac{C(\alpha + \beta)}{\alpha}$$

$$C^* = \frac{\alpha M}{\alpha + \beta}$$

Now putting Equation (E) into the constraint function:

$$M = C + E$$

$$M = \frac{\alpha}{\beta} E + E$$

By taking L.C.M

$$M = \frac{\alpha E + \beta E}{\beta}$$

$$M = \frac{E(\alpha + \beta)}{\beta}$$

$$E* = \frac{\beta}{\alpha + \beta} M$$

$$C* = \frac{\alpha}{\alpha + \beta} M \quad , \quad E* = \frac{\beta}{\alpha + \beta} M \qquad (3.5)$$

Substituting Equation (3.5) into Equation (3.4) the optimal quantity of pollution is obtained as follows:

$$P = C - C^{\alpha} E^{\beta}$$

$$P* = \frac{\alpha}{\alpha + \beta} M - (\frac{\alpha}{\alpha + \beta})^{\alpha} (\frac{\beta}{\alpha + \beta})^{\beta} M^{\alpha + \beta} \qquad (3.6)$$

The equation (3.6) specifies that if a + b > 1, the level of Pollution P* shows an inverted U-shaped function with respect to income M. If the income M is low, the level of consumption is low as well. Hence, the rising return of abatement means that the effect from abatement has small impact on the quality of environment. Consequently, one does not care to spend on abatement, and the level of pollution is rising with income. However, when M is high enough, an increased consumption causes the individual a lot of disutility from pollution. Consequent upon the increasing return, the abatement impact on the value of utility is greater.

Hence the individual has incentive to spend optimally spends more to abate. This makes pollution level decreasing per income.

The slop of the environmental Kuznets curve is obtained by taking the derivative of Equation (3.6) w.r.t M as follows:

$$\frac{\partial P*}{\partial M} = \frac{\alpha}{\alpha+\beta} - (\alpha+\beta)(\frac{\alpha}{\alpha+\beta})^{\alpha}(\frac{\beta}{\alpha+\beta})^{\beta} M^{\alpha+\beta-1} \quad (3.7)$$

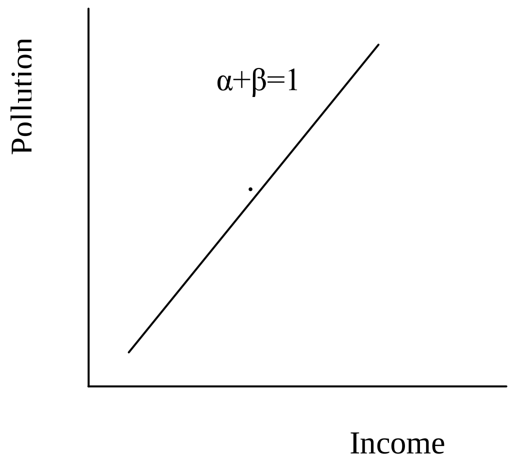
The sign of the slop depends on the parameters α and β. When α+β ≠ 1 the second derivative of Equation (3.6) is as follows:

$$\frac{\partial^2 P*}{\partial M^2} = -(\alpha+\beta-1)(\alpha+\beta)(\frac{\alpha}{\alpha+\beta})^{\alpha}(\frac{\beta}{\alpha+\beta})^{\beta} M^{\alpha+\beta-1-1}$$

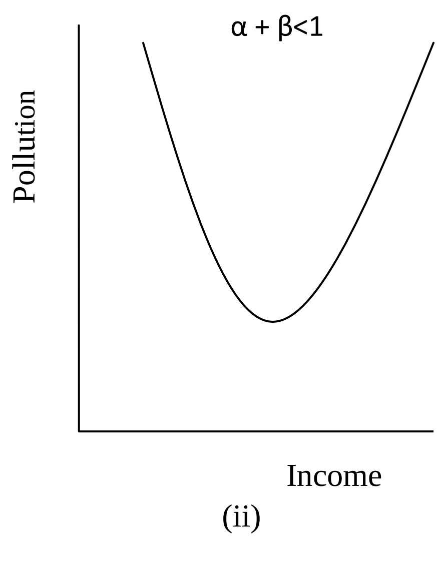
$$\frac{\partial^2 P*}{\partial M^2} = -(\alpha+\beta-1)(\alpha+\beta)(\frac{\alpha}{\alpha+\beta})^{\alpha}(\frac{\beta}{\alpha+\beta})^{\beta} M^{\alpha+\beta-2}$$

The possible shapes of the EKC are shown in the following figure:

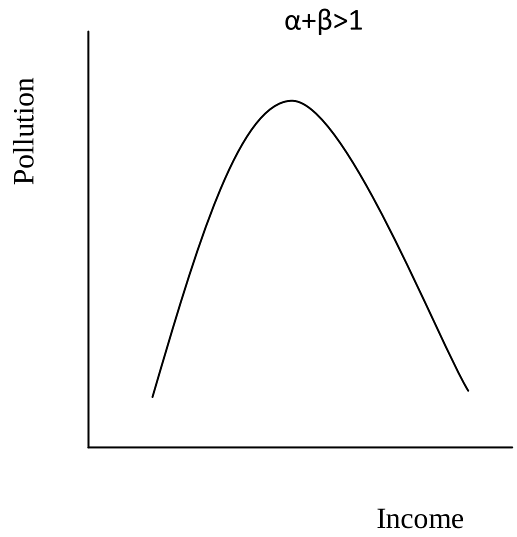
Figure: 3.1. The Possible Relationships between Income and Pollution



(i)



(ii)



(iii)

Where, α + β =1, α + β < 1 or α + β >1. α + β represents the increasing, decreasing and constant returns to scale with respect to abatement.

Hence the above foundation is utilized to estimate the effect of improvement in the standard of living of households on the environmental degradation in District Mardan.

3.3 Sampling Design

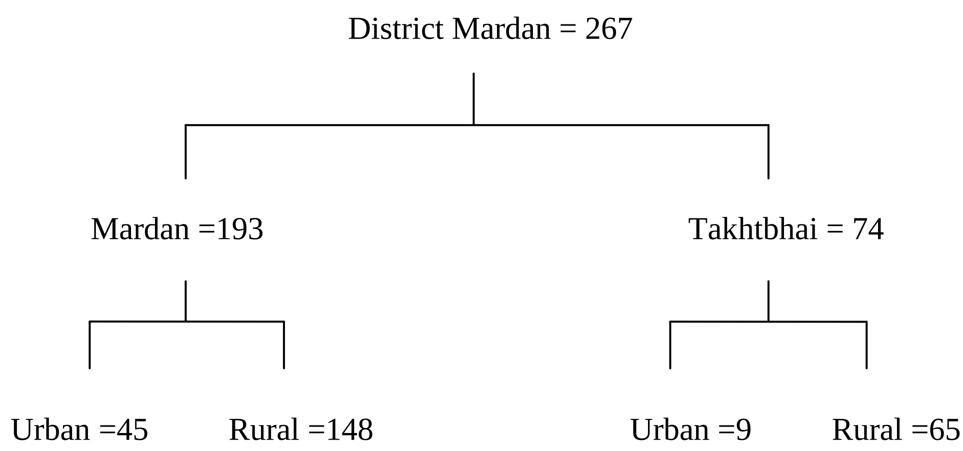
3.3.1 Nature of Data and its Collection

To assess the impact of the standard of living on the environment the present study is based on primary data and has been collected through the questionnaire (appendix-A). The questionnaire consists of the information relevant to the household's energy consumption in the form of electricity, natural gas, firewood, liquefied petroleum gas (LPG) cylinder, electrical appliances (refrigerators, freezers, air conditioners, air coolers, fans, washing machine, bulbs, energy savers, electric heater, geyser, iron, vaccume cleaner, television, desktop computer, laptop computer and microwave oven), fuel (petrol and compressed natural gas) used in personal vehicles (car and motorcycle), wastes produced by the household and the household characteristics including household income, family size, location (urban or rural) and education of the main income provider of the household. The survey was conducted during the months of November-January (2014-2015). The household has been selected by simple random sampling for getting information.

3.3.2 Sample Size and its Allocation

The total estimated number of the households in district Mardan during the year 2014 was 330544 (Government of Khyber Pakhtunkhwa, 2014). Keeping the confidence level as 95 percent and confidence interval at as ±6 percent, the required sample size calculated was 267 households. The sample has been proportionally allocated between two sub-districts namely, Mardan and Takhtabhai. Accordingly the sample size for each Tehsil is 193 and 74 households respectively which are given in the sample diagram as follows:

Figure: 3.2. The Sample Size Diagram



Further, the sample size for each Tehsil is allocated to rural and urban areas proportionally. Accordingly, the calculated sample size for urban and rural areas of Tehsil Mardan is 45 and 148 households, respectively. The sample for urban and rural areas of Tehsil Takhtabhai is 9 and 65 households respectively. The respondents in both rural and urban areas have been selected through simple random sampling.

3.4 Econometric Modeling

The study used household income as an indicator for the standard of living as proposed by (Government of New Zealand, 2007; OECD, 2013; Perry, 2013). Apart from income the other variables of interest included are the household size (number of the household members), the location of the household (whether the household is located in an urban area or rural area) and the education of the main income provider of the household (Buchs & Schnepf, 2013) and (Baiocchi et al., 2010), also used same explanatory variables for showing their impact on standard of living.

The household carbon emissions are computed by using emission factors (appendix-B) and household's energy consumption data. This procedure has also been used by (Zheng, Wang, Glaeser, & Kahn, 2010a) , (Zhao & Cui, 2013) and(Kavi Kumar & Viswanathan, 2013). The conversion formula is given as:

$$CO^{hh}{}_{2e} = \Sigma C_i * EF_i$$

Where

$CO^{hh}{}_{2e}$ = The household carbon dioxide emissions

C_i = The household consumption of the ith energy in the form of electricity, natural gas, firewood, liquefied petroleum gas (LPG) cylinder, electrical appliances (refrigerators, freezers, air conditioners, air coolers, fans, washing machine, bulbs, energy savers, electric heater, geyser, iron, vaccume cleaner, television, desktop computer, laptop computer and microwave oven), fuel (petrol and compressed natural gas) used in personal vehicles (car and motorcycle) and wastes produced by the household.

And

EF_i = The CO_2 emission factors of the ith energy

The emission factors for electricity, natural gas, waste, LPG, firewood and fuel (petrol and CNG) used in personal vehicles (car and motorcycle) with reference to Pakistan have been taken from (Carbon Neutral Company, 2014; DEFRA, 2012; Intergovernmental Panel on Climate Change's (IPCC's), 2006). Further the details of the formula for each category of the household's energy consumption are given in the (appendix-C).

The existence of EKC in a country always remained controversial. Apart from time series data, this should also be looked on basis of household level data. So, regression analysis has also been carried out to show the impact of household income (standard of living) and other socioeconomic and demographic factors as independent variables on carbon dioxide emissions estimated earlier as dependent variables (Buchs & Schnepf, 2013; Grunewald, Harteisen, Lay, Minx, & Renner, 2012a; Kavi Kumar & Viswanathan, 2013). To this end, the following model has been estimated:

$$\ln CO^{hh}{}_{2e} = \beta_0 + \beta_1 Y_h + \beta_2 {Y_h}^2 + \beta_3 HS + \beta_4 HS * Y_h + \beta_5 ED + \beta_6 ED * Y_h + \mu_i$$

Where $CO^{hh}{}_{2e}$ are the household CO_2 emissions in kg per month used as an indicator of the environmental degradation.

Y_h is the household income in rupees per month used as an indicator for household standard of living and its expected sign is positive as proposed by (Chik et al., 2013).

$Y^2{}_h$ is the squared term of the household income to estimate the existence of the environmental Kuznets curve (EKC) at household level. The expected sign of the squared term of the household income is negative as supported by (Grossman & Krueger, 1991) .

HS is the household size in number and its expected sign is positive as proposed by (Wu et al., 2012).

$HS * Y_h$ is the interaction term of the household size with household income. The expected sign of this is positive as proposed by (Grunewald, Harteisen, Lay, Minx, & Renner, 2012b).

ED is the number of years in education of the main income provider and its expected sign is negative as proposed by (Baiocchi et al., 2010).

$ED * Y_h$ is the interaction term of education of the main income provider with household income and the expected sign of this is negative as supported by (Grunewald et al., 2012b).

and μ_i is the error term.

Firstly the model is estimated for overall district Mardan and then estimated for rural and urban households of district Mardan separately.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter provides details about descriptive statistics of the dependent and independent variables, followed regression analysis. These are detailed in subsequent sections.

4.2 Region Wise CO_2 Emissions

There are two subs Tehsil in District Mardan namely Tehsil Mardan and Tehsil Takhtbhai. The average CO_2 emissions of rural and urban households and its influencing factors for both Tehsil Mardan and Tehsil Takhtbhai is also calculated which is discussed as follows:

4.2.1 Average CO_2 Emissions of the Households and Its Influencing Factors in Tehsil Mardan

The table 4.1 shows the average CO_2 emissions of the households and its influencing factors in Tehsil Mardan. In urban areas the usage of personal transportation has higher average CO_2 emissions. This is due to the fact that majority of the households have personal transportation facility in their homes. The firewood stands for higher CO_2 emissions in rural area mainly because of the households are depending on firewood for cooking activities. Similarly the LPG CO_2 emissions are greater in rural area than the urban area because of the low access of the supply system of Sui gas in rural areas. The average CO_2 emissions of waste in rural area is high than in urban area because of the large household size in rural areas followed by lower CO_2 emissions is from the Sui gas. In the electrical appliances the more polluting items are air conditioner, refrigerator and freezer. The usage of air conditioner, refrigerator and freezer results in higher average CO_2 emissions in urban areas and less in rural areas because of low consumption of these items by the rural households comparatively to urban households and also because of the carbon-intensive consumption activities of the urban households. While the lowest average CO_2 emissions is from the Sui gas both in urban and rural areas of Tehsil Mardan.

Tabel 4.1 Average CO_2 Emissions of the Households and Its Influencing Factors in Tehsil Mardan

	Unit	**Rural**	**Urban**
Monthly household Income	Rs.	45312.5	57761.644
Household size	Number	7.0	5.0
Education of the main income provider	Years	11.3	12.6
CO_2 Emissions of HH (kgs) per month			
Sui Gas	kg CO_2e	0.804	0.889
Firewood	kg CO_2e	209.083	1.392
LPG	kg CO_2e	15.390	5.871
Personal Transport	kg CO_2e	74.763	243.879
Waste	kg CO_2e	70.532	29.492
Electrical Appliances			
Fans	kg CO_2e	40.509	52.098
Air Conditioner	kg CO_2e	108.629	139.697
Air Cooler	kg CO_2e	22.167	20.019
Energy Saver	kg CO_2e	42.622	91.480
Bulb	kg CO_2e	36.508	25.437
Washing Machine	kg CO_2e	2.643	1.333
Refrigerator	kg CO_2e	90.971	120.405
Freezer	kg CO_2e	56.413	123.083
Television	kg CO_2e	21.454	14.763
Iron	kg CO_2e	9.835	10.488
Vacuum Cleaner	kg CO_2e	0.000	6.993
Geyser	kg CO_2e	65.271	75.528
Electric Heater	kg CO_2e	51.471	55.387
Computer	kg CO_2e	21.933	12.156
Laptop	kg CO_2e	8.695	12.110
Microwave oven	kg CO_2e	0.000	46.001

Source: Field Survey

4.2.2 Average CO_2 Emissions of the Households and Its Influencing Factors in Tehsil Takhtbhai

The table 4.2 shows the average CO_2 emissions of the households and its influencing factors in Tehsil Takhtbhai. The lowest CO_2 emissions are from the usage of Sui gas in both rural and urban areas of Tehsil Takhtbhai. The firewood and LPG emissions are higher in rural than in urban areas because of the low access of Sui gas to rural areas. The usage of personal transportation is more in urban area than in rural area. The average CO_2 emissions of waste in rural area is high than in urban area because of the large household size. In the electrical appliances the more polluting items are air conditioner, refrigerator and freezer. The usage of air conditioner, refrigerator and freezer results in higher average CO_2 emissions in urban areas and less in rural areas because of low consumption of these items in the rural areas comparatively to urban areas. Another reason is the carbon -intensive consumption pattern of the urban households.

Tabel 4.2Average CO_2 Emissions of the Households and Its Influencing Factors in Tehsil Takhtbhai

	Unit	Rural	Urban
Monthly household Income	Rs.	44884.615	77111.111
Household size	Number	5.953846	5.5555
Education of the main income provider	Years	12.038	11.111
CO_2 Emissions of HH (kgs) per month			
Sui Gas	kg CO_2e	0.576	0.611
Firewood	kg CO_2e	63.465	44.193
LPG	kg CO_2e	7.673	3.947
Personal Transport	kg CO_2e	61.919	76.770
Waste	kg CO_2e	67.886	59.883
Electrical Appliances			
Fans	kg CO_2e	34.573	35.627
Air Conditioner	kg CO_2e	0.000	103.595
Air Cooler	kg CO_2e	13.131	8.989
Energy Saver	kg CO_2e	45.339	56.170
Bulb	kg CO_2e	36.508	27.041
Washing Machine	kg CO_2e	2.252	3.012
Refrigerator	kg CO_2e	120.405	132.647
Freezer	kg CO_2e	0.000	112.826
Television	kg CO_2e	26.266	20.421
Iron	kg CO_2e	8.465	11.624
Vacuum Cleaner	kg CO_2e	0.000	0.000
Geyser	kg CO_2e	0.000	49.419
Electric Heater	kg CO_2e	27.973	54.393
Computer	kg CO_2e	22.921	20.886
Laptop	kg CO_2e	0.000	10.593
Microwave oven	kg CO_2e	0.000	0.000

Source: Field Survey

4.3 Regression Analysis of the Determinants of CO_2 Emissions in District Mardan

A Log-lin regression model is used to estimate CO_2 emissions resulting from the improvement of standard of living of the household. The regression is run for total, urban and rural households respectively. The estimated results for total households are presented in table 4.3 as below:

4.3.1 Impact of the Determinants of CO_2 Emissions in Overall Mardan

The coefficient of income is positive and significant depicting that with the

Tabel 4.3 Regression Results of the Determinants of CO_2 Emissions (Kg) in Overall Maradn

Dependent variable CO_2 (Kgs)				
	Coef.	**Std.Err**	**t-Statistics**	**P-values**
Income	0.0000177	0.00000478	3.70	0.000
Income^2	-0.0000000000211	0.00000000000868	-2.43	0.016
Household size	0.1304098	0.0274463	4.75	0.000
Income*Household size	-0.00000105	0.000000351	-3.01	0.003
Education	0.0261412	0.0139536	1.87	0.062
Income*Education	-0.000000401	0.000000189	-2.12	0.035
Constant	5.636288	0.3004329	18.76	0.000
R^2	0.1371			
F-Statistics	10.22			
Prob. F-Statistics	0.0000			

Note: *, **, *** 10%, 5% and 1% level of significance respectively.

increase in household income, CO_2 emissions increases. A one unit increase in income, increases CO_2 emissions by 0.0000177 percent. Income has a non-linear effect on CO_2 emissions as the coefficient of income squared term is negative and significant. This implies that an inverted U shaped relationship exist between CO_2 emissions and income at household level. This means that as household income increases, the household CO_2 emissions also increases, ultimately reaching a turning point where the household CO_2 emissions then start to decline with a further increase in household income. So our first hypothesis is accepted that as standard of living improves the environmental degradation increases. In addition the hypothesis of Environmental Kuznets curve also hold true at household level in district Mardan. The coefficient of household size is positive and significant. This means that larger household size also increases CO_2 emissions. An increase of one person in the household size increases the CO_2 emissions by 0.1304098 percent. The possible reason for this positive and significant relationship of the household size and amount of CO_2 emissions is that additional household member put pressure on energy consumption for lightening, cooking and heating purposes. This result is in line with the results of (Wu et al., 2012) but in contrast to the findings by (Li & Wang, 2010b) . The interaction term of income and household size is negative and significant showing that higher income with larger household size results in less emission. The education coefficient is positive and significant. This shows that if the main income provider of a household is educated then the household emits more CO_2 emissions. A one unit increase in education will increase CO_2 emissions by 0.0261412 percent. So there is a positive link between households education and households CO_2 emissions of the district Mardan households. This finding is in contrast to (Baiocchi et al., 2010) but in accordance to (Buchs & Schnepf, 2013) and (Seriño & Klasen, 2015). This positive link between education and household CO_2 emissions are due to the changes in the social status which are related with the attainment of education. As the households in District Mardan are getting more educated, they moved to a high social status and a more carbon intensive consumption pattern. Hence, the households with a higher educated main income provider are more likely to consume energy intensive goods. In this case, the argument that better educated households are more aware of the environmental issues is less apparent. The interaction term of income and education is negative and significant. A one unit increase in household income and education decreases household CO_2 emissions by -0.000000401 percent. It means that higher income with higher education contribute to fewer emissions. This result is supported by (Grunewald, Harteisen, Lay, Minx, & Renner, 2012c). The reason for this can be related to the fact that when people become wealthier they start to prefer clean environment and switch to less polluting energy consumption activities. Another reason for this may be that when both income and education level of the household's increases they tend to search for better energy sources. As a result the households CO_2 emission also decreases. This fact is also supported by the energy ladder model as explained by (Masera, Saatkamp, & Kammen, 2000). The value of R^2 is low due to using cross-section data which is always low as compared to time series regression models

(Lewis, 2012). However, the value of F-statistics favors the overall significance of the model.

4.3.2 Impact of the Determinants of CO_2 Emissions in Urban Areas in Mardan

To estimate the impact of income and other influencing factors of CO_2 emissions in urban areas, a separate regression is run for urban households of district Mardan. The estimated results for urban households are presented in table 4.4 as follows:

Table 4.4 Regression Results of the Determinants of CO_2 Emissions (Kg) in Urban Areas in Mardan

Dependent variable CO_2 (Kg)				
	Coef.	**Std.Err**	**t-Statistics**	**P-values**
Income	0.0000173	0.00000773	2.24	0.027
Income^2	0.00000000000193	0.0000000000213	0.09	0.928
Household size	0.120808	0.0477284	2.53	0.012
Income*Household size	-0.00000121	0.000000537	-2.26	0.025
Education	0.0472491	0.0241272	1.96	0.052
Income*Education	-0.000000688	0.000000383	-1.8	0.074
Constant	5.718356	0.441574	12.95	0.000
R^2	0.0825			
F-Statistics	2.73			
Prob. F-Statistics	0.0146			

Note: *, **, *** 10%, 5% and 1% level of significance respectively.

The estimation results for urban households show that the coefficient of income is positive and significant. This indicates that with the increase in household income in urban area CO_2 emissions also rises. A one unit increase in income of the urban households increases CO_2 emissions by 0.0000173 percent. The coefficient of income squared term is positive and insignificant. This shows that the inverted U shaped relationship does not exist between household income and household CO_2 emissions. This means that as the household income increases the household CO_2 emissions increases monotonically. So the hypothesis of Environmental Kuznets curve (EKC) does not hold true in urban areas of district Mardan. This result is in line with the result of (Kavi Kumar & Viswanathan, 2013) . The reason for this is that the urban households in district Mardan follow carbon intensive consumption activities. And this carbon intensive consumption activities has restricted the relationship between income and CO_2 emissions to the upward sloping segment of the EKC. The coefficient of household size is also positive and significant in urban areas showing that larger household size emit more CO_2 emissions. As the household size increase by one person the CO_2 emissions increases by 0.120808 percent. The interaction term of income and household size is also negative and significant in urban areas showing that higher income and larger household size contribute to less CO_2 emissions. Because as the household become wealthier they prefer a clean environment. A one unit increase in income and household size decreases CO_2 emissions by -0.00000121 percent. The coefficient of education in urban areas is positive and significant. This reflects a positive relationship between education and CO_2 emissions also in urban areas of district

Maradn. A one unit increase in education increases CO_2 emissions by 0.0472491 percent. The coefficient of interaction term of income and education is negative and significant in urban areas. A one unit increase in household income with education decreases household CO_2 emissions by -0.000000688 percent. The value of F-statistics favors the overall significance of the model. The value of R^2 is low due to using cross-section data which is always low as compared to time series regression models (Lewis, 2012).

4.3.3 Impact of the Determinants of CO_2 Emissions in Rural Areas in Mardan

To estimate the impact of income and other influencing factors of CO_2 emissions in rural areas, a separate regression is run for rural households of district Mardan. The estimated results for rural households are given in table 4.5 as follows:

Table 4.5 Regression Results of the Determinants of CO_2 Emissions (Kg) in Rural Areas in Mardan.

Dependent variable CO_2 (Kg)				
	Coef.	**Std.Err**	**t-Statistics**	**P-values**
Income	0.0000152	0.00000682	2.22	0.027
Income^2	-0.0000000000357	0.0000000000113	-3.17	0.002
Household size	0.1278079	0.0339542	3.76	0.000
Income*Household size	-0.00000081	0.000000474	-1.71	0.089
Education	0.000293	0.015955	0.02	0.985
Income*Education	-0.0000000973	0.000000231	-0.42	0.673
Constant	5.803158	0.358966	16.17	0.000
R^2	0.1822			
F-Statistics	7.65			
Prob. F-Statistics	0.0000			

Note: *, **, *** 10%, 5% and 1% level of significance respectively

The estimation results for rural households show that the income coefficient is positive and significant depicting that with the increase in income CO_2 emission also increases. A one unit increase in income increase CO_2 by 0.0000152 percent. There is a non linear effect of income on CO_2 emissions in rural areas of district Mardan as the coefficient of income squared term is negative and significant. This shows that there exists an inverted U shaped relationship between income and CO_2 emissions. This means the EKC exists in rural areas of district Mardan. The coefficient of household size in rural areas is also positive and significant. Increase in the household size by one person increase the CO_2 emissions by

0.1278079 percent. The interaction term of income and household size has a negative and significant coefficient showing that higher income and household size contribute to less emission. The coefficient of education is positive and insignificant in rural areas. A one unit increase in education increases the CO_2 emissions by 0.000293 percent which is a smaller quantity comparatively to urban households' education coefficient. The coefficient of the interaction term of income and education is negative and insignificant. One unit increase in income and education decreases the CO_2 emissions by -0.0000000973. Both education and the interaction term of income and education are insignificant showing that the education level of rural households is not high so the resulting social status is also not high which is associated to a high level of education. As the social status of the rural household is not high so their consumption pattern is also less energy intensive. And this contributes to less CO_2 emissions. This means that the contribution of education to emissions is very small in rural areas of district Mardan. The value of R^2 is small due to using cross-section data which is always low as compared to time series regression models (Lewis, 2012). However, the value of F-statistics favors the overall significance of the model.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter provides major findings, conclusion, recommendations, limitations of the study and suggestions for the future research. These are detailed in subsequent section.

5.2 Major Findings of the Study

The descriptive statistics is calculated for urban and rural households of both Tehsil Maradn and Tehsil Takhtbhai. The results of the descriptive statistics for Tehsil Mardan showed that average monthly income of urban households is Rs. 57761.644 while that of rural households is Rs. 45312.5 showing that average income of urban households is higher than rural households. Average household size of rural households is 7 members which is more than urban households. The descriptive statistics of Tehsil Takhtbhai revealed that average income of urban and rural households is Rs. 77111.111 and Rs. 44884.615 respectively. The average household size in both urban and rural household is 5 members. While average level of education of the main income provider is 12 years of education. Log-lin regression model is used for the estimation of the results. Regression results of the study revealed that the coefficient of income is 0.0000177 which is positive and significant at 1% level of significance. The coefficient of squared term of income is -0.0000000000211 and significant at 10% and 5% level of significance. The coefficient of squared term of income is negative which is in accordance to the theory showing that the environmental Kuznets curve is valid in case of district Mardan. The coefficient of the household size is 0.1304098 which is significant at 1% level of significance. This shows that there is a positive link between the number of the household members and CO_2 emissions. While the coefficient of the interaction term of income with household size is -0.00000105 and significant at 1% level of significance. This negative coefficient of the interaction term of income with household size shows that higher income with larger household size results in lower emissions. The coefficient of education is 0.0261412 which is positive and significant at 10% level of significance meaning that the household with educated main income provider results in more CO_2 emissions. While the coefficient of the interaction term of income with education is -0.000000401 which is negative and significant at 5% and 10% level of significance. It means that higher income with higher education results in less emission.

In urban areas the coefficient of income 0.0000173 which is positive and significant at 10% and 5% level of significance. While the coefficient of the squared term of income is 0.00000000000193 which is a positive and insignificant at all level of statistical significance showing that the hypotheses of the environmental Kuznets curve is not valid in urban areas of district Mardan. The coefficient of household size is 0.120808 and significant al 10% and 5% level of significance showing that household size positively affect CO_2 emissions. The coefficient of the interaction term of income with household size is -0.00000121 which is negative and significant at 10% and 5% level of significance. The coefficient of education is 0.0472491 and significant at 10% level of significance. The coefficient of the interaction term of income with education is -0.000000688 which is negative and significant at 10% level of significance.

In rural areas the coefficient of income 0.0000152 which is positive and significant 10% and 5% level of significance. While the coefficient of the square term of income is -0.0000000000357 which is negative and significant at 1% level of significance. This confirms the validation of the environmental Kuznets curve in rural areas. The coefficient of the household size is 0.1278079 and significant at all level of statistical significance. The coefficient of the interaction term of income with household size is -0.00000081 which is negative and significant at 10% level of significance. The coefficient of the education is 0.000293 which is positive but insignificant even at 10% level of significance. Similarly the coefficient of the interaction of income with education is -0.0000000973 which is negative and insignificant even at 10% level of significance.

5.3 Conclusion

The main objective of the study is to analyze the environmental impacts of the household standard of living in rural urban areas in District Mardan. The household income is used as an indicator for the standard of living. The influencing factors of household CO_2 emissions other than household income are also investigated. While the CO_2 emissions are estimated on the basis of household consumption activities. Log-lin multiple regression model was used for the estimation. First the model is run for the whole district Mardan irrespective of urban and rural households. After then the model is run for urban and rural households separately. The problems of multicollinearity and heteroskedasticity are also checked and removed prior to the final estimation results. Results of the first model showed that environmental degradation increases with improvement of the standard of living. As the household income increases it increases the different household consumption activities which ultimately increase the household emissions. The other influencing factors of the household emissions are household size and the level of education. Both household size and education positively and significantly affect the CO_2 emissions showing that with the increase in household size and education the CO_2 emissions also increase. The results also showed that the environmental Kuznets curve exists in district Mardan.

The results also showed that the EKC is valid in rural areas but not in urban areas.

The household income played an important role in increasing the CO_2 emissions both in rural and urban areas of district Mardan. The factors, other than household income, such as household size and the level of education positively and significantly affect the CO_2 emissions in urban areas. An increase in household size leads to an increase in household consumption activities which results in high emissions. Similarly high level of education means high social status which results in carbon intensive consumption activities.

In rural areas all the factors affect the CO_2 emissions in the same way as that in urban areas except the education. The level of education and its interaction term insignificantly affect the CO_2 emissions. This means that education does not play an important role in increasing the rural CO_2 emissions.

5.4 Recommendations

Improvement in the standard of living is a major factor of environmental degradation in district Mardan. So moving towards a sustainable standard of living will be helpful to control its environmental impacts. Therefore the government should take such measures that on one side, these lead to significant energy savings by the household sector and on the other, also increase awareness without affecting their comfort level. These measures include:

1. Consumers should be given incentive for choosing energy saving goods and services. These incentives can be given in the form of tax reductions for rewarding them to save the energy.
2. The government should strengthen and improve the public transport network to enhance the usage of Public transport. In this way the usage of personal transportation can be discouraged which will be helpful in controlling CO_2 emission.

5.5 Limitations of the Study and Future Research

The present study estimated the environmental impacts of the standard of living in terms of the carbon dioxide emissions. As the carbon dioxide emissions are estimated from the direct sources of household energy consumption activities. So the study is based only on direct carbon dioxide emissions ignoring the indirect carbon dioxide emissions, i.e. indirect emissions are those emissions which are related with the manufacture of goods for households such as furniture, food, clothes, services etc. Secondly the study is conducted only for 267 households in one district of Khyber Pakhtunkhwa province mainly because of the time and data constraints. Future research can be done by taking into account also the indirect carbon dioxide emissions of the household consumption activities as a result of improvement of the standard of living. Further the research can be conducted for large sample size in other districts of Khyber Pakhtukhwa and also for the other provinces of Pakistan.

REFERENCES

Ahmed, K., & Long, W. (2012). Environmental Kuznets Curve and Pakistan: An Empirical Analysis. *Procedia Economics and Finance, 1*, 4-13.

Akpan, G. E., & Akpan, U. F. (2012). Electricity Consumption, Carbon Emissions and Economic Growth in Nigeria. *International Journal of Energy Economics and Policy, 2*(4), 292-306.

Akpan, U. F., & Chuku, A. (2011). Economic Growth and Environmental Degradation in Nigeria: Beyond the Environmental Kuznets Curve, *news*.

Andreoni, J., & Levinson, A. (2001). The Simple Analytics of the Environmental Kuznets Curve. *Journal of public economics, 80*(2), 269-286.

Asafu-Adjaye, J. (2008). Environmental Quality and Economic Growth: The Case of Pacific Island Countries. *South Pacific Studies, 29*(1), 43-62.

Baiocchi, G., Minx, J., & Hubacek, K. (2010). The Impact of Social Factors and Consumer Behavior on Carbon Dioxide Emissions in the United Kingdom. *Journal of Industrial Ecology, 14*(1), 50-72.

Barrett, J., Birch, R., Baiocchi, G., Minx, J., & Wiedmann, T. (2006). *Environmental Impacts of UK Consumption: Exploring Links To Wealth, Inequality And Lifestyle.* Paper presented at the IABSE Henderson Colloquium, Cambridge.

Bozdağlıoğlu, E. Y., & Çakır, M. (2013). Economic Growth and Environmental Quality in Turkey: Are they Opposite Concepts? *International Journal of Economics and Finance Studies, 5*(1), 85-95.

Buchs, M., & Schnepf, S. V. (2013). UK Households' Carbon Footprint: A Comparison of the Association between Household Characteristics and Emissions from Home Energy, Transport and other Goods and Services.

Carbon Neutral Company. (2014). The Carbon Neutral Company Calculation Methodology for the Carbon Calculator.

Chaudhuri, S., & Pfaff, A. S. (2002). Economic Growth and the Environment: What Can We Learn from Household Data? *Columbia University, February*.

Chik, N. A., Rahim, K. A., Radam, A., & Shamsudin, M. N. (2013). Co2 Emissions Induced By Households Lifestyle in Malaysia. *International Journal of Business & Society, 14*(3).

Cialani, C. (2007). Economic Growth and Environmental Quality: An Econometric and a Decomposition Analysis. *Management of Environmental Quality: An International Journal, 18*(5), 568-577.

Cole, M. A., Elliott, R. J., & Zhang, J. (2011). Growth, Foreign Direct Investment, and the Environment: Evidence from Chinese Cities. *Journal of Regional Science, 51*(1), 121-138.

Das, D., Srinivasan, R., & Sharfuddin, A. (2013). Carbon Dioxide Emission by Major Fuel Consuming Countries: A Panel Data Analysis. *International Journal of Energy Science, 3*(3), 148-155.

De Bruyn, S. M., van den Bergh, J. C., & Opschoor, J. B. (1998). Economic Growth and Emissions: Reconsidering the Empirical Basis of Environmental Kuznets Curves. *Ecological Economics, 25*(2), 161-175.

DEFRA. (2012). *Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting*.

Deluna Jr, R. (2008). Anthropogenic Carbon Dioxide Emmision in Asia: Effect of Population, Affluence and Energy Effeciency.

Dinda, S. (2004). Environmental Kuznets Curve Hypothesis: A Survey. *Ecological economics, 49*(4), 431-455.

Druckman, A., & Jackson, T. (2008). Household Energy Consumption in the UK: A Highly Geographically and Socio-Economically Disaggregated Model. *Energy policy, 36*(8), 3177-3192.

Druckman, A., & Jackson, T. (2009). The Carbon Footprint of UK Households 1990–2004: A Socio-Economically Disaggregated, Quasi-Multi-Regional Input–Output Model. *Ecological economics, 68*(7), 2066-2077.

Feng, K., Hubacek, K., & Guan, D. (2009). Lifestyles, Technology and CO2 Emissions in China: A Regional Comparative Analysis. *Ecological Economics, 69*(1), 145-154.

Feng, K., Hubacek, K., Sun, L., & Liu, Z. (2014). Consumption-Based CO2 Accounting of China's Megacities: The Case Of Beijing, Tianjin, Shanghai And Chongqing. *Ecological Indicators, 47*, 26-31.

Feng, Z.-H., Zou, L.-L., & Wei, Y.-M. (2011). The Impact of Household Consumption on Energy Use and CO2 Emissions in China. *Energy, 36*(1), 656-670.

Government of Khyber Pakhtunkhwa. (2012). *Development Statistics of Khyber Pakhtunkhwa*. Peshawar.

Government of Khyber Pakhtunkhwa. (2014). *Development Statistics of Khyber Pakhtunkhwa 2014*. Peshawar.

Government of New Zealand. (2007). *Qulaity of life in twelve of new zealand's cities.* New Zealand,.

Government of Pakistan. (2007). *Pakistan Social and Living Standard Measurement (PSLM) Survey 2006-2007*. Islamabad.

Government of Pakistan. (2014). *Pakistan Social and Living Standard Measurement (PSLM) Survey 2013-2014*. Islamabad.

Grossman, G. M., & Krueger, A. B. (1991). Environmental Impacts of a North American Free Trade Agreement: National Bureau of Economic Research.

Grossman, G. M., & Krueger, A. B. (1994). Economic Growth and the Environment: National Bureau of Economic Research.

Grunewald, N., Harteisen, M., Lay, J., Minx, J., & Renner, S. (2012a). *The carbon footprint of Indian households.* Paper presented at the 32nd General Conference of the International Association for Research in Income and Wealth Boston, USA.

Grunewald, N., Harteisen, M., Lay, J., Minx, J., & Renner, S. (2012b). *The Carbon Footprint of Indian Households.* Paper presented at the the 32nd General Conference of The International Association for Research in Income and Wealth, Boston, USA.

Grunewald, N., Harteisen, M., Lay, J., Minx, J., & Renner, S. (2012c). *The Carbon Footprint of Indian Households.* Paper presented at the IARIW 32nd General Conference, Boston, USA, August.

Gupta, M. D. (2011). *Impact of Lifestyle Pattern on Energy Consumption and Carbon Emissions–A View from India*. Paper presented at the Jordan International Energy Conference 2011- Amman.

Hung, M.-F., & Shaw, D. (2004). 13. Economic Growth and the Environmental Kuznets Curve in Taiwan: A Simultaneity Model Analysis. *Human Capital, Trade, and Public Policy in Rapidly Growing Economies: From Theory to Empirics, 269*.

Intergovernmental Panel on Climate Change's (IPCC's). (2006). Guidlines for National Greenhouse Gas Inventories (intergovernmental Panel on Climate Change.

Irfany, M. I. (2014). Affluence and Emission Trade-Offs: Evidence from Indonesian Household Carbon Footprint: Courant Research Centre: Poverty, Equity and Growth-Discussion Papers.

Kaleem, S. A. (2014). *Relationship Between Econnomic Growth,Energy and Emissions: A Case Study of Pakistan.* MPhil, Pakistan Institute of Development Economics,Islamabad,Pakistan.

Kavi Kumar, K., & Viswanathan, B. (2013). Household Level Pollution in India: Patterns and Projections. *Climate and Development, 5*(4), 288-304.

Kerkhof, A. C., Nonhebel, S., & Moll, H. C. (2009). Relating the Environmental Impact of Consumption to Household Expenditures: An Input–Output Analysis. *Ecological Economics, 68*(4), 1160-1170.

Kiani, K. (2005). Standard of living has improved: survey, Daily DAWN.

Kubota, T., Surahman, U., & Higashi, O. (2014). *A Comparative Analysis of Household Energy Consumption in Jakarta and Bandung*. Paper presented at the 30th International Plea Conference, CEPT University, Ahmedabad.

Kumar, K. K., & Viswanathan, B. (2004). Does Environmental Kuznets's Curve Exist for Indoor Air Pollution? Evidence from Indian Household Level Data.

Kuznets, S. (1955). Economic Growth and Income Inequality. *The American economic review*, 1-28.

Lenzen, M., Jesper Munksgaard, A., & Smed, D. S. (2000). *Linking Environmental Effects to Consumption Pattern and Lifestyle-an Integrated Model Study*. Paper presented at the International Conference on Input-Output Techniques, Macerata, Italy.

Lewis, M. (2012). *Applied statistics for economists*: Routledge.

Li, J., & Wang, Y. (2010a). Income, Lifestyle and Household Carbon Footprints (Carbon-Income Relationship), A Micro-Level Analysis on China's Urban and Rural Household Surveys. *Environmental Economics,, 1*(2), 42-71.

Li, J., & Wang, Y. (2010b). Income, lifestyle and household carbon footprints (carbon-income relationship), a micro-level analysis on China's urban and rural household surveys. *Environ Econ, 1*(2), 42-71.

Lu, W., Chen, C., Su, M., Chen, B., Cai, Y., & Xing, T. (2013). Urban Energy Consumption and Related Carbon Emission Estimation: A Study at the Sector Scale. *Frontiers of Earth Science, 7*(4), 480-486.

Majid, M. R., Moeinzadeh, S., & Tifwa, H. (2014, 2014). *Income-Carbon Footprint Relationships for Urban and Rural Households of Iskandar Malaysia.* Paper presented at the IOP Conference Series: Earth and Environmental Science.

Masera, O. R., Saatkamp, B. D., & Kammen, D. M. (2000). From Linear Fuel Switching to Multiple Cooking Strategies: A Critique and Alternative to the Energy Ladder Model. *World development, 28*(12), 2083-2103.

Mrabet, A., Achairi, R., & Ellouze, A. (2013). *The Two-Way Relationship between Economic Growth and CO2 Emissions*. Paper presented at the International Conference on Business, Economics, Marketing and Management Research.

Munksgaard, J., Pedersen, K. A., & Wien, M. (2000). Impact of household consumption on CO 2 emissions. *Energy Economics, 22*(4), 423-440.
Nair, S. (2013). A Study on the Distribution of Household Carbon Dioxide Emission in a Small Town of C.G. India. *International Journal of Scientific & Engineering Research, 4*(10), 1217-1222.
Nasir, M., & Rehman, F. U. (2011). Environmental Kuznets Curve for Carbon Emissions in Pakistan: An Empirical Investigation. *Energy Policy, 39*(3), 1857-1864.
Ni, X., Lu, J., Lan, L., Gao, F., & Pan, C. (2010). Interactions between Environmental Quality and Economic Development in Shanghai, China. *International Journal of Engineering, Science and Technology, 2*(7).
Odhiambo, N. M. (2011). Economic Growth and Carbon Emissions in South Africa: An Empirical Investigation. *Journal of Applied Business Research (JABR), 28*(1), 37-46.
OECD. (2013). OECD Framework for Statistics on the Distribution of Household Income,Consumption and Wealth.
Omay, R. E. (2013). The Relationship between Environment and Income: Regression Spline Approach. *International Journal of Energy Economics and Policy, 3*(Special), 52-61.
Omisakin, O. A. (2009). Economic Growth and Environmental Quality in Nigeria: Does Environmental Kuznets Curve Hypothesis Hold? *Environmental Research Journal, 3*(1), 14-18.
Pachauri, S. (2004). An Analysis of Cross-Sectional Variations in Total Household Energy Requirements in India Using Micro Survey Data. *Energy policy, 32*(15), 1723-1735.
Panayotou, T. (1993). Empirical tests and policy analysis of environmental degradation at different stages of economic development: International Labour Organization.
Perry, B. (2013). *Using Household Income to Measure Living Standards*.
Pfaff, A. S., Chaudhuri, S., & Nye, H. L. (2004). Household Production and Environmental Kuznets Curves–Examining the Desirability and Feasibility of Substitution. *Environmental and Resource Economics, 27*(2), 187-200.
Seriño, M. N. V., & Klasen, S. (2015). Estimation and Determinants of the Philippines' Household Carbon Footprint. *The Developing Economies, 53*(1), 44-62.
Shafik, N., & Bandyopadhyay, S. (1992). *Economic Growth and Environmental Quality: Time-Series and Cross-Country Evidence* (Vol. 904): World Bank Publications.
Shahid, A., Maryam, B., & RABBI, F. (2014). A New Economic Dimension to the Environmental Kuznets Curve: Estimation of Environmental Efficiency in Case of Pakistan. *Asian Economic and Financial Review, 4*(1), 68-79.
Shahiduzzaman, M., & Alam, K. (2012). *Relationship between CO2 Emissions and Income in Australia: Is there any Evidence of an EKC?* Paper presented at the Proceedings of the 41st Australian Conference of Economists (ACE 2012).
Shaw, D., Pang, A., Lin, C.-C., & Hung, M.-F. (2010). Economic Growth and Air Quality in China. *Environmental economics and policy studies, 12*(3), 79-96.
Ubaidillah, N. Z. (2011). The Relationship between Income and Environment in UK's Road Transport Sector. Is There an EKC? *International Proceedings of Economics Development & Research, 4*.
Uddin, M. M. (2014). Carbon Emission and Economic Growth of SAARC Countries: A Vector Autoregressive (VAR) Analysis. *Global Journal of Human-Social Science Research, 14*(3).

Vanneman, Y. Z. a. R. (2008). *Economic Growth and the Environment: A Household Perspective from Cooking Fuel Choices and Indoor Air Pollution*. Department of Agricultural and Resource Economics and Department of Sociology University of Maryland. University of Maryland. University of Maryland.

World Bank. (2006). Pakistan Strategic Country Environmental Assessment.

World Bank. (2014). World Bank Statistical Database.

Wu, G., Liu, T., & Tang, M. (2012). Analysis of Household Energy Consumption and Related CO2 Emissions in the Disregarded Villages of Lijiang City, China. *International Journal of Sustainable Development & World Ecology, 19*(6), 500-505.

Yan, W., & Minjun, S. (2009). CO2 Emission Induced by Urban Household Consumption in China. *Chinese Journal of Population Resources and Environment, 7*(3), 11-19.

Zhao, T., & Cui, R.-h. (2013). *Study on Carbon Footprint of the Household Consumption in Tianjin Based on Input-Output Analysis.* Paper presented at the Proceedings of 20th International Conference on Industrial Engineering and Engineering Management.

Zheng, S., Wang, R., Glaeser, E. L., & Kahn, M. E. (2010a). The greenness of China: household carbon dioxide emissions and urban development. *Journal of Economic Geography*, lbq031.

Zheng, S., Wang, R., Glaeser, E. L., & Kahn, M. E. (2010b). The greenness of China: household carbon dioxide emissions and urban development. *Journal of Economic Geography, 11*(5), 761-792.

Zhuang, X., Jiang, K., & Zhao, X. (2011). Analysis of the Carbon Footprint and Its Environmental Impact Factors for Living and Travel in Shijiazhuang City. *Advances in Climate Change Research, 2*(3), 159-165.

Appendix-A

Questionnaire on

"ENVIRONMENTAL IMPACTS OF STANDARD OF LIVING: A CASE STUDY OF DISTRICT MARDAN, KHYBER PAKHTUNKHWA

Date: **_____/_____**/2014.

Province: --------------------------------------.

District: --.

Tehsil: --.

Urban/Rural Area: -------------------------------------.

Name of the Interviewer: ----------------------------------.

Name of the Respondent: --.

Household Size: --.

1. Information about the Household:

Household Members	Name	Gender 01=Male 02=Female	Age of the household members in years	Relationship to head of the household **Codes** 01=Head 02=Wife/husband 03=Son /daughter 04=Grandchild 05=Father /Mother 06=Brother/Sister 07=Nephew /Niece 08=Son/daughter-in-law 09=Brother/Sister-in-law 10=Father/Mother-in-law 11=Servant/their relatives 12=Other	Employment of the household members Employed =1 Non employed =2	What is the main occupation? **Codes** 01=Government official 02=Manager of an organization 03=Self business 04=Teacher 05=Police 06=Army 07=Shop worker 08=Sale man 09=Craftsman 10=Painter 11=Motor /vehicle driver 12=Doctor 13=Nurse 14=Engineer 15=Technician 16= Property dealer 17= Other	Average Monthly income of the working members of the household (Rs./month) (Wages)	Average Monthly income of the working members of the household (Rs./month) (Non-wages)	**Education of the working members in years** **Codes** 01= Class 1 02=Class 2 03= Class 3 04= Class 4 05= Class 5 06= Class 6 07= Class 7 08= Class 8 09= Class 9 10= Class 10 11= Class 11 12= Class 12 13= Class 13 14=B.A/B.Sc 15= Class 15 16=MA/M.sc/ M.ED 17= MBBS 18=Engineering 19=Diplomas 20= M.phil/Ph.D 21=Other
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									

Household Members	Name of the household members	Gender 01=Male 02=Female	Age of the household members in years	Relationship to head of the household **Codes** 01=Head 02=Wife/husband 03=Son /daughter 04=Grandchild 05=Father /Mother 06=Brother/Sister 07=Nephew /Niece 08=Son/daughter-in-law 09=Brother/Sister-in-law 10=Father/Mother-in-law 11=Servant/their relatives 12=Other	Employment of the household members Employed =1 Non employed =2	What is the main occupation? **Codes** 01=Government official 02=Manager of an organization 03=Self business 04=Teacher 05=Police 06=Army 07=Shop worker 08=Sale man 09=Craftsman 10=Painter 11=Motor /vehicle driver 12=Doctor 13=Nurse 14=Engineer 15=Technician 16= Property dealer 17= Other	Average Monthly income of the working members of the household (Rs./month) (Wages)	Average Monthly income of the working members of the household (Rs./month) (Non-wages)	Education of the working members in years **Codes** 01= Class 1 02=Class 2 03= Class 3 04= Class 4 05= Class 5 06= Class 6 07= Class 7 08= Class 8 09= Class 9 10= Class 10 11= Class 11 12= Class 12 13= Class 13 14=B.A/B.Sc 15= Class 15 16=MA/M.sc/ M.ED 17= MBBS 18=Engineering 19=Diplomas 20= M.phil/Phd 21=Other
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									

2. Household's Energy Consumption:

Serial Number (S.NO.)	Consumption Items	Unit	Monthly Consumption
1	Electricity	KWh	
2	Natural gas	Cubic meter	
3	Firewood	Kg	
4	Cylinder (LPG)	Kg	

3. Personal Transportation:

Serial Number (S.NO.)	Vehicles	No of vehicles	Average Monthly Consumption of Fuel
1	Car		
2	Motorcycle		
3	Other		

4. Waste:

Average waste produce per week in 2014	

5. Electrical Appliances:

Serial Number	Electrical Appliances	No .of Appliances	Wattage	Average Hourly Usage Per Day
1	Fans			
2	Air conditioner			
3	Air cooler			
4	Compact florescent bulb			
5	Incandescent bulb			
6	Washing machine			
7	Dryer machine			
8	Refrigerator			
9	Freezer			
10	Television			
11	Iron			
12	Vacuum cleaner			
13	Generator			
14	Geyser			
15	Heater			
16	Desktop computer			
17	Laptop computer			
18	Microwave oven			

Appendix-B

Emissions Factors per Unit of Energy Consumption

Fuel Category	**Emission Factors (Kg CO_{2e} per Unit)**
Electricity	0.62163 kg CO_2e/kWh
Natural gas	2.2422 kg CO_2e/m^3
Waste	0.8421 kg CO_2e/kg
Petrol	2.220 kgCO_2e/liter
LPG	2.960 kg CO_2e/kg
Firewood	1.870 kg CO_2e /kg
CNG	2.7244 kg CO_2e/kg

Source: DEFRA (2012), Carbon Neutral Company (2014), Intergovernmental Panel on Climate Change's (IPCC's) Guidelines for National Greenhouse Gas Inventories (Intergovernmental Panel on Climate Change 2006)

Appendix-C

Formulas for Converting Household's Energy Consumption into CO_2 Emissions

Category of the Household's Energy Consumption	Formulas
Electricity	Emissions (kg CO_2e)/month = Average use of electricity (kwh)/month* EF(kg CO_2e /kwh)
Electrical Appliances	Daily(kWh) consumption of electricity by the appliance= (Wattage of the appliance × average hourly usage per Day) ÷ 1000 1 kilowatt (kW) = 1,000 Watts Emissions (kgCO_2e)/month **=** Daily Kilowatt-hour (kWh) consumption*30 ***** Electricity EF(kg CO_2e /kwh)
Natural Gas	Emissions (kg CO_2e)/month = Average use of natural gas (kwh)/month * EF (kg CO_2e/kwh)
Personal Transportation	Emissions (kg CO_2)/month = Average use of fuel (Litre)/month *EF(kg CO_2 / litre)
Waste	Emissions (kg CO_2e)/month = Average waste (kg) produced/ week*4*EF (kg CO_2e/kg waste)
Firewood	Emissions(kgCO_2e)/month= Average use of firewood(kg)/month*EF(kgCO_2e/kg firewood)
LPG	Emissions(kgCO_2e)/month= Average use of LPG (kg)/month*EF(kgCO_2e/kg LPG)