Poverty and Indoor Air Pollution: A Case Study of Women in Rural Bihar

THESIS

SUBMITTED TO

BABASAHEB BHIMRAO AMBEDKAR UNIVERSITY
(A CENTRAL UNIVERSITY)
LUCKNOW

BABASAHEB
BHIMRAO
AMBEDKAR
UNIVERSITY
LUCKNOW
प्रज्ञा शील करुणा
ESTABLISHED 1996

FOR THE AWARD OF DEGREE OF

Doctor of Philosophy

IN

ECONOMICS

Under the Supervision of

PROF. SANATAN NAYAK

Submitted by

RAVINDRA SAH

DEPARTMENT OF ECONOMICS
SCHOOL FOR AMBEDKAR STUDIES
BABASAHEB BHIMRAO AMBEDKAR UNIVERSITY
(A CENTRAL UNIVERSITY)
VidyaVihar, Raebareli Road Lucknow-226025(U.P.), India

Enrollment No. 347/14 **Year 2020**

Dedicated

To My

Revered Parents

DECLARATION

I declare that the thesis entitled "**Poverty and Indoor Air Pollution: A Case Study of Women in Rural Bihar**" submitted to Babasaheb Bhimrao Ambedkar University, (A Central University), Lucknow for the award of Doctor of Philosophy in Economics. It is my original work and it has not previously been produced for the award of any degree, diploma, fellowship or similar other titles anywhere.

This research study is carried out under the supervision of Prof. Sanatan Nayak, Department of Economics, School for Ambedkar Studies (SAS), Babasaheb Bhimrao Ambedkar University (A Central University), Lucknow, Uttar Pradesh, India. This is also declare that the thesis is essentially free from all kinds of plagiarism.

Ravindra Sah

Place: Lucknow
Date: 10/02/2020

Ravindra Sah
(Enrolment No. 347/14)
Department of Economics
Babasaheb Bhimrao Ambedkar University,
Lucknow, Uttar Pradesh

35/DE/BBAU/2020
10.02.2020

CERTIFICATE

This is to certify that the thesis titled "**Poverty and Indoor Air Pollution: A Case Study of Women in Rural Bihar**" submitted by Mr. Ravindra Sah is an original research work and has not been previously submitted in part or full for the award of any other degree or diploma to this or any other university.

This thesis submitted to Babasaheb Bhimrao Ambedkar University, Lucknow satisfies all the requirements as stipulated in the Doctor of Philosophy (Ph.D.) regulations-1999 as mentioned in 2013 and it is fit for submission and evaluation for the award of the degree of Doctor of Philosophy of the University.

Date: 10/02/2020

Supervisor

Head of Department

PhD COURSEWORK CERTIFICATE

BABASAHEB BHIMRAO AMBEDKAR UNIVERSITY
LUCKNOW
प्रज्ञा शील करुणा
ESTABLISHED 1996

बाबासाहेब भीमराव अम्बेडकर विश्वविद्यालय
(केन्द्रीय विश्वविद्यालय)
विद्या विहार, रायबरेली रोड, लखनऊ–226 025

BABASAHEB BHIMRAO AMBEDKAR UNIVERSITY
(A Central University)
Vidya Vihar, Raebareli Road, Lucknow-226 025

Letter No.-652/COE/BBAU/2019 Dated: 22/11/2019

Ph.D. Course Work Certificate

This is to certify that **Ravindra Sah**, Enrollment No. 347/14 Ph.D. Research Scholar, Department of Economics of the University has successfully completed his Ph.D. Course work in the examination held during December, 2015.

Deputy Registrar (Exams.)

PLAGIARISM CERTIFICATE

URKUND

Urkund Analysis Result

Analysed Document:	Thesis_Ravindra_Economics.docx (D63595808)
Submitted:	2/7/2020 3:17:00 PM
Submitted By:	gbl.bbau@gmail.com
Significance:	3 %

Sources included in the report:

Vandana thesis-converted.pdf (D49863249)
https://www.coursehero.com/file/43920721/EEE-457-Introduction-Energy-Scenariopdf/
https://www.slideshare.net/FarisVallappuzha/me-482-energy-conservation-and-management-notes
https://lecturenotes.in/notes/16682-note-for-renewable-energy-system-res-by-prabhu-shankar
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5708075/
https://www.researchgate.net/publication/46443889_Energy_access_efficiency_and_poverty_how_many_households_are_energy_poor_in_Bangladesh
https://link.springer.com/chapter/10.1007/978-3-319-29650-0_2
https://www.scribd.com/document/354764677/Electronic-Tools-Guide
https://kingcenter.stanford.edu/sites/default/files/publications/304wp.pdf

Instances where selected sources appear:

38

Acknowledgement

All praises and thanks to Almighty God. The Omnipresent, The Omnipotent, The Cherisher and The Sustainer of Universe. I bow in reverence to Almighty God who gave me the much needed patience, strength, courage and zeal and bestowed, His Mercy Blessings in accomplishing this PhD thesis work. An enthusiastic guidance, dexterous work and dynamic cooperation have been provided by a number of people during the entire course of PhD. I feel contended to acknowledge those concerned.

I stand indebted for the knowledgeable supervision, excellent evaluation and embossing nature of Professor Sanatan Nayak (An Inspiring Mentor). The overall support he rendered with fruitful suggestions and unstinted guidance, keen interest, constructive criticism, comprising healthy discussions during the PhD. work is heartily appreciated. It would not have been possible to compile this report without his guidance and support.

I express my sincere thanks to Head of the Department, Professor Sanatan Nayak, for providing the necessary facilities during the entire tenure of PhD. I am highly grateful for his kind and helping nature.

I feel delighted in expressing my gratitude to teachers of the department and research advisory committee members Professor N. M. P. Verma, Dr. L.C.Mallaiah, Dr. D.K.Yadav, Dr. Surendra Meher, Dr. Pranav Kumar Anand for their continuous encouragement and moral support throughout the entire work.

I express my sincere thanks to Firdous Ahmad Malik, Pragya Sharma, Dr.Rashmi Mam Suhail Bhat, and Ruchi for providing cordial help during the course.

I would also like to thank the non-teaching staff of the department Mr. Atul Sahu, Deepak , Ram Sagar, for their kind cooperation and help.

Special recognition goes to my seniors, classmates and other colleagues Dr.Naveed, Dr Rahul , Dr Vandana, Dr Surendra, Priti Jha, Ekta, Alka, Abhisek and

Mangal Kanti for their friendly companies, constant help and assistance throughout the entire journey of the this work.

Bundle of thanks goes to my bosom near and dear ones and family members for their well wishes, supplications, timely help and encouragement especially to my Parents and elder brother Banka Sah, Malti Devi, Surendra Sah. Prem Kumar Also, back home I am thankful to all my cousins and little angels Suraj, Anshu for their company and enjoyment.

I am gratified with the company and help provided by my friends G.K.Sahu, Himnshu, Sanjay Lakda, Piyush, Manik Bhai, Nelish and the unending support from people during field survey are Gokul Ji, Manoj Ji, Birendra Ji,Umesh Ji and Anand during the course of PhD.

I am highly obliged and present my sincere pearls of acknowledgements to Kanti, for her continuous and unending support in every aspect. Her heartfelt wishes, supplications and encouragement have been phenomenal in accomplishing this work.

I express extraordinary gratefulness and appreciation, although mere words are inadequate to express my feelings of indebtedness from the core of my heart towards my beloved Parents (who toiled and sweated throughout their lives but skilled me with a bit creativity). They are the real pivots of my life. I thank them for moulding me, with the grace of Almighty Allah, into what I am today.

Last, but not the least, I would like to thank one and all, whose best wishes kept me afloat amidst the storm.

Ravindra Sah

LIST OF CONTENT

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

AAP	Ambient Air Pollution
ALRI	Acute Lower Respiratory Infections
ARI	Acute Respiratory Infections
AURI	Acute Upper Respiratory Illness
BPL	Below Poverty Line
CO	Carbon monoxide
CO	Carbon monoxide
CO2	Carbon dioxide
CO2	Carbon dioxide DALY –Disability Adjusted Life Years
COI	Cost of Illness
COPD	Chronic Obstructive Lung Disease
CVM	Contingent Valuation Method
DALY	Disability Adjusted Life Years
DBDC	Double Bounded Dichotomous Choice Method
EKC	Environmental Kuznets Curve
GBD	Global Burden of Disease
GDP	Gross Domestic Product
GHGs	Green House Gases
GOI	Government of India
HAP	Households Air Pollution
HEI	Health Effects Institute
IAP	Indoor Air Pollution
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate change

LPG	Liquid Petroleum Gas
Max	Maximum
MIN	Minimum
MOEF	Ministry of Environment and Forest
NAQI	National Air quality Index
NSSO	National Sample Survey Origination
ODF	Open Defection Free
PCC	Pollution Control Board
PM	Particulate Matter
PMUY	Pradhan Mantri Ujjwala Yojana
PPAC	Petroleum Planning & Analysis Cell
UN	United Nation
UNDP	United Nation Development Program
UNEP	United Nations environment Program
UT	Union Territories
VLS	Value of Statistical Life
WB	World Bank
WEC	World Energy Council
WHO	World Health Organization
WTP	Willingness To Pay

Chapter 1
Introduction

Chapter 1

Indoor Air Pollution: Issues and Methods

"The world environment does not mean something that surrounds us but an organism of all life within we are fastened."

-Mose Richards

1.0 Introduction

In this chapter, we have discussed how certain human activities are degrading our environment- life-support system, disrupting the eco-system and endangering human health in the process. Among those at greatest risk for serious illness due to environmental pollution are women, children and elderly and those living in poverty? Two types of pollution are found in the environment, first is outdoor and second is indoor, both are serious problems for human health. Environmental pollution remains a concern globally. All types of pollution such as water pollution, noise pollution and air pollution are the major cause of diseases. But among these, air pollution is significantly affecting the health of the people. Increasing population, excessive use of vehicles, construction activities, etc. are the main reasons for air pollution while the use of unclean fuels for cooking, the use of air condition in houses, etc. are the main reasons for indoor air pollution (Emily. S. 2009: pp.1-2). According to estimates published by the World Health Organization, 7 million people died as a result of air pollution exposure in 2012 (WHO 2014: p1). This number indicates that air pollution is now the world's largest single environmental health risk, killing more people than malaria and AIDS. Air quality is not only a country's concern; the case invokes universal cooperation, as air is a natural resource that does not follow to geopolitical borders (WHO 2014: p.1).Air pollution is one of the major causes of

premature death in developed and developing countries at present time. In the world, air pollution is the major environmental reason for disease and premature death in 2015, 9 million premature deaths had happened due to it, which was 16 percent of all death in the world and three times higher than death due to AIDS, tuberculosis, and malaria. It is also more than 15 percent higher than deaths because of wars and violence. In pollution-affected countries, one in four deaths occurs due to pollution. Air pollution is the fifth most prominent factor in mortality worldwide. It is responsible for more deaths than the risks of malnutrition, alcohol use, and physical inactivity. Each year, more people die from diseases caused by air pollution than the number of deaths due to road accidents, malaria. In 2017, around 4.9 million people died due to air pollution worldwide and 147 million people lost years of healthy life (Health Effects Institute. 2019: pp.1-2).

Indoor air pollution (IAP) is a significant reason for both morbidity and mortality throughout the world. It has been severely impacting developing countries as compare to developed countries due to burning of traditional biomass fuels such as wood, animal dung and crops residues from daily domestic cooking in rural households (World Bank 1992; Smith and Mehta 2000). In 2017, 3.6 billion people (47 percent of the global population) were exposed to indoor air pollution using dirty fuel for cooking. East Asia, South Asia and sub-Saharan Africa regions were the most common. In 13 countries in which more than 50 million population reside, more than 10 percent of the population was affected by domestic air pollution. Around 846 million people (60 percent of the population) in India and 452 million people (32 percent of the population) in China were affected by indoor air pollution in 2017. Burning dirty fuel around and indoors also contributes to air pollution. The contribution of domestic air pollution to air pollution varies by region and is not

calculated for most countries. Currently a global estimate has suggested that domestic energy use, as defined, contributes about 21 percent of the global ambient $PM_{2.5}$ concentration. Another study estimated that domestic energy consumption accounted for around 31 percent of deaths from global outdoor air pollution. According to the Global Burden of Disease from Major Air Pollution Sources (GBD MAPS) project found that in India, the burning of biomass at the indoor level was responsible for 24 percent of the total population-weighted of $PM_{2.5}$ concentrations in 2015. And China in the burning of biomass and coal in 2013 of $PM_{2.5}$ was responsible for 19 percent (Health Effects Institute. 2019: pp.8-9). Indoor air pollution is one of the most significant worldwide risk factors for initial death and disease. In 2017, indoor air pollution accounted for 1.6 million deaths (2.9 percent of all deaths) and 59 million DALYs (2.4 percent of all DALYs) (Health Effects Institute. 2019: p.14).

1.1 The History of Air Pollution

Air pollution refers to any material released into the air that would not then be nearby, the smoke that results from minor cooking and hitting fire is a single example that has been about for thousands and thousands of years. Although, this air pollution is frequently local and currently anywhere nearby as spread out as the pollution problems we have today, it still had certain bad health effects, even thousands of years ago. The fume and soot from a minor fire can cause breathing problems and other health issues; recent research has proposed that it may main to various lung diseases tuberculosis, lung cancer, asthma, and even eye diseases that can cause blindness. Air quality in urban areas has been a subject as long as cities have been. When firewood was used as a primary source of fuel, air quality difficulties were due mainly to the existence of so numerous people in a limited space deprived of that

than if we talk modern-day of swage or disposable system. Though, in the middle era, when coal began to be used in large cities like London, a new era of air pollution began. Both industries and homes used coal heating and power, which caused different kinds of air pollution, as well as the formation of urban smog- which in turn causes a vast rise in death due to air pollution. In 1875, the first air quality legislation was passed. The public health Act in Britain recognized that health problems were caused by the burning of coal and it implied a section that tried to decrease the quantity of fume released in cities and other urban areas. Though, despite these efforts at decreasing the amount of air pollution, the mid-1800s and the beginning of the industrial revolution marked the beginning of modern-day-problems in air quality pollutant levels that have sustained to rise since that era (Emily, S. 2009: pp.11-12).

1.2 Types of Pollution

Everyone needs clean air important to live healthy lives and to sustain ecosystems. When air is going bad, they affects human life. Discharge of several gaseous releases and particulate matter (PM) has been on the increase due to unlimited industrialized growth Anthropogenic discharges of several types are being pumped into the atmosphere these are called primary pollutants. And lead to the formation it produces new pollutants that are made due to chemical reactions in the atmosphere these are called secondary pollution. It is formed by the interaction of primary pollutants with other primary pollutants or with some natural components of the atmosphere, ozone (O3) peroxyactel nitrate (PAN) photochemical smog, etc. According to the IPCC's Fifth Evaluation Report, practically all non-CO_2 climate-change pollutants are injurious to health (Jain, R, Palwa; K, 2015: p. 1).

1.3 Review of Literature

To assessment the short term linkage between air pollution and mortality in diverse zones of an industrial city. In this study intra-urban design is used to test the hypothesis that socioeconomic features covert the acute health effects of ambient air pollution divestment. The city of Hamilton (Canada) was remained divided into five regions based on proximity to fixed site air pollution monitors. Inside each region, daily counts of non-trauma mortality and air pollution approximations were joint. Generalized linear models (GLMs) were used to test mortality relations with sulphur dioxide (SO2) and with particulate air pollution measured by the coefficient of haze (CoH). Three possible explanations are proposed for the modification of the effects of both. first, manufacturing sector people face more exposure at the workplace to produce larger health effects second, lower education individuals experience less exposure measurement error, Which reduces the bias toward zero and third, Manufacturing and education proxy air pollution for many social variables signifying material scarcity and poor material, growing a sensitivity to situations for health risks. Enlarged mortality was related to air pollution disclosure in a citywide model and in intra-urban regions with lower socioeconomic features. Low educational achievement and high manufacturing employment in the regions significantly and pointedly changed the acute mortality impact of air pollution exposure (Jarrett, M. et al. 2004: pp.31-40). This paper in disentangling the health effect of especially cluster ate social and physical environmental exposure and in exploring potential synergies among them with particular attention direct to the combined effect of psychosocial stress and air pollution. Both exposures may be elevated in lower-income urban communities and it has been hypothesized that stress, which can influence immune function and susceptibility, may potential the effect of air pollution respiratory

diseases onset and exacerbation. In this paper, social and environmental epidemiology, toxicology, immunology, and exposure assessment to provide a useful framework for environmental health (Clougherty, J. E., et al. 2009: pp.1351-1358). This paper indicates. What is cause of indoor air pollution how the impact of women and children health indoor air pollution causes by the burning of biomass fuels has been associated with increased risk of accurate respiratory infection among children loss than five years old in developing courtiers. This paper reviews the published literature on three technical interrelation options: access to cleaner burning fuels, improved cook stove and modification to housing to housing characteristics. This paper highlights the sustainability challenge related to the update and maintenance of technical for behavioral interventions to reduce child exposure it indoor air pollution in contexts likely succeed in the short term. This paper further highlight need technical intervention inclusive of sensitive to behavioral outcomes and process, also discuss quantitative and qualitative research in relation to evolution option (Brendon R. Barnes, 2005: pp.67-82). This paper based on developing country used fuel for domestic purpose. It impact on adult women and children. This paper mention expose to harmful air pollution gases its causes of respiratory problems, infant mortality etc. Exposure to smoke from solid fuel burning increase the risk of chronic obstructive planning diseases (COPS) and lung cancer in adults and acute lower respiratory tract infection/ pneumonia in children. This paper indicate strong evidence that white cool burning is a risk factor for long cancer exposure to other biomass fuel smoke is less so reduce the acute lower respiratory infection in children. So approaches to reduce biomass smoke exposure are likely to result in reduction in the global burden of respiratory disease. (Kurmi, O. P. et al. 2012: pp.239-254).Using unclean fuels affects women health. It also decreases nutrition level of women. Author appeals that

innovative techniques in cooking pattern should be adopted (Batliwala, S. 1983: pp. 2227-2230). The paper attempts to tell that the children less than five year and women are more affected by burning of biofuels. They recommended that petroleum policy should be redesign and kerosene oil should be provided at affordable price to the people, so that they will not depend on forest and it would have good impact on women health (Parikh, J; et al. 1999: pp. 539-544.). To examine in his paper an indoor air pollution and impact on health of rural women of Uttar Pradesh, Rajasthan and Himanchal Pradesh. To full fill the objective of the study author have taken comprehensive data on socio- economics variable and smoking habit etc. finding of the study there is a need for creating awareness about use of clean fuels and ventilation in kitchen (Laxmi, V; et al. 2003: pp. 50-68). In this paper examine the use and access of energy and how it links with poverty. There are two approaches to measure the energy poverty. First approach is based on fuel poverty line in which they compute the average energy consumption of households at a certain term and condition. Second approach is based on engineering type calculation for basic needs of households. Then an alternative approaches define that how households access to clean and efficient energy sources the quality consume by the households is an important measurement of poverty (Pachauri, S and Spreng, D 2004: pp.271-278.). Author focus in his study on the expenditure clean and dirty fuels in total cooking fuels the objective of the study is to consider the main determinants of fuel choice in rural and urban areas. Household's level data from NSS during 1983-2000 are used in this study. Author found wide disparity between rural and urban households (Viswanathan, B., and Kumar, K.S.K. 2005: pp.1021-1036). The paper explain that the biofuel is still a major source of cooking in developing countries like India. In India indoor air pollution is major cause of disease burden. Income, policies and price

of fuels are effected the choice of fuel. The main objective of this study is to examine the relationship of pollution, income for the period 1983-2000. The data cover both rural and urban areas it is unit level data taken from NSS. By using environmental Kuznets curve (EKC) the study found that there is a non-linear (non-Monotonic) relationship between income and pollution that means the as income increases the pollution decreases. This relationship is very helpful for policy making in large countries like India. It will be also helpful to reduce pollution level (Kumar, K.S.K, and Viswanathan, B. 2007: pp.5496-5504).One more study found that using unclean fuels resulted indoor air pollution in rural areas in Odisha. Indoor air pollution is main reason of respiratory disease. In this paper author covers 2400 households which are using unclean fuels finding this paper is frequency of respiratory disease is very high. There is high correlation between using traditional stoves and having symptoms of respiratory illness. Poverty health preference and bargaining power of women are other possible factors of respiratory disease (Duflo, E. et al. 2008: pp.71-76). Focus in this paper senility of energy schemes for women. There are two major energy scheme namely integrated energy policy and national energy policy are not able to give recognition to women in access energy program. Two new energy policies which are implemented for women betterment that are Pradhan Mantri Ujjwala Yojana and Saubhagya Scheme. These scheme need to improve energy security of women (Manjula, M 2019: pp.18-21). In rural areas of India most of the energy used for cooking purpose. Demand of biofuel is highest for cooking in rural India. Using biofuels is harmful for women health. By this statement author wants to examine the determinants of cooking fuel in rural areas. NSS 61st round data is used in this study by using logistic regression model. The study found that the educated women of age 10-50 and them who are getting regular salary are using clean fuel but

they who are below poverty line specially reserve category family size and form size negative linkage.

1.4 Statement of the Problem

Indoor air pollution (IAP) is a significant reason for both morbidity and mortality throughout the world. It has been severely impacting developing countries as compare to developed countries due to burning of traditional biomass fuels such as wood, animal dung and crops residues from daily domestic cooking in rural households (World Bank, 1992; Smith and Mehta 2000). Biomass fuel such as firewood and chips, dung cake and crop residues is still extensively being used in rural households of Bihar for daily household cooking. The effects of biomass fuel use on respiratory health of rural women in Bihar, but the overall impact of biomass fuel use on public health, especially that on women and children in rural areas. What are the reasons behind the changing socio-economic condition of rural people and how affected health and economic status of rural people is, by indoor air pollution? To answer these questions, we will study and analyze the impact of indoor air pollution on health and socio-economic condition of rural people in Bihar using some statistical tools and techniques.

1.5 National and International Scenario of Air Pollution

More than 90 percent of people worldwide live in areas more than WHO guidelines for healthy air. More than half live in areas that do not even converge the WHO's lowermost stringent air quality targets (Health Effects Institute. 2018: p.3). Air pollution emission in a populous country like China has stabilized and even induct to downfall gradually; Pakistan, Bangladesh, and India, in contrast, have seen the largest

increase in air pollution levels since 2010 (Health Effects Institute. 2018: p.4). Around the world, ambient strata of $PM_{2.5}$ remain to exceed the Air Quality Guideline installed by the WHO. The guideline for annual average $PM_{2.5}$ attention is set at 10 μg/m3 based on proof of the health effects of long-term unveiling to $PM_{2.5}$, but the WHO recognized it could not rule out health effects below that level. Aimed at regions of the world where air pollution is highest, the WHO recommended three interim air quality goals set at increasingly lower attentions: Interim Target 1 (IT-1, ≤35 μg/m3), Interim Target 2 (IT-2, ≤25 μg/m3), and Interim Target 3 (IT-3, ≤15μg/m3). These guidelines were exceeded in 2017. 92 percent of the world's population lived in areas that exceeded the WHO guideline. Guidelines for $PM_{2.5}$. 24 percent lived in areas greater than IT-1, 67 percent lived in more than IT-2 areas, and 82 percent lived in areas greater than IT-3.Worldwide, the percentage of the world's population living in areas that exceed the most-drastic WHO Air Quality Guideline (10 μg/m3 $PM_{2.5}$) reduced slowly, from 96 percent in 1990 to 92 percent in 2017. Similarly, the percentage living in zones that fail to converge even the least-stringent goal, IT-1 (35 μg/m3 $PM_{2.5}$), remained steady at around 54 percent (Health Effects Institute. 2019: pp.3-4).

Air pollution is the world's biggest environment risk, causing at least one in eight global deaths according to WHO. WHO's assessment shows there is a huge surge in disease burden and deaths due to air pollution exposure. Death due to air pollution, which includes outdoor as well as indoor pollution have increased four-fold across the globe over the past decade the latest data shows. While the total number of deaths due to air pollution is pegged at 8 million every year, data shows that China and India are by far the worst affected countries. Of the 8 million deaths globally, 3.7 million are from outdoor or ambient air pollution, the data show. Around 88 percent

of premature deaths due to air pollution exposure occurred in low and middle-income countries and the greatest number in the western Pacific and south-east Asia regions. Latest studies by WHO and other international agencies show that apart from development of respiratory diseases, exposure to air pollution leads to severe risk of cardiovascular diseases, such as strokes and ischemic heart disease. Moreover, stronger links of air pollution and cancer have also been established in recent studies. According to international agency for research on cancer (IARC), outdoor air pollution is carcinogenic to humans. The agency, specializing in cancer research, has found evidence that exposure to outdoor air pollution causes lung cancer besides increasing the risk of bladder cancer. Six of our cities have made it to the world's top 10 list, 13 to the top 20. We may be bored with our nation's impressive ranking near the bottom of various socio-economic indicators, but this performance will move even the most die-hard cynic, when it come to the quality of the air we breathe we lead, bar none. At the very bottom. Consider a string of imposing facts as per WHO's air pollution database of 1600 cities globally our national capital is the world's most polluted, by quite an impressive margin. A full one-third of the world's 100 worst cities are Indian. How much do we lead by? Well, with an average of 153mg of suspended particulate matter per cubic metre of are, Delhi's atmosphere is 8-20 times as polluted as that of other megacities with similar levels of vehicular intensity New York (14 mg per cubic meter), London (16), and Bangkok (20). In fact, this is one social indicator where we trump all the usual suspects, from Somalia to Rwanda and Sierra Leone. There was a time when China was a saving grace for us. Back in 2000, Beijing's air was more polluted than Delhi's. Today, Delhi is 2.5 times worse at 153mg versus 56. Over the past 13 years Delhi has deteriorated by 47 percent while Beijing has actually improved, by 40 percent. Mumbai (a "Shanghai in the making")

has slipped from being a lot better than its so-called role model, to 25 percent worse. The rest of urban India follows a similar script. Fair enough, but does it really matter? With such pressing problems as unemployment and hunger, poverty and illiteracy, isn't an issue like air pollution a bit distant...even esoteric? Well, think again. Air pollution is today estimated as the fifth largest killer in urban India, ahead of such hazards as tobacco smoking, high blood pressure and poor nutrition. It is responsible for a cut in life expectancy by 3.2 years for 660 million Indians (Delhi's residents can bid goodbye to five years of their life). 40 percent of Delhi's children fail the lung function test; our other metros follow closely with Bangalore at 36 percent, Kolkata at 35 percent and Mumbai at 27 percent. Over half of Delhi's students suffer from Respiratory Disorder Syndrome. The quality of air we breathe is seen as the primary cause of such disorders. The sources for the above findings are varied and weighty: WHO's Air Pollution Database 2014; study by Environmental Economists from Harvard, Yale and Columbia, Feb 2015; World Allergy Organization Journal published in 2013. The world's environmental and health experts are totally aligned on the view that the menace of air pollution in urban India needs tackling on a war footing.

1.6 Issue Involves in Indoor Air Pollution

Indoor air pollution (IAP) is a significant reason for both morbidity and mortality throughout the world. It has been severely impacting developing countries as compare to developed countries due to burning of traditional biomass fuels such as wood, animal dung and crops residues from daily domestic cooking in rural households. (World Bank, 1992; Smith and Mehta, 2000). Smoke expose from biomass burning is regarded as one of the most serious environmental problems facing the developing

countries throughout the world. It is estimated that indoor air pollution (IAP) from biomass burning is responsible for 4 percent of the global burden of disease (Bruce et al. 2000, and practice of biomass fuels health hazardous of 400-700 million people across the world and causes 2.8 million premature death every year. (Bruce et al. 2000). The use of biomass fuels not only effect women but also children who spend long hours inside the cooking areas (Larson and Rosen, 2002). In our country, not only rural areas but also hilly areas intensively use biomass fuel for their households cooking and room heating respectively. So it is harmful for public health, especially for women and children.

Indoor air pollution is a silent killer which has resulted in premature death of 1.24 lakh people in India (Lancet 2015: p.30). The biggest reason of indoor air pollution is the firewood and chips, cow-dung, coke, coal, agriculture waste that is burned as cooking fuel in the rural areas. Access to clean energy plays an important role to achieve the social goal. Traditional cooking fuel are responsible to serious risk to health and women empowerment. (According to the world energy outlook 2016), 819 million people in India use traditional fuel cook stoves for their cooking needs. Closely of the world's half population a total number of 3.6 billion people were exposed to indoor air pollution in 2017. In 2017, 3.6 billion people (47 percent of the global population) remained exposed to household air pollution from the practice of dirty fuels for cooking. These exposures remained most common in sub-Saharan Africa, South Asia, and East Asia.13 countries with a population of over 50 million in the world in which more than 10 percent of the population was exposed to indoor air pollution. A projected 846 million people (60 percent of the population) in India and 452 million people (32 percent of the population) in China were exposed to indoor air pollution in 2017 according to (Health Effects Institute. 2019: p.8). In India, the use of

dirty fuels in large quantity is mainly used in rural areas. Clean fuels are far from the reach of rural households in India. Large population are dependent on dirty fuel for cooking purpose, while better condition in urban areas shifting to clean fuels in comparison of rural areas. According to the geographical area, the disparity of fuel are increases. Continuously using unsustainable fuel in huge quantity results negative impact on health especially for women. More than two-thirds of the population lives in rural India, firewood and chips were used in more than two-thirds (67.3 percent) of the rural households, followed by LPG, which was used by 15 percent of the households. Only 9.6 percent cow dung, 1.1 percent coke, coal, 1 percent kerosene, 5 percent other sources were used in rural households. 1.3 percent of rural households did not have cooking facilities (NSS 2011-12: p.14).

The highest number of deaths due to indoor air pollution was in India (482,000), where 60 percent of the population cooks with unclean fuels, followed by China (271,000) where 32 percent of the population lives. Indoor air pollution is the cause of about 46 percent of deaths in two major developing countries and about 37 percent of DALY. Countries in Sub-Saharan Africa, mainly Eastern, Central and Western Sub-Saharan Africa, where 80 to 92 percent of the population is dependent on unclean fuels, collectively are responsible for 24 percent of other deaths and 34 percent of DALY causes. Indoor Air Pollution: Afghanistan, Pakistan, Indonesia, and Myanmar have also suffered major deaths from the risk of domestic air pollution. Women and children are particularly affected due to indoor air pollution.60 percent of deaths of women and children are caused by indoor air pollution. Children under the age of five are the most likely to die due to pneumonia worldwide. The disease kills the lives of about one lakh children each year. More than 50 percent of pneumonia deaths are due to indoor air pollution. Women and girls are the primary buyers and

users of household energy services and bear the major share of the health and other burdens allied with major on polluting and inefficient energy systems (WHO 2016: p.9).There have been some studies on the effects of biomass use on respiratory health of rural women in India, but the overall impact of biomass fuel use on public health, especially that of women and children in rural areas of the country, is yet to be elucidated. Many other studies have been undertaken in this area of research:

1.7 Objectives of the Study

1. To examine the relationships between indoor air pollution and rural poverty.
2. To study the impact of indoor air pollution on health of rural people.
3. To study the reason for not using clean fuel and willingness to pay for it.

1.8 Research Questions

1. What is the relationship between indoor air pollution and rural poverty?
2. What are the effects of indoor air pollution on health of rural people?
3. Whether people are WTP from use of better energy?

1.9 Hypotheses of the Study

1. In rural areas, indoor air pollution causes poverty and vice-versa.
2. Indoor air pollution causes substantial ill-health in rural areas.
3. People are using biomass fuel instead of clean fuel and also they are WTP from better energy.

1.10 Methodology and Research Design

(a) Criteria for Selection of the Study Area

The study is based on unclean fuel used for cooking and its impact on health of women. We have taken NSS 68th round data to define the unclean fuels[1]. To select the state for primary survey, we have taken the state wise data of energy consumption from NSS 68th round. The consumption pattern of cooking energy has been taken from 17 states. With this data the average percentage of energy consumption of all the cooking sources is calculated among the states. Chhattisgarh (97.9 percent) has first rank in using unclean fuel among 17 major states followed by Odisha (95.5 percent), Jharkhand (95.4 percent), and Bihar (94 percent). These four major states are using more unclean fuel than other states. Among these states, most of the states are using firewood and chips more than other sources of unclean energy. However Bihar is the only state who uses all sources of unclean fuels. In the case of dung cake Bihar is using 20.8 percent which is highest among these four state. Same case in using other sources such as coke and coal and kerosene Bihar has highest percent among the states (NSS 2011-12, 68th Rounds: pp.14). Further, comparing the per capita income of these four states, Bihar has lowest per-capita income that is Rs.22582 after Chhattisgarh Rs.48366, Odisha Rs.43463 and Jharkhand Rs.36554 (Planning Commission 2011-12). Hence, based on above two indicators, viz., unclean fuels consumption and per capita income, Bihar is one of the poorest state. Therefore, Bihar is selected among the states for the study. Further using unclean fuels for cooking and per capita income selection of district is done. It is observed that Paschim Champaran is one of the districts, where substantial percentage of households depends on unclean energy for cooking purpose. Unclean fuels data viz., firewood & chips, dung cake,

[1]Firewood and chips, cow dung, coke coal and kerosene etc. have categorized as unclean fuel for source of cooking.

crop residue, coal lignite charcoal, biogas, are among these 38 districts Kishanganj has 1st rank (99.3 percent) after Kishanganj in sequence second Purnia (98.8 percent), third Araria (98.6 percent), fourth Madhepura (98.5 percent) and fifth Paschim Champaran (97.7 percent). To know the poverty status of these five districts we use the data of Ministry of Rural Development, Government of Bihar. We have taken the percentage of BPL card family data of these five districts. We found that Purnia has highest number of BPL card holder i.e. 4.251, Paschim Champaran has 4.236, Araria has 2.68, Kishanganj has 2.31 and Madhepura has lowest number of BPL card holder 2.07. On this basis Paschim Champaran was selected for primary survey, as it is one of the poverty ridden districts (Table 1.1).

Table 1.1: District wise number of BPL family of Bihar

No.	District Name	No. of BPL family	Percentage
1	Araria	304793	2.688
2	Arwal	80274	0.708
3	Aurangabad	226526	1.997
4	Baka	206944	1.825
5	Begusarai	319388	2.816
6	Bhagalpur	279170	2.462
7	Bhojpur	256221	2.259
8	Buxar	170332	1.502
9	Darbhanga	371134	3.273
10	**Purbi Champaran**	**594443**	**5.242**
11	**Paschim Champaran**	**480386**	**4.236**
12	Gaya	360848	3.182
13	Gopalganj	265491	2.341
14	Jamui	195234	1.721

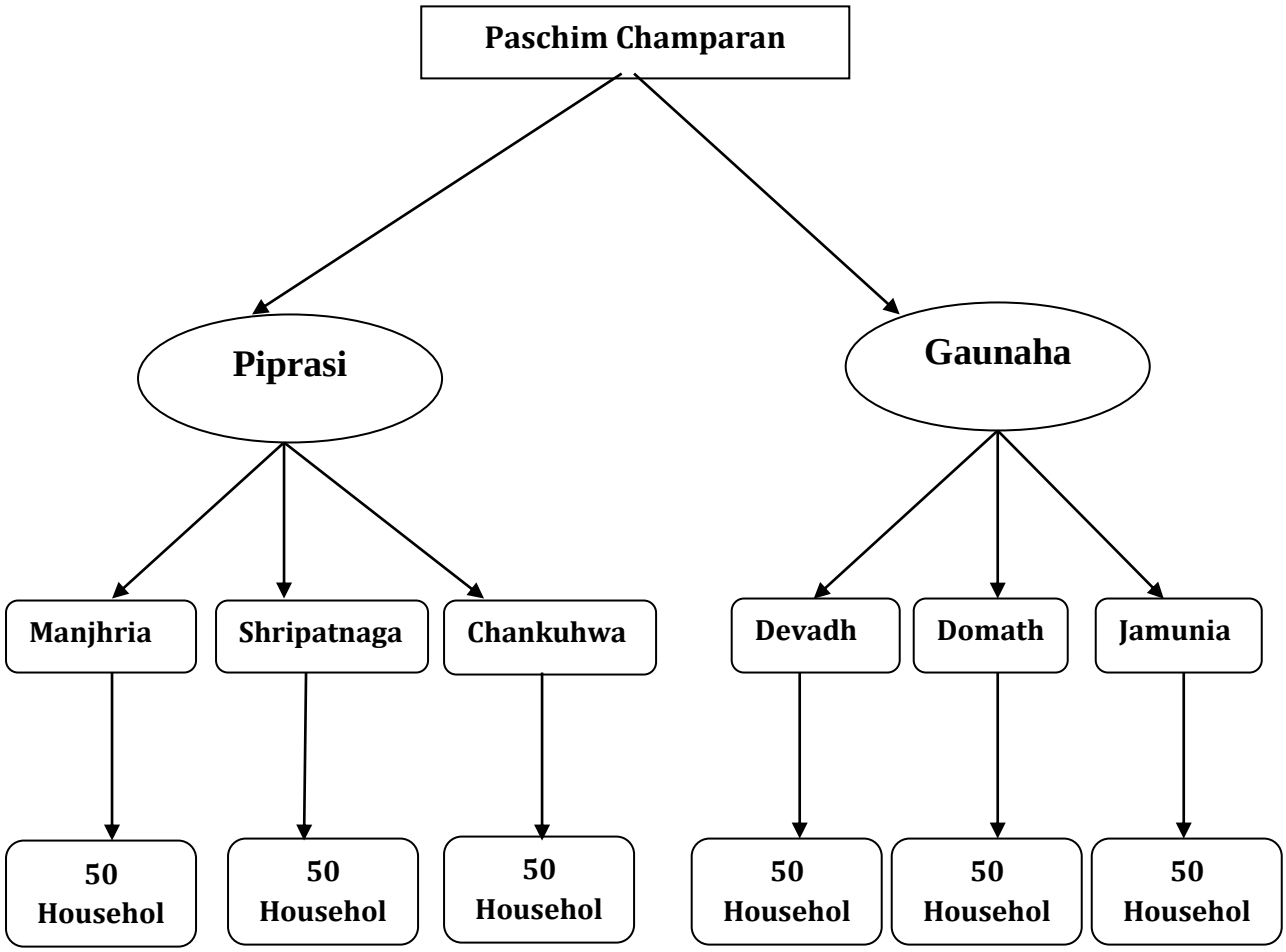
15	Jehanabad	96258	0.849
16	Kaimur	187599	1.654
17	Katihar	295576	2.606
18	Khagaria	233715	2.061
19	Kishanganj	262574	2.315
20	Lakhisarai	76706	0.676
21	Madhepura	235255	2.074
22	Madhubani	662909	5.845
23	Munger	136619	1.205
24	Muzaffarpur	596244	5.257
25	Nalanda	330943	2.918
26	Nawada	193116	1.703
27	Patna	403781	3.560
28	Purnia	482114	4.251
29	Rohtas	282017	2.487
30	Saharsa	212465	1.873
31	Samastipur	459922	4.055
32	Saran	405443	3.575
33	Sheikhpura	59492	0.525
34	Sheohar	80569	0.710
35	Sitamarhi	444998	3.924
36	Siwan	315461	2.782
37	Supaul	305815	2.697
38	Vaishali	470215	4.146
Total		11340990	100.000

Source: Rural Development Department, Government of Bihar.

(b) Sample Design and Size

Based on the records of Department of Rural Development, Government of Bihar, Paschim Champaran District is divided into 18 sub districts. Among them, two sub-districts, viz., Piprasi (99.7 percent) and Gaunaha (99.4 percent) are selected subsequently, there villages from each sub-district are identified based on the criteria as maximum number of households use unclean energy for cooking and other purposes. In total, six villages are selected from two sub-district (Chart 1). Further, household's selection was done with the help of complete enumeration of households within each village and systemic random sampling method was applied for selecting households.

Chart 1: Selection Process of Households



(C) Approaches for data analysis

The present study tried to examine indoor air pollution and its impact on human health. Many diseases are involved in the environment due to indoor air pollution, which affects human health viz., bronchitis, cancer, allergy, skin infection, eye infection, etc. The household uses a different type of preventive measure to minimize the effect of disease through expenditure a considerable proportion of their income. So, due to indoor air pollution, the standard of life and economic conditions are adversely affected, and households are trapped within vicious cycle of poverty.

Health Cost Method

Cost-of-illness method-: The cost of illness method is considered to be an essential evaluation technique for health cost measurement. The cost-of-illness is associated with mortality, morbidity and disability, and other disease characteristics. The effects of mortality and morbidity have been studied under the Health cost method (Gunatilake, H.M. 2003 & Freeman, A.M.III, et.al. 2001-2006).[2] Cost of illness approach will be used to measure the economic burden of health risk on the households. According to the human capital approach, cost of illness studies can be categorized as (1) prevalence studies (ii) Incidence studies. We includes some variable in the study such as medical expenses, loss of wage, defensive expenditure, loss of time and direct and indirect cost of health. Measurement of mortality case can be in this studies through value of statistical life (VLS) method. The Mortality is directly associated with death. It is measured as the total number of death from all causes during a period of time to the average number of the population. Morbidity is

[2]Mortality and morbidity are the two major health effects. Mortality is related to death and morbidity is the change in metal health and physical status. Morbidity can be categorized two part (1) acute- a few day of illness with a well defining beginning and the end. (2) Chronic- long term illness of indefinite duration.

directly related to the time duration of illness. The aforementioned includes chronic Ailment (ailment more than one month, affecting at least one body organ or taking a cause of treatment of one month or more). Ailments of short Run (less than one month) and Spell of ailment (A spell is a continuous period of sickness due to specific ailments) it also includes restrictive activity days, bed disability days, and work loss days (Herath M. Guntilak, 2003 pp113-115 & NSS 71st Round).

Contingent Valuation Method (CVM)

Contingent valuation method (CVM is the survey technique that attempt to obtained stated preference. It is an example of a hypothetical direct valuation technique require the involvement of respondents. It mainly asks people, whether they are willing to pay and not for a benefit. In this method respondents are asked whether they would pay a specified amount for the good that has been described. Under this method fix an initial amount and ask respondents to pay for it if respondent are agree to pay then we increase the amount a certain proportion and ask to pay again. Keep to asks until respondents gives a negative response. If respondents deny/disagree to pay the initial amount then we decrease the amount until respondent gives a positive response.

(e) Statistical Technique for the Study

Several tools and techniques are used for the analysis of primary as well as secondary data such as descriptive statistics, frequency distribution, and graphical presentation. Further, statistical models such as logistic regression is used.

1.11 Chapterisation

Chapter 1 entitled "Indoor Air Pollution: Issues and Methods" covers national and international scenario of air pollution and indoor air pollution. The chapter focus on

the problem of indoor air pollution which affects human health. Moreover, this chapter also presents review of literature, objective, hypothesis, research design and methodology.

Chapter 2 entitled "Energy Consumption and Economic Development: Conceptual & Theoretical Background" analyzes the conceptual linkage between energy consumption and economic development.

Chapter 3 entitled "Pattern of Energy Consumption in Rural and Urban areas in India" has analyzed the usage of different sources of energy for cooking and lighting in rural and urban areas of India on the basis of NSSO's 50^{th}, 55^{th}, 61^{st}, 66^{th}, & 68^{th} rounds. This chapter concludes that the consumption of unclean energy sources in rural areas has been declined at nominal rate, while in urban areas, use of unclean energy has been declined rapidly and use of clean energy has been enhanced.

Chapter 4 entitled "Demographic, Socio-Economic Profile of Households in Paschim Champaran District, Bihar" describes social, economic and demography profile of study area. As a social and demographic indicators age, caste, religion, gender, land holding have been analyzed while as economic indicator status of occupation and income in study area have been discussed.

Chapter 5 entitled "Health Cost Measurement of the Households in Paschim Champaran District, Bihar" deals with health cost through Cost of Illness Method in the Study Area. In this chapter, the total cost of illness has been calculated on the basis of direct and indirect cost method, using the primary data from surveyed area.

Chapter 6 entitled "Willingness to Pay for Clean Energy in the Survey Area: This chapter presents an overview of willingness to pay for clean energy for cooking and

other purposes. To acquire the data for it, two categories of Bid was designed; less than 300 and above 300.

Chapter 7 of the study "Major Findings and Conclusions" finally makes some concluding remarks and policy implications which may be useful for policy makers.

Chapter 2
Energy Consumption and Economic Development: Conceptual & Theoretical Background

Chapter 2

Energy Consumption and Economic Development: Conceptual & Theoretical Background

2.0 Introduction

This chapter analyses the linkage between energy consumption and economic development. The relationship between energy consumption and economic development remains a very burning issue. Energy has always been a problem after the first oil crisis in the 1970s, a lot of work has been done and is happening in the field of energy economy around the world. The mainstream theories of economic growth show little or no role of the energy in encouraging economic growth (stern 2003: p.1). Resource and ecological economists have scalp this theory in fundamental sense, particularly the inferences of thermodynamics for economic production and development. The chapter analyses the background of the theory of energy and economic growth from a different point of views having base in economics as well as in the natural sciences. The worldwide concerns about climate change have encouraged a number of studies assessing the link between economic growth and energy consumption. The Energy sector is the backbone of any economy. None of the economic sectors can flourish without energy. Energy is a fundamental source for economic and social development for every country to reduce poverty and grow. It supports people as they seek a whole range of development benefits viz. cleaner and safer homes, lives of greater dignity and less drudgery, better livelihoods, quality education and health services. Higher economic growth requires more energy consumption and more efficient energy use needs a higher level of economic growth

(Rufael, Y. W, 2006: pp.1106 -1114). Stated that various energy sources are crucial for socio-economic development and none of the countries in the world have subsistence economies that have grown without the utilisation of energy. Ahmad and Ahmad (2014) and Oztruk (2010) observed four different views in this regard: unidirectional causal relationship from energy consumption to economic growth (growth hypothesis); unidirectional causal relationship from economic growth to energy consumption (conservation hypothesis); no causality between energy consumption and GDP (neutrality hypothesis); bi-directional causality between energy consumption and GDP feedback hypothesis (YU, H 2015: p. 3). Behera (2015) in his study of relation between energy consumption and economic growth in India covering period from 1970 to 2011, found mixed and inconsistent results compared to earlier studies in the context of India. He found that in India, GDP growth fuels energy consumption. Yu (2015) carried out a case of the link between energy consumption and economic development in China and found a bi-directional causality between the two. He also verified the Environment Kuznets Curve in the context of China Shahbaz et al (2018). Empirically examined the inter-linkages between economic growth and energy consumption using quintile-on-quintile approach and observed a positive association between economic growth and energy consumption. However, there were significant inter-state variations in the within each country. Above literature suggests that the energy and economic development linkage varies time to time and country to country. Demand for energy is not fulfilled in the developing countries because the size of their population is very high and energy production is very low. India is the fourth largest energy consumer in the world, only behind USA, China and Russia. However, it's the per capita energy consumption is quite low due to large population size. Thus, there exists a huge gap between energy

demand and supply in India as well as in other developing countries. However, despite the crucial role of energy sources, energy consumption has become one of the major causes of the emission of greenhouse gases, which can significantly affect the balance of the global ecosystem. The huge amount of greenhouse gases emitted from the combustion of conventional energy sources (fossil fuels) have led to air pollution and increased earth temperatures resulting into climate change. Energy is the capacity to do the work which comes in various forms, such as motion, heat, light, electrical, chemical, nuclear energy, and gravitational. Total energy is the totality of all forms of the energy that a system keeps. The total energy of a system consists of the kinetic potential and internal energy. In this chapter, we focus on the relationship between energy consumption and economic development. The objective of the study is to find out whether energy consumption influences economic development or not and vice versa.

2.1 Defining Energy

Energy is the major input for sustainable development and poverty reduction efforts. With increasing awareness on environmental issues, energy production and consumption have developed to be the focus areas as they result in environmental pollution at local as well as at global level. Historically, industrialized countries have released huge amount of pollutants into the earth's atmosphere as a result of their industrialization and urbanization. This is now becoming an issue of major concern for developing countries. The developmental activities in the upcoming developing nations will also increase GHG emissions. Eighty percent of the world population lives in developing countries but their energy consumption amounts to only 40 percent of the world's total energy consumption. This is an unpleasant situation

between developed and developing countries of the energy consumption. The high energy consumption level in developed countries reflects their higher standard of living. In developing countries, the standard of living is not high but the growth rate of population is significant which raises their per capita energy consumption and they fall in the category of high energy consumption countries.

Environmental consideration is directly related to pursuits of energy needs. At present time every household needs modern and clean energy sources to live to healthy and long life. Access to modern energy services is fundamental to fulfilling basic social needs, driving economic growth and fuelling human development. This is because energy services have an effect on productivity, health, education, availability of safe water and communication services. Modern energy sources such as electricity, natural gas, modern cooking fuels and mechanical power are necessary for improved health and education, better access to information and agricultural productivity.

2.2 Benefits from modern energy sources

Pachauri et al (2011) outlined some of the benefits which people relish with access to modern energy sources are outlined below:

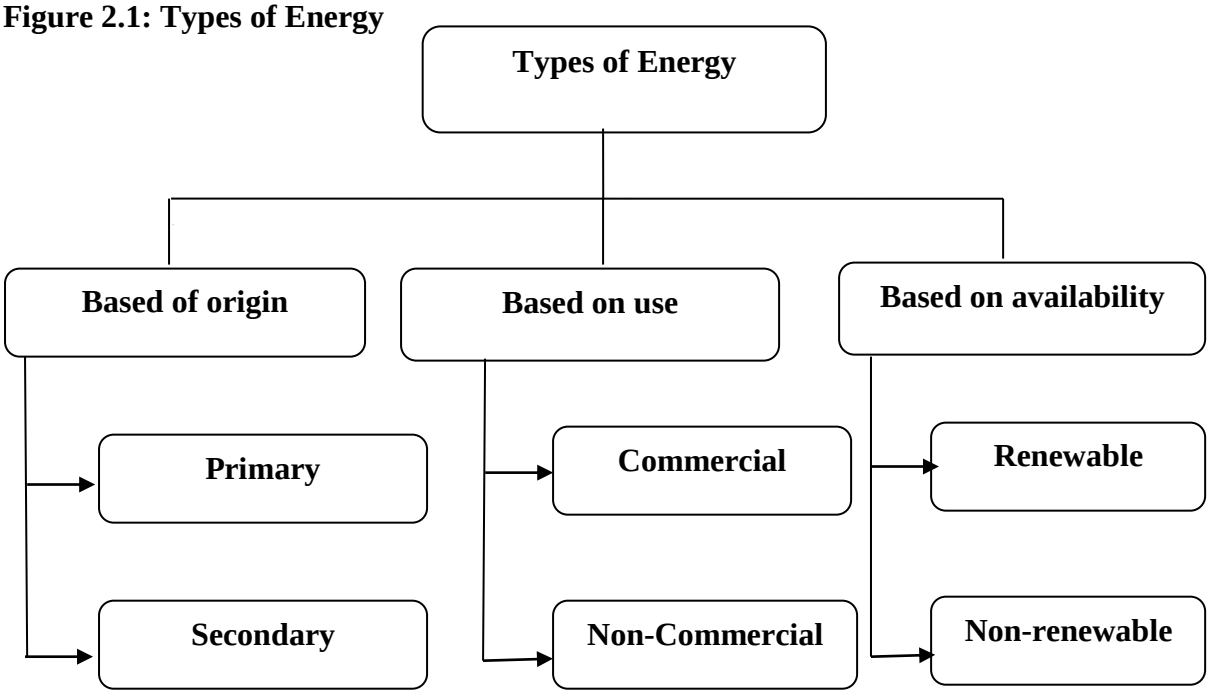
Private Benefits: Household Lighting, Communications & Entertainment, Thermal Comfort, Other Appliances**,** Enhanced Income Generation Options Mechanical, Power, Microenterprises, Community Services Public Lighting, Health (refrigeration for vaccines), Education, Economic/ Livelihood Impacts of Lacking Access to Modern Energy: Limited productive hours in the day for those un-electrified and who spend time in own fuel collection Lack of access to electricity and mechanical power also limits work and business possibilities

Environmental Impacts of Solid Fuels Dependence:

Ecological impacts right now getting most consideration are related with the arrival of Ozone depleting substances into the climate, essentially carbon dioxide, from ignition of fossil energizes. The three essential non-renewable energy sources coal, oil, and petroleum gas- each incorporate carbon. During ignition, carbon consolidates with oxygen to deliver carbon dioxide, the essential ozone depleting substance. Carbon dioxide gathers in the environment and is relied upon to result in huge inconvenient impacts on the world's atmosphere, including a worldwide temperature alteration, ascends in the sea levels, expanded power of hurricanes, and misfortunes in biodiversity. Coal burning, especially high sulphur coal ignition, produces oxides of sulphur, which, through barometrical substance responses, bring about corrosive downpour. Vehicle fuel ignition discharges oxides of nitrogen and unpredictable natural mixes, which, within the sight of daylight, bring about brown haze. Electric producing offices regularly utilize a lot of water for cooling and discharge the warmed water into lakes or seas, prompting neighbourhood impacts on the biological system. Extraction of oil or mining of coal can prompt subsidence of the land overlying of the extricated stores. Inescapable natural effects of energy use, missing administrative intercession, infer that noteworthy expenses of energy use are excluded in the value energy client's face. These supposed externalities (see ecological financial matters section) lead to abuse of energy and give solid inspiration for intercessions intended to decrease energy use (Sweeney, undated).

2.3 Classification of energy

Figure 2.1: Types of Energy



2.3.1 Primary and Secondary Energy

Primary energy– Primary energy sources are either found or stored in nature. Coil, oil, natural gas and biomass are common primary sources. Other primary sources include nuclear energy from the radioactive substance, thermal energy store in the earth's interior, and potential energy developed from the earth gravity. Most primary energy sources are converted into secondary energy sources for industrial.

Secondary energy – Secondary energy is transformed from the primary energy in the form of electricity or fuel. Characteristic the primary and secondary energy source is important in the energy balances to calculate and record energy supply, transformations, and losses.

2.3.2 Commercial and Non-Commercial Energy

Commercial energy - The energy sources that are available in the market and are traded as commodities for a definite price are known as commercial energy. The

commercial fuels are predominant sources of energy not only for economic production, but also for many households' requirements of the population. Coal, Lignite petroleum products and natural gas are the most important sources of commercial energy. The sources of commercial energy in India are both natural and derived.

Non-Commercial Energy- Non-commercial energy not available in the market for a price and are classified as non-commercial energy. Firewood and chips, cow-dung, agriculture residues fall within this category. They are usually not bought on a certain price but gathered by people and its use is more prevalent in rural areas of India and developing countries. Non-commercial fuels are often ignored in energy accounting. But in a developing country like India, non-commercial fuels (energy) plays a critical role is satisfying the basic energy requirements of the people.

2.3.3 Renewable and Non-Renewable Energy

Renewable energy– Renewable energy is found from sources that are essentially inexhaustible. Resource of renewable energy, biomass, hydropower, wind, solar energy, water, nuclear, weaves, geothermal and ocean energy. The most important feature of renewable energy is that it can be harnessed without the release of major harmful pollutants. Non-renewable energy – Non-renewable energy is exhaustible since its sources are available in limited amount and take millions of years to be regenerated. The sources of non-renewable energy include conventional fossil fuels such as coal, oil and gas, which are likely to exhaust with time.

2.4 Energy Security

The International Energy Agency defines energy security as "the uninterrupted availability of energy sources at an affordable price". The International Energy

Agency (IEA), as a nodal agency for ensuring global energy security, was formed in November 1974. There is no consensus on the definition of energy security. Different people define of the energy security in different ways. Some of the mentionable definitions are given as follows:

Clawson defined it as "a continuing access of energy source to the consumer at a reasonable price to support the economic and commercial activities necessary for the sustained growth of the economy"

Yergin defined energy security as "the security and integrity of the world supply chain and infrastructure, from production to the consumer"

Dr. APJ Abdul Kalam (2005), renowned scientist and former president of India, defined energy security as "ensuring that our country can supply lifeline energy to all its citizens, at affordable costs at all times"

The Planning Commission of India (2006) defined it as "we are energy secure when we can supply lifeline energy to all our citizens irrespective of their ability to pay for it as well as meet their effective demand for safe and convenient energy to satisfy their various needs at competitive prices, at all times and with a prescribed confidence level considering shocks and disruption that can be reasonably expected".

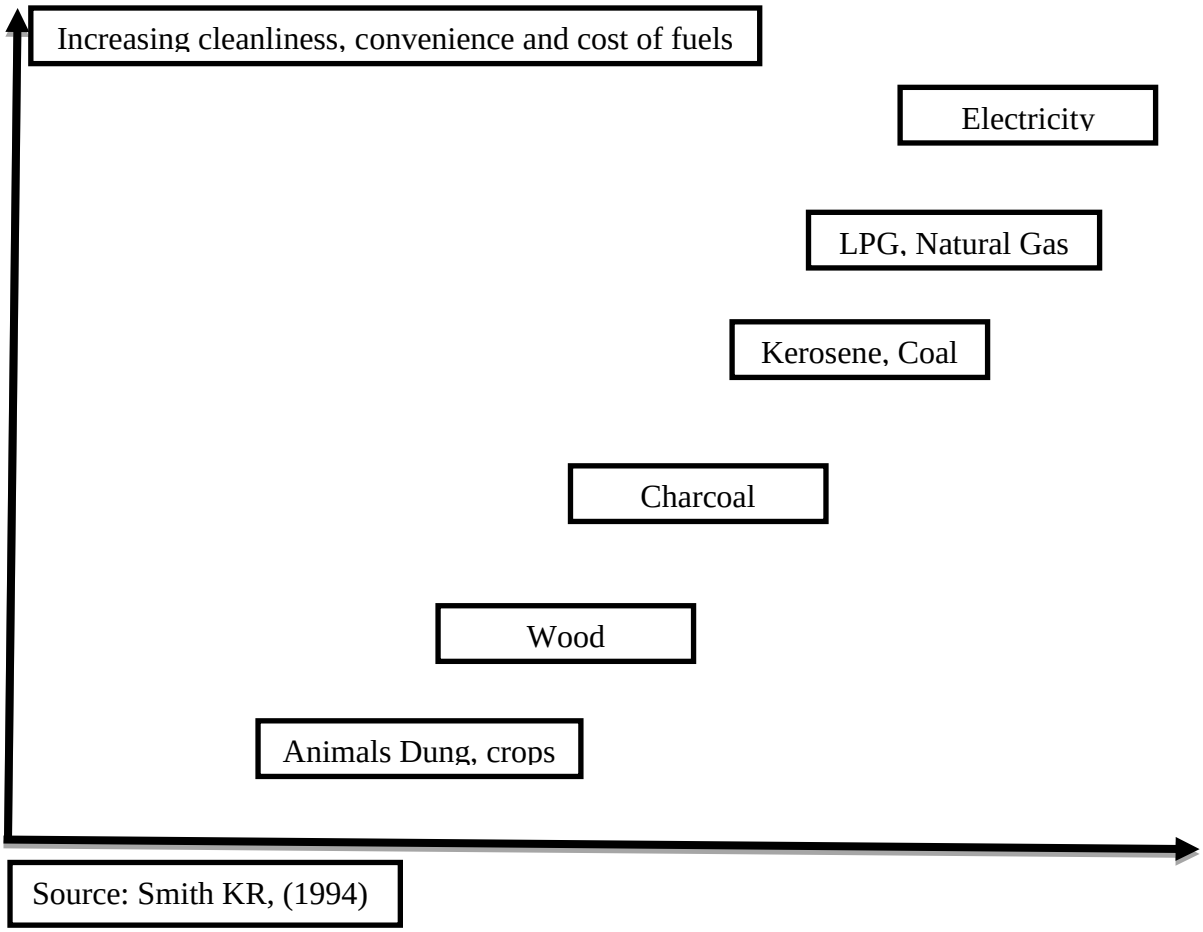
Azzuni and Breyer (2017) in a literature review on energy security, found fifteen dimensions of energy security, which are, availability, diversity, cost, technology and efficiency, location, time frame, resilience, environment, health, culture, literacy, policy, employment, military and cyber security.

2.5 Energy and Economic Development: Conceptual Linkages

Fuel use in developing countries depends on income level and socioeconomic status, which is the poorest households, consuming cow dung, charcoal, wood, and agricultural waste while electricity, LPG, kerosene oil cities and those having good socioeconomic status are households use. Which is called the energy ladder, as shown in the figure 2.2 (Smith KR, 1994: p. 588). Relations between energy, other inputs, and economic activity change significantly as the economy goes through different stages of development. Barnes and Floor refer to the "energy ladder" to define this occurrence, however, it is acknowledged by these authors and others that the ladder thought does not imply a monotonic transition from one type of energy to another (Barnes and Floor, 1996: pp. 500-502).

Being at the lowest level of income and social development, people mainly depend on more processed biofuels (wood, charcoal, agricultural wastes, and cow dunk). Commercial fossil fuels and eventually electricity become predominant in the most advanced stages of industrialization and development. Energy resources at different levels of re-development can be used concurrently at any stage of economic development. Along with the change in relative opportunity costs, income can move energy upward (Barnes and Floor, 1996, pp. 500-502). This is stated in his 2003 article Energy and Economic Development: An Assessment of the State of Knowledge, (Toman, M. A., & Jemelkova, B, 2003: pp. 95-96).

Figure 2: Energy ladder in developing countries



Source: Smith KR, (1994)

Despite substantial differences in the nature of energy forms and economic activities at various stages of development, some common elements can be observed. Energy provision or acquisition is an expensive activity, depending on a wide variety of inputs, such as the cost that domestic labour biomass has in the lane or the expenditure for commercial fuels and the inputs needed to provide them. Energy use also depends on the opportunity costs of other inputs (kitchen or power grid). Lastly, the literature makes clear that experiential patterns of energy production and utilization signify a great deal of micro-adaptation behaviour, given the constraints faced by economic performers (Barnes and Floor, 1996, pp. 500-526, & (Toman, M. A., & Jemelkova, B, 2003: p. 96).

2.6 Theoretical Linkage between Energy Consumption and Economic Development

Physical theory shows that energy is essential for economic production and therefore growth (David I. Stern, 2004: p1).Reproducibility is the main notion in the economics of production. Certain inputs to production remain non-reproducible, though others are able to be manufactured at a cost inside the economic production system. Capital, labour, then in the longer term even natural resources, are reproducible components of production, while energy is a non-reproducible component of production, though of sequence energy vectors-fuels- are reproducible components (Stern, 1999: p. 4). Thus, natural scientists and some ecological economists have placed huge importance on the role of energy and its availability in the economic production and growth processes (Hall et al., 2001, 2003: p. 4). Toman and Gemelkova have a different approach. In their article Energy and Economic Development: An Assessment of the State of Knowledge 2003 examines the relationship between economic growth and energy, how energy use is driven by economic development is. He claimed that the relationship between energy and economic development differs from the stages of the development process and concludes that energy is a significant component of economic development. For example, at the lowest level of development, energy comes mainly from biological sources (wood, cow dung, and incense for drying) and human effort. In the intermediate stages, more processed biofuels (charcoal/fuel wood), animal power and some commercial fossil energy are more important. In the most advanced stages of development, demand for commercial fuels such as modern fuel commercial fossil fuels and ultimately electricity becomes drastic in the most advanced phases of industrialization and development (Toman, M. A., and Jemelkova, B, 2003: pp. 93-

96). Azlina, A.A. has also discussed energy consumption and economic development in his article Energy Consumption and Economic Development in Malaysia: A Multivariate Cointegration Analysis (Azlina, A.A, 2012: pp. 675-676). Energy use is also used an indicator of the state of economic development (Kardashev, 1964: p. 4). This study is usually classified into three types. The first type of energy consumption as a crucial input factor of production in different economic development models is how energy consumption, economic development, and development, in theory, can be affected. The second type of empirically investigates the Granger cause between energy consumption and economic growth. The third type is related to the so-called environmental Kuznets formations (EKC), a hypothetical inverted-U-shaped construction and essentially the environment. Used to reflect the relationship between pollution and economic development. Some researchers gradually enlarge the application of EKC to examine the relationship between energy consumption and economic development. Theoretical research on economic development and energy consumption relations can be traced to seminal research conducted by Hotelling (1931), who first examined the effect of total resources on economic development. The overall idea is that fossil energy is a kind of exhaustible resource, and its price would inevitably go up to a prohibitive level as its reserves approach zero. So, around is an optimal time path for fossil energy to find out and use, so that the flat and sustainable economic growth could be sustained. The proxy studies include Solow (1974), Stiglitz (1974), Weinstein and Zeckhauser (1975) and were surveyed by Dasgupta and Heal 1979 (YU, H, 2015: p. 1). Environmental literature has been formulated by English economists who lived between the late 18th and early 20th centuries. These theories include the Malthusian doctrine of population growth and resources scarcity, John Stuart Mill's theory of the steady-state economy,

and the Neo-classical economic notion of efficient markets as the solution to an environmental and resource problem.

Classical economics considers land, labour, and capital as the primary factors of production. Land is the physical capital (environment) which serve as indispensable natural resources for every economic activity to take place. According to mainstream theories, labour and capital are considered to be the major inputs of production and the role of energy is downplayed. In reality, it is not so as energy is required in every single economic activity. However, the exhaustibility of natural resources gives rise to concerns about its possible effect on productive capabilities. The oil crises in the 1970s signalled that the world would run out of oil and, consequently, of energy (Tahvonen, 2000) leading to a slowdown in productivity (Stern, 2004a).The economic theory recognizes labour and capital as two important inputs of the production process and does not give energy per se as a factor of production. Energy is treated, instead, as an intermediate product of labour and capital. The contention for or against this complex notion is not central to our present discussion. What is central is that, if energy is not a primary input to the economy, it follows that the availability of energy, and the price of energy, are not critical to economic activity or growth. From the neoclassical perspective, it could be argued that raising the price of energy by even a factor of two would only reduce the GDP by a negligible amount. The established theory assumes that growth is mostly attributable to technological progress, which is assumed to be exogenous and automatic. The increase in the state of technical knowledge raises the return to capital, thereby offsetting the diminishing return to capital. However, Energy, the environment, and economic growth, this book written by Dale W. Jorgenson and Peter J. Wilcoxen in this book mention that Economic growth is a critical determinant of demand for

energy. The utilization of energy, especially the combustion of fossil fuels, is an important source of environmental pollution. Growth projections are essential for estimates of future demands and supplies of energy and future requirements for pollution controls to maintain environmental quality. The natural point of departure for modelling economic growth is the neoclassical theory of growth originated by Solow (1956, 1988).This theory has been developed in the form used in modelling the interrelationship between energy, the environment, and economic growth by Cass (1956) and Coopman (1967). Maler (1974, 1975) and Uzawa (1975, 1988) have presented neo-classical theories of economic growth with pollution abatement and Solow (1974a, 1974b) has provided a theory that includes supply and demand for an exhaustible resource (Jorgenson, D. W & Wilcoxen, P.J, 1993: p. 1267).

Some other biological economic models suggest that energy is the main essential factor of production. This could be comprehended as there being a given load of energy that is debased during the time spent giving services to the economy. Be that as it may, this implies the accessible energy in every period should be exogenously decided (Stern, 1999). In some biophysical monetary models (for example Gever et al., 1986) land limitations fix the pace of energy extraction. Then again, capital and work are treated as streams of capital utilization and work benefits instead of as stocks. These streams are figured in terms of embodied energy use related with them and the whole worth included the economy is viewed as the rent arising to the energy utilized in the economy (Costanza, 1980; Hall et al., 1986; Gever et al., 1986; or Kaufmann, 1987). Costs of products should then be calculated by exemplified energy cost (Hannon, 1973b) – correlated with energy cost (Constanza, 1980). This hypothesis – like the Marxian worldview - should then clarify how labour, capital and so forth wind up accepting piece of the surplus. Energy surplus

must be appropriated by the proprietors of labour, capital, and land with the genuine conveyance of the surplus relying upon the relative haggling intensity of the diverse social classes and remote providers of fuel (Kaufmann, 1987). On the off chance that we expect constant returns to scale, the process of production can be represented by Leontief input-output model with a solitary essential factor of production (Hannon, 1973a; Stern, 1999). Nonetheless, these biological experts additionally contend that the energy required to create fuels and other intermediate product as the nature of assets, for example, oil stock decays after some time. Subsequently changing asset quality can be spoken to by changes in the embodied energy. Nordhaus (1992) has presented a Dynamic Integrated Climate-Economy (DICE) model for analysing the economics of global warming. Nordhaus's model of world economic growth provides a dramatic illustration of the power of the neo-classical framework in analysing the impact of energy and environmental policies. This model is calibrated to extensive data on the growth of the world economy. Changes in the global climate are generated by economic activity, especially the combustion of fossil fuels. The physical model of climate change includes the principal feature of simulation models for the global climate developed by climatologists. Climate change feeds back to economic activity by reducing productivity levels. These mechanisms provide the basis for the design of an optimal environmental policy by the application of a sophisticated version of cost-benefit analysis. (Jorgenson, D. W., & Wilcoxen, 1993: p.1271). As developing countries demand more energy to drive economic growth, an important policy issue arise that whether they should follow industrial countries and follow a policy of polluting first and clean later or leap-frog towards adoption of cleaner technology and avoid the mess in the first place. The economic logic behind the first comes from the observation known as the environmental Kuznets Curve which suggests an inverted U

curve so that the relationship between per capita pollution and per capita income. However, there are several criticisms of environmental Kuznets hypothesis. Firstly, there is no standard shape or relationship that is valid for all pollutants or for all regions. Secondly, the result is highly dependent on the econometrics methods used and the data analysed. Different researchers have reported different results for the same pollutant, indicating the lack of robustness of the results. Thirdly, the research that finds such a relationship is unable to explain the process through which the cure takes place. Lastly, the estimation often ignores the feedback from environmental damage to economic activities. If the environmental damage is sufficiently strong, it is likely that the economic activity will be affected and therefore, ignoring this does not provide a correct picture. Further, in this regard, Stern (2003) concludes that there is no strong evidence that countries follow a common inverted U shaped pathway for environmental damage as their income rises. Webber and Allen (2010) conclude that there is no single relationship between environmental quality and income. Moreover, it may take decades before reaching the trend inversion and accordingly, waiting for such times will not make sense. Proactive policies and measure would be required to mitigate the problem (Bhattacharya, S. C, 2011: pp. 527-561). Okun (1974, 1975), on the neo-classical line of thinking, argued that energy as compared to other production inputs, constitutes only relatively 'a small cost share' in total output. This being the case, energy price changes would have relatively a small impact on the economy. Others have also supported this view. Perry (1975, 1977) further suggested that it is hard to believe that high-energy prices can affect productivity and output growth, since it is only one of the many production components. This also supports the belief that the increase in price of energy would substitute labour for capital without affecting production and growth (Ebohon, 1996). Bemdt and Wood (1975) argued

that while energy and labour may be substitutable, the complementary relationship between energy and capital raises its importance far more than its cost share. Implicitly, the dynamic impact of this relationship for output and productivity underlines the important influence that energy has on economic growth. Okun (1974, 1975) evidenced that energy and labour, on the one hand and capital and labour on the other are substitutable. Thus, it is possible to compensate for an energy-induced decline in national income by substituting labour or capital. However, there is no unanimous agreement on the relationship between energy and capital. Opposite to the belief of Neo-classical perspective, which demonstrates that energy plays an insignificant role in the development process of an economy; however, the magnitude of energy's influence on the economy has been hotly debated by macroeconomists. Consequently, efforts have been made on to discover the exact relationship between energy and other factors of production as to whether energy complements or substitutes other factors in production. Such knowledge would have significant bearing on energy policy formulation as already have been emphasized in most of the literature. The qualitative argument for introducing usefulness of these inputs as factors is that economic growth has always been a positive feedback cycle, in which lower cost leads to lower prices of goods and services which generates increased demand and through economies of scale, R & D and learning from experience, lowers the cost again. Efficiency gain in the economy as a result of energy consumption also leads to additional costs. These costs would slow down the growth rate and make production less competitive. This is why the developed economies such as Canada and United States have greater reluctance to move forward on energy efficiency.

Neoclassical assume that the technological change is endogenous and follows a stochastic path. The indignity is not needed to explain past growth, but one would be

interested to allow the technology to follow a stochastic path. To model future technological change one needs to model the endogenous process. Such modelling also needs to take into account the technological change which cannot overcome the limits to substitution imposed by physical laws and that .there are decreasing returns to research effort. In this biophysical model of growth, increased energy use does not generate much economic growth unless accompanied by increased use of capital and labour. However, increasing capital and labour use without increasing energy use also results in little gain in output. Therefore, in our view, while energy is essential in production, increased energy use cannot have been the driver of economic growth. Instead, the inability to expand energy use would hold back or constrain the level of economic output. The innovations that increased energy supply at the beginning of the industrial revolution removed a constraint that prevented modern economic growth. Continuous smooth expansion of the energy supply and its rising quality has been essential to maintaining the growth path since then. The oil crises in the 1970s and early 1980s depict the story about what happens when there is a hiccough in this smooth expansion path. It could result in slowdown in economic growth. The shifts in the mix of the other inputs, for instance from a more labour intensive economy to a more capital-intensive economy can affect the relationship between energy and output and thereby, the energy consumption and economic growth (Stern and Cleveland, 2004). Studies have reached varying conclusions on whether capital and energy are complements or substitutes (Berndt and Wood, 1979; Apostolakis, 1990). Based on the differences in time series and cross-sectional results, Apostolakis, (1990) concluded that capital and energy act more as substitutes in the long-run and more as complements in the short-run. There are evidences of complementarity where the cost share of energy is found to be small (Frondel and Schmidt, 2002).

The causality between India's energy consumption and GDP were mostly focused on aggregate energy consumption or on a single source of energy. Generally, such studies were done in oil, petroleum and at the most electricity. Besides, the evidence obtained by these studies is mixed and not absolute. To verify the causal relationship between energy consumption and GDP, Granger causality test has been utilised. Granger causality test is a statistical hypothesis for determining that a particular time series is useful in forecasting another or not. To show the relationship between energy consumption and GDP at aggregate as well as sectorial level, there will be used long period data by using a two-step procedure" (Bhaskar, B., 2011: pp. 103-112).

Further, an article estimates the reactivity of prices and household expenditure of energy consumption for cooking and lighting at the household level in rural and urban India. This article used a dummy variable regression approach estimated for energy elasticity for the rural and urban areas in India. The data has been taken from NSSO 66th quinquennial rounds of unit-level data for the year 2009-10. The author found that energy intensity for rural areas is higher than in urban areas while the average expenditure recorded on energy for cooking and lighting in urban areas is higher than in rural areas at all India level. Most of the households are using dirty fuel for cooking in rural areas while in urban areas clean fuel, that is, LPG is used for cooking. The expenditure of energy for cooking and lighting at the household level is inelastic. The marginal budget share in rural and urban areas is the same. Results expose the fact that a hundred percent increase in the prices of energy for cooking and lighting will increase the expenditure of households in rural regions more than in the urban region. (Pandey, A. K. 2014: pp.77-92). Energy system are defined as a transmission and distribution network when energy or energy benefits are needed as needed. Energy is

fundamental to economic and social development; to reduce poverty and continue to grow. Important role of energy whole development of people and safe and clean home, lives of greater dignity to batter livelihood and better education and health services. (Bilgiç, G. 2017). The above theoretical discussion is based upon the relevant mainstream and neoclassical theory of growth, biophysical theory, and resource economics models of growth, and the various mechanisms that can weaken and strengthen the links between energy and economic growth. Physical theory shows that energy is necessary for economic production and therefore, growth but the mainstream theory of economic growth, except for specialized resource economics models, downgrades the role of energy. In line with physical theory, the resources models of economic growth points out that along with the use of other resources, when the composition of energy use is more in favour of high quality energy, it leads to higher economic growth as the lower quality of energy may impede economic growth due to emission of CO2 and consequent large scale environmental degradation, this is a negative externality. The chapter subsequently reviews some of the empirical literature that finds energy use per unit of economic output has been declined, but this is to a large extent due to a shift from poorer quality fuels such as coal to the use of higher quality fuels and electricity. In contrasts, developing countries like India presents a different picture where either there is a decline or constancy in the various forms of energy consumption as a percentage to GDP and sometimes it is observed that they consume greater quantity of energy which is abundant in its supply in the domestic economy. The decline in electricity consumption as a percentage of GDP along with decline in other form of energy consumption. The decline in various forms of energy consumption is not associated with any compositional changes in the high quality of energy consumption. The

decline in the ratio could be due to faster growth rate of GDP than the energy consumption itself, simultaneously with an absolute rise in various forms of energy.

2.7 Conclusion

This chapter discusses that there is a very strong link between energy consumption and both the level of economic activity and economic development. After reviewing many articles and theories of energy consumption we found that energy plays an important role in economic development. Considering, energy consumption, it is observed that energy use/consumption depends on income i.e. higher-income group usage more clean fuel than lower income group). The chapter studies the linkage between various forms of energy and the importance of energy in economic growth/development while going through various theories and models. Further, the chapter provides a review of the environmental issues related to energy consumption and economic development. It also presents the benefits, impacts of energy on an individual and overall wellbeing of the society. The chapter subsequently reviews some of the empirical literature available on energy use pattern and trend, thereby ascertaining that energy use per unit of economic output has declined but this is to a large extent due to a shift from poorer quality fuels such as coal to the use of higher-quality fuels and electricity. The chapter has explained economics and environmental thinking on this important issue and considered alternative options to deal with the problem.

Chapter 3
Pattern of Energy Consumption in Rural and Urban Areas in India

Chapter 3

Pattern of Energy Consumption in Rural and Urban Areas in India

3.0 Introduction

Worldwide Energy access must go beyond electricity to ensure that people have access to clean fuels for meeting their heating and cooking requirements, and also help in livelihood enhancement. Energy access is not only essential at the household level, but is also very critical to the provision of basic minimum infrastructure such as hospitals, schools and industries among others. Developmental goals and energy access are very closely linked for a country like India. "Worldwide Energy Access" as a goal is necessary not just for each household but also for the associated sectors in an economy that will play an important role in economic development with sustainable environment. There is a shift towards usage of unsoiled fuel in India but these changes are negligible as other variables like population are also surging up in an economy like India. More than two-thirds of the population lives in rural India, firewood and chips were used by more than two-third (67.3 percent) of rural households, followed by LPG, which was used by 15 percent of households. For the year 2011-12 only 9.6 percent of the rural household used dunk cake and 1.1 percent coal while 1.3 percent rural households did not have any arrangement for the cooking purpose. Even after six decades of independence and two decades of economic liberalization, it remains the bitter truth that majority of rural people are still dependent upon biomass fuel for cooking. It is adversely affecting the health of rural household's especially females. The availability of energy is an important determinant of the quality of life in human settlements. Access to modern energy services is

fundamental for fulfilling basic social needs, driving economic growth and driving human development. This is because energy services have a dichotomous relationship with productivity, health, education, availability of safe water and communication services. Modern energy sources such as electricity, natural gas, modern cooking fuels, and mechanical power are necessary for improving health and education, better access to information and agricultural productivity. Furthermore, the way in which energy is generated, distributed and consumed affects the local, regional and global environment with serious implications on livelihoods, income and human development. Energy is essential to attain the quality of life and economic prosperity. The study focused on energy consumption in Indian households, particularly the impact of indoor air pollution on females. Rural households in particular, are almost entirely reliant on traditional biomass for their basic cooking energy needs. In India, the energy consumption patterns in rural areas have been largely driven towards using firewood and other traditional biomass fuels such as chips, charcoal and dung cake. The demand for energy particularly in these areas consists mainly of energy for cooking and energy for lighting. Improving and extending access to energy services is one of the most important tasks that needs to be taken care of. Energy is also classified as renewable and non-renewable energy sources. Renewable sources of energy help the nation in keeping the environment clean and green. Though these sources of energy are pollution are free, but a bitter fact is that they do not reach to the whole population. Cooking energy has the major share in total household energy consumption. Accessibility and availability of cooking, fuels at affordable prices is becoming difficult day by day for poor people, many of homes are outside the accessibility of modern energy system. Cooking fuels in the rural areas of India are predominantly unprocessed bio-fuels, such as fuel-wood, crop residues and animal

dung (Barnes and Sen., 2000), the use of these bio-fuels causes, many health problems especially to females (Parikh, 1995; Parikh and Vijay Laxmi, 2000).

The household sector is one of the major consumers of energy in India. In an overall national energy budget it accounts for about 50 percent of the total energy consumption though its share in commercial sector is only 12 percent (2005-2006). In India, about 75 percent of the total population lives in villages. In this chapter, an attempt is done to analyse the energy scenario of rural India' after globalization. A paramount changes in the nature of energy consumption can be witnessed as observed by various NSS round (50th to 68th round). This chapter present the separate consumption of rural and urban households by primary source of energy in terms of cooking and lighting, separately for each major state

3.1 Estimation of Poverty during 1993-94 to 2011-12 in India

Table 3.1 shows during the period 1993-94, the percentage of poor in the rural areas was highest in 50.1 percent are comparison to urban areas, i.e. 31.8 percent. During 2004-05, the percentage of poor in the rural areas was again highest in comparison to the urban areas i.e. 41.8 percent in rural and 25.7 percent in urban areas but with each passing time, the share of poorer has been decreasing. In 2011-12, the percentage of poor in the rural areas was 25.7 percent and 13.7 percent in the urban areas 2011-12, From the table, it can be concluded that the share of poor in the rural areas is higher in comparison to urban areas, secondly, the number of poor is decreasing gradually during the year observed in both the areas of rural and urban (Planning Commission 2014: p.18).

Table 3.1: Percentage of poor as estimated by Expert Group

Year	Rural	Urban	Total
1993-94	50.1	31.8	45.3
2004-05	41.8	25.7	37.2
2009-10	33.8	20.9	29.8
2011-12	25.7	13.7	21.9

Source: GOI, Planning Commission, 2014

Poverty alleviation program was launched in post-independence India through the Five Year Plan, which resulted in the percentage of poverty falling in subsequent year's between1993-94 to 2004-05 i.e., 0.75 percent in the rural areas and 0.55 percent in an urban area. The total decline was 0.74 percent in both areas in eleven years. But in almost seven years between2004-05 to 2011-12, the rural area declined by 2.32 percent and the urban area by 1.69 percent. Seven years declined by 2.18 percent in both the areas, which was higher than the previous years? The overall decline was 1.36 percent in rural areas and 1.01 percent in urban areas, 1.30 percent in both areas (Planning Commission 2014: p.18). Due to economic backwardness, many households do not currently have access to clean fuel. Due to which households have to face many types of diseases related to air pollution and poor people get caught in the vicious cycle of poverty. As per the report published by planning commission (2014) the decline in poverty ratio was highest for the period 2004-05 to 2011-12 (2.18). During this period a decline in poverty ratio can be estimated for both rural as well as urban area. For the period 1993-94 to 2011-12 the decline in poverty ratio as estimated by the commission is 1.30 in total while for rural areas a decline of 1.36

percent can be observed and for urban areas a meagre decline of 1.01 percent can be observed.

3.2 Energy Poverty

The relationship between energy and poverty has been one of the debatable topics among development experts for decades (IEA, 2002). It has been argued that energy used especially modern energy such as electricity, is essential for economic development (Besant-Jones 2006: p. 35; UNDP 2005: p.9). Energy poverty is a frequently used term among various energy specialists, but unfortunately the concept is rather loosely defined. Several existing approaches measure energy poverty as an energy poverty line where the minimum quantity of physical energy needed to perform such basic tasks as cooking and lighting. This definition of poverty has evolved over the years from being a measure of income poverty to a much more comprehensive measure of deprivations of any kind such as health, education, income, energy and so on. Energy poverty is often defined in terms of expenditure on energy as a proportion of household expenditure. According to the data published by various energy reports approx 2 billion people live without access to electricity in the world, 400 million (57 percent population) without access to electricity in rural India. If defined according to the definition than almost 57 percent households are energy poor in rural areas and 22 percent that are income poor in India while for urban areas the energy poverty rate is 28 percent as compared with 20 percent that are income poor. The lack of energy, especially modern energy, is a cause of poverty. The linkage between modern energy access and welfare is well documented. The use of more modern fuels like LPG can reduce the problem of fuel poverty. In rural areas, wood and fuel are often collected by women and school-going children, forcing them to get away from other productive activities (Saghir 2005: p.10 Barnes and Toman 2006: pp.

6-7). Thus, replacing traditional way of consuming biomass with more efficient energy-consumption methods or consumption of modern energy can lead to time saving and better opportunities. Use of electricity need to be extended to household members' on work and study hours which contribute to productivity and educational achievements (Cabraal and Barnes 2006; Roddis 2000; Wassermann and Davenport 1983; World Bank 2002c). Energy poverty is regularly mobilized as a normative argument in international negotiations. India has always been particularly outspoken in this respect, taking the lead of the G77 and also of the BASIC countries (Brazil, South Africa, India, China) (Michaelowa and Michaelowa. 2012: p. 235). In the EU-India energy discourses, the subject of energy poverty is mentioned implicitly. The significance of continued growth comes up constantly. Energy security has been promoted as a new focus of the dialogues from the Indian side. While this may not be directly apparent for European partners in the discourse, Indian actors construct "energy security" not just as "security of supply," but more comprehensively so as to cover all aspects of access, affordability, availability, and sustainability, echoing notions of "human security" going decisively beyond limited geopolitical considerations (King and Murray 2001; Noronha 2012: p.2). The Government of India's Planning Commission delivers a conforming definition of energy security: "We are energy secure when we can supply lifeline energy to all our citizens irrespective of their ability to pay for it as well as meet their effective demand for safe and suitable energy" (Government of India's Planning Commission 2006: p.54). Directly or indirectly, the argument stands behind India's request that industrialized countries should support, or at least not impede India's and other developing and emerging countries' quest for economic growth and their determined for energy security. According to International Energy Agency (IEA) in 2010, 66 percent of the

Indian population used traditional biomass for cooking, and at least 25 percent did not have access to electricity (IEA 2014). Generally, India thus strongly opposes any emissions-related commitments for emerging economies.

3.2.1 Pattern of Energy Consumption at Household's level in India

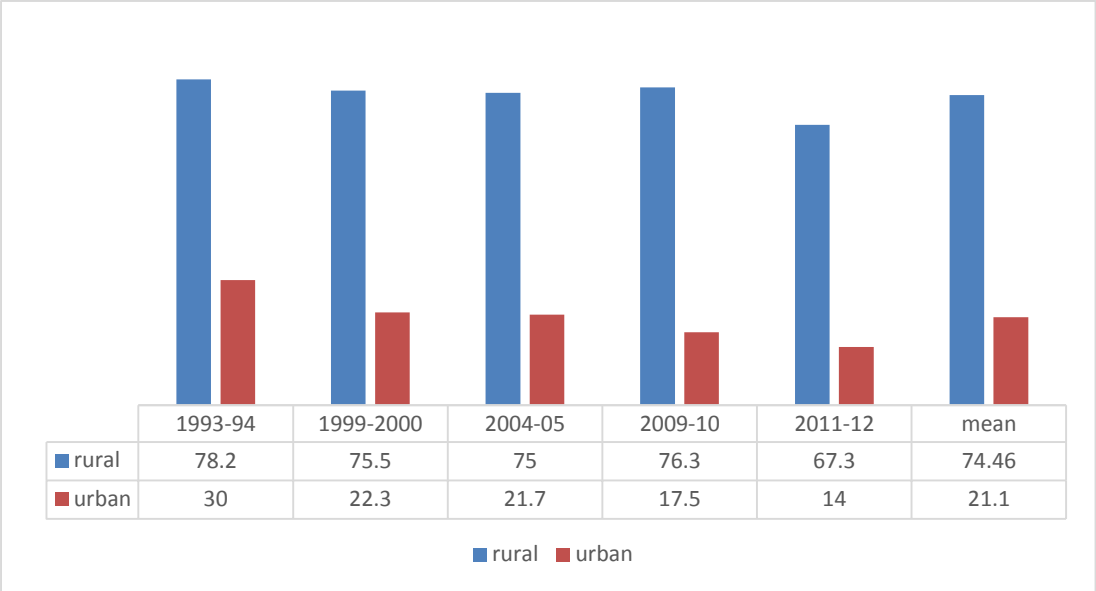
In the present study, the pattern of energy consumption at household level in 17 major states for cooking and lighting has been measured on the basis of NSSO: 50th 55th 61st 66th 68th rounds. In India at household level seven different types of fuels are used for cooking that is, coke/coal, firewood & chips, LPG, Gobar gas, dung cake, kerosene, electricity and also five different type of fuels are used as primary source for lighting namely, kerosene, other oil, electricity, gas and candle. The demand for these items varies in rural and urban areas. For rural areas some variable like (coke/coal, Gobar gas, kerosene and electricity) are merged and included in other sources as their percentage is separately very low. For urban areas variables like (dung cake coke/coal, electricity) are merged and included in other sources. The proportion of rural households depending on firewood and chips for coking has shrunk by only 2 percentage point between 1993-94 and 2009-10, though the percentage using LPG has increased from about 2 percent to 11.5 over the same period. The percentage of urban areas dependent on the firewood and chips for cooking has fallen from about 30 percent to 17.5 percent between 19993-94 and 2009-10 while the proportion using LPG has more than double from under 30 percent to 64.5 percent during the same period. In rural areas, percentage of households depending on the firewood and chips remaining at 67.3 percent in 2011-12. A drop of 8.2 percentage point since 1999-2000- even though the percentage using LPG has increased from about 5.4 percent to 15.0 percent over the same period. The incidence of depending on firewood and chips for cooking in urban areas has fallen from about

22.3 percent to 14.0 percent between 1999-2000 and 2011-12, a drop of 8.3 percentage point-and incidence of dependence on kerosene has severely dropped from 21.7 percent to 5.7 percent during the same period 73.7 percent fall, while the urban households using LPG has increased by 54.8 percent from 44.2 percent.

3.2.1.1 Percentage of Households using Primary Source of Energy at all India level for Cooking

Figure 3.1 shows that during 1993-94 the consumption of firewood and chips in rural areas went 78.2 percent and for urban areas, it was only 30 percent. In 1999-2000 for rural areas it has decline to 75.5 percent and that of urban it declined to 22.3 percent. Again in 2004-05, a declining trend can be observed to 75 percent for rural and 21.7 percent for urban areas. The trend has increased in 2009-10 (76.3 percent). At national level, the consumption of firewood and chips by rural households in 2011-12 is 67.3 percent while for urban areas it is 14 percent. From the data a declining trend can be observed because of innovative substitutes of energy sources such as solar energy, electricity, LPG, etc. and also awareness among people about the ill uses of these sources increased. Lastly income and occupation of the people are sole responsible factors which have changed the life pattern of people more at urban areas than rural. In rural areas, the percentage of households depending on firewood and chips for cooking exceeded 56.0 percent in all major states except Punjab and Haryana (NSS 2011-12: p.14). Similarly, in urban areas, dependence on firewood and chips for cooking was highest in Odisha (36.5 percent) closely followed by Kerala (36.3 percent) and Chhattisgarh (34.7 percent) households (NSS 2011-12: p. 5).

Figure 3.1: Percent wise Consumption of Firewood & Chips

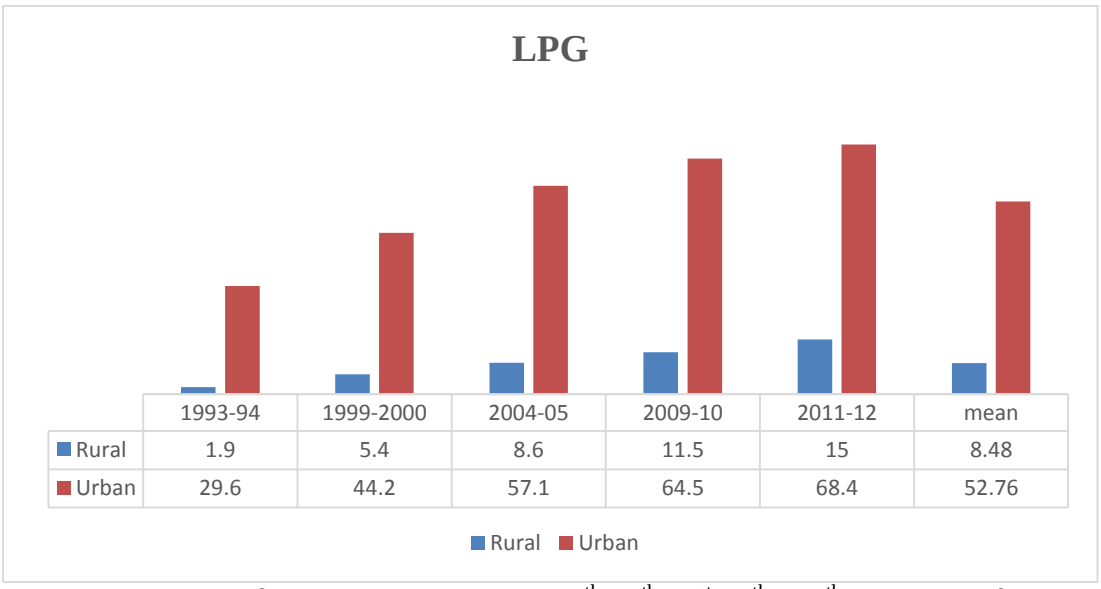


Source: Calculated from NSS each rounds 50th 55th 61st 66th&68th, Ministry of statistics and programme implementation, GOI, New Delhi.

Figure 3.2 shows India's consumption of LPG during the year 1993-94 to 2011-12, a rapid growth but not sufficient growth can be witnessed. The reason being demand is very high and supply is very low. India's LPG consumption is expected to grow to 9.7 percent for the current financial year to 23.7 million tons, Imports of LPG, mostly used as cooking fuel, soared 23 percent during the financial year to 11million tons. According to estimates by the petroleum planning and analysis cell (PPAC) at all India level LPG as a primary source for cooking is used by more than 15 percent rural households, while most of the households use LPG as a primary source for cooking 68 percent in the urban areas. In rural areas, compare to other states, incidence of use of LPG for cooking in households was much higher in Tamil Nadu 37.2 percent, Kerala 30.8 percent, and Punjab 30.5 percent. Use of LPG was least in Chhattisgarh 1.5 percent, followed by Jharkhand 2.9 percent and Odisha 3.9 percent in the recent year. Nearly 40 percent or more of the urban households used LPG as principle fuels for cooking in all the major states. It was highest in Haryana 86.5 percent households,

followed by Andhra Pradesh 77.3 percent, Punjab 75.4 percent and Maharashtra 74.5 percent. It is lowest in Chhattisgarh 39.8 percent in the year 2011-12. After globalization, LPG consumption is continuously increasing in rural and urban areas but in urban areas LPG consumption is higher than the rural areas. This is a huge gap between rural households and urban households in India. One such challenge is income and expenditure in the rural and urban households in India, how much LPG will remain as a main cooking fuel for India over the next decade.'' In rural areas LPG consumption is very low every rounds compare to urban areas, LPG intensity for rural areas higher than to urban areas at all India level, while urban areas LPG consumption is higher than to rural areas. Rural households less than consuming LPG compare to other fuels as firewood & chips, coal, kerosene, others source etc. figure: 3.2 show the LPG poverty in the rural areas, year 1993-94 to 1999-2000. The Rajiv Gandhi Grameen LPG Vitaran Yojana (RGGLVY) has been launched in 2009. Under this scheme 75 percent rural population is to be covered by 2015, where LPG coverage is low in the rural areas.

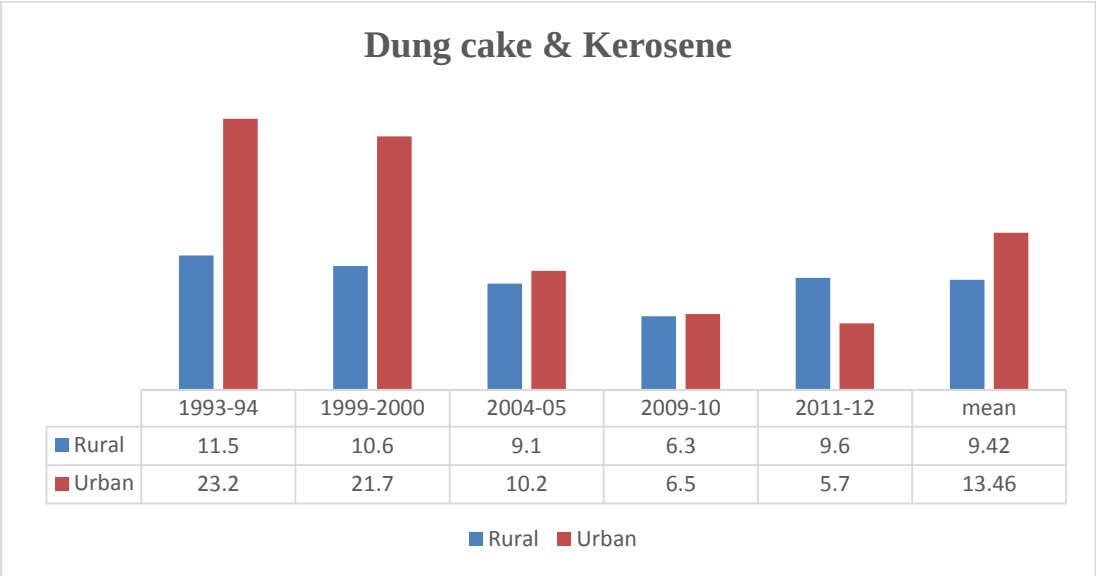
Figure 3.2: Percent wise Energy Consumption of LPG



Source: Calculated from NSS each rounds 50th 55th 61st 66th&68th, Ministry of statistics and programme implementation, GOI, New Delhi.

Figure 3.3 says dung cakes are used in rural areas and kerosene is used in urban areas as primary source of energy for cooking. Figure shows the huge gap between use of dung cakes in rural areas and kerosene in urban areas. Even after 5-6 year the situation regarding the usages of dung cakes and cooking remain same in the rural as well as urban areas. If we see the yearly usages of dung cakes and kerosene in the figure we observe that the uses of dung cakes in the rural areas is 11.5 percent (1993-94) whereas the use of kerosene in the urban areas is also high in 1993-94. In the year 1999-2000, the yearly usage has gone down to 10.6 percent from 11.5 percent whereas if we see the urban areas of kerosene. A fall is also seen from 23.2 to 21.7 percent. If we look at the year 2004-05 usage of dung cakes has gone further down to 9.1 percent and urban usage of kerosene to 10.2 percent. For the year 2009-10, the usages of dung cakes is lowest here is 6.3 percent and kerosene usage is urban areas is 6.5 percent. But surprisingly we see sudden rise in in percent use of dung cakes from 6.5 to 9.6 percent in the year 2011-12. Dung cake was the one of the major fuels for cooking for 33.4 percent of rural households in Uttar Pradesh, 30.3 percent in Punjab, 24.4 in Haryana, 20.8 percent in Bihar and 10.6 percent Madhya Pradesh in the year 2011-12. Whereas for kerosene use in urban is continuously decreasing from 6.5 to 5.7 percent. The kerosene has been significant role in the household energy and it helps in reducing the indoor air pollution. Provision to kerosene distribution in rural areas through subsidized price to public distribution system (PDS) (Kumar. K.K and Viswanathan. B, 2016: p. 6.). The less percentage of rural households used kerosene for cooking. The depended on kerosene households are shifting of electricity and LPG in urban and rural areas but less quantity rural areas compare to urban areas. The PDS system has been failure in the India so indoor air pollution is increase day by day. In the recent year government has been drop the kerosene subsidies.

Figure 3.3: Percent wise Primary Source of Energy Consumption of Dung Cake & Kerosene

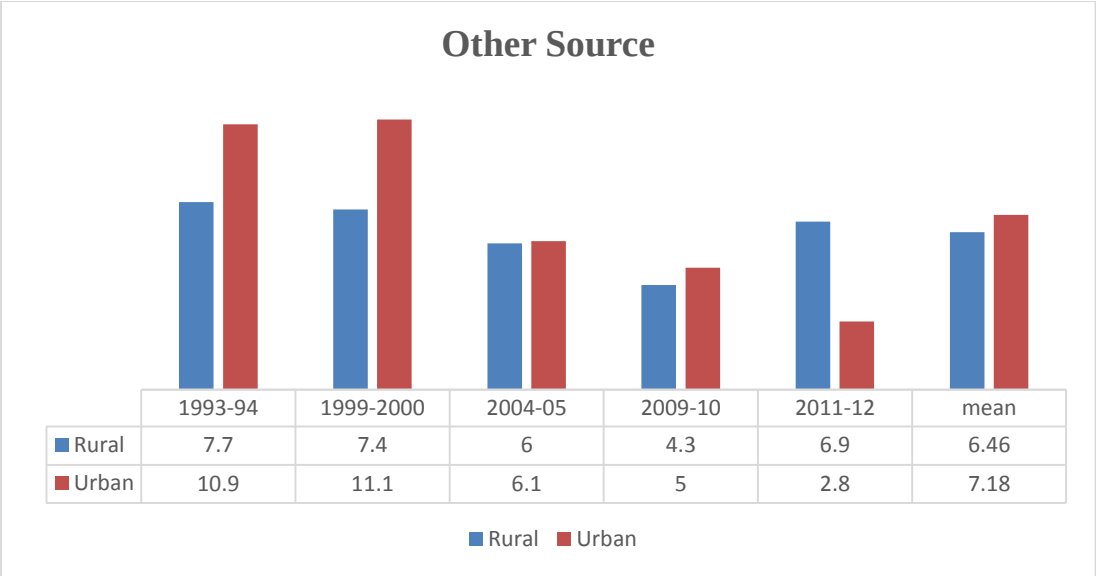


Source: Calculated from NSS each rounds 50th 55th 61st 66th&68th, Ministry of statistics and programme implementation, GOI, New Delhi.

Figure, 3.4 shows that the percentage of households depending on other source like primary energy for cooking for the major states rural and urban India. In the statement, 'other sources'[3]. In the Year of 1993-94 to 1999-2000 remain the same situation energy consumption of other source rural and urban households. In the year 2004-05 same situation 6.0 percent of rural and 6.1 percent in urban households energy consumption of the other source for cooking. In year 2009-10 decreasing percentage of others source rural percentage is 4.3 and urban percentage is 5.0 primary source for cooking in India.

[3]Includes coke/coal, kerosene and dung cake.

Figure 3.4: Percent of Energy Consumption of Other Sources during 1993-2012

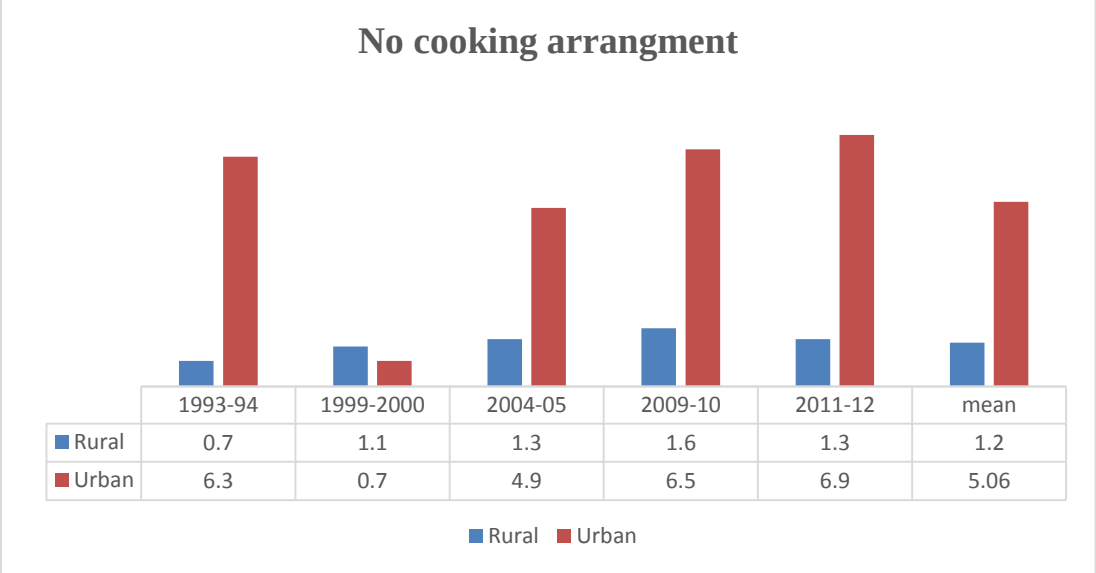


Source: Calculated from NSS each rounds 50th 55th 61st 66th&68th, Ministry of statistics and programme implementation, GOI, New Delhi.

Figure 3.5 depicts that at all-India level, 'No cooking arrangement' reported by 6.9 percent of the urban households. The highest proportion of the households of this category were seen in Karnataka (13.9percent), Tamil Nadu (9.2 percent), and Andhra Pradesh (9.1 percent) in the year (2011-12). In the Year 1993-94, 63 households have no cooking arrangement in the urban areas and 0.7 percent households have no cooking arrangement in the rural areas. This percentage is decreasing after 5-6 year this ratio is 1.1percent rural areas and 0.7 percent urban areas, once again no cooking arrangement is increasing both areas urban and rural year 2004-05 and no cooking arrangement ratio is continuously increasing 5-6 year (2011-12). It means Indian people situation are not better for the perspective of energy security in the present time. It is clear from this data that even today, the number of such households in both the city and the villages is still present, in which there is no permanent system for cooking. It is clear that the level of energy poverty is high in the present time. The probability of illness in these households can also increase. The system of cooking

food in the cities is worse than in the villages. The main reason for this is that free of cost dirty fuel is present in the villages but has to be bought in the cities.

Figure 3.5: Percent wise Primary Source of Energy Consumption of no Cooking Arrangement



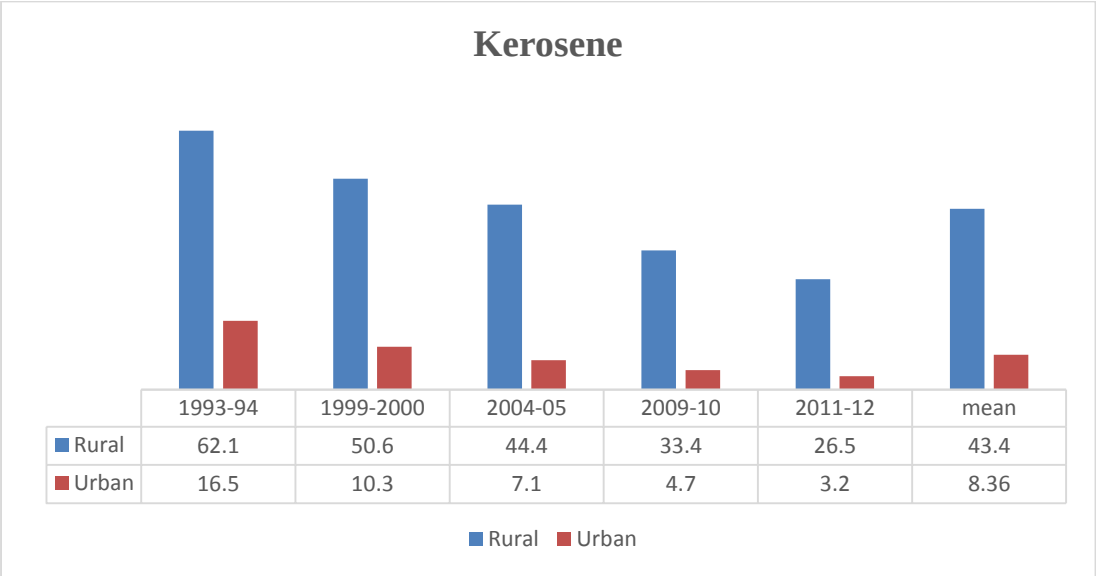
Source: Calculated from NSS each rounds 50th 55th 61st 66th&68th, Ministry of statistics and programme implementation, GOI, New Delhi.

3.2.2.2 Percentage of Households using Primary Source of Energy at all India level for Lighting

Figure: 3.6 shows percent-wise distribution of households by primary source of energy used for lighting for the major states. In the year 1993-94, 62.1 percent household in rural areas were using kerosene as primary source of energy for lighting, which had dropped to 26.5 percent household using kerosene year 2011-12. In the urban areas during 1993-94, 16.5 percent household using kerosene as primary source of energy for lighting, which had dropped to 3.2 percent household using kerosene energy for lighting. In this figure there is continuously decrease of kerosene consumption in rural and urban India during 19993-94 to 2011-12. Primary source of

energy for lighting pattern of energy consumption change over time period. People are shifting electricity and others modern fuels energy for lighting.

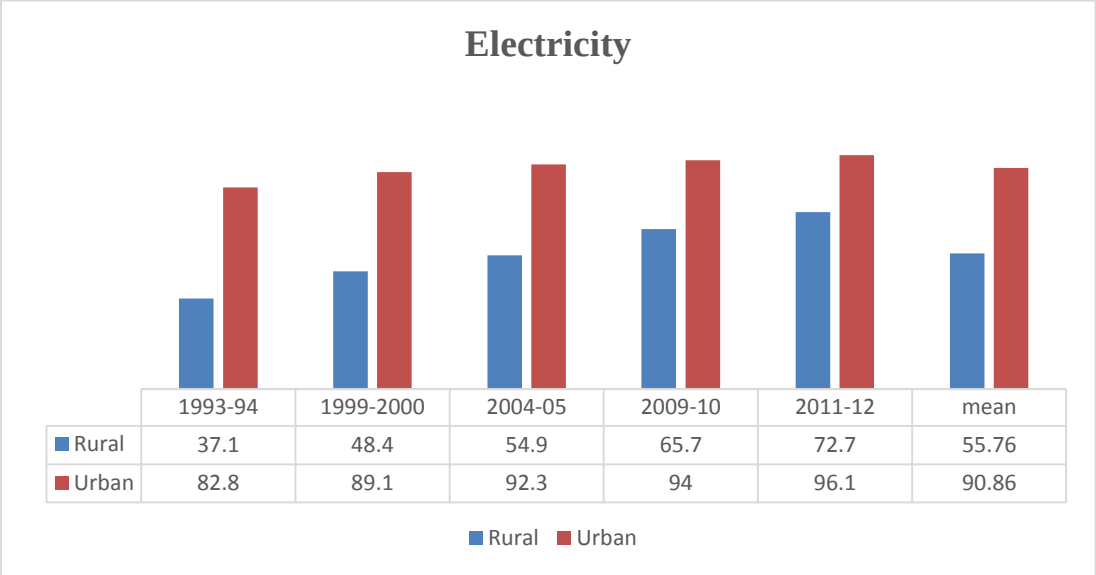
Figure 3.6: Percent-wise Consumption as Primary Source of Kerosene for Lighting



Source: Calculated from NSS each rounds 50th 55th 61st 66th & 68th, Ministry of statistics and programme implementation, GOI, New Delhi.

In this figure 3.7 shows the continuous increase in consumption of electricity in rural and urban areas in India as primary source of energy for lighting. In year 1993-94, consumption of electricity 37.1 percent rural and 82.8 percent urban areas. This figure shows the huge gap consumption of electricity rural and urban India and between in year 1993-94-2011-12. Rural household's consumption of electricity is very low compare to urban households. Energy intensity in rural areas is higher than urban areas but consumption is lower than compare to urban areas.

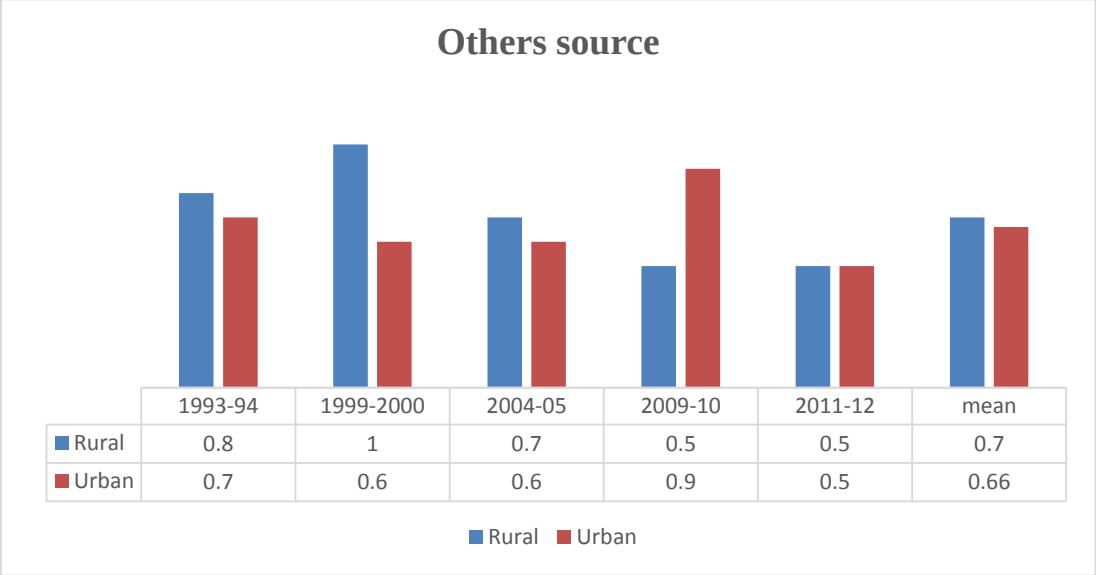
Figure 3.7: Percent-Wise Consumption as Primary Source of Electricity for Lighting



Source: Calculated from NSS each rounds 50th 55th 61st 66th & 68th, Ministry of statistics and programme implementation, GOI, New Delhi.

Figure 3.8 shows primary source of energy for lighting of others sources in India as per NSS rounds are as 1993-94 to 2011-12 rural and urban scenario. It shows that in 1993-94 the use of other source energy is 0.8 percent in rural area and 0.7 percent in urban area because there person are used agriculture waist resources energy. The figure shows that in rural area this energy is consuming with the fluctuating rate because it was 1 percent in 1999-2000 and 0.5 in year 2009-10 and 2011-12. While urban energy consumption is also showing the fluctuating rate but it is less compare than rural areas and it is highest in 2009-10 which was 0.9 percent and this year the rural energy is only 0.5 percent which is lowest in all year of energy consumption.

Figure 3.8: Percent-wise Consumption as Primary Source from Other Source for Lighting



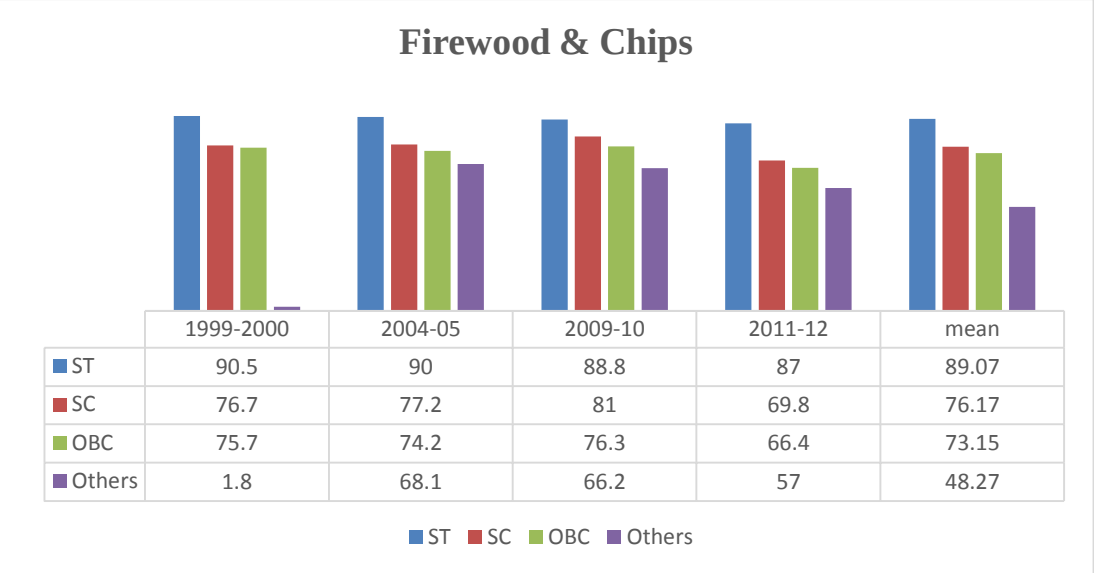
Source: Calculated from NSS each rounds 50th 55th 61st 66th & 68th, Ministry of statistics and programme implementation, GOI, New Delhi.

3.2.2.3 Percent of Households of each Social group using Primary Source of Energy for Cooking (Rural India)

From the figure 3.9, the consumption of firewood and chips among the population of the country are as follows from 1999-2000, The ST population across the country have consumed 90.5 percent which is the highest among all the castes. Followed by SC population 76.7 percent then OBC 75.7 percent and others consumed 1.8 percent etc. Similarly in 2004-05 again ST ranks highest with 90 percent followed by SC with 77.2 percent OBC with 74.2 percent and also much improvement in the consumption of others have been increased to 68.1 percent. In 2009-10 a slight decrease in consumption of ST population with percentage of 88.8 percent but improvement in increasing consumption of SC reached to 81 percent similarly improvement followed by OBC population too with 76.3 percent and lastly a decrease in the consumption of others reached to 66.2 percent. Therefore from the last NSSO round report of 2011-12 all the population have shown decrease in consumption of firewood chips which are

ST 87 percent, SC 69.8 percent, OBC 66.4 percent and others have mere consumed 57 percent. The declining trend of consumption of firewood and chips among the castes in the country is because of advancement of technology that of use of electricity and LPG. Standard of people have been increased and government programs have benefited rural people by making them aware of the ill-effects of firewood and chips etc.

Figure 3.9: Percentage wise Consumption of Firewood and Chips among Social Group



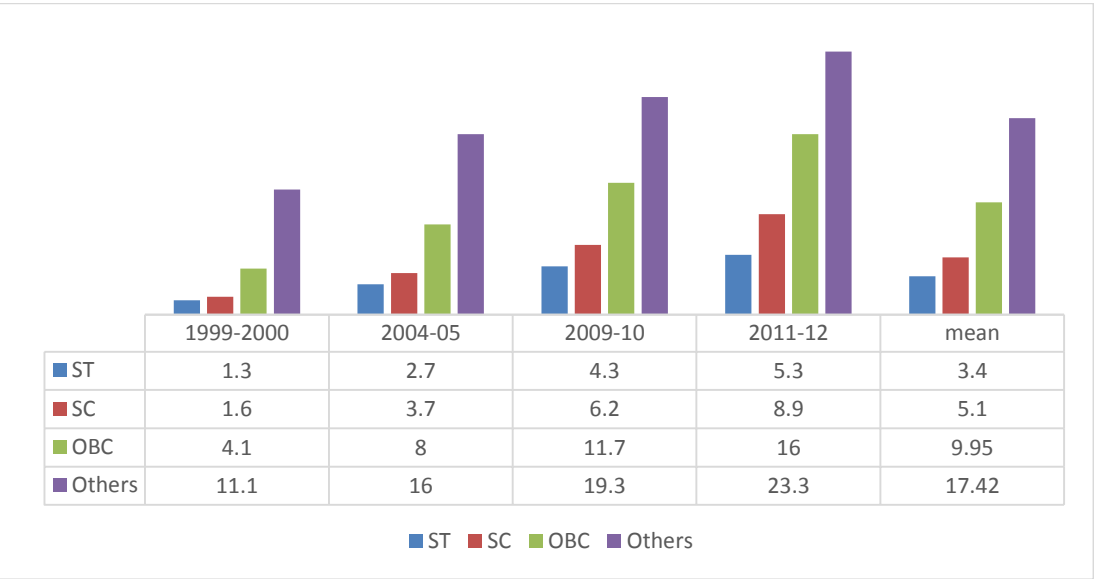
	1999-2000	2004-05	2009-10	2011-12	mean
ST	90.5	90	88.8	87	89.07
SC	76.7	77.2	81	69.8	76.17
OBC	75.7	74.2	76.3	66.4	73.15
Others	1.8	68.1	66.2	57	48.27

Source: Calculated from NSS each rounds 50th 55th 61st 66th & 68th, Ministry of statistics and programme implementation, GOI, New Delhi.

Figure 3.10 shows, Consumption of LPG among social groups in India as per NSS rounds are for 1999-2000 scheduled tribe 1.3 percent, scheduled cast 1.6 percent, OBC 4.1 percent and others 11.1percent. Likewise in 2004-05 ST 2.7 percent SC 3.7 percent OBC 8 percent and others 16 percent. In the year 2009-10, the figures are for ST 4.3 percent SC 6.2 percent then OBC 11.7 percent and others with 19.3 percent. Consequently, in 2011-12 ST 5.3 percent SC 8.9 percent OBC 16percent and others 23.3percent respectively. LPG consumption among social groups has increased continuously for 10 to 11 years but this is not enough. Even today, LPG has not

reached every household in India, due to which people are dependent on dirty fuel. Messy fuel is contaminating our health as well as our environment. In rural areas, people get dirty fuel at no expense, but it is affecting the health of the people very badly. Present Governments and previous governments until now have been running different types of policies so that people can shift towards clean fuel. Every household should have access to clean fuel and more work is required to keep the house and environment clean. Because India cannot be a developed country without raising socially and economically backward people. Many types of research show that even today the people of SC and ST groups could not get economic development. Due to which the data is showing that the reach of clean energy LPG in both these communities is quite less lot.

Figure 3.10: Percentagewise Consumption of LPG among Social Groups in India



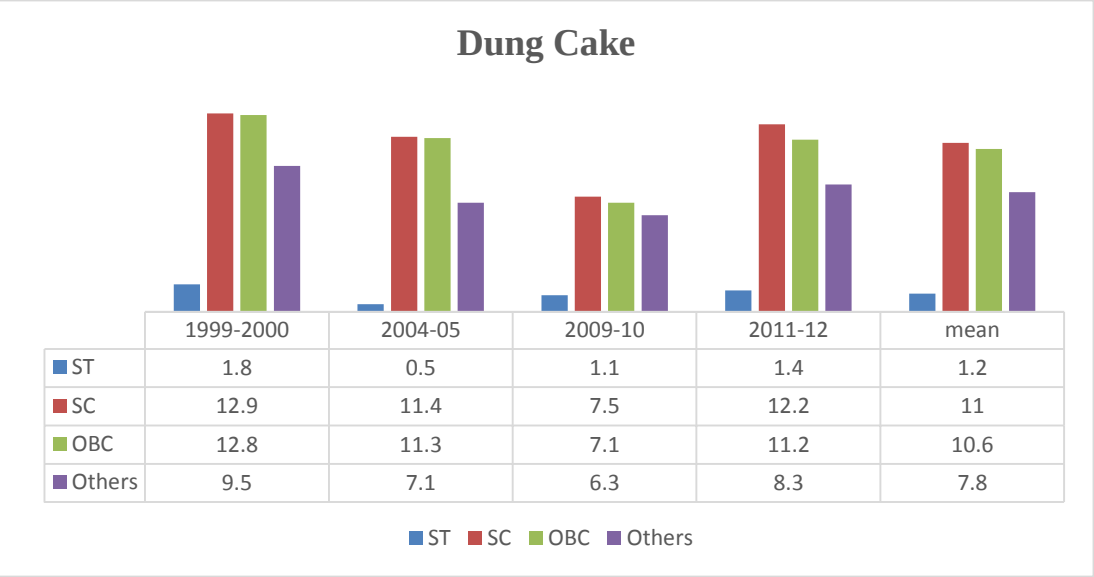
	1999-2000	2004-05	2009-10	2011-12	mean
ST	1.3	2.7	4.3	5.3	3.4
SC	1.6	3.7	6.2	8.9	5.1
OBC	4.1	8	11.7	16	9.95
Others	11.1	16	19.3	23.3	17.42

Source: Calculated from NSS each rounds 50th 55th 61st 66th & 68th, Ministry of statistics and programme implementation, GOI, New Delhi.

Figure 3.11 shows the Consumption of dung cake among social groups in India as per NSS rounds areas 1999-2000 ST 1.8 percent SC12.9 percent OBC 12.8 percent and others 9.5 percent. Equally in 2004-05 ST 0.5 percent SC 11.4 percent OBC 11.3

percent and others 7.1 percent. Evidence from 2009-10 the figures are for ST 1.1 percent SC 7.5 percent then OBC 7.1 percent and others with 6.3 percent. The data results for 2011-12 ST 1.4 percent SC 12.2 percent OBC 11.2 percent and others 8.3 percent. The figure shows that consumption of dung cake is increasing in SC, OBC, other categories, consumption of dung cake has also increased in the scheduled tribe, But compared to the three categories, the consumption of dung cake is very less in this category. Tribal society has always been in the forests, the forest is their means of livelihood. That is why even today these people depend on the forests for fuel needs. In recent years, LPG is slowly reaching this group. These people have not yet shifted towards 100 percent clean energy. This data shows that even today energy poverty along with poverty is sufficiently present in society.

Figure 3.11: Percentagewise use of Dung Cake among Social Groups



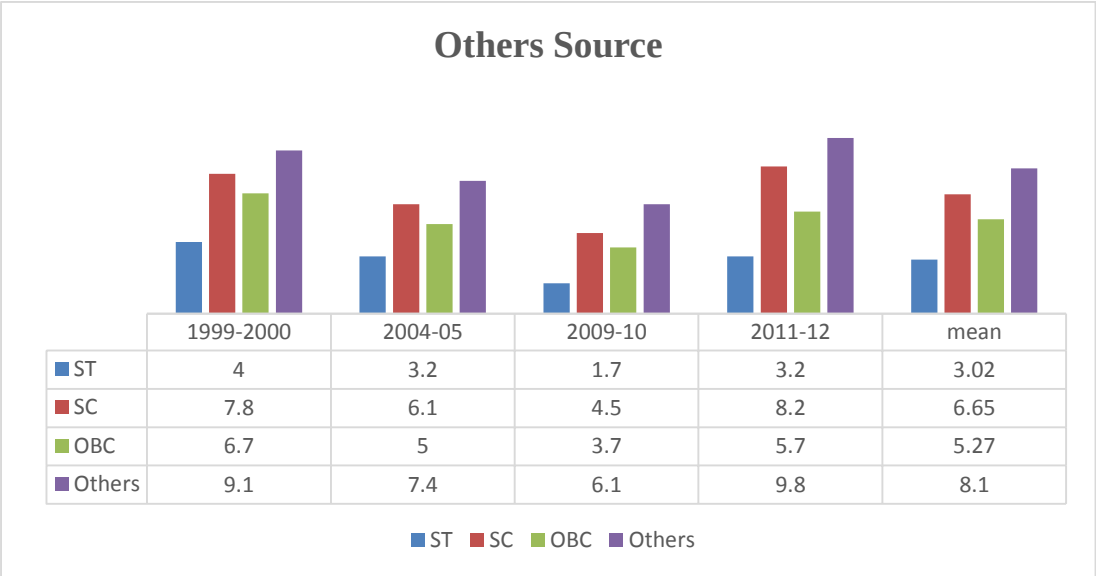
	1999-2000	2004-05	2009-10	2011-12	mean
ST	1.8	0.5	1.1	1.4	1.2
SC	12.9	11.4	7.5	12.2	11
OBC	12.8	11.3	7.1	11.2	10.6
Others	9.5	7.1	6.3	8.3	7.8

Source: Calculated from NSS each rounds 50th 55th 61st 66th & 68th, Ministry of statistics and programme implementation, GOI, New Delhi.

Figure: 3.12, shows that others sources among social groups in India as per NSS rounds are 1999-2000 ST 4 percent SC 7.8 percent OBC 6.7 percent and others 9.1 percent respectively. In 2004-05 ST 3.2 percent SC 6.1 percent OBC 5 percent and

others 7.4 percent. In 2009-10 the data figures are, for ST 1.7 percent SC 4.5 percent then OBC 3.7 percent and others with 6.1 percent .therefore in 2011-12 ST 3.2 percent SC 8.2 percent OBC 5.7 percent and others 9.8 percent.

Figure 3.12: Percentagewise use of others Source among Social Groups

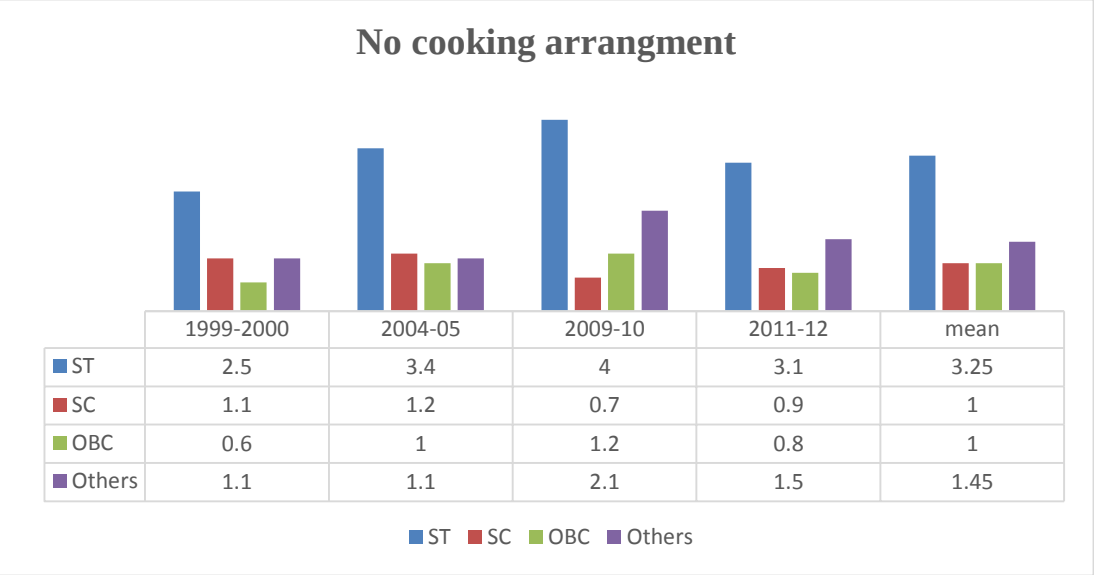


	1999-2000	2004-05	2009-10	2011-12	mean
ST	4	3.2	1.7	3.2	3.02
SC	7.8	6.1	4.5	8.2	6.65
OBC	6.7	5	3.7	5.7	5.27
Others	9.1	7.4	6.1	9.8	8.1

Source: Calculated from NSS each rounds 50th 55th 61st 66th & 68th, Ministry of statistics and programme implementation, GOI, New Delhi.

No cooking arrangement among social groups in India as per NSS rounds are for 1999-2000 ST 2.5 percent SC 1.1 percent OBC 0.6 percent and others 1.1 percent. Also in 2004-05 ST 3.4 percent SC 1.2 percent OBC 1 percent and others 1.1 percent. In 2009-10 the figures are for ST 4 percent SC 0.7 percent then OBC 1.2 percent and others with 2.1 percent .Hence in 2011-12 ST 3.1 percent SC 0.9 percent OBC 0.8 percent and others 1.5 percent.

Figure 3.13: Percent-wise Source of no Cooking Arrangement among Social Groups



	1999-2000	2004-05	2009-10	2011-12	mean
ST	2.5	3.4	4	3.1	3.25
SC	1.1	1.2	0.7	0.9	1
OBC	0.6	1	1.2	0.8	1
Others	1.1	1.1	2.1	1.5	1.45

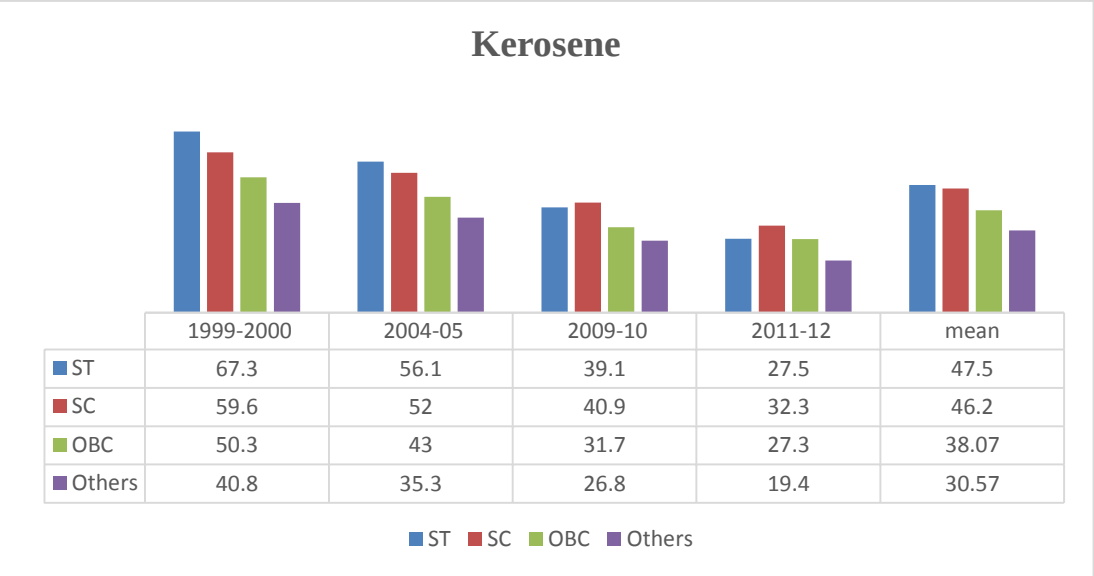
Source: Calculated from NSS each rounds 50th 55th 61st 66th & 68th, Ministry of statistics and programme implementation, GOI, New Delhi.

3.3.1 Percent-Wise Energy Consumption for Lighting among Social Groups (Rural)

Kerosene was the only source of lighting in rural areas of India that was used as the primary fuel for lighting. From 1999 -00 to 2011-12 i.e. after a decade, access to village's electricity increased, due to which people are gradually moving towards electricity. The data given below shows that the kerosene consumption of each community has decreased every year. But this figure is not satisfactory because electricity has not reached every household yet.

Kerosene used as a primary source of energy for lighting in rural areas among social groups in India as per NSS rounds are 1999-2000 ST 67.3 percent SC 59.6 percent OBC 50.3 percent and others 40.8 percent. Similarly in 2004-05 ST 56.1 percent SC 52 percent OBC 43 percent and others 35.3 percent. In 2009-10, ST 39.1 percent SC 40.9 percent then OBC 31.7 percent and others with 26.8 percent. Therefore in 2011-12 ST 27.5 percent SC 32.3 percent OBC 27.3 percent and others 19.4 percent.

Figure 3.14: Percent-wise use of Kerosene among Social Groups



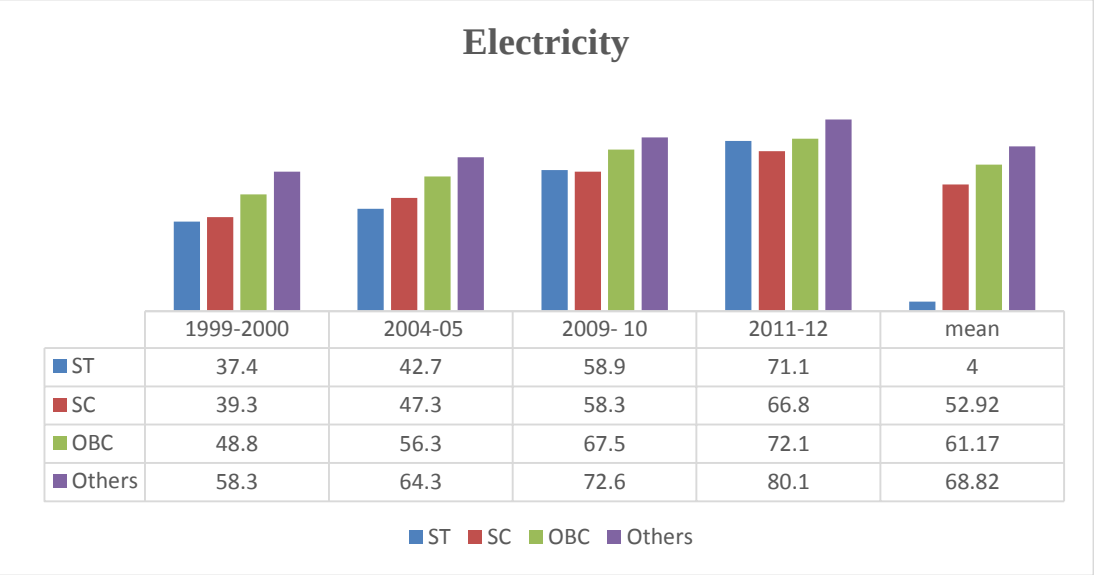
	1999-2000	2004-05	2009-10	2011-12	mean
ST	67.3	56.1	39.1	27.5	47.5
SC	59.6	52	40.9	32.3	46.2
OBC	50.3	43	31.7	27.3	38.07
Others	40.8	35.3	26.8	19.4	30.57

Source: Calculated from NSS each rounds 50th 55th 61st 66th & 68th, Ministry of statistics and programme implementation, GOI, New Delhi.

Electricity is the backbone of any economy, in today's present era, the country which has more power generation and more consumption is the rich country. Electricity is the cleanest source of energy so that both health and the environment will be safe. The demand for electricity in India is increasing every year and the population is also increasing. Ensuring access to electricity to the entire population is a big challenge. Between1999-00 to 2011-12 a lot of fast efforts have been made so that electricity is available to every community. But this target has not been met yet, the data below shows that not all villages and communities have access to electricity yet. Consumption of electricity in rural areas among social groups as per NSS rounds are 1999-2000 ST 37.4 percent SC 39.3 percent OBC 48.8 percent and others 58.3 percent. Similarly in 2004-05 ST 42.7 percent SC 47.3 percent OBC 56.3 percent and others 64.3 percent. In 2009-10 the figures are ST 58.9 percent SC 58.3 percent then OBC 67.5 percent and others with 72.6 percent. Then in 2011-12 ST 71.1 percent SC 66.8 percent OBC 72.1 percent and others 80.1 percent. Government of India is

making a lot of efforts in this area, for this, the government started the Saubhagya scheme. By October 16, 2017, more than 249 million led bulbs were spent. Especially women are being encouraged through this scheme.

Figure 3.15: Percent-wise use of Electricity for Lighting among Social Groups



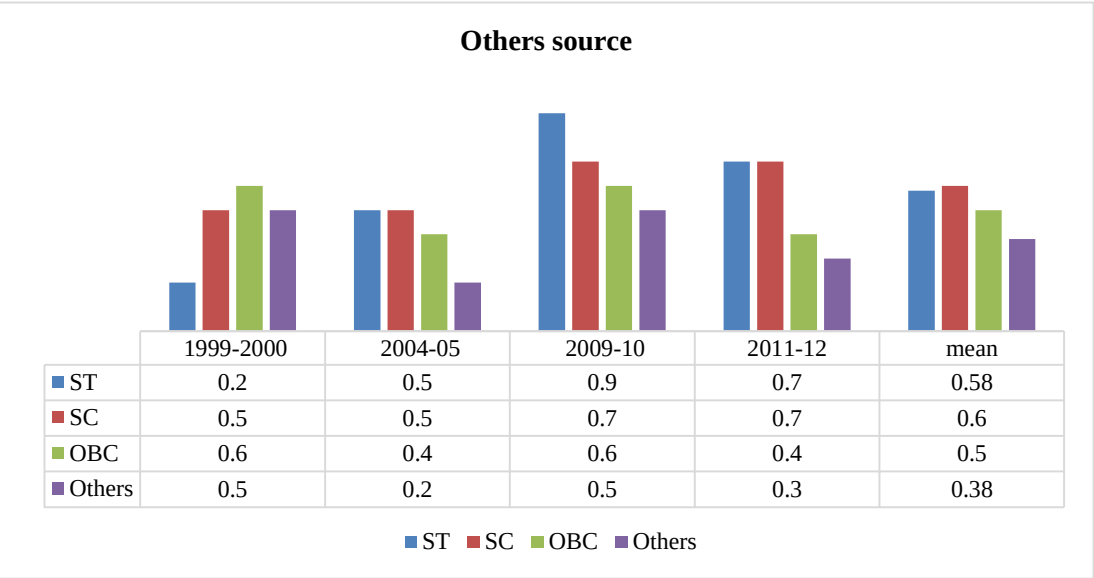
	1999-2000	2004-05	2009- 10	2011-12	mean
ST	37.4	42.7	58.9	71.1	4
SC	39.3	47.3	58.3	66.8	52.92
OBC	48.8	56.3	67.5	72.1	61.17
Others	58.3	64.3	72.6	80.1	68.82

Source: Calculated from NSS each rounds 50th 55th 61st 66th & 68th, Ministry of statistics and programme implementation, GOI, New Delhi.

Figure 3.16 Even after several decades of independence, every household in the villages of India has not yet got electricity. Due to which many households are still consuming traditional fuel for centuries. These fuels are dangerous to their health and make homes dirty. From the data given below, it is clear that clean fuel has yet to reach many of the country's population. Primary sources of energy for lighting are mixture of various raw items given a joint name as Others-Sources in rural areas among social groups in India as per NSS rounds are 1999-2000 ST 0.2 percent SC 0.5 percent OBC 0.6 percent and others 0.5 percent. Similarly in 2004-05 ST 0.5 percent SC 0.5 percent OBC 0.4 percent and others 0.2 percent. In 2009-10 the figures are for ST 0.9 percent SC 0.7 percent then OBC 0.6 percent and others with 0.5 percent.

Therefore in 2011-12 ST 0.7 percent SC 0.7 percent OBC 0.4 percent and others 0.3 percent.

Figure 3.16: Percent-wise Consumption of Others Source among Social Group



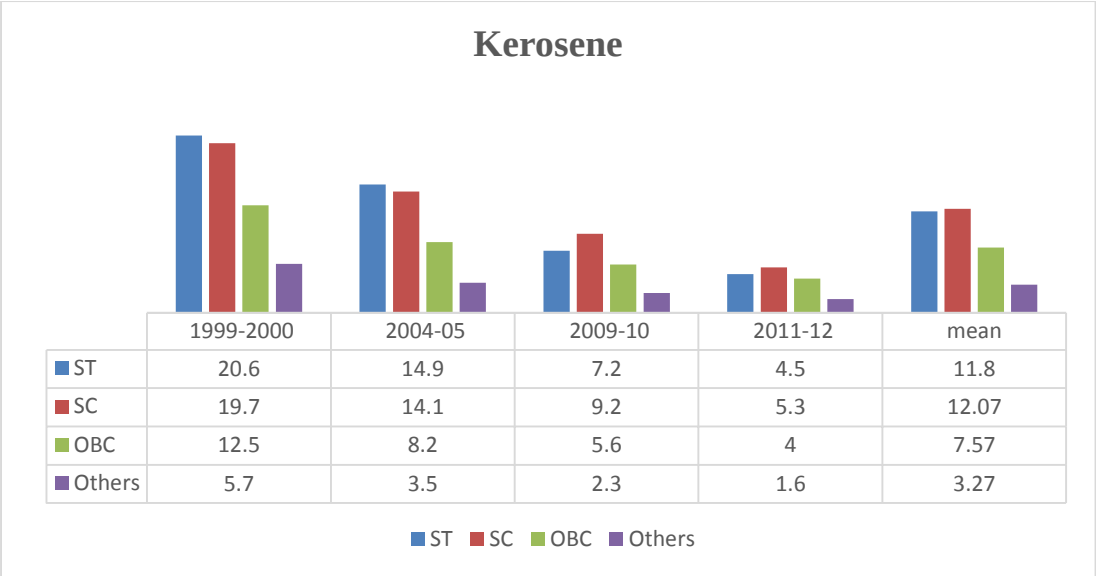
	1999-2000	2004-05	2009-10	2011-12	mean
ST	0.2	0.5	0.9	0.7	0.58
SC	0.5	0.5	0.7	0.7	0.6
OBC	0.6	0.4	0.6	0.4	0.5
Others	0.5	0.2	0.5	0.3	0.38

Source: Calculated from NSS each rounds 50th 55th 61st 66th & 68th, Ministry of statistics and programme implementation, GOI, New Delhi.

3.3.2 Percent-wise Energy Consumption for Lighting among Social Groups (Urban)

Primary source of energy for lighting purpose is kerosene, Indian urban households are consuming as per NSS rounds is 1999-2000 ST 20.6 percent SC 19.7 percent OBC 12.5 percent and others 5.7 percent. Therefore in 2004-05 ST 14.9 percent SC 14.1 percent OBC 8.2 percent and others 3.5 percent. In 2009-10 the figures are for ST 7.2 percent SC 9.2 percent then OBC 5.6 percent and others with 2.3 percent. Hence in 2011-12 ST 4.5 percent SC 5.3 percent OBC 4 percent and others 1.6 percent.

Figure: 3.17 Percent-wise Consumption Kerosene among Social Groups

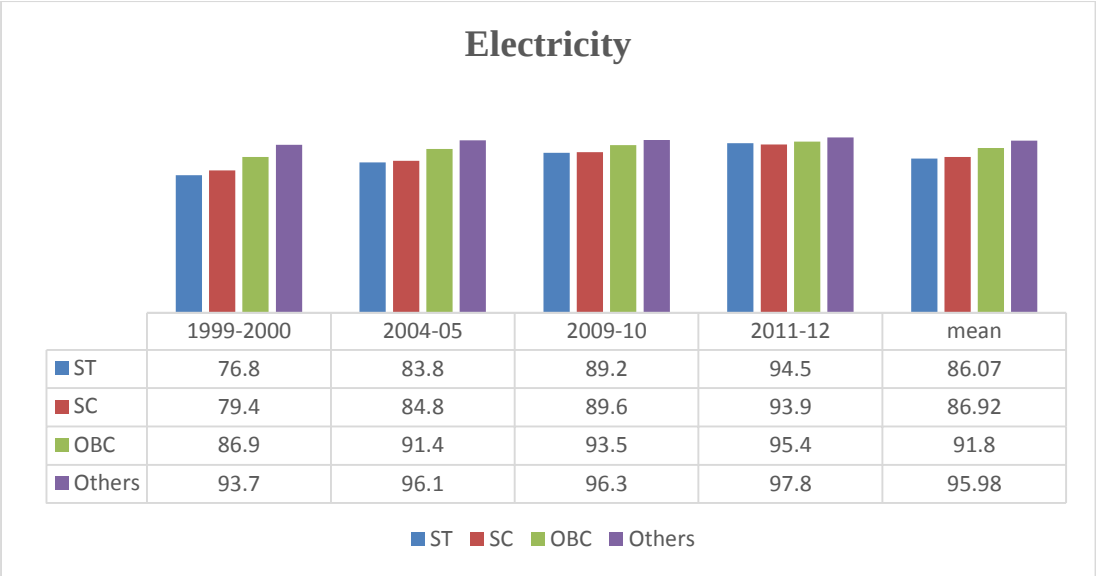


	1999-2000	2004-05	2009-10	2011-12	mean
ST	20.6	14.9	7.2	4.5	11.8
SC	19.7	14.1	9.2	5.3	12.07
OBC	12.5	8.2	5.6	4	7.57
Others	5.7	3.5	2.3	1.6	3.27

Source: Calculated from NSS each rounds 50th 55th 61st 66th&68th, Ministry of statistics and programme implementation, GOI, New Delhi.

Primary source of energy for lighting consumption of kerosene in urban areas among social groups in India as per NSS rounds are 1999-2000 ST 76.8 percent SC 79.4 percent OBC 86.9 percent and others 93.7 percent. Likewise in 2004-05 ST 83.8 percent SC 84.8 percent OBC 91.4 percent and others 96.1 percent. In 2009-10 the figures are ST 89.2 percent SC 89.6 percent then OBC 93.5 percent and others with 96.3 percent. Thus in 2011-12 ST 94.5 percent SC 93.9 percent OBC 95.4 percent and others 97.8 percent.

Table 3.18: Percent-wise use of Electricity among Social Groups

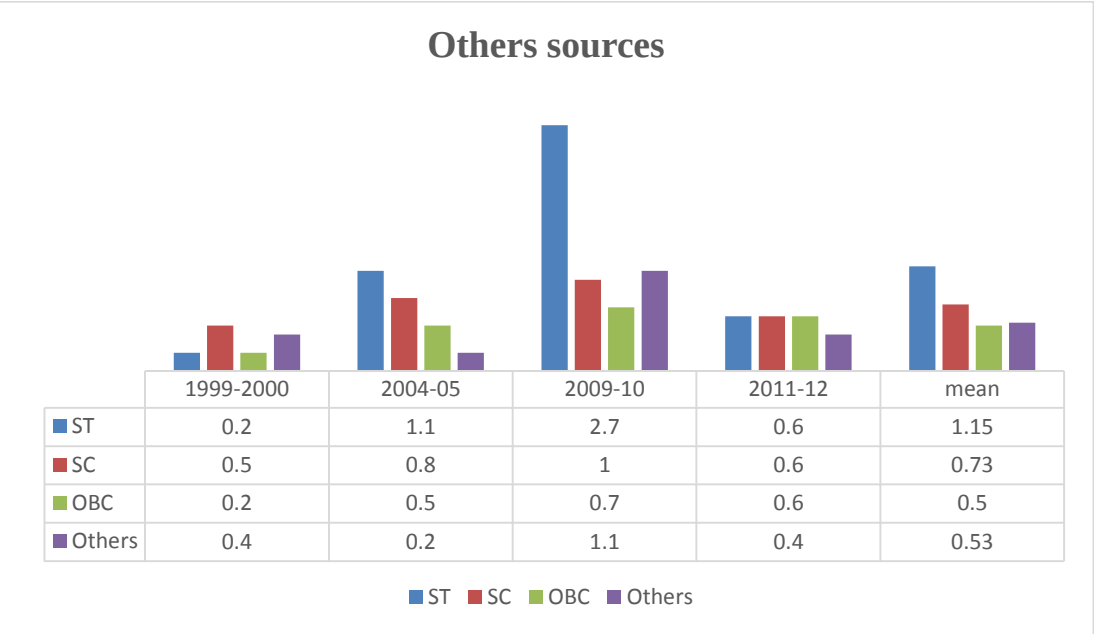


	1999-2000	2004-05	2009-10	2011-12	mean
ST	76.8	83.8	89.2	94.5	86.07
SC	79.4	84.8	89.6	93.9	86.92
OBC	86.9	91.4	93.5	95.4	91.8
Others	93.7	96.1	96.3	97.8	95.98

Source: Calculated from NSS each rounds 50th 55th 61st 66th&68th, Ministry of statistics and programme implementation, GOI, New Delhi.

Others sources used for lighting purposes in urban India among social groups as per NSS rounds are for 1999-2000 ST 70.2 percent SC 0.5 percent OBC 0.2 percent and others 0.4 percent. Similarly in 2004-05 ST 1.1 percent SC 0.8 percent OBC 0.5 percent and others 0.2 percent. In 2009-10 the figures for ST 2.7 percent SC 1 percent then OBC 0.7 percent and others with 1.1 percent. Therefore in 2011-12 ST 0.6 percent SC 0.6 percent OBC 0.6 percent and others 0.4 percent respectively.

Figure 3.19: Percentagewise use of other Sources among Social Groups



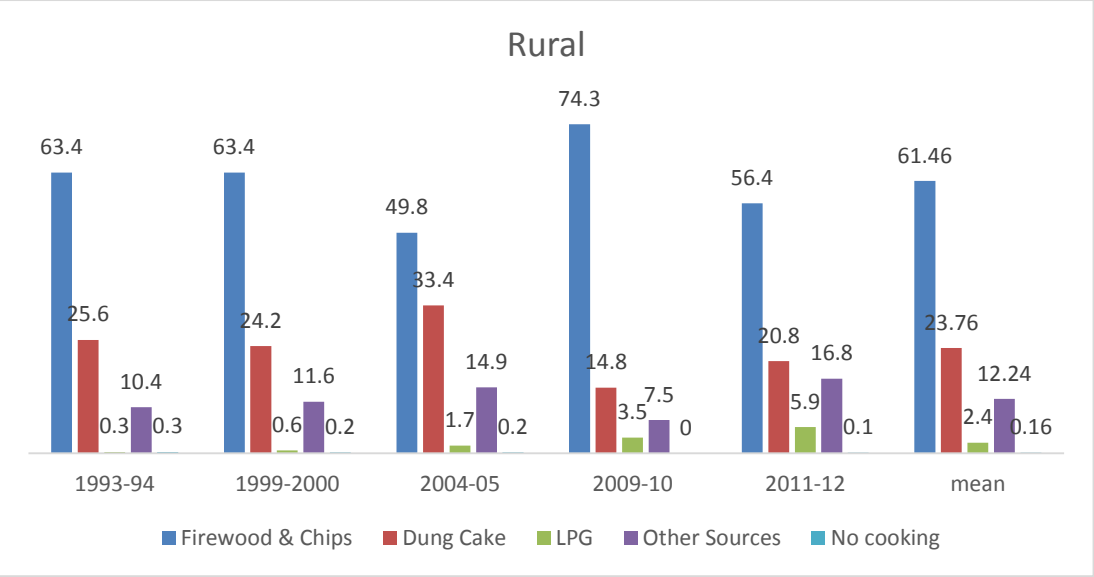
Source: Calculated from NSS each rounds 50th 55th 61st 66th&68th, Ministry of statistics and programme implementation, GOI, New Delhi.

3.4.1 Pattern of Energy Consumption at Households level in Bihar for Cooking

The figure below gives the pattern of energy consumption at household level in the rural areas of Bihar. It can be observed that most of the population depend upon firewood and chips for cooking food. Almost 63 percent rural population use firewood and chips while 25.6 percent use dung cake for cooking food. 10.4 percent of population depend upon other sources while just a small population depend upon LPG. If the data for LPG using population is observed then just a meagre population of 0.6 use it as a fuel for energy consumption for the year 1999-2000. The next round on the energy pattern observe that more number of population is shifting towards LPG and dung cakes and are not depending upon firewood and chips for cooking food. The number increased from 0.6 to 1.7 for LPG while for the year 2009- 10 the number increased to 3.5. The pattern observed that the population is shifting its pattern from the firewood and chips to more renewable source of energy. We can also observe that

people have shifted their energy consumption patter as less number of people are depending upon dung cakes. A decline from the 33 percent (2004-05) to 15 percent (2009- 10). The year 2011-12 observes that though the population has increased for LPG users but the population for dung cakes has also increased from the year 2009-10. Less number of people are depending upon firewood and chips.

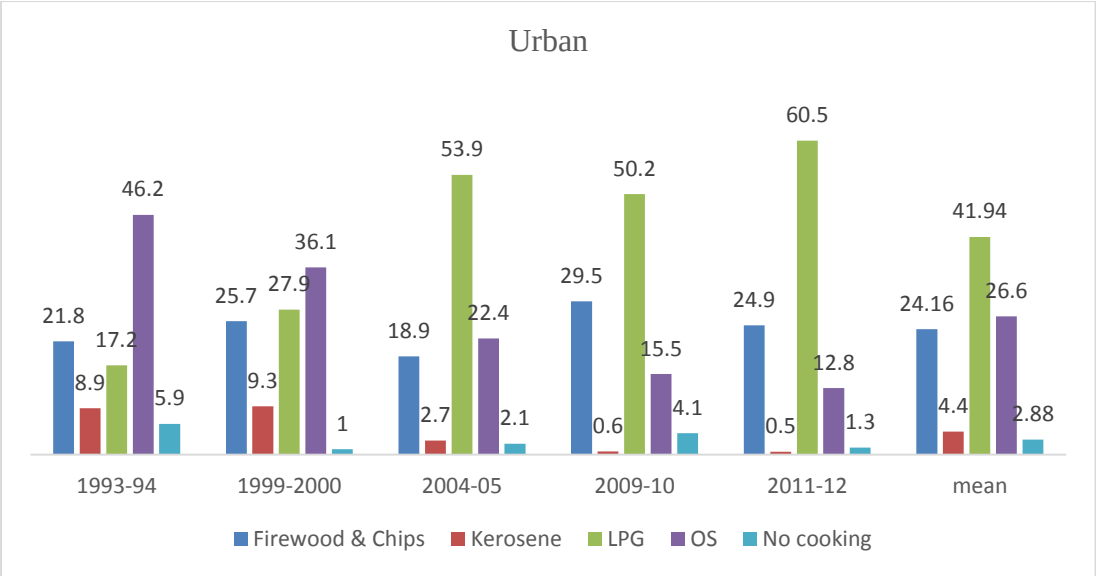
Figure 3.20: Source wise Energy Consumption for Cooking



Source: Calculated from NSS each rounds 50th 55th 61st 66th & 68th, Ministry of statistics and programme implementation, GOI, New Delhi.

The figure 3.21 below highlights that during 1993-94, the major source of cooking were other sources, which comprises 46.2 percent, followed by firewood and chips i.e. 21.8 percent. However, after 1993-2000 the energy consumption for cooking has declined in other source and the energy consumption of LPG has started increasing drastically. During 2011-12 the energy consumption from LPG has reached to 60.5 percent, while the energy consumption for cooking from other sources and firewood and chips has declined to 12.8 percent and 24.9 percent respectively.

Figure 3.21: Source wise Energy Consumption for Cooking in Urban Bihar



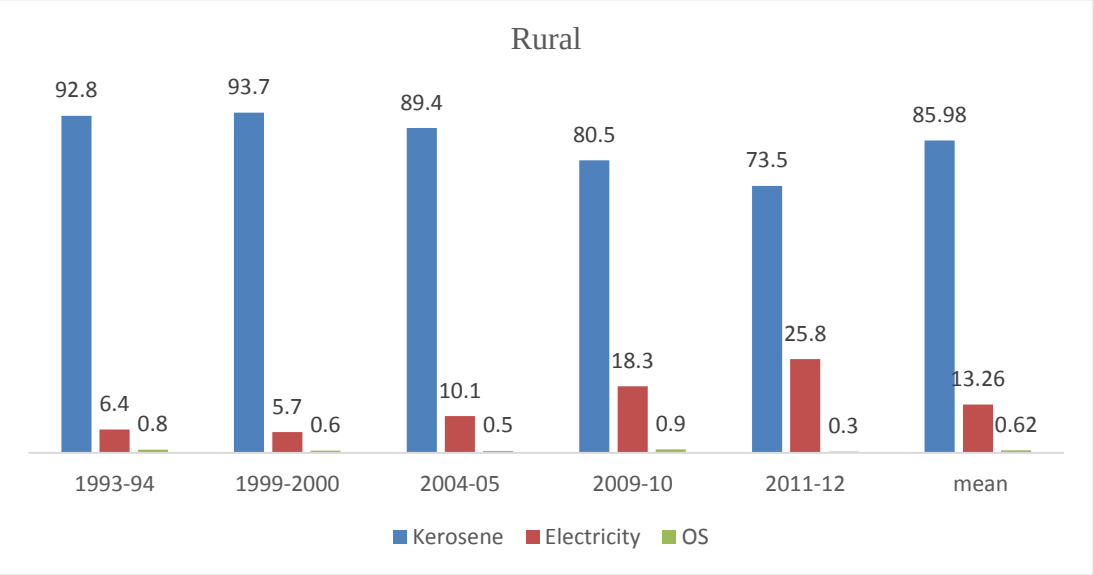
Source: Calculated from NSS each rounds 50th 55th 61st 66th & 68th, Ministry of statistics and programme implementation, GOI, New Delhi.

3.4.1.2 Pattern of Energy Consumption at Households level in Bihar for Lighting

The figure 3.22 below observes the pattern of energy consumption at household's levels in rural areas for lighting purpose. The table takes into consideration various NSSO reports. For the year 1993-94. 92.8 percent people depend upon kerosene while just 6.4 percent depend upon electricity. The next round of NSSO observes that there was an upward shift in the number of people depending upon Kerosene and a decline in number of people using electricity. 93.7 percent of people depend upon Kerosene while 5.7 percent of people depend upon electricity as a medium of lighting. Though the next rounds observe a decline in the percentage of people using Kerosene as a medium of lighting and an increase in the percentage of population using electricity as a medium of lighting. The data for the year 2011-12 observes that 25.8 percent of people started using electricity as a medium of lighting while still 75 percent people are using Kerosene oil as a medium of lighting. This shows that though the percentage

of population has decreased but still an approx of one forth population is depending upon electricity as a medium of lighting.

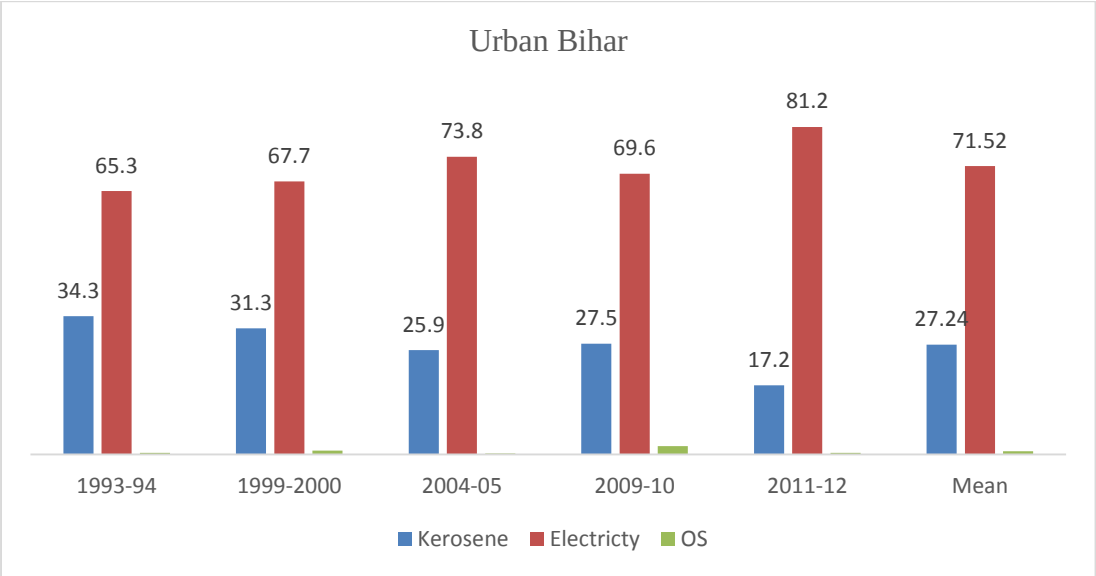
Figure 3.22: Energy Consumption for Lighting in Bihar



Source: Calculated from NSS each rounds 50th 55th 61st 66th & 68th, Ministry of statistics and programme implementation, GOI, New Delhi.

The figure 3.23 below highlights that from 1993-94 the electricity consumption for lighting has increased significantly in the urban areas of Bihar. The energy consumption of electricity for lightning has increased from 65.3 percent in 1993-94 to 67.7 percent in 1999-2000, whereas the consumption of kerosene has declined from 34.3 percent in 1993-94 to 31.3 percent in 1999-200. However, after 1999-2000 the consumption of electricity has increased from 67.3 percent to 73.8 percent in 2004-05 and the consumption of kerosene has declined from 31.3 percent to 25.9 percent in this period. However, after 2004-05 the energy consumption of electricity has declined from 73.8 percent to 69.6 percent in 2009-10 and the kerosene consumption increased to 27.5 percent. In 2011-12 the consumption of electricity has increased sharply from 69.6 percent to 81.2 percent and the consumption of kerosene has declined from 27.5 percent to 17.2 percent respectively.

Figure 3.23: Energy Consumption for Lighting in Bihar



Source: Calculated from NSS each rounds 50th 55th 61st 66th & 68th, Ministry of statistics and programme implementation, GOI, New Delhi.

3.4 Conclusion

In this chapter major finding relating to primary source of energy used for cooking and lighting base on each rounds (50th 1993-94, 55th 61st 66th 68th**).** It is found that household energy consumption levels and fuels used are closely related to variables such as availability, Income, occupation and household size. Majority of the households are using unsustainable fuel for cooking in the rural areas while clean fuel used in the urban areas for cooking. It is also observed that the huge variation in rural energy after globalization in India. However State level variation is high in rural as compare to urban areas, use of LPG in urban India is around 68 percent in recent year where as reverse situation is found in rural India around 67 percent in the usage of firewood and chips for cooking in Rural India. The weightage of use of unsuitable fuels for cooking and lighting among social group ST and SC third OBC and lastly others. There is high inequality perceived in Rural and Urban India while Kerosene is

superior fuel compare to bio-fuels. The flexibility in the budget with an auxiliary subsidy may leads to low fix cost and this is overall aiming to achieve high willingness to pay for sustainable fuels like LPG that has good spread effect on health and environment. Clean fuel are not easily available so people are ultimately relying on unsustainable energy sources. People are shifted towards clean fuel but this percentage is very low in order to obtain the sustainable economy with sustained environment where as after globalization there is a shift in usage of qualitative fuel. Moreover, NSSO reports shows that after 1999-200 to 2011-12 the energy consumption in Bihar for LPG has increased sharply, while as the consumption of firewood and chips has declined drastically. Apart from this, the energy consumption of kerosene for lightning has declined drastically and the consumption of electricity for lightning has increased sharply in the recall period.

Chapter 4
Demographic, Socio-Economic Profile of Households in Paschim Champaran District, Bihar

Chapter 4

Demographic, Socio-Economic Profile of Households in Paschim Champaran District, Bihar

4.0 Introduction

Socio-economic background is very important tool to show the real situation of any society. The allocation of social and economic services not promoting economic growth but also for assuring the social justice and better improvement of standard of living. Social character of a person and his involvement to the society is based on his socio-economic condition. This is necessary condition to know the income, age structure, education level, consumption expenditure their land asset and wealth. Socio-economics status is the term which is mostly used by social scientists such as sociologist, economist and other social scientists. The social scientists used this term to describe the class standing of an individual or group. It is measured by a number of factors, including income, occupation and it can have either a positive or negative impact on a person's life (Crossman A. 2019: p.1). Socioeconomic status (SES) is defined by way of measure of one collective economic and social status (House, J. S. 2002: p.125 and Galobardes et al. 2006: p.7). Commonly, socioeconomic status (SES) is observed as a latent concept and is measured using a compound indication such as education, income, and occupation or some disparity of these three indicators. Though, these three indicators represent the most broadly recognized measures of socioeconomic status, yet SES is sometimes defined in terms of subjective factors such as wealth, home ownership, or as neighborhood disadvantage. Analyzing the indicators of education, income, and occupation and their association to health

through the framework suggested in the Black Report (Mancityre 1997: p.723). Rural area of Paschim Champaran is mainly associated with low level development and, which is having low per capita income, low education and low economic growth. Here the development of the industry has been one of the lowest level. The people here mainly depend on agriculture, and agricultural is the main source of their livelihood.

4.1 Demographic Structures of Bihar and Paschim Champaran

Bihar state is plays an important role in Indian economy as it contribute more labor force. It is located in the eastern part of India covering an area of 94,163 sq. km. The state has a population of 103 million and is one of the most densely-population state in the country. It touches the border of Uttar Pradesh, Jharkhand and West Bengal and international border with Nepal. Bihar has total 38 district, Patna district is the capital of state and other major districts of state are Gaya, Bhagalpur, Muzaffarpur and Darbhanga[4]. The Ganga, the major river flow through the state which makes its land very fertile for agriculture. Bihar state is plays an important role in Indian economy as it contribute more labor force. The state has a huge base of industrial labour and manufacturing sectors, it a perfect destination for extensive range of industries.

Paschim Champaran district is located is low land of Himalaya. According to census 2011, Paschim Champaran district has 39, 35,042 population which is 3.7 percent of total population of the state. The district divided into 18 community development

[4] Araria, Arwal, Aurangabad, Banka, Begusarai, Bhagalpur, Bhagalpur, Bhabua, Bhojpur, Buxar, Darbhanga, Gaya, Gopalganj, Jehanabad, Jamui, Kaimur, Katihar, Khagaria, Kishanganj, Lakhisarai, Madhepura, Madhubani, Munger, Muzaffarpur, Nalanda, Nawada, Purbi Champaran, Paschim Champaran, Patna, Purnia, Rohtas, Saharsa, Samastipur, Saran, Sheikhpura, Sheohar, Sitamarhi, Siwan, Supaul, Vaishali.

blocks, 1483 villages. 5 towns and 3 census town. The district is 9th most populous' district among all the districts Of Bihar. It has 20, 61,610 males and 18, 73,932 females spread over 5.6 percent area of the State. Among 18 community blocks of district, Bagaha is most population while Piprasi is least populous community block.

(a) Economic base of Paschim Champaran

Agriculture is the main occupation of the people of the district and also the main source of livelihood of the people. Rainfall still controls the agriculture of Paschim Champaran district. Mainly three types of crops are produced in the district viz., Bhadai (autumn crop), Aghani (Kharif) and Rabi (spring crop). Bhadai crops comprise mainly maize and sugarcane. The main crops of Aghani season are paddy and potato etc.[5] Total forest area 9012 hector. Total irrigated land 184892.4 hqt, total unirrigated land 119355.1ht, cultivable wasteland 20061.1hqt barren & un-cultible land 9289.4hqt, area under non-agriculture land in hectares (census, 2011). In this chapter an effort has been made to attempt to cover socio-economic and demographic profile of rural households of Paschim Champaran district of Bihar state.

[5] Mustard, Green Pea, Wheat, Barley, gram, etc.

Table 4.1: Demographic Profile of Households Paschim Champaran and Bihar

Parameter	**Paschim Champaran**	**Bihar**
Demographic Profile		
Total Population (in Number)	39,22,780	**103,804,637**
Males (in Number)	2,057,669	54,185,347
Females (in Number)	1,865,111	49,619,290
Decadal population growth rate (in percentage 2001-2011)	28.89	25.07
Population Density (Per Sq.)	750	1,102
Sex Ratio (Per 1000)	906	916
Educational Profile		
Literacy Rate (in percentage)	58.06	63.82
Males (in percentage)	68.16	73.39
Females (in percentage)	46.79	53.33
Health Profile		
Crude Birth Rate (CBR)	28.7	27.1
Crude Death Rate (CDR)	8.5	7.2
Infant Mortality Rate (IMR)	51	53
Under 5 Mortality Rate	76	76
Occupational Profile		
Work Participation Rate	37.58	33.4
Main Workers	20.26	20.51
Marginal Workers	9.45	12.83
Marginal Agriculture worker	13.57	8.28

Source: Census of India 2011 & Annual Health Survey Bulletin 2011-12, Bihar. Bihar Statistical Hand Book 2014, Directorate of Economics & Statistics Department of Planning & Development Bihar, Patna.

4.2. Socio-Economic Status of Households in the Study Area

4.2.1 Family Status

Family status Study found that there are higher percentage of joint families in comparison to nuclear families. Joint families are 71.33 percent which is more than two times higher to nuclear families i.e., 28.67 percent (Table 4.2). In joint families, mostly family size is larger which affect consumption pattern, education and per capita income and of family.

Table 4.2: Nature of Family of the Households

Family	Frequency	Percent
Joint	214	71.33
Nuclear	86	28.67
Total	300	100

Source: Estimated from Primary Data

4.2.2 Gender and Population Distribution

Table 4.3 show that concerning to the gender wise distribution of total family members. In the study area there are total 300 hundred households which have 1983 total population where 1006 male and 977 are female population. The total percentage of male population is 50.73 percent and female is 49.27 percent. Table data show that number are females are relatively lower compare to male.

Table 4.3: Gender Wise Profile of the Households

Gender	frequency	Percent
Male	1,006	50.73
Female	977	49.27
Total	1983	100

Source: Estimated from Primary Data

4.2.3 Religion and Population Distribution

Table 4.4 shows that there are basically two religion in study area viz., Hindu and Muslim. The population of Hindu is (1911) which is larger than Muslim population i.e. 72 percent. These village are tribal-dominated area, largely concentrated with Hindu population. These people have migrated from other places Hindu is 96.37 percent and Muslim is 3.63 percent only.

Table 4.4: Religion wise profile of the households

Religion	Frequency	Percent
Hindu	1,911	96.37
Muslim	72	3.63
Total	1,983	100.00

Source: Estimated from Primary Data

4.2.4 Caste and Sample Distribution

The below table describe category wise household profile. Almost half of the respondent belong to schedule tribe i.e. 47 percent, followed by other backward class's i.e.18 percent of the respondent. Schedule caste constituted 18.61 percent and rest of the respondent fall under other than above followed category. Further ST

category has highest percentage, which is 47.00 percent flowed by OBC 30.01 percent, SC 18.61 percent and other category has lowest percentage which is 4.39 percent.

Table 4.5: Category wise Household Profile of the Study Area

Caste Group	Frequency	Percent
ST	932	47.00
SC	369	18.61
OBC	595	30.01
Others	87	4.39
Total	1,983	100.00

Source: Estimated from Primary Data

4.2.5 Age Composition

Age is one of the basic demographic feature which has an important role in the family such as access to cooking and other household's facilities. By 2050, half of the population of China, Japan, etc. will increase, but India will remain a young population and India will be the richest country in human capital. This is the better indicator of this area for economic development. Table 4.6 shows the distribution of respondent along with their family members on the basis of age composition. Maximum number of households i.e. 36 percent falls in the age group of 15-34 .It is considered as a young population. Following by this, 31 percent are falls in the age group of 0-14. Further, 24.26 percent households fall in the age group of 35-39. Only 8.98 percent households are in the old age group that is 60-93.

Table 4.6: Distribution of Population on the basis of Age composition (Individual Members)

Age Group	Percent
Children 0-14	612 (30.86)
Young age 15-34	712 (35.91)
Adult 35-59	481 (24.26)
Old-age 60-93	178 (8.98)
Total	1,983 (100.00)

Source: Estimated from Primary Data

Table 4.7 shows the social group wise population distribution of sub districts, Gaunaha and Piprasi. The data shows that the number of ST category is highest in Gaunaha i.e., 96.48 percent in row wise and 91.33 percent in column wise. While Piprasi has lowest ST category households with 3.52 percent in row and 3.33 in column. Further SC population in Piprasi has highest number of SC category household that is 90.74 percent in row and 32.67 percent in column. In other hand, if we talk about OBC category, we can see in above table that Piprasi Sub districts has highest number of OBC category, 91.01 percent in row wise and 54 percent in column wise while Gaunaha has only 8.99 percent in row wise and 5.33 in column wise OBC category. Gaunaha sub district has no other category while Piprasi has 15 percent other category in row wise and 100 percent in column wise. The result shows that

Gaunaha sub district has majority of ST category while in Piprasi sub district OBC is major caste while SC is second major caste. A combination of all casts could be seen in Piprasi sub district. The Gaunaha sub-district is a completely tribal-dominated area with the largest population being the tribal community and the other community having the least population. In contrast, the Piprasi sub-district is a non-tribal block, where the population of tribal communities is very less. Piprasi sub-district is the smallest of the 18 blocks in West Champaran, where the population is the least among these 18 blocks.

Table 4.7: Social Group wise Population of Sub-Districts

Social Group	Gaunaha	Piprasi	Total
ST	137 96.48* 91.33**	5 3.52* 3.33**	142 100* 47.33**
SC	5 9.26* 3.33**	49 90.74* 32.67**	54 100* 18**
OBC	8 8.99* 5.33**	81 91.01* 54**	89 100* 29.67**
Others	0 0* 0**	15 100* 10**	15 100* 5**
Total	150 50* 100**	150 50* 100**	300 100* 100**

Source: Estimated from Primary Data

Note: * is represented as Row wise percentage, while ** is represented as Column percent.

4.2.6 Government Schemes and Basic Amenities

(a) Ration Card

Table 4.8 shows cross tab of caste and ration card. The percentage of ST population who are holding ration card are Antodaya (18.64 percentage), BPL (77.79 percentage) and other category are just holding 3.39 percent. Similarly SC population who are holding ration card are Antodaya 21.57 percentage, BPL 78.43 percent. Antodaya BPL card has the maximum number of tribal people, this figure shows that the ratio of poverty is highest in tribal people. Even today, it is deprived of basic amenities and dependent on government.

Table 4.8: Distribution of type of Ration cardholders on the basis of Social group

Caste Wise	Antodaya	BPL	other	Total
ST	22 (18.64)* (51.16)**	92 (77.97)* (44.44)**	4 (3.39)* (50)**	118 (100)* (45.74)**
SC	11 (21.57)* (25.58)**	40 (78.43)* (19.32)**	0 (0)* (0)**	51 (100)* (19.77)**
OBC	9 (11.69)* (20.93)**	65 (84.42)* (31.4)**	3 (3.9)* (37.5)**	77 (100)* (29.84)**
Others	1 (8.33)* (2.33)**	10 (83.33)* (4.83)**	1 (8.33)* (12.5)**	12 (100)* (4.65)**
Total	43 (16.67)* (100)**	207 (80.23)* (100)**	8 (3.1)* (100)**	258 (100)* (100)**

Source: Estimated from Primary Data

Note: * is represented as Row wise percentage, while ** is represented as Column percent.

(b) Drinking Water Facility

Mukhyamantri Gramin Peyjal Nishchay Yojana was launched on 27th September 2016. Under the seven-decision plan by the Development Sanitation Rural and Urban Development Mission, "Har Ghar Nal Ka Jal" is to provide clean drinking water to every citizen of Bihar without any discrimination. The target (2015-20) is to provide clean drinking water to about 2 crore households in the state. Under this, with a view to eliminating the dependence on hand-pumps (chapakal) and other sources of drinking water in every household, it is planned to transport water from pipes to every household (Bihar Vikas Mission Government of Bihar 2019-20). Source of drinking water is very important feature to show the socio economic condition of a society. It is a major content of sustainable growth of the society. If a society has good and enough source of drinking water it shows that the prosperity of the society, safe drinking water is important for human health. Table 4.9 shows the source of drinking water of study area. The self-hand pump has highest number frequency, which is 78.33 percent. It means that the most of the households are using self-hand pump as primary source of drinking water. Nearly 10 percent households are using government hand pump as primary source of drinking water as they do not have any source of water in their house. A noticeable situation is seen in the table that about 6 percent household are using uncover well as primary source of drinking water. This situation shows the lack of save drinking water. Pukka cover well and tank/lake has equal frequency which 0.33 percent and other source (fountain, tube well and from other's hand pump) users are 5.33 percent. The overall situation is not a good situation as still people are using uncover well for drinking water.

Table 4.9: Distribution of main source of drinking water

Main source of drinking water	Frequency	Percent
Government hand pump	30	10
Self-hand pump	235	78.33
Pukka cover well	1	0.33
Uncover well	17	5.67
Tank/ lake/ pond	1	0.33
Other source	16	5.33
Total	300	100

Source: Estimated from Primary Data

In the table 4.10 the sub-district wise row column frequency distribution of source of drinking water as primary source are portrayed. In the Gaunaha sub district, self-hand pump has highest percentage which is 70 percent in row wise and 44.68 percent in column wise. Percentage of government hand-pump is 14.33 which is second highest in row wise but the column wise percent it has highest percentage 73.33. The source of uncover well shows the highest percentage in Gaunaha sub district, which is 11.33 percent in row wise and 100 percent in column wise. It shows the poor condition of availability source of drinking water in Gaunaha. People are forced to drink unsafe water of uncover well in Gaunaha block. In Piprasi block self-hand pump has highest 86.67 percent in row wise and in column wise percentage. It has highest percentage in other source 68.75 percentage. There are no uncover well in Piprasi block, government hand pump is also less than Gaunaha block which is5.33 in row wise and 26.67 percent in column wise. The result shows that the Piprasi block has better drinking water facilities than Gaunaha block.

Table 4.10: Sub-district wise Distribution of Source of Drinking Water

Sub-District	Govt. hand pump	Self hand pump	Puckka Cover well	Uncover well	Tank / lake	Others	Total
Gaunaha	22 14.67* 73.33**	105 70* 44.68**	1 0.67* 100**	17 11.33* 100**	0 0* 0**	5 3.33* 31.25**	150 100* 50**
Piprasi	8 5.33* 26.67**	130 86.67* 55.32**	0 0* 0**	0 0* 0**	1 0.67* 100**	11 7.33* 68.75**	150 100* 50**
Total	30 10* 100**	235 78.33* 100**	1 0.33* 100**	17 5.67* 100**	1 0.33* 100**	16 5.33* 100**	300 100* 100**

Source: Estimated from Primary Data

Note: * is represented as Row wise percentage, while ** is represented as Column percent.

(c) Sanitation Facility

The development of toilets is being done under the Lohia Swachh Bihar campaign under the seven-decision plan by the Development Sanitation Rural Department. 1.21 cror to facilitate the construction of individual household latrines (IHHL) by the beneficiaries and for the construction of community sanitation centers for landless rural families. Behavior change and all 8386- Gram Panchayats in connection with the construction of individual and household toilets among rural people as well as the regular and regular use of wires among rural people to eliminate open defecation in rural areas. The goal is to do ODF. (Bihar Vikas Mission Government of Bihar 2019-20).

The toilet facility of households in which we can see the percentage of having toilet is 58.33 while not having toilet percentage is 41.67. The result shows that the area has poor sanitation facility that 41.33 percent are not using toilet, it means they are using open field for defecation which can badly impact on their health.

Table 4.11: Percentage of Toilet of the Households

Toilet Facility	Frequency	Percent
Yes	175	58.33
No	125	41.67
Total	300	100

Source: Estimated from Primary Data

(d) Drainage System

The drainage system is very important, it is the most important part of cleaning for any city, village or house. The government tries to resolve the problem of drainage system by planning at its level. The drainage system is a huge problem for the backward states like Bihar, for both the village and urban areas. Table 4.12 which Shows the Valuable information 'The Types of drainage system of Households' of this study area. The facility of no drainage system has highest percentage of 61.95. It means that the most of the households have not facility primary source of drainage system. And also nearly 9.43 percent households covered with 'cover pukka drainage system'. A noticeable situation is seen in the table that about 61.95 percent household are not having pukka drainage system. This situation shows the lack of sanitary facility in the study area in Bihar.

Table 4.12: Type of Drainage System of Households

Type of Drainage System	Frequency	Percent
Kucha Open	50	16.84
Pukka open	24	8.08
Cover pukka	28	9.43
Underground	11	3.7
No Drainage System	184	61.95
Total	297	100

Source: Estimated from Primary Data

The type of house structure type one of households where they are living, pukka house has highest percentage that is 52 percent. Pukka house means at least one room with roof is cemented Kucha house has second highest percentage (30.33 percent). Semi Pukka house owner has lowest percent. The table shows that even after years of Independence, people are deprived of basic facilities, facilities which should be there to live a dignified life. At present, many types of policies have been made to give facilities to the poor, but these facilities are not seen here in the table.

Table 4.13: Structure of Houses in the Study Area

Type Home of Houses	Frequency	Percent
Pukka	156	52
Semi Pukka	53	17.67
Kucha	91	30.33
Total	300	100

Source: Estimated from Primary Data

4.3 Educational Status

"If your plan is for one year, plant rice. If your plan is for ten years, plant trees. If your plan is for one hundred years, educate children."Kaun Chung (7th century BC)

Education is a powerful driver of development and one of the most solid tools for reducing poverty and improving health, gender equality, peace, and stability. Developing countries have made marvelous progress in getting children into the classroom and the majority of children worldwide are now in primary school. Nevertheless, some 260 million children are still out of primary and secondary school (World Development Report 2018). The sample for survey comprised of 50.52 percent males and 49.48 percent females. The educational profile depicts inequality in terms of literacy levels among males and females. Nearly 15.52 percent of the males are found to be illiterate, while 29.38 percent (nearly twice of the male) of females were found to be illiterate. Nearly 78 percent of the total surveyed population was literate. Nearly 50 percent of both the male and female population are educated below secondary level. The number of both male and females is found to be declining in higher education level. The female participation is lower than of males in higher education.

Table: 4.15 Distribution of Household on the basis of Gender wise Educational Profile

Gender	Illiterate	Informal Literate	Below Primary	primary	Middle	Secondary	higher Se.	Diploma	Graduate	PG	Total
Male	151 15.52* 35.03**	20 2.06* 20.83**	273 28.06* 55.49**	119 12.23* 61.34**	178 18.29* 62.46**	133 13.67* 54.29**	49 5.04* 46.23**	3 0.31* 100**	41 4.21* 63.08**	6 0.62* 66.67**	973 100* 50.52**
Female	280 29.38* 64.97**	76 7.97* 79.17**	219 22.98* 44.51**	75 7.87* 38.66**	107 11.23* 37.54**	112 11.75* 45.71**	57 5.98* 53.77**	0 0* 0**	24 2.52* 36.92**	3 0.31* 33.33**	953 100* 49.48**
Total	431 22.38* 100**	96 4.98* 100**	492 25.55* 100**	194 10.07* 100**	285 14.8* 100**	245 12.72* 100**	106 5.5* 100**	3 0.16* 100**	65 3.37* 100**	9 0.47* 100**	1,926 100* 100**

Source: Estimated from Primary Data

Note: * is represented as Row wise percentage, while ** is represented as Column percent.

4.4 Land Distribution of Survey Areas

Table 4.16 reflect the land distribution of the number of marginal land holders is maximum 188 (62.67 percent) followed by landless (30.67 percent). It could clearly see that large holders are very few in numbers, which reveal economic status in the study area.[6]

[6] Marginal land holder are those who have 0.01- 2.5 acre land, small land holders have 2.51- 5 acre land, medium land holder have 5.01-10 acre land and large farmers are those who have more than 10 acre land.

Table 4.16: Distribution of Households on the basis of Land Distribution

Agriculture land in acre	Frequency	Percent
Landless	92	30.67
Marginal	188	62.67
Small	15	5
Medium	3	1
Large	2	0.67
Total	300	100

Source: Estimated from Primary Data

Table 14.17 shows that there is remarkable inequality is observed in terms of income. However, in terms of land ownership there is a wide gap. It is only the highest income earning group top 20 percent who own medium and large land holdings. Even within the highest earning group only 5 out of 56 households own medium and large lands. More than half of the households own marginal lands. Nearly 30 percent of all the households were landless. 68 percent of the landless households are in the bottom 60 percent income group. Large and medium land holdings leads to higher income earnings while landless and marginal land holdings leads to low income earnings. Here is vicious circle of poverty is working that the poor has less land holdings that's why they are poor as they has low income and vice versa. Those who have more land also have more income.

Table 4.17: Household wise distribution quintile of Income and Land size

Quintile of income_hh	Landless	Marginal	Small	Medium	Large	Total
	29	42	1	0	0	72
	40.28*	58.33*	1.39*	0*	0*	100*
1	31.52**	22.34**	6.67**	0**	0**	24**
	16	31	1	0	0	48
	33.33*	64.58*	2.08*	0*	0*	100*
2	17.39**	16.49**	6.67**	0**	0**	16**
	18	48	4	0	0	70
	25.71*	68.57*	5.71*	0*	0*	100*
3	19.57**	25.53**	26.67**	0**	0**	23.33**
	17	35	2	0	0	54
	31.48*	64.81*	3.7*	0*	0*	100*
4	18.48**	18.62**	13.33**	0**	0**	18**
	12	32	7	3	2	56
	21.43*	57.14*	12.5*	5.36*	3.57*	100*
5	13.04**	17.02**	46.67**	100**	100**	18.67**
	92	188	15	3	2	300
	30.67*	62.67*	5*	1*	0.67*	100*
Total	100**	100**	100**	100**	100**	100**

Source: Estimated from Primary Data

Note: * is represented as Row wise percentage, while ** is represented as Column percent.

Table 4.18 in this study has made an attempt to study the distribution of respondent on the basis of gender and land Distribution .The above table depicts that the maximum number of household that is 62.67 percentages had marginal Land Holdings in which 69 percent are male and 31 percent are female. In other hand 5 percent had small land holdings in which 87 percent were Male and 13 percent were female. Only 1 percent had medium land holding. Only minimum percentage that is 0.67 percent had Large Land Holding which is completely in the name of Male. 30.67 percent are landless in

which 68 respondent was Male and 31 percent were female. The above table shows that maximum type of land holdings that is Marginal, small, and large are distributed more in the name of males compared to females. Only in the medium land holding maximum percentage is female compared to male.

Table 4.18: Gender wise land distribution on the basis of Head of the households

Agriculture	Female	Male	Total
	29	63	92
	31.52*	68.48*	100*
Landless	31.87**	30.14**	30.67**
	58	130	188
	30.85*	69.15*	100*
Marginal	63.74**	62.2**	62.67**
	2	13	15
	13.33*	86.67*	100*
Small	2.2**	6.22**	5**
	2	1	3
	66.67*	33.33*	100*
Medium	2.2**	0.48**	1**
	0	2	2
	0*	100*	100*
Large	0**	0.96**	0.67**
	91	209	300
	30.33*	69.67*	100*
Total	100**	100**	100**

Source: Estimated from Primary Data

Note: * is represented as Row wise percentage, while ** is represented as Column percent.

4.5 Occupation

The occupational structure is an important basis for the main aspect of social stratification (Blau and Duncan. 1967: pp. 6-7). Table 4.19 depicts that the maximum number of respondents are 42.51 percent are students that means 42 percent population is not working. Maximum number of respondents who are student belongs

to OBC category (45.96 percent) followed by ST (44.51 percent) and other (40.3 percent). The Minimum number of respondents in the student group hails from SC category that is 31.8 Percent. Apart from students, maximum number of respondent that is 22.89 percent engages as a daily wage worker. They work on a daily wage basis. 13.47 percentage of respondent are categorized as housewife. 6.5 percent and 3.28 percent respondent are occupationally distributed as self-employed agriculture and self-employed non agriculture respectively. 5.15 percentage of respondent were doing private job and 4 percentages were engaged as casual Labor. Only 1.76 percent was employed in Government sector. A minimum percentage that is 0.41 percent engage on other occupation.

Table 4.19: Distribution of Households on the basis of Occupational Pattern and Social Group

Occupation	ST	SC	OBC	Others	Total
Private	62 (70.45)* (7.48)**	5 (5.68)* (1.64)**	11 (12.5)* (2.17)**	10 (11.36)* (14.93)**	88 (100)* (5.15)**
Government	16 (53.33)* (1.93)**	3 (10)* (0.98)**	7 (23.33)* (1.38)**	4 (13.33)* (5.97)**	30 (100)* (1.76)**
Self-employ Agriculture	35 (31.53)* (4.22)**	9 (8.11)* (2.95)**	60 (54.05)* (11.83)**	7 (6.31)* (10.45)**	111 (100)* (6.5)**
Self-employ Non-agriculture	27 (48.21)* (3.26)**	7 (12.5)* (2.3)**	20 (35.71)* (3.94)**	2 (3.57)* (2.99)**	56 (100)* (3.28)**
Daily wage worker	161 (41.18)* (19.42)**	133 (34.02)* (43.61)**	95 (24.3)* (18.74)**	2 (0.51)* (2.99)**	391 (100)* (22.89)**

Student	369 (50.83)* (44.51)**	97 (13.36)* (31.8)**	233 (32.09)* (45.96)**	27 (3.72)* (40.3)**	726 (100)* (42.51)**
Casual Labor	47 (68.12)* (5.67)**	11 (15.94)* (3.61)**	11 (15.94)* (2.17)**	0 (0)* (0)**	69 (100)* (4.04)**
Other	5 (71.43)* (0.6)**	1 (14.29)* (0.33)**	1 (14.29* (0.2)**	0 (0)* (0)**	7 (100)* (0.41)**
Housewife	107 (46.52)* (12.91)**	39 (16.96)* (12.79)**	69 (30)* (13.61)**	15 6.52* 22.39**	230 100* 13.47**
Total	829 48.54* 100**	305 17.86* 100**	507 (29.68)* (100)**	67 (3.92)* (100)**	1,708 (100)* (100)**

Source: Estimated from Primary Data

Note: * is represented as Row wise percentage, while ** is represented as Column percent.

4.5 Consumption Pattern

Taking into consideration the consumption pattern in the sample households, social group wise expenditure on food grains in a month has been presented in table 4.20. The data shows that the average expenditure of household belonging to ST category is Rs.7951.40 while the minimum expenditure is Rs.1500, maximum is Rs.40000 and the standard deviation is Rs.3904.87. In the case of SC social group, the average expenditure is Rs.9203.70, minimum is Rs.3000, maximum expenses on food items is Rs.18000 and the standard deviation is Rs.3604.92. The mean expenditure on food grains is highest in General category i.e. Rs.10200 followed by OBC group (Rs.9050.56), SC (Rs.9203.70) and ST (Rs.7951.40).

Table 4.20: Caste wise Expenditure on Food grains (Rs. /month)

Caste	Mean	Min	Max	SD
ST	7951.408	1500	40000	3904.875
SC	9203.704	3000	18000	3604.921
OBC	9050.562	3000	25000	4153.343
Others	10200	5000	16000	2426.049

Source: Estimated from Primary Data

Focusing on the expenditure on non-food grains, table 4.21 has been depicted below. The data shows that the average expenditure of household belonging to ST category is Rs.3190.71 while the minimum expenditure is Rs.200, maximum is Rs.20000 and the standard deviation is Rs.2475.16. In the case of SC social group, the average expenditure is Rs.2055.76, minimum is Rs.200, maximum expenses on food items is Rs.5000 and the standard deviation is Rs.1243.71. The mean expenditure on non-foodgrains is highest in General category i.e. Rs.3733.33 followed by ST category (Rs.3190.71), OBC (Rs.2758.82) and SC (Rs.2055).

Table 4.21: Caste wise Expenditure on Non-Food grains (Rs. /month)

Social Group	Mean	Min	Max	SD
ST	3190.714	200	20000	2475.169
SC	2055.769	200	5000	1243.716
OBC	2758.824	500	10000	2151.428
General	3733.333	1000	8000	1830.951

Source: Estimated from Primary Data

Focusing on the expenditure on other household items, the expenses social group wise are presented in table 4.22.The data shows that the average expenditure of household belonging to ST category is Rs.3774.49 while the minimum expenditure is Rs.135.83,

maximum is Rs.95416.7 and the standard deviation is Rs.8084.84. In the case of SC social group, the average expenditure is Rs.2470.81, minimum is Rs.376.66, maximum expenses on food items is Rs.16767.1 and the standard deviation is Rs.2496.67. The mean expenditure on other household items is highest in General category i.e. Rs.5281.5 followed by OBC category (Rs.4213.77), ST (Rs.3774.49) and SC (Rs.2470.81).

Table 4.22: Caste wise Expenditure on Other Items (Rs. /month)

Caste	Mean	Min	Max	SD
ST	3774.49	135.833	95416.7	8084.847
SC	2470.81	376.667	16767.1	2496.675
OBC	4213.77	191.667	33224.2	4730.959
General	5281.5	916.667	14726.7	4313.599

Source: Estimated from Primary Data

As far as total expenditure is concerned, social group wise pattern has been depicted in table 4.23. The data shows that the average expenditure of household belonging to ST category is Rs.14871.7 while the minimum expenditure is Rs.2471.67, maximum is Rs.155417 and the standard deviation is Rs.13061.63. In the case of SC social group, the average expenditure is Rs.13654.1, minimum is Rs.3576.67, maximum expenses are Rs.36767.1 and the standard deviation is Rs.6188.85. The mean expenditure is highest in General category i.e. Rs.19214.8 followed by OBC category (Rs.15899.2), ST (Rs.14871.7) and SC (Rs.13654.1).

Table 4.23: Caste wise Total Expenditure (Rs. /month)

Caste	Mean	Min	Max	SD
ST	14871.7	2471.67	155417	13061.63
SC	13654.1	3576.67	36767.1	6188.853
OBC	15899.2	3316.67	59334.2	9212.472
Others	19214.8	7916.67	35726.7	7204.965

Source: Estimated from Primary Data

The below above table 4.24 depicts caste-wise income distribution of the households. It suggests that the mean incomes of different caste groups are not varying much. However, there is a huge income variation within each caste group. In the ST category, the income range is the largest, ranging from a minimum of Rs.2000 to Rs.90, 000. Among the OBCs as well, a large income variation is observed. Thus, within each caste group there is huge income inequality. Given the wide income differences, the mean income does not fairly represent the average income of each caste group. The income variation among the SC and Others category is observed to be small.

Table 4.24: Caste wise Income Distribution of households

Caste	Mean income HH	SD Income HH	Min Income HH	Max Income HH
ST	16037.32	10949.14	2000	90000
SC	14246.3	6793.274	3000	32000
OBC	15250	10241.54	2000	60000
Others	18058.27	9230.277	8000	38512

Source: Estimated from Primary Data

4.6 Conclusion and Finding

Income, education, occupation and health are main indicator of the development of any country and society. In this chapter, the socio-economic status of the study area on the basis of data collection of the 300 households. The discussion based on demographic structure, family structure, occupation, income, education, and sanitation etc. it reflects gap across the social and religious group on the basis of occupation, education, income, land distribution in the study area. Poverty condition of schedule tribe very high on the basis on below poverty line (BPL) and Antodaya cardholder. In terms of literacy rate, the number of both males and females is found to be declining in higher education level. The female participation is lower than that of males in higher education. The educational situation is truly depressing. Certain of the schools' absence of basic educational services, particularly for girls, which are reflected in an alarmingly low literacy rate between girls and the gender disparity in educational attainments. Overall literacy rate of district is below state average. The population of this area is completely dependent on agriculture as there is a shortage of industries. The labor force is in bigger amounts because the younger population is more. The population of age 15-34 is approximately 36 percent. Due to lack of work opportunity, the people of this area migrate to work in other states after doing agricultural work. Most of the people working on daily wage worker in this population. In this area, most of the daily wage worker, Schedule tribe (ST) and Schedule cast (SC) compared to the other backward classes (OBC) and general classes. Agriculture, wage labour, private job, self-employ in non-agriculture are the main source of income of the people of the district. It could be witnessed from the data that General category households have high expenditure with reference to

foodgrains, non-foodgrains and other household items. As far as total expenditure is concerned, the average of General category household is highest i.e. Rs.19214.8/month followed by OBC (Rs.15899.2), ST (14871.7) and SC (Rs.13654.1).

Chapter 5
Health Cost Measurement of the Households in Paschim Champaran District, Bihar

Chapter 5

Health Cost Measurement of the Households in Paschim Champaran District, Bihar

5.0 Introduction

Many literature and reports suggest that indoor air pollution is a serious problem for countries in Asia and Sub-Saharan Africa. Due to which the morbidity and mortality in these countries are quite high. In a country like India, most of the attention has been given about air pollution, while in terms of research, indoor air pollution is still an ignored area. Vehicle pollution is the biggest cause of the problem in urban areas. On the other hand, indoor air pollution is considered as a special problem for rural households where wood and agriculture waste are the major sources of energy. The consumption of dirty fuels, the health burden is increasing in rural households due to which they are not able to live a healthy life even today. Health is influenced by economic, social and environmental determinants. Progress in health is dependent on economic, social and environmental progress (WHO 2015: p.9). "A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO 1948 and Jakab, Z.). Health is important for human development, contributing significantly to the development of both communities and societies. Exposure to air pollution is leading to increased morbidity and mortality worldwide. The mortality and illness due to ambient air pollution from 1990 to 2015 are as follows. Ambient PM 2.5 was the fifth largest risk factor for death in 2015. Contact to ozone caused an additional 254 000 deaths and a loss of 4·1 million (1·6 million to 6·8 million) DALYs from chronic obstructive pulmonary disease in 2015 (Cohen, A. J., et al. 2017: p. 1907).

The chapter discusses key features telling information on health data taken during the survey such as illnesses, expenditures incurred on hospitalization and non-hospitalization related issues. The main objective of the study is assess the effect of indoor air pollution on the health of rural people and to measure the impact on health costs due to the effect of indoor air pollution and how much of the wages are lost. Health is a very important factor for the economy of any country, the country whose people are healthier, that economy grows rapidly and the economy of the country where more people are sick also gets sick. All developed countries in the world have a higher life expectancy and lower disease rates whereas those in developing and underdeveloped countries with lower life expectancy and higher disease rates. The survey has been conducted mainly in six villages in two blocks of rural areas of the Paschim Champaran district of Bihar. In the study, inpatient and outpatient within fifteen days have been taken to survey. Similarly, inpatient and outpatient have been taken for 365 days. This study has been done to examine the prevalence rates of various diseases households among different caste different age-sex group's different occupational group and religions. When a person remains ill for more days, he has to lose more wages. On the basis of this, we can say the disease directly affects human capital.

5.1 Methods for Measuring Morbidity

Indoor air pollution is currently considered to be one of the most prominent causes of morbidity and mortality, especially in developing countries such as India. The Lancet Commission and WHO reports state that the condition of indoor air pollution in India is very bad. Cost-of-illness measures the economic burden of disease and evaluation the maximum amount that might potentially be saved or gained if a disease were to be

eliminated. Researchers and policymakers have moved on to the disease cost of illness method to better describe health spending and improve the cost-effectiveness model. This method provides information on the relative importance of specific diseases and injuries in terms of the use of all relevant components of health care and the costs involved. This method is a way of communicating with the public and policymakers on the relative impact of diseases at the population level in order to provide information about the costs of various types of diseases. Government agencies also use this method to reduce disease costs and improve health facilities and make public policy. The study uses two types of approach study the first, approach is **Incidence** based cost of illness method he/she amount spent within a particular time period in a person's lifetime due to an illness or injury falls under the incidence study. Second, is **prevalence** based cost of illness method, i.e., the amount spent each year for the care of a person for an illness or injury is studied within the spread based. The broad field of calculating some or all of the costs of particular diseases is an exercise that distinguishes health economics from other specialties in economics. A greater amount of money spent on a specific disease can be reduced by paying more attention to preventing or improving the underlying factors that result from the disease (Kennelly, B. 2017: p. 736).

Acute and Chronic Disease

Acute Disease: Acute illness generally develop suddenly and last a short, time, often only a few days or weeks. Acute illness is often produced by a virus or an infection, but can also be produced by an injury resulting from fall or due to accident, or by the misuse of drug or medication. Acute Disease worldwide, there is no uniformly accepted norm of taking the disease and the definitions in use are not entirely

intuitive. These vary according to the place and geographical boundaries. This study uses the WHO definition of acute disease flowing symptom phlegm, runny nose, phlegm with a sore throat, or lung and pneumonia infections (WHO 1991: p. 12).

Chronic Disease : Chronic condition develop slowly and may worsen over an extended period of time-month to years The burden of chronic diseases and their risk factors is increasing worldwide especially those countries which fall under the category of low and medium-income countries where chronic diseases are considered common. According to estimates, in 2005, 35 million deaths out of 58 million worldwide are due to chronic diseases. A projected 388 million people will die due to chronic illness in the next ten years. 80 percent of deaths will occur in low and middle-income countries and most of the deaths will be from the most productive age groups (WHO 2006: p.1). There can be many reasons for the chronic condition, use of unclean fuel, use of smoking, pollution, and genetic factors, etc. which are more likely to develop more chronic conditions. Age-specific death rates due to chronic diseases are higher in many low-income and middle-income countries than in high-income countries. The overall age-standardized mortality rate for chronic diseases was 769 per 100000 for men and 602 per 100 000 for women based on death registration data for 15 selected countries. These rates are 54 percent and 86 percent higher than correspondingly men and women in high-income countries in 2005 (Abegunde et al. 2007: p. 1931). Must contain sufficient data to identify the patient, support the diagnosis or reason for attendance at the health care facility, justify the treatment and accurately document the results of that treatment (Huffman, 1990, The World Health Organization has written this thing in its medical manual record in 2006: p.7). The patient is admitted to the hospital for 24 hours (overnight), several days or weeks, he is called the **inpatient.** Inpatients are always counted in the hospital, each day, usually

at midnight (WHO 2006: pp. 60-61). The patient is not admitted to the hospital for 24 hours or more but goes to the hospital or clinic for treatment or diagnosis, he is called the **outpatient** (WHO 2006: pp. 80-83). Chronic ailments: if any member of households was experiencing symptom persisting for more than one month on the date of survey indicating any problem cause by an aliment affecting any organ of the body it define as chronic element. An ailment of short duration: Any ailment which is not of chronic nature is defined as ailment of short duration, one week or less than one month this is called acute illness (NSS 2014: p.13). The analysis of morbidity has been done on the basis of acute and chronic diseases acute diseases have been taken within 15 days while diseases ranging from 16 days to one year have been taken as sub-chronic and chronic diseases.

5.2 Indoor Air Quality and Disease in the Study Villages

Respiratory Disease

Even today, 3 billion poor people in the world use dirty and highly polluting fuels (wood, animal dung, charcoal, crop waste, and coal) for cooking and heating. Due to which about 4 million premature deaths occur due to respiratory and cardiovascular and cancer diseases of children and adults (WHO 2014: p. 1). Dirty fuel consumption is common in developing countries, due to which many serious diseases are being faced. Unclean fuel is also contributing to air pollution. Indoor air pollution is the most important global environmental health risk today. The study found that is seven types of respiratory disease the households of the study village. Such as asthma, tuberculosis, chronic obstructive pulmonary disease (COPD), lung cancer, acute upper respiratory infection (ARI), cough with sputum and pneumonia.

Cardio Vascular Disease

Cardiovascular disease was responsible for 12 percent of the total illnesses including diabetes mellitus as well as coronary heart disease and stroke, with cancer and chronic respiratory diseases responsible for 9 percent. In the select 23 low-income and middle-income countries, chronic diseases responsible for 50 percent of their total disease burden in 2005 (Abegunde et al; 2007: p. 1931).

Neurological Disease

Air pollution is associated with an increased risk of environmental exposure, particularly neurological disorders. In 2017, the Lancet Commission conducted a study on pollution and health that air, water, soil, chemicals and commercial pollutants are the world's biggest environmental causes for poor health. Pollution accounted for around 9 million deaths in 2015. This pollution is responsible for 16 percent of deaths worldwide. The discovery, understanding, and prevention of the effects of air pollutants on the brain and potential links to nervous system diseases will be one of the future challenges for global health (Jeremy, W. 2017: p. 103).

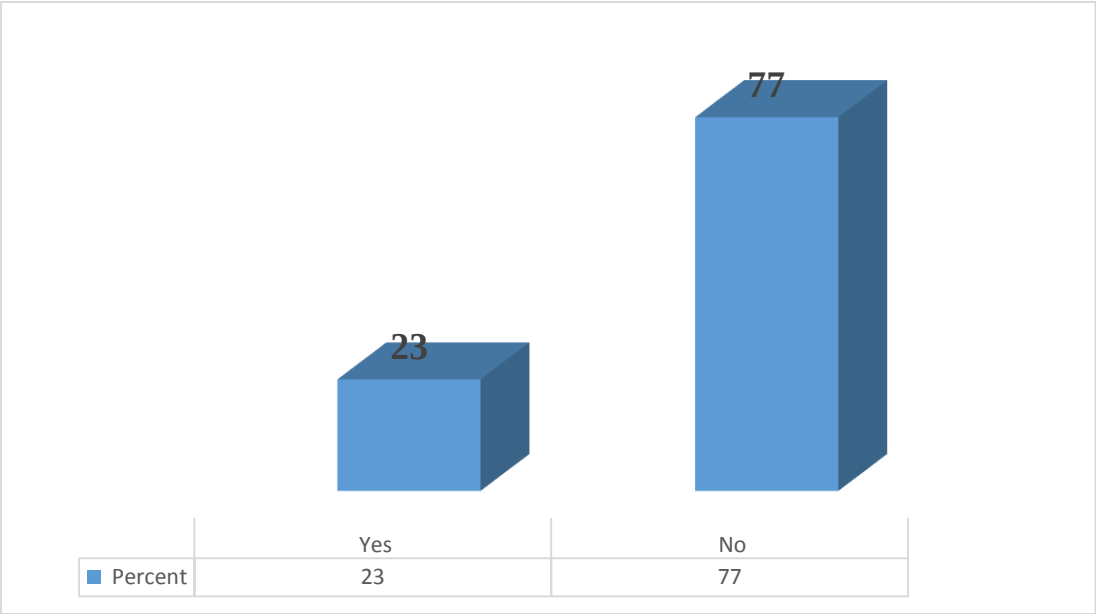
Infectious Disease

Infections and infectious diseases are a great burden on any society and country including all over the world. The risk of infection to patients is greatly increasing day by day. There are many factors that can cause infection and infectious diseases. Geographical, environmental, seasonal, economic and social factors.

Figure 5.1 shows during the field survey, questions were asked to the households to know about the problem related to the environment. Whether or not he/she is aware of air pollution. it is conformed that 23 percent of the 300 households are aware of air

pollution, While 77 percent of people are not aware. Studying literature shows that in the absence of environmental education, people lack environmental awareness. Lack of environmental education is very dangerous for human health and climate.

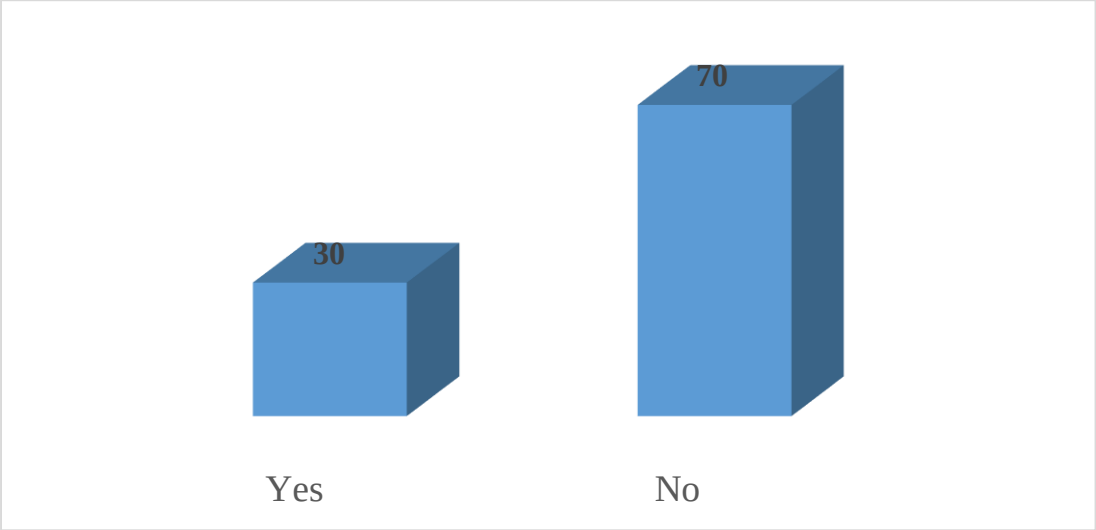
Figure 5.1: Awareness to Air Pollution



Source: Estimated from Primary Data

In figure 5.2 shows below, during the field survey, questions were asked the households to know about the problem related to indoor air pollution. Whether or not he is aware of indoor air pollution, he was asked about the problem he faced during a year, showing in the figure that 30 percent of the 300 households hold about indoor air pollution that while 70 percent of people do not know, but they are facing a lot of problems related to indoor air pollution. A study of literature shows that there are millions of deaths due to indoor air pollution and huge Health-related problems have to be faced.

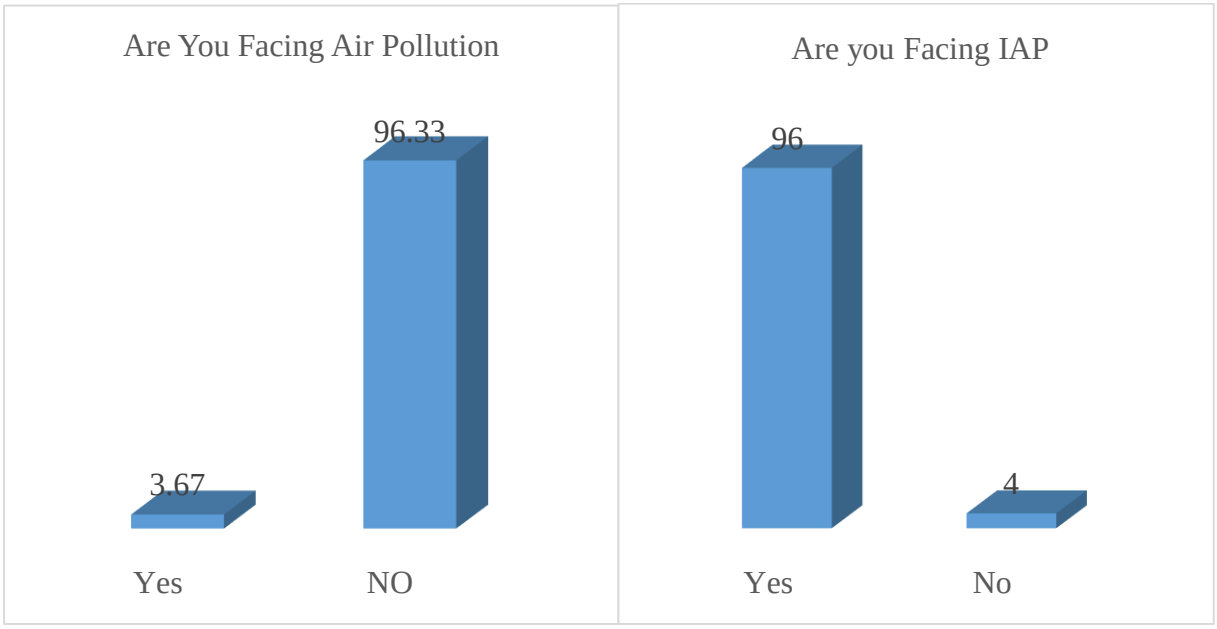
Figure 5.2: Awareness of Indoor Air Pollution (IAP)



Source: Estimated from Primary Data

In figure 5.3 show below, how many people face the problem related to indoor air pollution and air pollution at the household level, both of them can be seen completely in reverse. Where 3.67 percent of people are affected or are facing external pollution and 96. 33 percent of people are not affected. Whereas affected by indoor air pollution 96 percent of people are and 4 percent are not affected. This shows that the problem of domestic air pollution is more in rural areas than air pollution. Domestic air pollution has increased health problems in rural households. The Ujjwala scheme of the government has not yet fully reached rural areas.

Figure 5.3: Households Facing Air Pollution and Indoor Air Pollution (IAP)

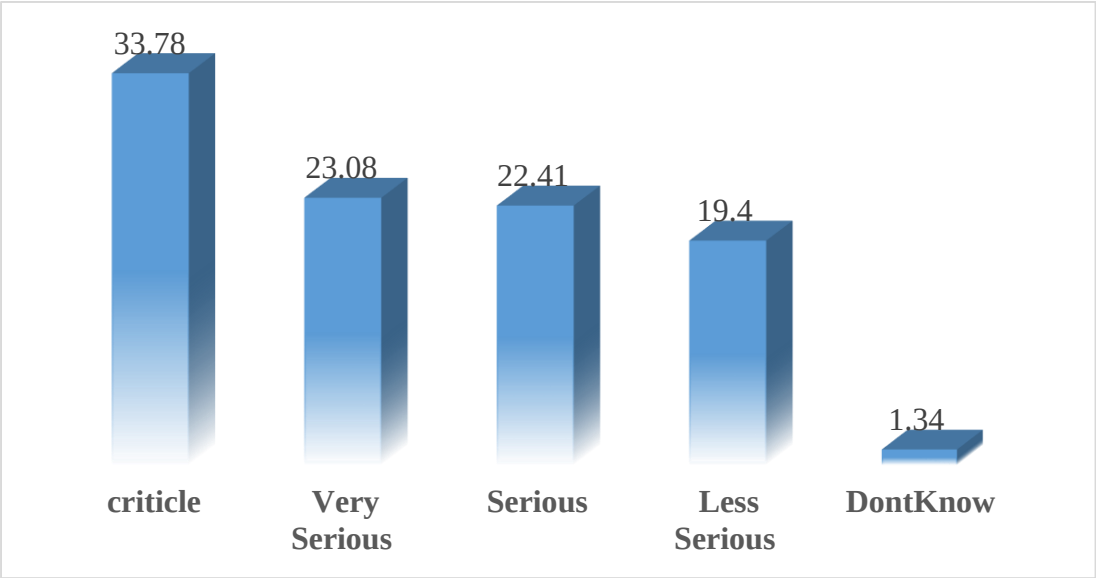


Source: Estimated from Primary Data

In figure 5.4 shows, a healthy home or dwelling is a shelter that fully supports a state of physical, mental and social well-being. A healthy home includes a sense of security and privacy. Healthy housing refers to physical structure, and it enables physical health, including being structurally sound. Healthy housing includes protection from moisture, temperature, adequate hygiene, lights, adequate space, safe fuel, pollutants, injury hazards, mold, and pests, etc. Healthy housing services, green space, active and public transport options provide protection from disaster impacts, whether natural or human (WHO 2018: p. 2). This figure shows that the situation of indoor air pollution is quite pathetic, with the first category being households with 33.78 percent indoor air pollution levels which are very fragile category households. The second number is households which falls in the very severe category which faces 23.08 percent of indoor air pollution. The percentage of number three households is 22.41, with indoor air pollution being severe. The fourth category is those with less severe indoor air pollution, with a percentage of 19.4. And the fifth category is for those households

who do not know how the situation of air pollution inside the house is 1.34 percent. This figure clearly shows that people are completely out of reach of healthy housing and clean fuels, affecting health and people are not leading a respectable life.

Figure 5.4: Condition about Indoor Air Pollution in Households

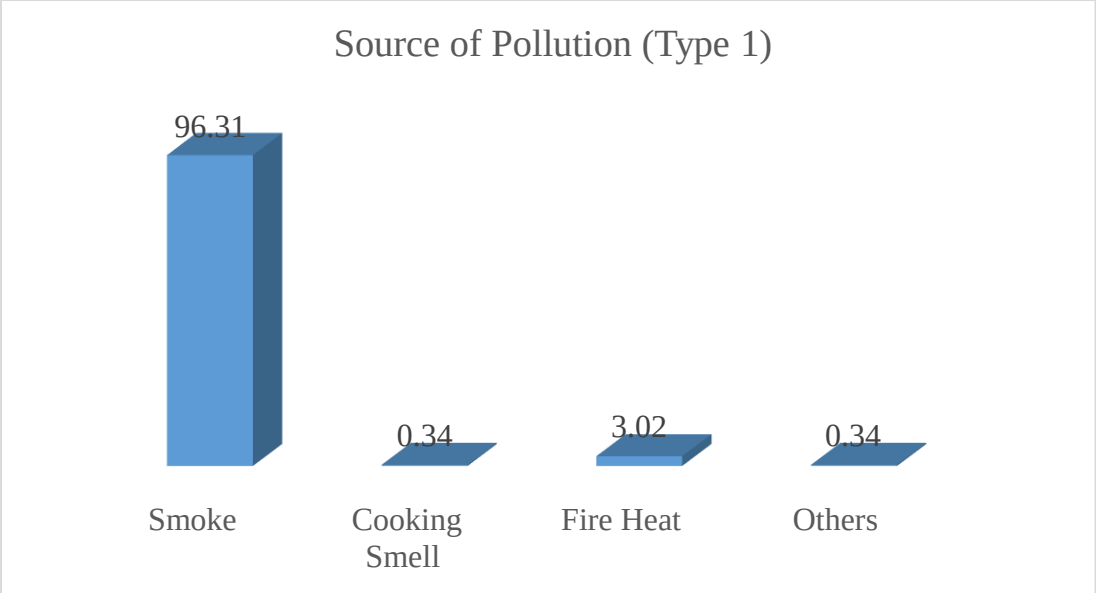


Source: Estimated from Primary Data

Figure 5.5 shows, Smith reported between 410 000 and 570 000 premature deaths of children and adult women under 5 years of age due to exposure to indoor air pollution. The most important conclusion of this study is that indoor air pollution in rural areas of developing countries was based on studies done in a developing country based on risk and risk data (Bruce, N., et al: 2000 p. 1086). The effects caused by air pollution have shaken the world and have emerged as a burning problem among researchers around the world. Today, the whole world is thinking and thinking about how to reduce air pollution. Every year, the number of people dying from outdoor pollution and indoor pollution is increasing. There are ten cities in India that fall in the top ten polluted cities in the world. According to several recent reports, morbidity and Mortality has increased due to Pollution in India. In 2017, indoor air pollution

accounted for 1.6 million deaths (2.9 percent of all deaths) and 59 million DALYs (2.4 percent of all DALYs) (Health Effects Institute 2019: p.14). Indoor air pollution is a silent killer which has resulted in premature death of 1.24 lakh people in India Lancet (2015). Looking at the figure shows that 9.6 percent of the households are facing smoke, 3.02 percent of the households are affected by the heat at the time of cooking in the second number, 0.34 percent of the households from the cooking smell and 0.34 other problems during cooking Percent of Households are facing. It is becoming clear from the figure that indoor air pollution is a big problem in rural areas.

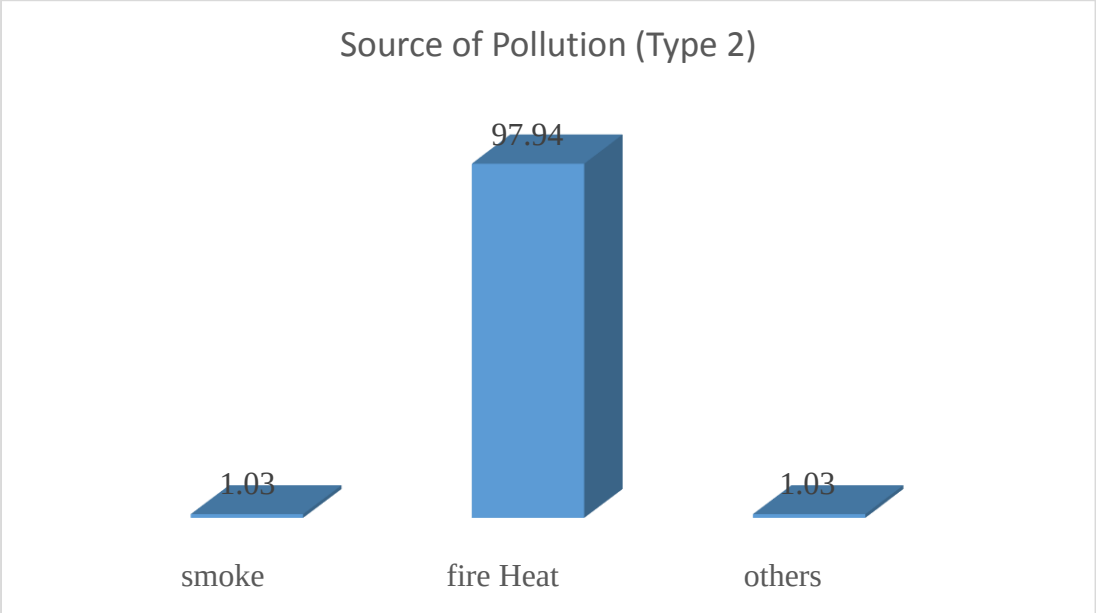
Figure 5.5: Source of Pollution



Source: Estimated from Primary Data

Looking at figure 5.6 shows (type 2 pollution) that 97.94 percent of the households are facing heat, 1.03 percent of the households are facing smoke and 1.03 percent of the households facing other problems during the cooking period. The figure shows that smoke and heat are a big problem because of the use of dirty fuel for rural households. Dirty fuel is also the biggest reason for indoor air pollution.

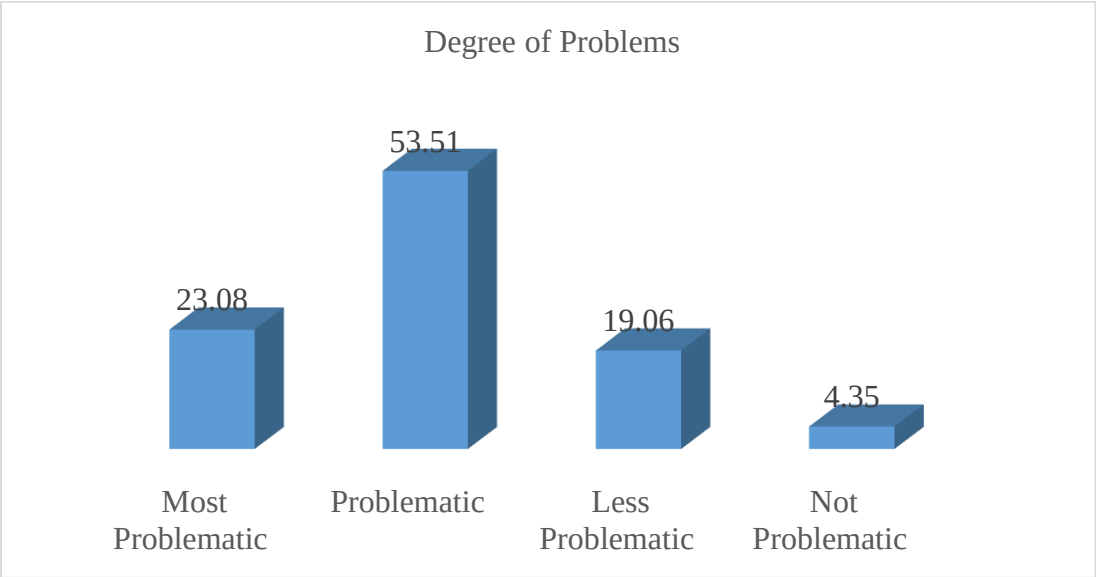
Figure 5.6: Source of Pollution (second problems)



Source: Estimated from Primary Data

Looking at figure 5.7 shows, that the highest number of 53.51 percent of the households for which indoor air pollution is problematic. The second number of households is 23.08 percent of the households most problematic. The third number of households is 19.06 percent for whom less problematic. The final and fourth numbers are 4.35 percent of households for whom indoor air pollution is not a problem. Most households are experiencing indoor air pollution as shown by the figure. According to households, indoor air pollution is a big problem in rural areas and a lot of literature also tells that indoor air pollution is a big problem in developing countries.

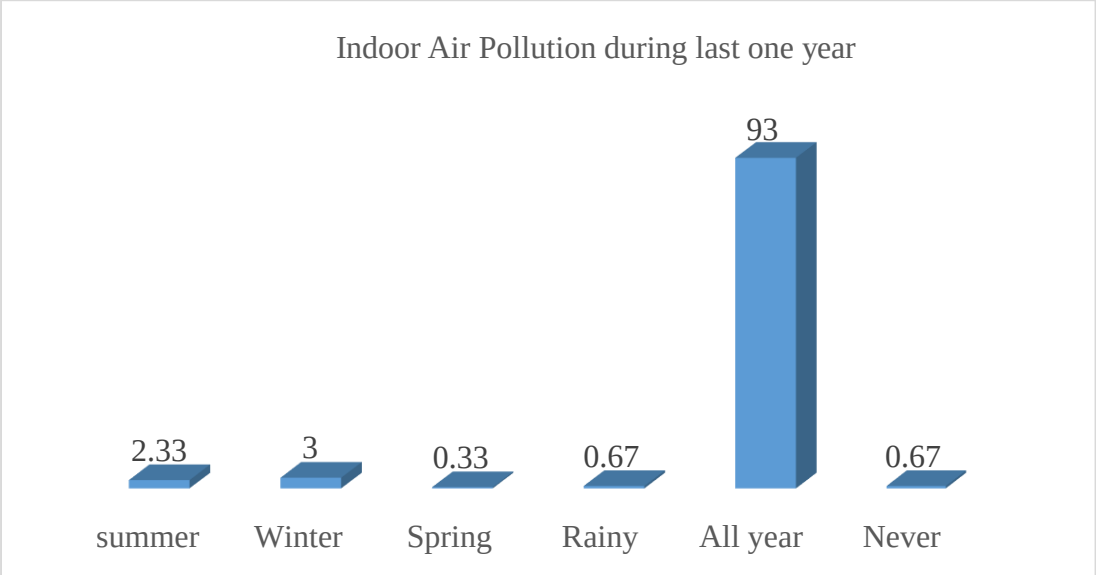
Figure 5.7: Degree of the Problems due to Indoor Air Pollution



Source: Estimated from Primary Data

Figure 5.8 shows, at what time of the year is the indoor air pollution the most or families have to face. It is seen in the figure that 93 percent of the families considered that most of the indoor air pollution is encountered throughout the year. 2.33 percent of households considered to have indoor air pollution in the summer. 3 percent of households said indoor air pollution is encountered in winter. 0.33 percent of households said that indoor air pollution in spring causes problems. 0.67 percent of the families said that indoor air pollution is the problem during the rainy season and only 0.67 percent of the families never have to face indoor air pollution.

Figure 5.8: Indoor Air Pollution during last One Year

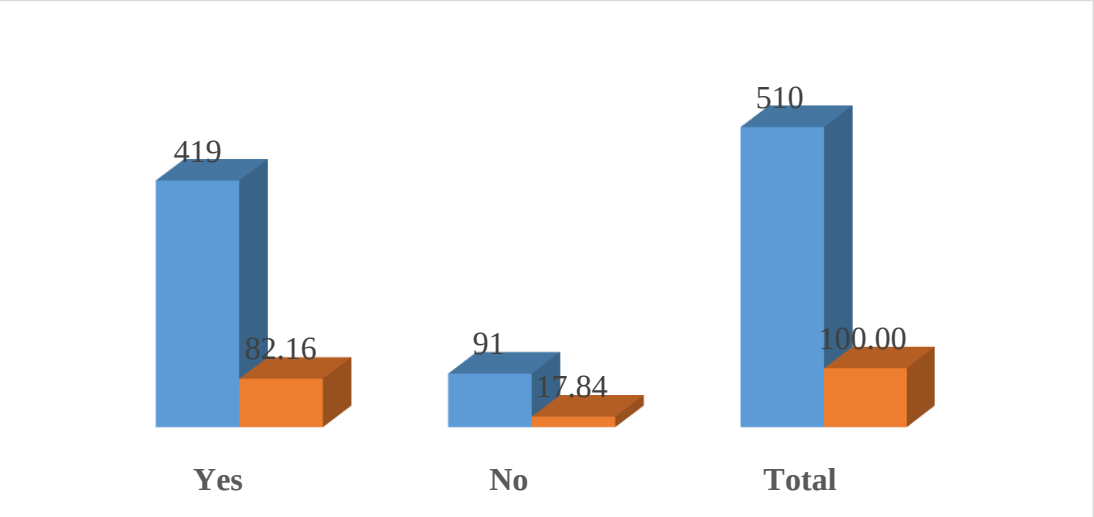


Source: Estimated from Primary Data

5.3 Distribution of Disease

Figure 5.9 shows the total sample size of the study area is 300 households and the total sample population is 1983, 510 people out of 300 households were suffering from the disease. 25.72 percent of the total sample population suffered from the disease. In which 419 people i.e. 82.16 percent are receiving treatment and 91 people i.e. 17.84 percent of people are not getting treatment due to lack of money and for other reasons.

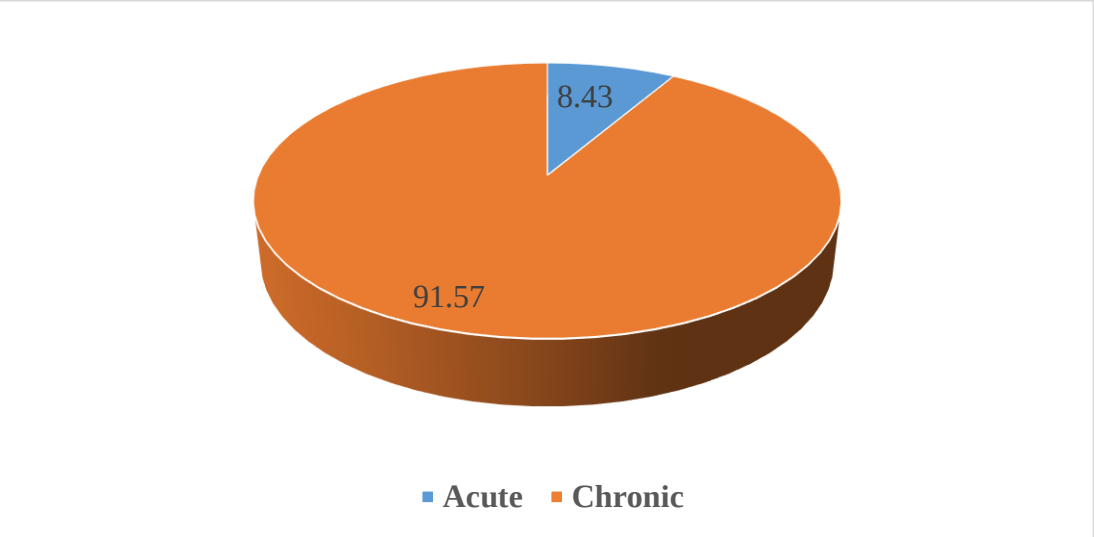
Figure 5.9: Total Number of Patient and Percentage



Source: Estimated from Primary Data

The study area found that 91.57 percent of the people suffer from chronic disease and 8.43 percent from acute disease. Households in the study area are completely dependent on the forest and agriculture waste. This area comes in the most remote areas of Bihar where people are still deprived of modern fuel. Because of this, the only source of fuel they have is wood, which burns smoke and has to be faced by the households. Because of which people face disease for a long period.

Figure 5.10: Types of Disease (in percent).



Source: Estimated from Primary Data

5.3.1 Distribution of Disease Age Wise

Compared to high-income countries, middle-aged adults in low- and middle-income countries are particularly vulnerable to chronic disease. In these countries, the possibility of disease increases in people at an early age and people continue to suffer from the disease for a long time and people of underdeveloped countries die sooner than developed countries. Dying at an early age weakens economic development. Developing and underdeveloped countries that fall into the low and middle-income countries that face the most public health challenges, old and new. At the same time, many are experiencing rapid fluctuations in infectious diseases and chronic diseases. The projected increase in the burden of chronic diseases in these countries is largely driven by the underlying determinants of globalization, urbanization, and rapidly increasing age. And these are contributing to the occurrence of chronic diseases World Health Organization (WHO 2005: p.2). In the below above table 5.1 shows, frequency and percentage of inpatient suffering the particular disease has been estimated. Out of the total 143 in-patients suffering from respiratory diseases 76 inpatients suffered the highest in the age group of adult following it was young age patients and the lowest was for children. For the cardiovascular disease out of total 152 inpatients 80 inpatients in the adult age group suffered the highest while the lowest were in the children category. In the other two categories i.e. infection and neurological the highest percentage of inpatients lie under the adult category.

Table 5.1: Age wise Disease (Inpatient) in 365 Days

Age Group	RD	CD	Infectious	Neurological
Children (0-14)	2 1.40	1 0.66	1 0.74	1 3.03
Young Age (15-34)	36 25.17	39 25.66	31 22.79	10 30.30
Adult (35-59)	76 53.15	80 52.63	73 53.68	15 45.45
Old Age (60-93)	29 20.28	32 21.05	31 22.79	7 21.21
Total	143 100.00	152 100.00	136 100.00	33 100.00

Source: Estimated from Primary Data
Note: **Colom percentage

The below above table 5.2 explains total number of outpatients suffering from respiratory, cardiovascular, neurological and infectious disease is estimated. In the age group of young age category 28.26 percent outpatients suffered from respiratory diseases, 30.77 percent suffered from chronicle disease, 28.39 percent suffered from infectious disease and 23.53 percent suffered from neurological disease. In the age group of adult category 52.17 percent suffered from respiratory disease, 48.08 percent suffered from cardiovascular disease, 50.97 percent suffered from infectious disease and 55.88 percent suffered from neurological disease. In the old age category approx 18 percent outpatients suffered from these diseases.

Table 5.2: Age wise Disease Outpatient in 365 Days

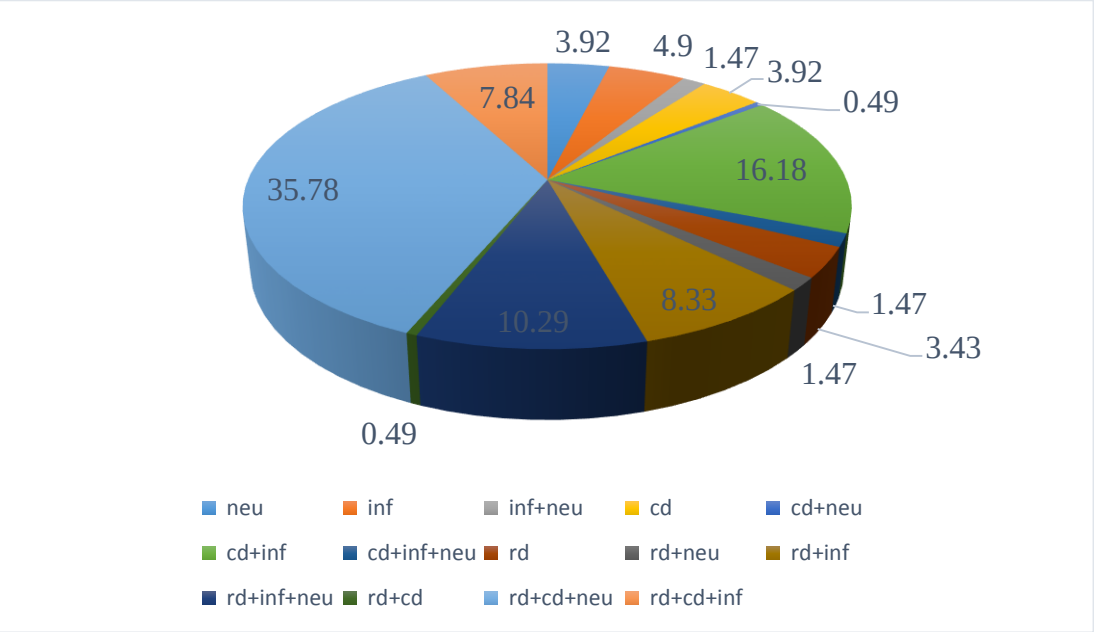
Age Group	RD	CD	Infectious	Neurological
Children	4 2.90*	5 3.21*	4 2.58*	1 2.94*
Young Age	39 28.26*	48 30.77*	44 28.39*	8 23.53*
Adult	72 52.17*	75 48.08*	79 50.97*	19 55.88*
Old Age	23 16.67*	28 17.95*	28 18.06*	6 17.65*
Total	138 100.00	156 100.00	155 100.00	34 100.00

Source: Estimated from Primary Data

Note: **Colom percentage

Looking at the figure 5.11 shows, that during 365 days, inpatient respiratory, cardiovascular & infectious disease has the highest number of patients with 43.17 percent. Respiratory and cardiovascular disease among other patients is 17.49 percent the third number is cardiovascular disease & infectious 8.74 percent. And fourth respiratory disease, cardiovascular disease, infectious & neurological disease is 6.56 percent. Similarly Respiratory Disease & Infectious 6.01 percent, neurological 1.64 percent, infectious 2.73 percent, infectious & neurological 2.73 percent, cardiovascular 2.19 percent, cardiovascular & neurological 1.09 percent, Cardiovascular Disease, Infectious & neurological 2.73 percent, respiratory disease 1.64 percent, respiratory disease, cardiovascular disease & neurological 1.09 percent respiratory disease, Infectious & Neurological 1.64 percent and lastly have proportion is respiratory disease & neurological 0.55 percent.

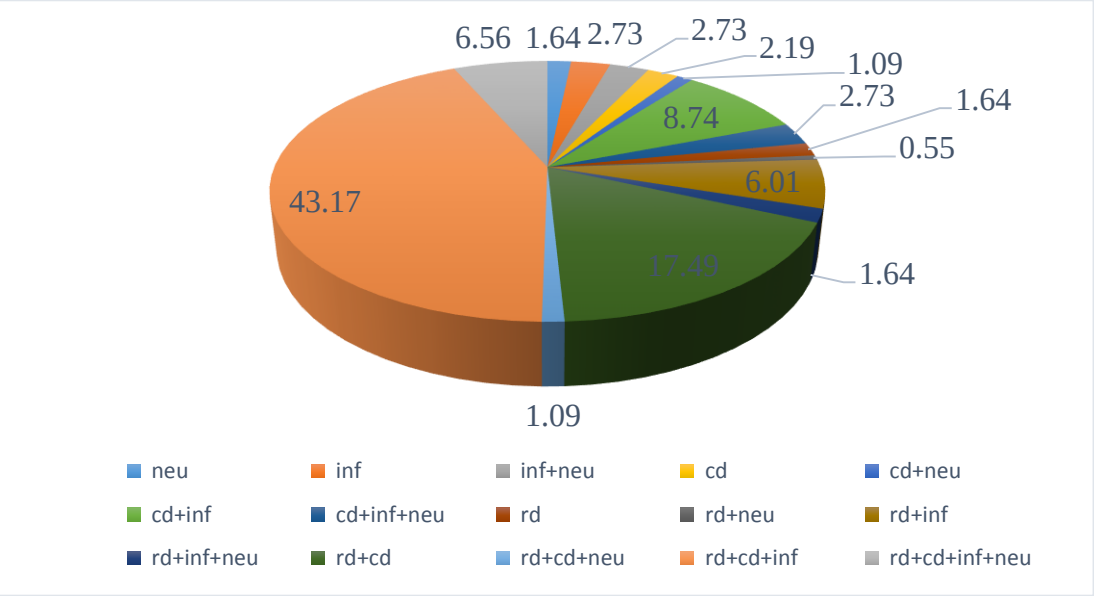
Figure 5.11: Disease wise distribution of Inpatient



Source: Estimated from Primary Data

Figure 5.12 shows that during 365 days, outpatient respiratory, cardiovascular and neurological disease has the highest number of patients with 35.78 percent. Cardiovascular, Infectious disease among other patients is 16.18 percent, the third number is respiratory, infectious and neurological is 10.29 percent and fourth respiratory disease and infectious disease is 8.33 percent. Similarly, Neurological 3.92, infectious 4.9 percent, infectious neurological 1.47 percent, cardiovascular disease is 3.92, Cardiovascular Disease Infectious and Neurological is 1.47 percent, respiratory disease is 3.43 percent, respiratory disease and neurological is 1.47, respiratory disease & cardiovascular disease is 0.49 percent, respiratory disease, cardiovascular disease and infectious is 7.84 percent.

Figure 5.12: Disease wise distribution of Outpatient

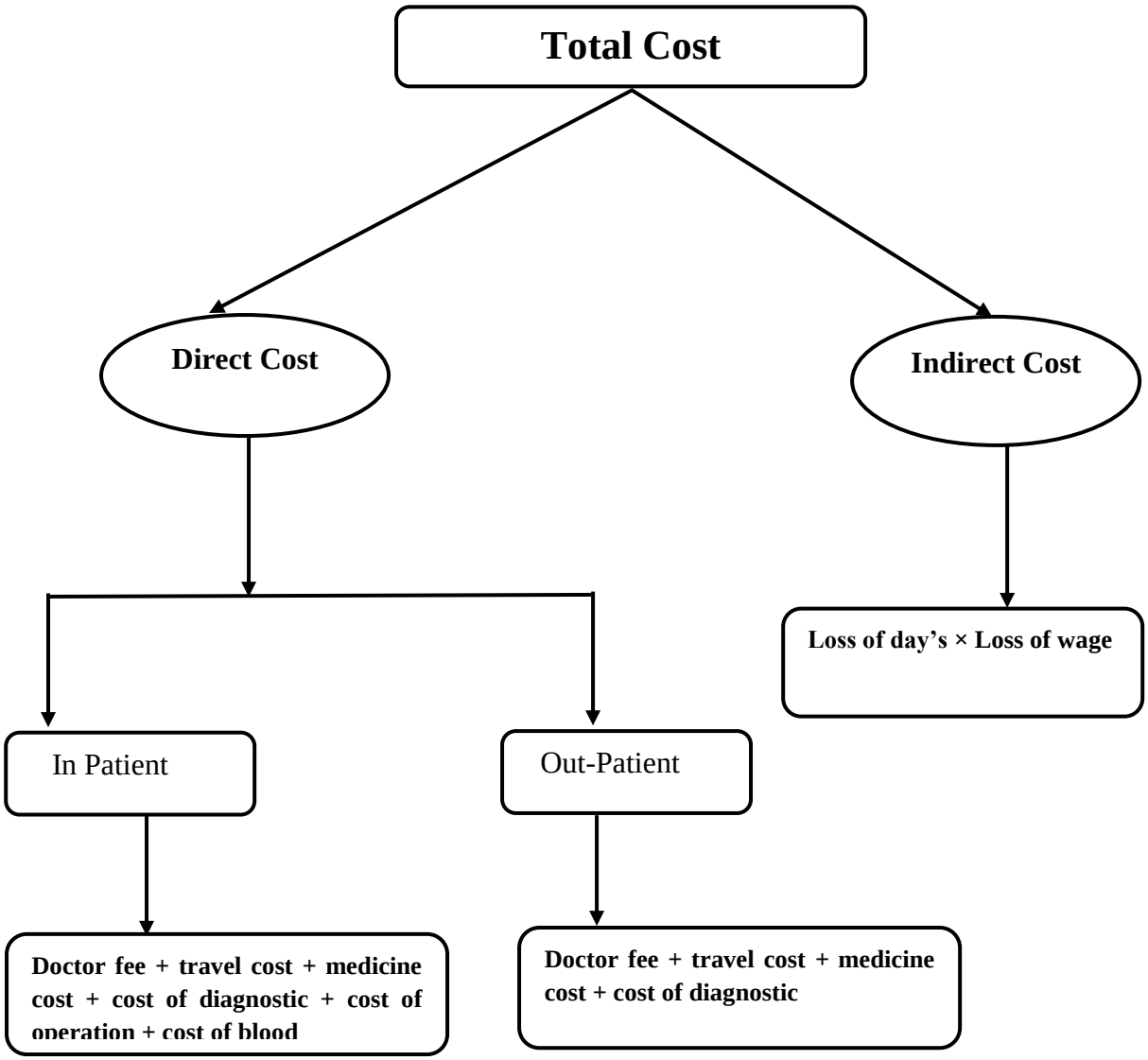


Source: Estimated from Primary Data

5.4 Pollution and Cost of Illness

In comparison to developed countries on the national budget is more spent on pollution-related deaths and disease costs in developing countries. About 0.5 percent of GDP in high-income countries costs about 1.3 percent of GDP in low-income countries and 0.13 percent of GDP globally. Health-related precaution spending on pollution-related diseases around the world further affects low-income countries. An estimated 7 percent of middle-income countries have to spend on health expenditure every year, while high-income countries have to spend 1.7 percent annually. Pollution deaths and disease worldwide cause a welfare deficit equal to the US $ 4.6 trillion every year (equivalent to 6.2 percent of global economic output). Compared to the proportion of spending of developed and developing countries, it is found that low-income countries pay 8.3 percent of their gross national income for pollution-related death and disease, whereas high-income countries have to pay 4.5 percent (Mayor, S. 2017: p.3).

5.5 Distribution of Health Costs



Direct Cost

The below above table 5.3 calculates the direct cost for the inpatients and outpatients for the time span of 15 days. The average cost of inpatients for 15 days is 11027.5 and for the outpatients is 2142.214. Minimum cost for inpatient was Rs 430 and for outpatients was Rs 200. The maximum cost for inpatient was 24000 and for outpatients was 9000.

Table 5.3: Direct cost Inpatient and Outpatient (15 Days)

Direct Cost (In Rs.)		
Statistics	**In Patient (15 days)**	**Out Patient (15 days)**
Mean	11027.5	2142.214
Std. Dev.	9835.044	2314.343
Min	430	200
Max	24000	9000

Source: Estimated from Primary Data

The table below above estimates the direct cost of inpatients and outpatients for the time span of 365 days. The average cost of inpatients was 29268.1 and for outpatients was 5070.299. Minimum and maximum cost for in patients is 700 and 205000 respectively while for outpatients minimum and maximum cost is 60 and 110000 respectively.

Table 5.4: Direct cost Inpatient and Outpatient (365 Days)

Direct Cost (In Rs.)		
Statistics	**In Patient (365)**	**Out Patient (365)**
Mean	29268.1	5070.299
Std. Dev.	28498.91	9254.013
Min	700	60
Max	205000	110000

Source: Estimated from Primary survey

The below above table calculates the indirect cost of inpatients and outpatients for the time span of 365 days. The average cost of inpatients was 6785.225 and for outpatients was 866.9174. Minimum and maximum cost for in patients is 100 and 98000 respectively while for outpatients minimum and maximum cost is 40 and 27000 respectively.

Indirect Cost

Table 5.5: Indirect cost Inpatient and Outpatient (365 Days)

Indirect Cost (In Rs.)		
Statistics	**In Patient (365)**	**Out Patient (365)**
Mean	6785.225	866.9174
Std. Dev.	14050.77	2933.631
Min	100	40
Max	98000	27000

Source: Estimated from Primary Data

The below above table calculates the indirect cost of inpatients and outpatients for the time span of 15 days. The average cost of inpatients was 3333 and for outpatients was 866.9174. Minimum and maximum cost for in patients is 3333 and 3333 respectively while for outpatients minimum and maximum cost is 100 and 334 respectively.

Table 5.6: Indirect cost Inpatient and Outpatient (15 Days)

Indirect Cost (In Rs.)		
Statistics	**In Patient (15)**	**Out Patient (15)**
Mean	3333	189.3333
Std. Dev.	NA	126.4331
Min	3333	100
Max	3333	334

Source: Estimated from Primary Data

5.6 Gender Wise Disease and Health Costs

Diseases from indoor air pollution first received serious attention as a public health problem in the 1960s, when some of the first measurements of indoor pollutant concentrations, including nitrogen dioxide, carbon monoxide, and particulate matter,

were made. It was first identified in the 1980s that indoor exposure problems were caused by the burning of biomass fuels for cooking and heating. Smith pointed out that most particulate matter and high personal indoor air exposure for women face during the cooking period. Because of which causes acute respiratory illness in childhood and chronic lung disease in adulthood (Samet, J. M et al., 2016: p. 2342). Indoor air quality and indoor air pollutants have come to be recognized as a health hazard for the entire world population. The quality of indoor air pollution also depends on the fuel used. Women are the main victims of indoor air pollution as this is the main cook in the house, so most of their time is spent in the kitchen, so women face the risk of more indoor air pollution. About 60 percent of all indoor air pollutant-induced deaths make up women (WHO 2000: p. 17). In a country like India, women have inherited Household work, especially in rural areas. As Indian farmers are born in debt, they grow up in debt and die in debt. In the same way, rural women take birth in smoke, the whole life spends in smoke and dies in the smoke itself. Table 5.7 shows, analyzing the gender-wise disease, we see that women are more affected than men by indoor air pollution, literature also confirms this. In the table, the disease Wise Respiratory Disease + Cardiovascular Disease + Infectious Disease is seen row-wise, it is found that 45.83 percent of the men and 54.17 percent of the women are ill. When you see the difference between the two, it is found that 8.34 percent of women are more affected than men. When we look at the second disease Cardiovascular Disease + Neurological Disease, So the most affected women, their percentage is 47.62 percent and females are 52.38 percent. The difference between females and males is about 4.76 percent. The third disease is the disease of Respiratory Disease + cardiovascular disease in which male 47.06 percent and female 52.69 percent. The gender wise difference between males and females is 5.4 percent. This figure shows

that women are more affected by each disease than men. It is clear that indoor air pollution more affects gender the most and its victims are the most women.

Table 5.7: Gender wise disease Outpatient 365 Days

Gender wise disease Outpatient 365 Days			
Disease Name	Male	Female	Total
Respiratory Disease +cardiovascular Disease + infectious Disease	22 45.83* 22.92**	26 54.17* 24.07**	48 100.00* 23.53**
Cardiovascular Disease +neu	50 47.62* 52.08**	55 52.38* 50.93**	105 100.00* 51.47**
Respiratory Disease + Cardiovascular Disease	24 47.06* 25.00**	27 52.94* 25.00**	51 100.00* 25.00**
Total	96 47.06* 100.00**	108 52.94* 100.00**	204 100.00* 100.00**

Source: Estimated from Primary Data
Note: * is represented as Row wise percentage, while ** is represented as Column percent.

When analyzing the gender-wise inpatient disease, it is seen that most of the women are suffering from the disease. Indoor air pollution is affecting women more than men. Looking at the disease wise Respiratory Disease + Cardiovascular Disease + Infectious Disease row-wise in the table, it is found that 40.54 percent of men and 59.46 percent of women are ill. There is a big difference between men and women 19 percent of women are affected more than men by these diseases. When we look at the second disease cardiovascular disease + neurological diseases, more than women are affected compared to males, their percentage is 42.86 of males and female 57.14 percent. The difference between women and men is about 14.28 percent i.e. women face 14.28 percent more disease than men. The third disease is observed in

Respiratory Disease + Cardiovascular Disease, in which male is 36.80 percent and female 63.20 percent the gender-wise difference is 26.4 percent. The difference between Respiratory Disease and Cardiovascular Disease is the highest in this figure, it shows that women are living life in the gas chamber. This figure shows that women are more affected by each disease than men. It is clear that indoor air pollution affects the gender the most and its victims are mostly women, as the Lancet report also tells.

Table 5.8: Gender wise distribution of disease Inpatient 365 Days

Disease Name		Female	Total
Respiratory Disease + cardiovascular Disease + infectious Disease	15 40.54* 21.43**	22 59.46* 19.47**	37 100.00* 20.22**
Cardiovascular Disease + Neurological Disease	9 42.86* 12.86**	12 57.14* 10.62**	21 100.00* 11.48**
Respiratory Disease + cardiovascular Disease	46 36.80* 65.71**	79 63.20* 69.91**	125 100.00* 68.31**
Total	70 38.25* 100.00**	113 61.75* 100.00**	183 100.00* 100.00**

Source: Estimated from Primary Data
Note: * is represented as Row wise percentage, while ** is represented as Column percent.

Below above table 5.9 calculates the direct cost for the inpatients male and female for the time span of 365 days. The average cost of inpatients male for 365 days is 2803.46 and for the female inpatients, it is 30034.16. Minimum cost for inpatient female was Rs 700 and for inpatients, male was Rs 2150. The maximum cost for inpatient males was 100332 and for female inpatients was 205000.

Table 5.9: Gender wise Direct Cost for Inpatient (365 Days)

Gender	Mean Total In-cost (365Days)	SD Total In-cost	Min Total In-cost	Max Total In-cost
Male	28031.46	26201.66	2150	100332
Female	30034.16	29921.7	700	205000

Source: Estimated from Primary Data

Below above table 5.10 calculates the direct cost for the outpatients male and female for the time span of 365 days. The average cost of outpatient male for 365 days is 4417.146 and for the female outpatients, it is 5650.88. Minimum cost for outpatient female was Rs 150 and for outpatients, male was Rs 60. The maximum cost for outpatient males was 39000 and for female outpatients was 110000.

Table 5.10 Gender Wise Direct Cost Outpatient 365 Days

Gender	Mean Cost	SD	Minimum Cost (Rs.)	Maximum Cost (Rs.)
Male	4417.146	5817.479	60	39000
Female	5650.88	11476.03	150	110000

Source: Estimated from Primary Data

5.7 Distribution of Disease Wise Cost

The below above table estimates the disease wise cost of outpatients for the period of 15 days. Average cost for cardiovascular and infection disease was Rs 1520 and minimum and maximum cost is Rs 350 and 6000 respectively. Average cost for respiratory and infection disease was Rs 3400 and minimum and maximum cost is Rs 2050 and 7000 respectively. The average cost for the three disease i.e. respiratory,

cardiovascular and infectious disease was 590 while minimum and maximum cost was 280 and 900 respectively.

Table 5.11 Distribution of disease wise outpatient cost (15 days)

Disease Name	Mean Cost	SD	Minimum Cost (Rs.)	Maximum Cost (Rs.)
CD+ infection	1520	2208.257	350	6000
RD + Infection	3400	2119.552	2050	7000
RD + CD + Infection	590	438.4062	280	900
RD + CD	6333.33	2309.401	5000	9000
Respiratory Disease	1137.33	1281.476	212	2600
Infection	1540	1211.26	280	3250
RD	1300	NA	1300	1300

Source: Estimated from Primary Data

The below above table estimates the disease wise cost of inpatients for the period of 15 days. Average cost for cardiovascular and infection disease was Rs 430 and minimum and maximum cost is Rs 430. Average cost for respiratory and infection disease was Rs 8000 and minimum and maximum cost is Rs 8000. The average cost for respiratory and cardiovascular disease was 11680 while minimum and maximum cost was Rs. 11680.

Table. 5.12 Distribution of disease wise Inpatient cost (15 days)

Disease Name	Mean Total In cost	Min Total In cost	Max Total In cost
CD + Infectious	430	430	430
RD + Infectious	8000	8000	8000
RD + CD	11680	11680	11680
Infectious Disease	24000	24000	24000

Source: Estimated from Primary Data

The below above table explains the disease wise cost of in patients for the time span of 365 days. The average cost of respiratory, cardiovascular, infectious and neurological disease is Rs 24420.83 and the minimum and maximum cost is Rs 700 and 57300 respectively. The above table also observes that the average cost for respiratory, cardiovascular and infectious disease is 24928.99 while for RD, CD and neurological disease is 25600. Minimum and maximum cost for RD, infectious and neurological disease is Rs. 13170 and Rs. 39800 respectively while the minimum and maximum cost for RD and CD is 3000 and 205000 respectively.

Table 5.13 Distribution of disease wise cost (In Patient 365 days)

Disease Name	Mean Total (in cost)	SD Total (in cost)	Min Total (in cost)	Max Total (in cost 365)
Neurological	19666.67	11015.14	7000	27000
Infectious	24884	22145.59	2150	50000
Infectious + Neurological	22300	10177.18	11500	36500
Cardiovascular Disease	37225	40259.36	3600	95000
CD + Neurological	67750	66821.59	20500	115000
CD +Infectious	8805	12576.35	1700	49400
CD+ Infectious+ Neurological	25520	17296.01	9000	51000
Respiratory Disease	35733.33	32600.05	6700	71000
RD + Neurological	56000	NA	56000	56000
RD + Infectious	18710.91	24963.16	2320	90000
RD + Infectious + Neurological	25990	13342.58	13170	39800
Respiratory Disease + Cardiovascular	54613.5	41268.95	3000	205000
RD + CD + Neurological	25600	31678.38	3200	48000
RD + CD + Infectious	24928.99	19920.22	1250	97500
RD + CD + Infectious + Neurological	24420.83	18552.89	700	57300

Source: Estimated from Primary Data

The below above table 5.14 observes the disease wise cost of outpatient for the time span of 365 days. The average cost for four diseases i.e. RD, CD, infectious and neurological is 6374.667. The minimum and maximum cost is 600 and 29000

respectively. Average cost for RD, CD and infectious disease is 5548.865 while the minimum and maximum cost is 150 and 39000 respectively.

Table 5.14: Distribution of disease wise cost (Outpatient 365 days)

Disease Name	Mean Cost	SD	Minimum Cost (Rs.)	Maximum Cost (Rs.)
Neurological	4368.75	3479.115	700	10200
Infectious	2217.5	3491.74	60	12000
Infectious + Neurological	6400	2351.595	4000	8700
Cardiovascular Disease	2343.75	2068.201	350	6550
CD + Neurological	12300	NA	12300	12300
CD + Infectious	2211.515	2235.405	300	9500
CD +Infectious + Neurological	38466.67	61951.7	2200	110000
Respiratory Disease	4802.857	6145.369	800	18270
RD + Neurological	13200	8346.856	4100	20500
Respiratory Disease + Infectious	4264.706	5317.917	250	17200
RD + Cardiovascular	4046.667	2959.127	550	12000
RD + CD +Neurological	1650	NA	1650	1650
RD + CD +Infectious	5548.865	6918.748	150	39000
RD +CD + Infectious +Neurological	6374.667	7175.757	600	29000

Source: Estimated from Primary Data

The table suggests that as income increases the average expenditure on health also increases. The mean health cost incurred by households in the first quintile is Rs.1788.66 while the households in second quintile have monthly health expenditure of Rs.2344.97. Households belonging to third quintile group have medical expenses of Rs.1938/month. The highest amount of health expenditure is done by households falling in fifth quintile group viz. Rs.3403.72 per month. The expenses by fourth quintile group on an average are Rs.2861.11. The maximum medical cost is also borne by high income group people i.e.Rs.33333.33/month.

Table 5.15: Income Quintile wise Heath Expenditure of Households (in Rs/month)

Quintiles of Income	Mean	Maximum	Minimum	SD
1	1788.66	9583.33	0	1986.60
2	2344.97	30000	0	4483.73
3	1938.21	7916.67	0	1775.79
4	2861.11	25833.3	0	4124.18
5	3403.72	33333.3	0	4694.72

Source: Estimated from primary data

The table refers to the average percentage of health cost out of the total expenditure of the household in a month. The percentage share of medical expenditure out of total expenditure is 21.34 percent in case of households belonging to first income quintile group. The share of second quintile group is 19.36 percent, third quintile is 13.68 percent, fourth is 20.31 percent and fifth income quintile category is 13.64 percent. Thus, it is observed that the medical expense share is highest for lower income group while lowest for high income group. Although, it could be seen from previous table that total expenditure on health increases when income rises but the proportion of health expenditure is lowest with reference to other categories.

Table 5.16: Income Quintile wise average percentage of Heath Expenditure out of Total Consumption Expenditure (in percent)

Quintiles of Income	Percentage
1	21.34
2	19.36
3	13.68
4	20.31
5	13.64

Source: Estimated from primary data

5.8 Finding and Conclusion

This chapter measures health-cost through cost of illness method (COI). Cost-of-illness method measures the economic burden of diseases and evaluates the monetary value of health expenditure. Educated peoples are less effected by diseases as compare to uneducated people. During 15 day reference period the mean of In-patient direct cost is Rs. 11027.5 and outpatient Rs. 2142.214. For 365 day reference period the mean value of direct cost for in-inpatient is Rs. 29268.1 and for out-patient the mean value is 5070.299 rupees. The inpatient health cost expenditure is more as compare to out-patient. The socio economic variable has affected to health expenditure. The Gender Wise result shows that women face more illness than male. The biggest reason for this is that women spend more time at home due to which they have to face more smoke. Because of which women are getting sicker. When we look at the gender-wise health cost, it is found that due to more illness, the health cost of women is higher than that of men. It is clear that the situation of women of rural India has not improved much even today. The majority of the people in the study area suffer from chronic disease which is 91.57 percent while 8.43 percent suffer from acute disease. Further 17.84 percent of people are not getting treatment due to lack of money and for other reasons. Women are the main victims of indoor air pollution, which suffers the most number of diseases and the highest health cost is being borne by them.

Chapter 6
Willingness to Pay for Clean Energy in the Survey Area

Chapter 6

Willingness to Pay for Clean Energy in the Survey Area

6.0 Introduction

Ecological products and services are public goods, which somewhat, might be bridled by numerous individuals without antagonistically influencing each other's advantage. In any case, these goods have a point of confinement to their bearing limit, past which they can't support their utilization. Swarming on their utilization can diminish user's utility. Public goods frequently suffer from free-rider's problem. Every consumer understands the use value of the resource but none has an impetus to pay to look after them or protect them. Natural goods and services also face externality problem and this leads to market failure. Thus, the valuation such products and services may help the society to manage the impacts of market disappointments, by estimating their social and opportunity costs. The expenses to society would then be able to be forced, in different ways, on the individuals who are mindful, or can be utilized to assess and direct ecological effects (Mishra, undated).

Economists in order to value the environment came up with different valuation techniques. These techniques are based upon either observed behavior (revealed preferences) toward some marketed good with a connection to the non-marketed good of interest or stated preferences in surveys with respect to the nonmarket good. The stated preference approach is frequently referred to as contingent valuation especially when it is used in the context of environmental amenities (Carson 2000 p.1413). The public opinion survey was first proposed by Bowen (1943) and Ciriacy-Wantrup (1952). They used it to capture view of people about public goods. The Contingent

Valuation Method (CVM) gained prominence after the U.S government initiated projects to know people's preferences on outdoor recreational services. In order to estimate the value of national parks and other outdoor recreational sites the researchers used willingness to pay (WTP) technique. Davis (1963) is supposed to be the first economist to make use of Contingent Valuation (CV) survey with reference to Maine Woods. The clearest approach to gauge nonmarket values is through legitimately addressing people on their ability to-pay for a conservation programme or any improvement. It is basically an overview or poll based way to deal with the valuation of non-market goods or services. The contingent valuation procedure has incredible adaptability, permitting valuation of a more extensive assortment of non-market goods and services than is conceivable with any of the circuitous methods. It is, indeed, the main strategy as of now accessible for assessing nonuse values. In case of natural assets, contingent valuation infers values through the elicitation of respondents' ability to-pay to forestall wounds to environmental assets or to reestablish harmed natural resources. Contingent Valuation is a method of estimating the value that a person places on a good. Under this method, responses are taken up through personal meetings, phone meetings, or mail overviews. The personal interviews are the most costly way however is commonly viewed as the best. Non-reaction or no response in such interviews inclination is constantly a worry. The approach asks people to directly report their willingness to pay (WTP) to obtain a specified good, or willingness to accept (WTA) to give up a good, rather than inferring them from observed behaviours in regular market places. It creates a hypothetical market and then seeks answers from respondents based on it (Venkatachalam 2004: p.1). It mainly asks people, whether they are willing to pay and not for a benefit.

6.1 Willingness to Pay (WTP)

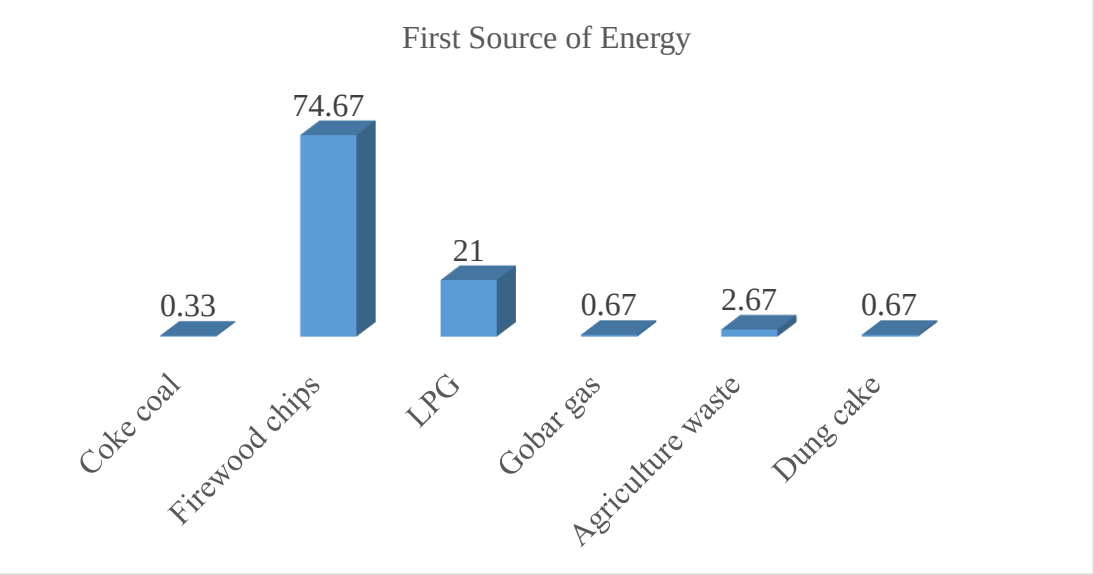
The concept of willingness-to-pay (WTP) has become very popular over the last twenty years in economic assessment studies in various fields. It is widely used term in economics now, which can be defined as "the maximum amount a person would be prepared to pay, sacrifice or exchange in order to receive goods or services or to avoid something that is undesired". WTP is a methodological tool that seeks to estimate the capacity to pay of certain social groups in a search to find out the hypothetical monetary value for programs and specific interventions and policies (Quevedo 'et al'. 2009: p.2). The willingness to pay concept generally refer to the economic value of a good to a person or a household under the given conditions. The use of this approach is not age old; its appearances have grown rapidly after 1990s in environmental and health economics (Mariani and Fernandes 2014: p.1). Iterative bidding approach is used in the study. In this method, respondents are asked whether they would pay a specified amount for the good that has been described or not. Under this method, fix an initial amount and ask respondents to pay for it if respondent agrees to pay then we increase the amount to a certain proportion and ask whether he/she would pay and keep him asking until the respondent gives a negative response. If respondents deny/disagree to pay the initial amount then we decrease the amount until respondent gives a positive response. WTP and its methods were designed to determine prices for pure public goods and services. It is still used for subjects as varied as the value of human life or minimization of risks threatening human life (Jennings and Jennings, 2000), public financing of the arts, theatre, music, museum etc. (Thompson et al, 2002), programs for the prevention of domestic violence (Sorenson 2003; as cited in Gall-Ely; 2009: p.95). The WTP measurement technique proposes the application of a questionnaire to measure willingness to pay. Considering that the results might be

potentially skewed, the application of various techniques has been put forward in an attempt to correct them and to bring them closer to the true values.

6.2 Data Analysis of Study Area

As shown in flowing figure 6.1 among the 300 households consumption of primary energy for cooking as firewood & chips 74.67 percent, LPG 21 percent, agriculture waste 2.67 percent cow dung 0.67 percent, coke coal 0.33 percent, and gobar gas 0.67 percent. Of this 21 percent is using LPG as the first source and some houses are also using Dirty Fuels as the second source.

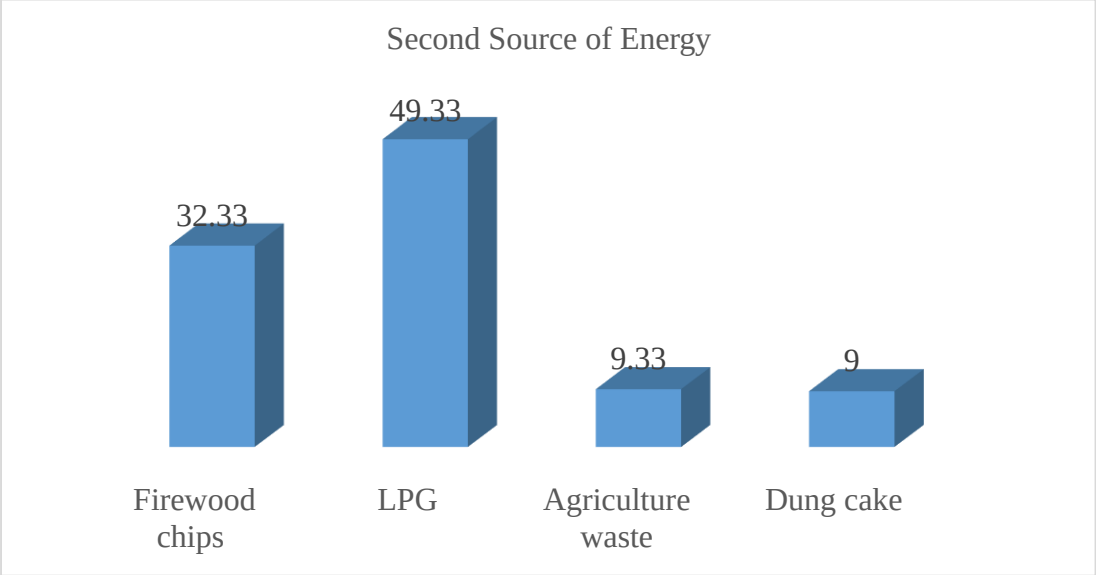
Figure: 6.1 First Source of Energy for Cooking of Households



Source: Estimated from primary Data

As shown in figure 6.2, the percentage of households that are consuming the second source of energy for cooking in the home is as follows: Firewood and chips 32.33 percent, LPG 49.33 percent, Agricultural waste 9.33 percent and Dung cakes is 9 percent. Households that are consuming the second source are also involved in consuming the first source.

Figure: 6.2 Second Source of Energy for Cooking of Households



Source: Estimated from primary Data

The iterative biding method takes the single-bounded (SB) dichotomous choice (DC) approach. In addition by presenting respondents with a series of discrete choice willingness-to-pay (WTP) questions. Iterative biding is defend on the grounds that it will capture the highest price consumers are willing to pay, thus measuring full consumer surplus (Cumming et al., 1986 K.G. cited: p. 308). Considering the linkage between location and willingness to pay of the respondent table 6.2 has been presented. The location or area is an important determinant of a person's response on questions related to WTP. Naanwaab et.al. (2014) also considered location of the respondent as a factor affecting WTP in their study on bacteriophage treated fresh produce. As different set of problems are faced in different states, district with reference to the good or service in question so the respondents WTP also varies. Forleo et.al. (2015) in their study on determinants of WTP for an Urban Green Area they used residence location as an independent variable. Table 6.1 shows sub-district wise WTP for clean energy. In Gaunaha 38.13 percent opted for bid 1 (less than Rs.300) and 61.87 percent for bid 2 (above Rs.300). In Piprasi, 23.57 percent said that

they are willing for bid1 and 76.43 percent for bid 2. Out of the total sampled households, 69.18 percent stated that they prefer bid 2 while 30.82 percent accept bid 1.

Table 6.2 Sub-District-wise response of WTP for clean Energy

Sub-district	Bid 1	Bid 2	Total
Gaunaha	53 38.13* 61.63**	86 61.87* 44.56**	139 100* 49.82**
Piprasi	33 23.57* 38.37**	107 76.43* 55.44**	140 100* 50.18**
Total	86 30.82* 100**	193 69.18* 100**	279 100* 100**

Source: Estimated from primary Data,

Note: * is represented as Row wise percentage, while ** is represented as Column percent.

Xiong et.al. (2018: p.1) in their study used multiple factors affecting individual's WTP including household disposable income. However, there was no significant relationship could be established with it. Wodimo and Bekle (2011: p.59) in their paper analysed the determinants of households' willingness to pay (WTP) for quality water supply, using the contingent valuation method (CVM). The study was conducted with randomly selected households in the factory villages of Wonji Shoa Sugar Estate, Ethiopia. The value elicitation method used is a close ended format questionnaire with additional close ended format, and open ended follow up questions which is closer to the market scenario respondents are familiar with. The empirical

model used in this study is the Tobit model. The result of the study revealed that income of the household, education level of the respondent, reliability on existing water supply, respondent perception about quality of the existing water supply, household family size and age of the respondent are significant variables that explain WTP (Mukurati 'et.al' 2017: p.15) in their study seeks to analyse the determinants of household willingness to pay for improved residential solid waste management in Gweru. An open ended contingent valuation method was used to elicit household's willingness to pay and a binary logit model was used to account for the factors influencing the respondent's Willingness to Pay. The results from the study indicated that monthly average expenditure which is a proxy of household income, highest level of education and the age of household head are important determinants of household willingness to pay for solid waste management (Goktolga 'et al', 2009) in their study used several factors including household's income as a factor affecting WTP. The study outcomes reflect that family unit size, monthly family income, family's food consumption, level of buyers' affectability over the issue influenced greater expenses for genetically unmodified items. Considering income wise WTP response, table 6.3 reveal that in 1st Quintile 55.07 percent opted for Bid 2 and 44.93 percent for bid 1. In the 2nd Quintile, 66.67 percent preferred bid 2 and 33.33 percent said they would pay as per Bid 1. In the 3rd income quintile, 80.6 percent accepted bid2 and just 19.4 percent response was bid 1. In the 4th quintile, 64.58 percent said their WTP is as per bid 2 and 35.42 mentioned their WTP as per bid1. In the 5th income quintile, a higher percentage of households agreed to pay as per bid 2 and 20 percent according to bid 1. Overall, 69.18 respondents were in favour of giving payment as per bid 2 and 30.82 percent according to bid 1.

Table 6.3 Income-wise HH Response of WTP for clean Energy

Quintile of Income HH	Bid 1	Bid 2	Total
	31	38	69
	44.93*	55.07*	100*
1	36.05**	19.69**	24.73**
	15	30	45
	33.33*	66.67*	100*
2	17.44**	15.54**	16.13**
	13	54	67
	19.4*	80.6*	100*
3	15.12**	27.98**	24.01**
	17	31	48
	35.42*	64.58*	100*
4	19.77**	16.06**	17.2**
	10	40	50
	20*	80*	100*
5	11.63**	20.73**	17.92**
	86	193	279
	30.82*	69.18*	100*
Total	100**	100**	100**

Source: Estimated from primary Data,

Note: * is represented as Row wise percentage, while ** is represented as Column percent.

Education levels are generally linked with greater importance to environment and its services. Makwinja et.al. (2019) in their research study on water resources in the Chia lagoon in Malawi quantified the communities' willingness-to-pay (WTP) and their influencing factors while using contingent valuation (CV) techniques. The study shows WTP is high if the respondent is well educated. In another study by Pantis 'et.al', 2006) education was used as a variable in determining willingness to pay for National Marine Park of Zakynthos, Greece. A study by Akter (2006) stated WTP

amounts have been found to be varying significantly with respondents' levels of mass media exposure, standards of living, age, number of children in each household, the level of education of the adult family members and distance from arsenic-free drinking water source. (Likewise Kutcher 'et.al', 2019) in their study on willingness to pay for price premium for ecological goods in Ukraine considered socio economic variables including education as a determining factor. Table 6.4 provides an overview of WTP as per different education levels. Out of the total illiterate respondents, 65.85 percent agreed to pay as per bid 2 and 34.15 according to bid 1. In the informal literate category, 71.43 percent said they are ready to pay above Rs. 30 and 28.57 would pay below Rs.300. In the primary education category, 72.73 percent said they would pay as per bid 2 and 27.27 according to bid 1. In the middle education category, 57.69 percent respondents agreed to pay more than Rs.300 and 42.31 percent below Rs.300. In the secondary education category, 76 percent were ready to pay as per Bid 2 and 24 percent as per Bid 1. In higher Secondary and graduate as well as post graduate level the percentage respondents paying according to bid 2 is high as compared to bid1.

Table 6.4 Education-wise Response of WTP for Clean Energy

Education	Bid 1	Bid 2	Total
Illiterate	42 34.15* 48.84**	81 65.85* 41.97**	123 100* 44.09**
Informal Literate	10 28.57* 11.63**	25 71.43* 12.95**	35 100* 12.54**
Below primary	9 32.14* 10.47**	19 67.86* 9.84**	28 100* 10.04**
Primary	3 27.27* 3.49**	8 72.73* 4.15**	11 100* 3.94**
Middle	11 42.31* 12.79**	15 57.69* 7.77**	26 100* 9.32**
Secondary	6 24* 6.98**	19 76* 9.84**	25 100* 8.96**
Higher Secondary	3 18.75* 3.49**	13 81.25* 6.74**	16 100* 5.73**
Graduate	2 15.38* 2.33**	11 84.62* 5.7**	13 100* 4.66**
Postgraduate	0 0* 0**	2 100* 1.04**	2 100* 0.72**
Total	86 30.82* 100**	193 69.18* 100**	279 100* 100**

Note: * is represented as Row wise percentage, while ** is represented as Column percent.

A study by Donfouet et.al.(2011) with reference to determinants of WTP for community healthcare program find out that age, religion, profession, knowledge of community-based health insurance, awareness of usual practice in rural areas, involvement in association and disposable income are the key factors influencing WTP. Sihem 2017:p.1) in a study identified the determinant factors in using agricultural insurance and to provide evidence that matters of religion, besides the socio-economic ones, play an explanatory role in demand for agricultural insurance in American and European countries in the period 2000–2012. Likewise in our study we have used Religion as a factor in WTP. Religion wise estimation of willingness to pay has been done which is presented the table 6.5. The table shows that 68.77 percents respondents belonging to Hindu category opted for bid 2 and 31.23 said they would pay as per bid 1. In the Muslim category, 80 percent said they are ready to pay as per bid 2 and just 20 percent agreed to pay as per bid 1.

Table 6.5: Religion-wise response of WTP for clean Energy

Religion	Bid 1	Bid 2	Total
Hindu	84 31.23* 97.67**	185 68.77* 95.85**	269 100* 96.42**
Muslim	2 20* 2.33**	8 80* 4.15**	10 100* 3.58**
Total	86 30.82 100**	193 69.18 100**	279 100 100**

Source: Estimated from primary Data.

Note: * is represented as Row wise percentage, while ** is represented as Column percent.

Dupont (2000, p.1) in a study on willingness to pay for recreational benefits from improved water quality mentioned that gender play a crucial role. The study elaborates upon various reasons regarding low willingness to pay among women for environment than men. Further, in an empirical estimation of gender differences in WTP has been presented through a Tobit model. A study by Adamu 'et.al', 2017: p.95) was conducted to examine the factors that determine the local visitors' willingness to pay (WTP) for conservation in Yankari game reserve, Bauchi, Nigeria. The study employed a contingent valuation survey on local tourists. Binary logit and Probit models were used to estimate the visitors' willingness to pay (WTP) for conservation. The empirical results revealed that the game reserve has significant use value as 77.9 percent of the visitors were willing to pay. The results showed that age, gender, income, level of education and first-time visit are the significant determinants of visitors' willingness to pay. Study by George 'et.al', (2012) stated that income, age, gender, coastal recreational activities and environmental quality of the site serve an important role in determining people's WTP for quality improvement of the coastal zone. Kucher 'et.al', 2019) in their study discussed the factors affecting consumers' willingness to pay a price premium for ecological goods. The study was carried out in selected regions of Ukraine, in the cities of Kharkiv and Kyiv. The comparison of consumer attitudes across different cities regarding ecological goods, revealed their willingness to pay a price premium depending primarily on the purchasing power of the population, gender, age and social status. The analysis showed that men were more likely to pay a higher price for environmentally safe goods. The study states that the purchasing decision of men was based on price while women prime factor of decision is not price of the product.

A picture of WTP as per gender has been presented in table 6.6. The table reflects that there is no significant difference in WTP across males and females. In the Male category, 69.3 percent agreed to pay as per bid 2 while 30.7 said they would pay as per bid 1. In the female category, 69.09 percent preferred paying according to bid 2 and 30.91 as per bid 1.

Table 6.6 Gender-wise Response of willingness to pay (WTP) for Clean Energy

Gender	Bid 1	Bid 2	Total
Male	35 30.7* 40.7**	79 69.3* 40.93**	114 100* 40.86**
Female	51 30.91* 59.3**	114 69.09* 59.07**	165 100* 59.14**
Total	86 30.82* 100**	193 69.18* 100**	279 100* 100**

Source: Estimated from primary Data.

Note: * is represented as Row wise percentage, while ** is represented as Column percent.

A picture of WTP as per different ration card wise has been presented in table 6.7. The table reflects that in the Antodaya category, 67.5 percent agreed to pay as per bid 2 while 32.5 said they would pay as per bid 1. In the BPL category, 68.56 percent preferred paying according to bid 2 and 31.44 as per bid 1. In the Other category all the respondents preferred bid 2.

Table 6.7: Ration Card-wise Response of WTP for clean Energy

Type of Ration Card	Bid 1	Bid 2	Total
Antodaya	13 32.5* 17.57**	27 67.5* 16.27**	40 100* 16.67**
BPL	61 31.44* 82.43**	133 68.56* 80.12**	194 100* 80.83**
Others	0 0* 0**	6 100* 3.61**	6 100* 2.5**
Total	74 30.83* 100**	166 69.17* 100**	240 100* 100**

Source: Estimated from primary Data

Note: * is represented as Row wise percentage, while ** is represented as Column percent.

Caste dynamics in India are extremely complex and caste may play an indirect role in Willingness to pay for clean energy. Dhungana (2017) in a study on determinants of willingness to pay for solid waste management system in an area of Nepal considered several factors including caste. Jyothis (2000) also used caste as a variable in the study on conservation of Periyal Tiger Reserve in Kerala. The results in the study depict that the lower caste medium landholding communities have the higher chances to join the proposed conservation program. Such literature suggests that an analysis of WTP with reference to caste should be done. An overview of Caste wise WTP responses has been depicted in table 6.8. The table shows that in ST social group,

63.36 percent respondents opted for bid 2 while 36.64 for bid 1. In SC category, 69.23 agreed to pay as per bid 2 while 30.77 as per bid 1. In OBC category, 75 percent preferred bid 2 and 25 percent opted for bid 1. In General category, 91.67 percent WTP was as per bid 2 and only 8.33 percent said that they would opt for bid 1.

Table 6.8 Caste-wise Response of WTP for clean Energy & Protection of Health

Caste	Bid 1	Bid 2	Total
ST	48 36.64* 55.81**	83 63.36* 43.01**	131 100* 46.95**
SC	16 30.77* 18.6**	36 69.23* 18.65**	52 100* 18.64**
OBC	21 25* 24.42**	63 75* 32.64**	84 100* 30.11**
General	1 8.33* 1.16**	11 91.67* 5.7**	12 100* 4.3*
Total	86 30.82* 100**	193 69.18* 100**	279 100* 100**

Source: Estimated from primary Data.

Note: * is represented as Row wise percentage, while ** is represented as Column percent.

The company named CRISIL (An S & P Global Company) analyzed state-wise LPG access by petroleum planning & analysis cell (PPAC) with ministry of petroleum and natural gas (MoPNG) based on the number of active users of LPG from oil marketing companies and households on 1 June 2015, in which 13 states were taken. This estimate is based on the 2011 census for urban and rural areas is state-wise. The

willingness to pay for LPG in the hill, plains, and desert, tribal and non-tribal belts is Rs 317 per month. 313 per month and Rs.333 per month are estimated in rural and urban areas respectively (CRISIL 2016 pp. 21-63). When the LPG Price Subsidy Scheme was evaluated in 2015, it was found that the benefits of LPG Price Subsidy throughout India were mostly going to the higher income group which was deprived of lower-income. The higher income group was spending the most on fuel like LPG and petroleum, while the lower-income group was on kerosene (Anand, R. 'et al.'2013: pp. 9-10).

As shown in the below above table 6.9. Out of 300 respondents 279 revealed their willingness to pay (WTP) from the given alternative choice sets of monetary values in multiples of Rs. 150. The average willingness to pay is Rs.381.54 rupees per month with a standard deviation of 82.94. In August 2018, the price of 14.2 kg LPG gas cylinders was Rs. 789.50 and the mean value of willingness to pay of the households in the study area were per month 381.54. For the consumption of clean energy, the average WTP of households is 381.54 rupees per month while the price of 14.2 kg gas cylinder was 789.50 rupees. If we see the difference between the two, it will be 407.94 rupees it means to consume the clean energy, households have to bear the net burden of 407.94 rupees.

Table 6.9 Mean, SD, Min, Max of Willingness to pay for LPG of Households

Variable	Obs	Mean	Std.Dev.	Min	Max
How much do you pay for LPG (WTP)	279	381.541	82.941	150	500

Source: Estimated from primary Data

6.3 Quantity of cooking fuel per month

Consumption of firewood in the densely forested areas and tribal-dominated districts was more than 150 kg/month on average. Tribal dominated areas are as follows: East Champaran in Bihar, Rajasthan, Uttar Pradesh, Nagaland, Meghalaya, Assam, West Bengal, Jharkhand, Odisha, Chhattisgarh, and Gujarat. The combined consumption of wood, cow dung, biomass, three sources is 307 kg per month (CRISIL 2016: pp. 40-45). As shown in Table 6.10 below, 279 households in 300 households use firewood and biomass fuel as primary sources for cooking. The average wood consumption is 387 kg per month and the standard deviation is 145.62. The monetary value of this fuel is Rs 1935 per month, which is double the price of 14.2 kg LPG. However, if people are given about Rs. 381.54 LPG gas, then the dirty fuel is ready to be released. People of the study area are consuming smoke of Rs 1935 per month.

Table 6.10 Wood and Biomass for Cooking Per Month

Variable	Obs	Mean	Std. dev.	Min	Max
Wood & Biomass Quantity in Kg (per month)	279	387.6344	145.6218	30	640

Source: Estimated from primary Data

6.4 Factors Determining Willingness to Pay

After an extensive review of literature, we have considered certain variables as determinants of willingness to pay. All the variables have been re-coded into binary form. The dependent variable is 1= willing to Pay and 0 if not willing to pay. The independent variables include income, caste, family size and education. Income has been classified as 1=Low, which includes bottom 60 percent sample population and 0=High which has others. Caste is divided into classes viz. 1= ST and 0= other social

groups. Similarly, educational qualification of the respondent is classified into two categories i.e. illiterate and literate. Family size has been coded as 1=Joint and 0= Nuclear.

The logistic regression model which is used to estimate the probability of WTP for clean energy among the sample households is as follows:

$$Y_i = ln\frac{P_i}{1-P_i} = \alpha_i + \beta_i X_i + e_i$$

Wherein, Y_i=WTP i.e. willingness to pay for clean energy,

X_i=explanatory variables comprising all socio-economic variables

β_i = co-efficient of unknown parameters

α =intercept,

e_i = is the error term

The results show that education and income are significant among the independent variables. The respondents belong to low income households are more willing to pay for clean energy. The odd ratios reveal that probability of willingness to pay for clean energy is more than 2 times higher for low income respondents as compared to high income respondents as they are more suffered from air pollution due to use of unclean energy. Considering education, the regression outcome depicts that if the respondent is literate then the probability for paying for clean energy is 0.30 times lesser than illiterate category. As far as caste of the respondent is considered, if the respondent belongs to other than ST social group there is a higher probability of him/her willing to pay for clean energy. The log odds of willing to pay increase by 0.04 if the respondent is from ST category. Considering family size in this context, data shows that respondent belonging to joint family has 1.66 times higher chances of agreeing to pay for clean energy sources. Out of all the independent variables, income and education are found to be statistically significant.

Table 6.11 Result of Logistic regression

Variables	Coefficient	Odd Ratio.	Z value	p-value	Significance level
Caste (ST=1,0=Others)	0.04	1.04	0.08	0.93	-
Education (Literate=1,0=Illiterate)	-1.18	0.30	-2.02	0.04	**
Income (Low=1, 0=High)	0.88	2.41	1.88	0.06	*
Family Size (Joint=1, 0=Nuclear)	0.50	1.66	0.97	0.33	-
Constant	2.55	12.90	-2.27	0.00	***
Number of Obs.= 300 *LR chi2=9.75* *Prob > chi2=0.04* *Psuedo R2= 0.06* **** p<0.01, ** p<0.05, * p<0.1*					

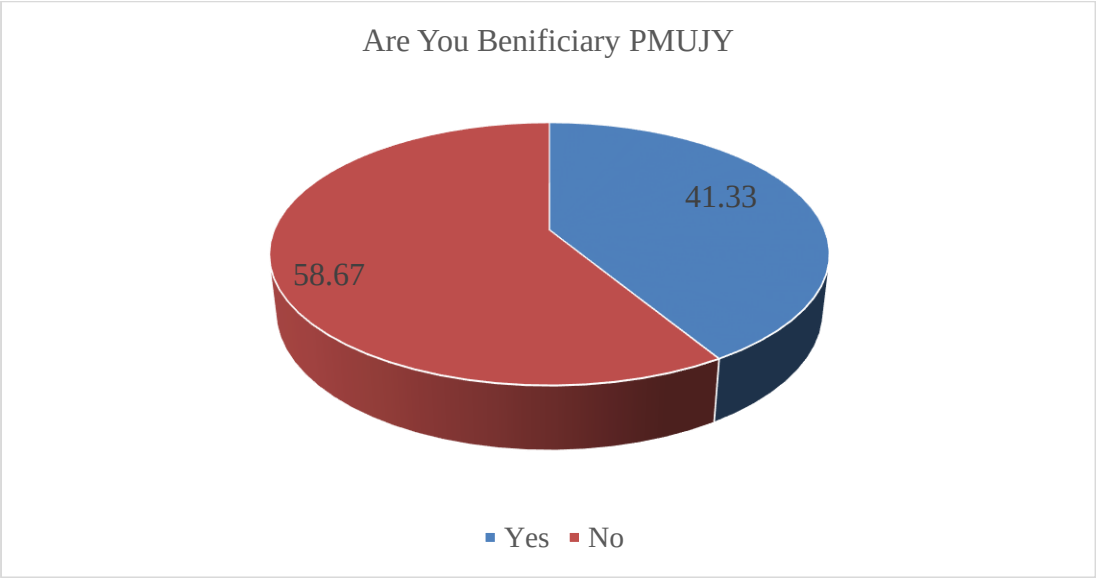
Source: Estimated from Primary Data

6.5 Accessibility of Pradhan Mantri Ujjwala Yojana (PMUY)

Women living in the poverty line who cook food on the woodstove did not have access to clean fuel. She used to face smoke every day and cooked food on wood stove, for those women the Government of India started the Pradhan Mantri Ujjwala Yojana (PMUY) in the year May 2016. The objective of this scheme was to extend the LPG connection to five crore women and rid them of smoke. Those to be identified from the Socio-Economic and Caste Census (SECC) -2011 list. Later, by expanding the scheme, the target of the scheme was targeted to reach eight crore women. An alternative loan facility was to be provided under this scheme which would help in its expansion. The year 2016 to 2019 government target 6 crore households to provide LPG connection. But this target achieves in the year 2016-17 (2 crores), 2017-18, (1.56) crore and 2018-19, (0.25) crore. The total PMUY achievement connection is 3.81 crore. And EPMUY connection 2018-19, 3.81 crores both are added to 7.19 crore achievement (Comptroller and Auditor General of India

on Pradhan Mantri Ujjwala Yojana 2019 p.3). Figure: 6.3 depicts the accessibility of PMUY by the households the figure is showing that out of 300 sample 124 (41.33percent) accepting that they are beneficiary of Pradhan Mantri Ujjwala Yojana while 58.67 percent are not beneficiary of PMUJY. The figure is showing that large number of households are not beneficiary of PMUJY.

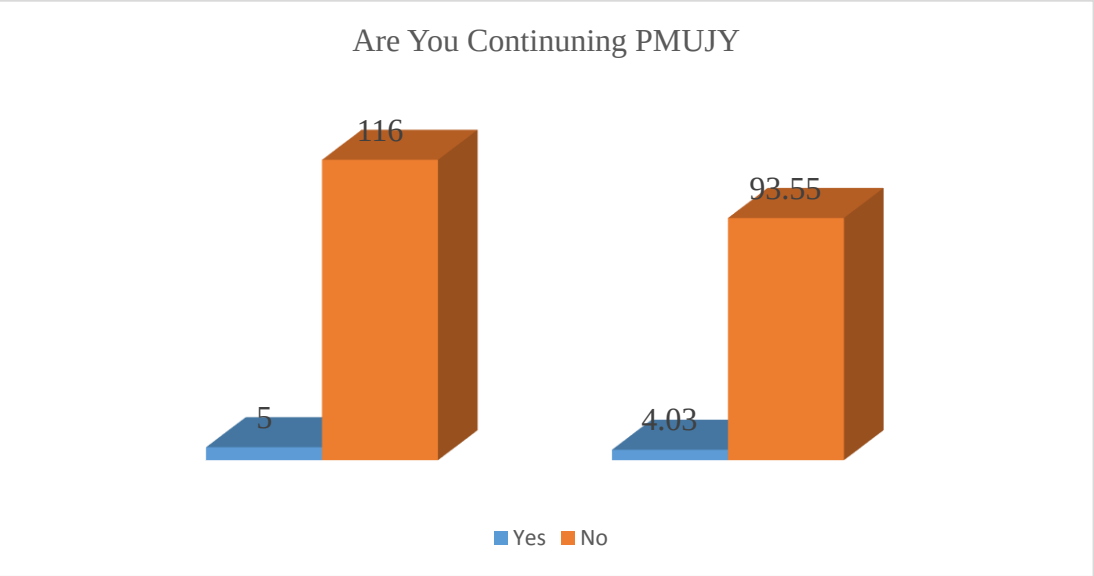
Figure: 6.3 Are You Beneficiary of Pradhan Mantri Ujjwala Yojana (PMUY)



Source: Estimated from Primary Data

Figure 6.4 showing that how many households are continuing this scheme PMUJY. We can see that 0nly 4.03 percent households are continuing while a large number of households 93.55 percent are not continuing the Pradhan Mantri Ujjwala Yojana.

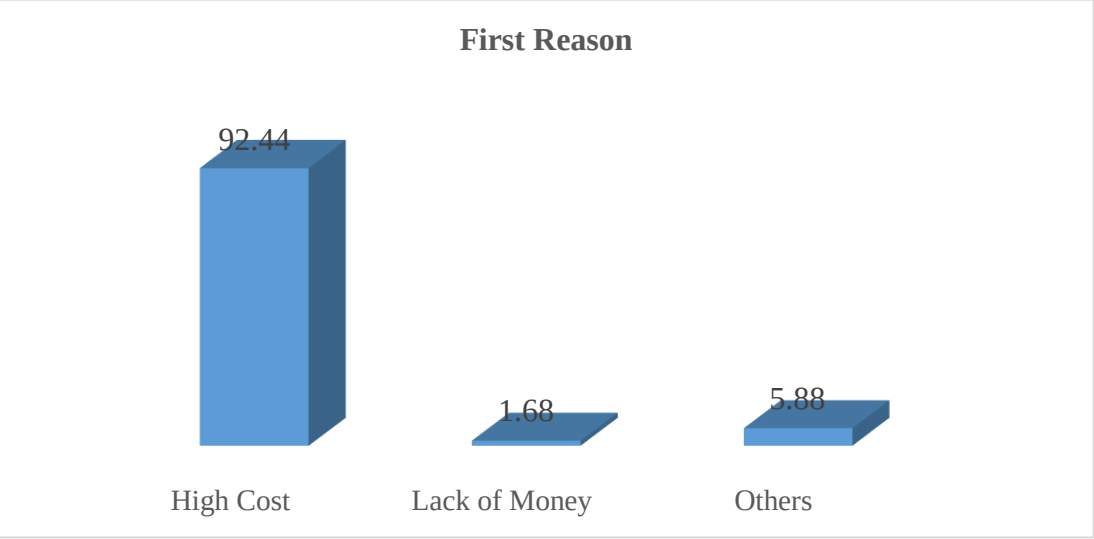
Figure: 6.4 Are You Continuing Pradhan Mantri Ujjwala Yojana PMUJY



Source: Estimated from Primary Data

Figure 6.5 is showing the first reason behind not continuing the PMUJY. 93.44 percent households are not continuing this scheme because of high cost of LPG, 1.68 percent are accepting that they have lack of money show that they are not able to continue while 5.88 percent household are not continuing this scheme for other reason such as log distance of PMUJY, tough procedure to get the LPG, lack of time, for the test purpose.

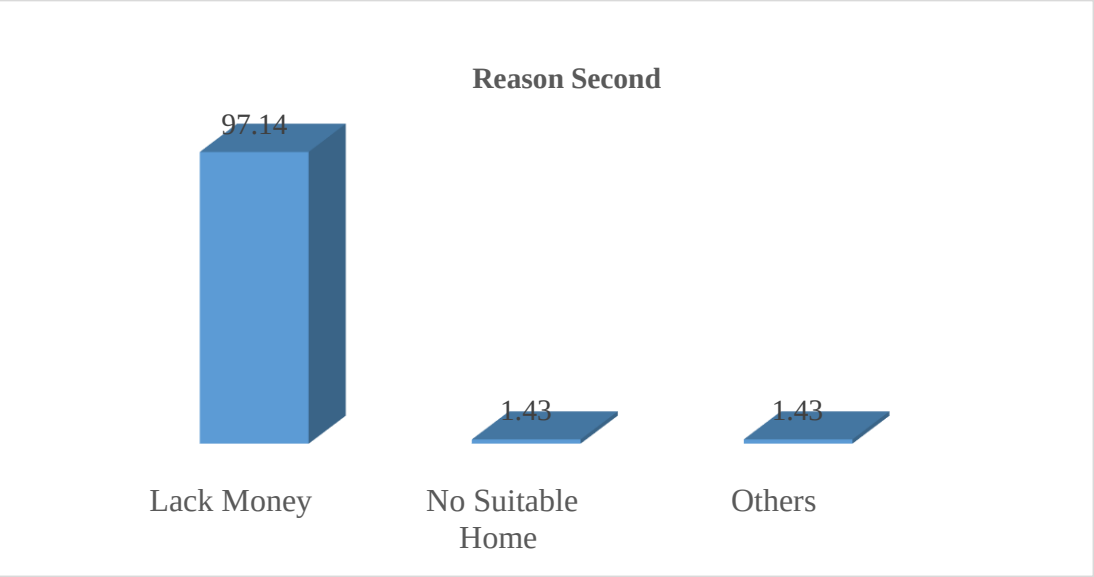
Figure: 6.5 Reasons for not continuous use of PMUJY



Source: Estimated from Primary Data

Figure 6.6 is showing the second reason of not continuing the PMUJY. The figure shows that 97.14 percent households are saying they are able to continue this scheme because they have lack of money. 1.43 percent households are not continuing because no suitable place in house to put the cylinder and 1.43 percent are not continuing because of other reason such as long distance, time problem etc.

Figure: 6.6 Reasons for not continuous use of PMUY



Source: Estimated from Primary Data

6.5 Finding and Conclusion

The block-wise willingness to pay of households show that people are prefer 69.18 percent on bid 2 (above 300 rupees) and 30.82 percent on bid 1 (Below 300 rupees). In the 5th income quintile, a higher percentage of households agreed to pay as per bid 2 and 20 percent according to bid 1. Overall, 69.18 respondents are in favor of giving payment as per bid 2 and 30.82 percent according to bid 1. Education plays a significant role in the willingness to pay. It has direct impact on willingness to pay of households as the level of education is increasing willingness to pay (WTP) is also increasing. There is no significant difference between men and women on the basis of willingness to pay (WTP) because women have more saving behavior than men. The

caste plays an important role in the consumption of goods and services. The people spend according to their economic status, if they are poor then their willing to pay less. Likewise, if they are rich then their willingness to pay has more. As per social caste categorization the willingness to pay (WTP) of general category 91.62 percent is highest followed by OBC 75 percent, SC 69.23 percent and ST 63.36 percent. Out of 300 households 279 revealed their willingness to pay (WTP) for the given alternative choice sets of monetary values in multiples of Rs. 150. The average willingness to pay is Rs.381.54 rupees with a standard deviation of 82.94. For the consumption of clean energy, households have to bear the financial burden, so they are not able to access clean energy. So they have to use unclean fuel under compulsion because of the high cost of clean fuel. The average wood consumption is 387 kg per month and the standard deviation is 145.62. The monetary value of this fuel is Rs 1935 per month, which is double the price of 14.2 kg LPG. However, if people are given about 400 rupees LPG gas, then the dirty fuel is ready to be released. People of the study area are consuming smoke of Rs 1935 per month.

Chapter 7
Major Findings and Conclusions

Chapter 7

Major Findings and Conclusions

7.0 Introduction

This chapter discusses humans' living place in the environment world. It highlight certain human activities those degraded our environment life-support system, disrupting the eco-system and endangering human health in the process. Among those at greatest risk for serious illness due to environmental pollution are women, children and elderly and those living in poverty? Two types of pollution are found in the environment, first, is outdoor and second is indoor air pollution both are serious problems for human health. Environmental pollution remains a concern globally. All types of pollution such as water pollution, noise pollution and air pollution are the major cause of all diseases. But among these, air pollution is affecting most the health of the people. Increasing population, excess use of vehicles, construction, etc. are the main reason for air pollution, while the use of unclean fuels for cooking, the use of air condition in houses, etc. are the main reasons for indoor air pollution.

7.1 Major Findings

Chapter one entitled “Indoor air Pollution Issues and Methods” deals with extent of indoor air pollution and its impact on human health. It further comprises of research questions, objectives and hypothesis, research methodology and Chapterisation. Chapter two entitled “Energy Consumption and Economic Development: Conceptual and Theoretical Background” includes various theories related to importance of energy consumption in economic development. The classical economists highlighted the pivotal role played by natural resources in economic development and so did the neo-classical economists. Chapter three entitled “Pattern of Energy Consumption in

Rural and Urban Areas in India". In this chapter, primary source of energy used for cooking and lighting are based on various rounds of NSS data. Majority of the households are using unsustainable fuel for cooking in the rural areas, while clean fuel is used in the urban areas for cooking. It is also observed that the huge variation in rural energy after globalization in India. However, state level variation is high in rural as compared to urban areas. The use of LPG in urban India is around 68 percent in recent years where as reverse situation is found in rural India. Nearly 67 percent use of firewood and chips is for cooking in rural India. The weightage of use of unsuitable fuels for cooking and lighting is significantly higher among ST and SC social groups as compared to OBC and General category. There is high level of inequality persist in Rural and Urban India, while kerosene is superior fuel compare to bio-fuels. Secondary data analysis depicts that clean fuel are not easily available so people are ultimately relying on unsustainable energy sources. People are shifting towards clean fuel but the percentage is very low in order to obtain the sustainable economy with sustained environment where as after globalization there is a shift in usage of qualitative fuel.

Chapter Four "Demographic, Socio- Economic Profile of Households in Study Area of Paschim Champaran, Bihar" shows that income, education, occupation and health are main indicators of the development of any country and society. In this chapter, discussion on the socio-economic status of the study area are done on the basis of 300 sample households has been done. The discussion based on demographic structure, family structure, occupation, income, education, and sanitation etc. Primary data analysis reveals that poverty condition of schedule tribe (ST) is very high on the basis on below poverty line (BPL) and Antodaya cardholders. Considering education pattern in the area, data reflects that in terms of literacy rate, the number of both males

and females is found to be declining in higher education levels. The female participation is lower than that of males in higher education. The educational situation is truly depressing. Certain schools lack basic educational as well as infrastructural services, particularly for girls, which are reflected in an alarmingly low literacy rate between girls and the gender disparity in education attainment. Overall, literacy rate of district is below the state average. Taking into account the occupational pattern, the population of this area is completely dependent on agriculture. There are very limited numbers of industries in the area and those which exist are micro or small. Work force participation rate is low in the sampled district as the population of young people is more. However, due to lack of work/job opportunities, the people of this area migrate to work in other states if they do not work on agricultural fields. Agriculture, wage labour, private job, self-employment in non-agriculture are some of the main sources of income of the people in the sampled area.

Chapter Five is entitled as "Health Cost Measurement of the Households in the Study Area of Paschim Champaran District" This chapter measures health-cost through cost of illness method (COI). Cost-of-illness method measures the economic burden of diseases and evaluates the monetary value of health expenditure. The data shows that educated people are less affected by diseases as compared to uneducated people. During the 15 day reference period, in-patient average direct cost is Rs.11027.5 and for outpatient is Rs.2142.21. For 365 day reference period, the mean value of direct cost for in-inpatient is Rs.29268.1 and for out-patient the mean value is Rs.5070.29 rupees. The inpatient health cost expenditure is higher as compared to out-patient. The socio economic variables affect health expenditure. The gender wise study shows that women suffer more from indoor air pollution borne illness than male. The biggest reason for this is that women spend more time at home due to

which they have to face more smoke. Focusing on gender-wise health cost, it is found that due to prevalence of higher incidence of illness, the health cost of women is higher than that of men. It is clear that the situation of women of rural India has not improved even today. The majority of the people in the study area suffer from chronic diseases (91.57 percent), while a lower percentage (8.43 percent) suffers from acute diseases. Within our sampled population, 17.84 percent of people are not getting treatment due to lack of money and for other reasons. Women are the main victims of indoor air pollution and bear high health cost.

Chapter Six is entitled as "Willingness to Pay for Clean Energy in the Survey Area" which shows the block-wise willingness to pay of households. Out of the total population, 69.18 percent opt for bid 2 (above 300 rupees) and 30.82 percent preferred bid 1 (Below 300 rupees). In the 5th income quintile (i.e. high income group) a higher percentage of households agreed to pay as per bid 2 and 20 percent according to bid 1. Overall, 69.18 percent of respondents are in favor of giving payment as per bid 2 and 30.82 percent according to bid 1. Education plays an important role in the willingness to pay. There is no significant difference between men and women on the basis of willingness to pay (WTP) because women have more saving behavior than men. The caste plays a key role in the consumption of goods and services. Further, data reflects that the people spend according to their economic status, if they are poor then they are willing to pay less. Likewise, if they are rich then their willingness to pay is more. As per social caste categorization, the willingness to pay (WTP) is high in case of general category 91.62 percent followed by OBC (75 percent), SC (69.23 percent) and ST (63.36 percent). Out of 300 households, 279 respondents revealed their willingness to pay (WTP) for the given alternative choice sets of monetary values in multiples of Rs. 150. The average willingness to pay is

Rs.381.54 rupees with a standard deviation of Rs. 82.94. For the consumption of clean energy, households have to bear the financial burden, so they are not able to access clean energy. The average wood consumption is 387 kg per month and the standard deviation is Rs.145.62. The monetary value of this fuel is Rs 1935 per month, which is double the price of 14.2 kg LPG. However, if people are given about Rs. 382 for LPG gas, then the dirty fuel can be replaced. People of the study area are consuming smoke of Rs 1935 per month. The logistic regression model is used to find the determinants of willingness to pay (WTP) and the results show that education and income are significantly related to WTP. The low income and illiterate households are more willing to pay for clean energy than high income and educated households. The reason may be that they are more suffered from air pollution due to use of unclean energy.

7.2 Conclusions

Energy plays an important role in economic development. However, the energy consumption is highly depended on the income of the households. The higher income households are using clean fuel whereas the lower income groups are using unclean fuels for cooking and lightening. According to NSSO (68^{th} round), there is considerable variations in using energy fuels between urban and rural areas. 67.3 percent of the rural households are using firewood and chips for cooking, while about 68 percent of the urban households are using LPG for cooking. The study concludes that there is a wide gap across social and religious groups on the basis of occupation, education, income and land distribution in the Paschim Champaran district of Bihar. The incidence of poverty among the SC and ST households are higher as compared to OBCs and other households. Moreover, majority of the ST and SC households are working as a daily wage workers and they have marginal land holding. Therefore, the

households are using unclean fuels for cooking and other purposes due to poverty. The unclean energy leads to indoor air pollution, due to which the households are facing the health problems, particularly which is more vulnerable for female as compared to male. The health problem puts burden of health costs on the households, which further endures them into the vicious circle of poverty. Therefore, due to health problems from the unclean fuels the sampled households are willing to pay some amount to avoid the health cost. The average willingness to pay of sampled households for clean energy is 381 rupees.

7.3 Policy Implications

1. Housing quality is one of the major essential elements for the health of the rural people. Hence the condition of the houses to prevent the disease caused by indoor air pollution Healthy housing conditions can be the first step to avoid indoor air pollution.
2. The average willingness to pay of the study area is Rs 381.54 if the government provides 14.2 kg of gas cylinders at the price of Rs.400, then people can afford it and replace dirty fuel with clean fuel in the kitchens.
3. To provide relief to poor families from smoke, the government will have to take an electricity bill of up to Rs 400 for cooking, heating, and lighting.

References

8. References

Aakanksha, RatnaKatiyar, S.K.Rastogi. (2014). 'Study of Indoor Air Quality of Kitchens of Rural Area's in Lucknow' *Current World Environment, Vol.*9 No.2.

Abegunde, D. O., Mathers, C. D., Adam, T., Ortegon, M., & Strong, K. (2007). 'The burden and costs of chronic diseases in low-income and middle-income countries', *The Lancet*, Vol. *370*, No. 9603.

Abegunde, D., & Stanciole, A. (2006). 'An estimation of the economic impact of chronic noncommunicable diseases in selected countries', *World Health Organization, Department of Chronic Diseases and Health Promotion*.

Adamu, A., Yacob, M.S., Radam, A., Hashim, R. (2017). 'Factors Determining Visitors Willingness to Pay for Conservation in Yankari Game Reserve, Bauchi, Nigeria', *International Journal of Economics and Management*, 95 (114).

Ahmad Waseem and Tanvir Ahmad. (2014). 'Energy Sources and Gross Domestic Product: International Evidence." *The Pakistan Development Review*, Vol. 53, No. 4.

Akter, S. (2006). 'Determinants of Willingness to Pay for Safe Drinking Water: A Case Study in Bangladesh', *Asian Journal of Water, Environment and Pollution*, Vol. 5, No.3.

Anand, R., Coady, D., Mohommad, M. A., Thakoor, M. V. V., & Walsh, M. J. P. (2013). 'The fiscal and welfare impacts of reforming fuel subsidies in India', *International Monetary Fund. (Working Paper* No. 13/128).

Apex, M., & Perobelli, F. S. (2010). 'Solow meets Leontief: Economic growth and energy consumption', *Energy Economics*, Vol.*32*, No. 1.

Aqeel, A., & Butt, M. S. (2001). 'The relationship between energy consumption and economic growth in Pakistan', Asia-*Pacific Development Journal*, Vol.8 *No.*2.

Azlina, A. A. (2012). 'Energy consumption and economic development in Malaysia: A multivariate cointegration analysis', *Procedia-Social and Behavioral Sciences*, Vol. *65*.

Azzuni, A., & Breyer, C. (2018). 'Definitions and dimensions of energy security: a literature review', *Wiley Interdisciplinary Reviews: Energy and Environment*, Vol. 7, No.1.

Bailis, R., Ezzati, M., and Kammen, D. (2005). 'Mortality and greenhouse gas impacts and petroleum energy futures in Africa', *Science,* 308(5718).

Baker, E. H. (2014). 'Socioeconomic Status, definition", *The Wiley Blackwell encyclopedia of health, illness, behavior, and society*'.

Balsdon, E., & Kolstad, C. D. (1999). 'Environmental Economics', *Oxford University Press*.

Barnes, B. R. (2005). 'Interventions to reduce child exposure to indoor air pollution in developing countries: behavioral opportunities and research needs', *Children Youth and Environments*, Vol.*15, No.*1.

Barnes, D. F., & Floor, W. M. (1996). 'Rural energy in developing countries: a challenge for economic development1', *Annual review of energy and the environment*, Vol. *21*.

Batliwala, Srilatha. (1983). 'Women and Cooking Energy', *Economic and Political Weekly*, Vol.18, No. (52/53).

Behera Jaganath. (2015), "Energy Consumption and Economic Growth in India: A reconciliation of Disaggregate Analysis," *Journal of Energy Technologies and Policy*, Vol. 5, No.6.

Berndt, E. R., & Wood, D. O. (1979). 'Engineering and econometric interpretations of energy-capital complementarity', *The American Economic Review*, Vol. *69, No.* 3.

Bhaskar, B. (2013), "*Energy Security and Economic Development in India: a holistic approach*," *The Energy and Resources Institute (TERI)*.

Bhattacharyya, S. C. (2011). 'Energy economics: concepts, issues, markets and governance', *Springer Science & Business Media.*

Bihar statistical Hand Book. (2014). '*Directorate of Economics & Statistics Department of Planning & Development Bihar', Patna.*

Bilgiç, G. (2017). 'The Measure and Definition of Access to Energy Systems by Households and Social Effects of Lack of Modern Energy Access', *Energy and Environmental Engineering,* Vol. 5, No.1.

Bruce, N., Neufeld, L., and Boy, E. (2000). 'Indoor biofuel air pollution and respiratory health', *Int. J. Epid.,* 27: 454-458.analysis. *Energy Policy*, Vol.*32,* No.5.

Bruce, N., Perez-Padilla, R., & Albalak, R. (2000). 'Indoor air pollution in developing countries: a major environmental and public health challenge', *Bulletin of the World Health organization*, No. *78*.

CAG (2019). 'Report of the Comptroller and Auditor General of India on Pradhan Mantri Ujjwala Yojana', *Union Government (Commercial) Ministry of Petroleum and Natural Gas,* 14

Carson, R.T. (2000). 'Contingent Valuation: A User's guide', *Environment, Science and Technology*, Vol. 34, No.8.

Census of India. (2011). *Office of Director of Census Operations, Bihar, Patna*

Clabaugh, G., & Ward, M. M. (2008). 'Cost-of-illness studies in the United States: a systematic review of methodologies used for direct cost', *Value in Health*, Vol. *11 No.*1.

Clougherty, J. E., & Kubzansky, L. D. (2009). 'A framework for examining social stress and susceptibility to air pollution in respiratory health' *Environmental health perspectives*, *117(*9).

Cohen, A. J., Brauer, M., Burnett, R., Anderson, H. R., Frostad, J., Estep, K., & Feigin, V. (2017). 'Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution: an analysis of data from the Global Burden of Diseases Study 2015', *The Lancet*, Vol. *389 No.* 10082.

Connelly, R., Gayle, V., & Lambert, P. S. (2016). 'A review of occupation-based social classifications for social survey research' *Methodological Innovations*, Vol. *9.*

CRISIL. (2016). 'Assessment Report: Primary Survey on Household Cooking usage and Willingness to Convert to LPG', *Petroleum Planning & Analysis Cell, Ministry of Petroleum and Natural Gas, Government of India*.

Crossman,A.(2019). 'An Introduction to Socioeconomic Status', https://www.thoughtco.com/socioeconomics -status-3026599

Devalia, H.N., Wang, X. and Ding, H. (1997). 'Domestic environment and health of women and children', TERI Annual Report.

Dhungana, A.R. (2017). 'Determinants of Willingness to Pay for Improved Solid Waste Management System in Lekhnath, Kaski, Nepal', *Janpriya Journal of Interdisciplinary Sciences*. 6.

Donfouet, H. P. P., Makaudze, E., Mahieu, P. A. et al. (2011). 'The determinants of the willingness-to-pay for community-based prepayment scheme in rural Cameroon', *International journal of health care finance and economics*, Vol. 11, No. 3.

Duflo, Esther; Greenstone, Michael and Hanna Rema. (2008). 'Cooking stoves, Indoor Air Pollution and Respiratory Health in Rural Orissa', *Economic and Political Weekly*, Vol.43, No.32.

Duflo, Esther; Greenstone, Michael and Hanna Rema. (2008). 'Cooking stoves, Indoor Air Pollution and Respiratory Health in Rural Orissa', *Economic and Political Weekly*, Vol. 43, No. 32.

Dupont, D.P. (2000). 'Gender and Willingness-to-pay for Recreational Benefits from Water Quality Improvement', *IIIFT Proceedings*.

Dutta, S., & Banerjee, S. (2014). 'Exposure to indoor air pollution & women health: the situation in urban India. *Environment and Urbanization Asia*', Vol. *5 No.*1.

Ebohon, O. J. (1996). 'Energy, economic growth and causality in developing countries: a case study of Tanzania and Nigeria', *Energy policy,* Vol. *24, No.* 5.

Emily, Sanna. (2009). 'Air Pollution and Health', *Alpha House Publishing,*

Galobardes, B., Shaw, M., Lawlor, D. A., Lynch, J. W., & Smith, G. D. (2006). 'Indicators of socioeconomic position (part 1)', *Journal of Epidemiology & Community Health*, Vol. *60, No.*1.

Galobardes, B., Shaw, M., Lawlor, D. A., Lynch, J. W., & Smith, G. D. (2006). 'Indicators of socioeconomic position (part 2)', *Journal of Epidemiology & Community Health*, Vol. *60, No.* 2.

George, H., Steriani, M. (2012). 'Determinants of willingness to pay for coastal zone quality improvement', *Journal of Behavioral and Experimental Economics*. Elsevier, Vol. 41, No. 4.

Goktolga, G.Z., Esengun, K. (2009). 'Determining the factors affecting the consumers' willingness to pay higher prices for genetically unmodified products: Tomato case study in Turkey', *British Food Journal*, 111(11).

Gordon, R. J, (1975). 'Alternative responses of policy to external supply shocks', *Brookings Papers on Economic Activity,* Vol. *1975, No.*1.

Gunatilake, H. M. (2003). 'Environmental valuation: theory and applications', *Postgraduate Institute of Agriculture, University of Peradeniya, Sri Lanka*.

Gurjar, B. R., Molina, L. T., & Ojha, C. S. P. (2010). 'Air *pollution: health and environmental impacts',* CRC press.

Health Effects Institute. (2019). 'State of Global Air 2019'.

Hodgson, T. A., & Meiners, M. R. (1982). 'Cost-of-illness methodology: a guide to current practices and procedures", *The Milbank Memorial Fund Quarterly. Health and Society'*, Vol. 60, No. 3.

House, J. S. (2002). 'Understanding social factors and inequalities in health: 20th century progress and 21st century prospects', *Journal of health and social behavior,* Vol. 43, No.2.

Hoyos, D., Mariel, P. (2010). 'Contingent Valuation: Past, Present and Future', *Prague Economic Papers,* Vol. 4, No. 2010.

Hussen, A. M. (2004). '*Principles of environmental economics'*, Psychology Press.

India State of Forest Report, (2011). '*Ministry of Environment, Forest and Climate Change',*

Jaeger, M. D., & Michaelowa, K. (2015). 'Energy poverty and policy coherence in India: Norms as means in a strategic two-level discourse' in Micheleknodt, NadiniPiefer and Franzisk Muller (ed.)', *Challenges of European External Energy Governance with Emerging Powers* (235-248). London: Routledge.

Jeremy, W. (2017). 'Air pollution and brain health: an emerging issue. *Lancet*', Vol. 17, No. *390.*

Jerrett, M., Burnett, R. T., Brook, J., Kanaroglou, P., Giovis, C., Finkelstein, N., & Hutchison, B. (2004). 'Do socioeconomic characteristics modify the short term association between air pollution and mortality? Evidence from a zonal time series in Hamilton, Canad', *Journal of Epidemiology & Community Health,* Vol. *58, No.*1.

Jorgenson, D. W., & Wilcoxen, P. (1993). 'Energy the environment, and economic growth', *Elsevier,* Vol. 3.

Jorgenson, D. W., Goettle, R. J., Ho, M. S., & Wilcoxen, P. J. (2013). 'Energy, the environment and US economic growth', *Handbook of Computable General Equilibrium Modeling*, Vol.*1*.

Jyothis, S. (2000). 'Willingness to Participate in Biodiversity Conservation in Periyar Tiger Reserve: A Contingent Valuation', *Working paper*, ISEC.

Kelkar, G., Nathan, D., Mukhim, P., & Dzuvichu, R. (2017). 'Energy, gender and social norms in indigenous rural societies' *Economic and Political Weekly*, Vol. (*52)*, No.(1).

Kennelly, B. (2017). 'How cost-of-illness studies should be interpreted?', *The Lancet Psychiatry*, Vol. *4*, No. 10.

Khandker, S. R., Barnes, D. F., &Samad, H. A. (2010). 'Energy poverty in rural and urban India: are the energy poor also income poor', *The World Bank.* (*WP/5463).*

Kneese, A. V., & Sweeney, J. (1993). 'Handbook of Natural Resource and Energy', *Elsevier*, Vol. 3.

Knodt, M. and Piefer, N. eds., (2016), '*Challenges of European External Energy Governance with Emerging Powers',* Routledge.

Kucher, A., Hełdak, M., Kucher, L., & Raszka, B. (2019). 'Factors Forming the Consumers' Willingness to Pay a Price Premium for Ecological Goods in Ukraine', *International journal of environmental research and public health*, Vol. *16, No.*5.

Kumar, K. K., & Viswanathan, B, (2016). 'Kerosene Consumption in India: Welfare and Environmental Issues', No. 138.*Madras School of Economics, Chennai, India.*

Kumar, K.S.K and Viswanathan B. (2005). 'Cooking fuel use Pattern in India: 1983-2000', Energy *Policy*, Vol. 33, No. 8.

Kumar, K.S.K and Viswanathan B. (2007). 'Changing Structure of income indoor air pollution relationship in India', *Energy Policy,* Vol. 35, No.11.

Kumar, K.S.K., & Viswanathan, B. (2007). 'Changing structure of income indoor air pollution relationship in India', *Energy Policy,* Vol. *35, No.*11.

Kurmi, O. P., Lam, K. B. H., & Ayres, J. G. (2012). 'Indoor air pollution and the lung in low-and medium-income countries'.

Landrigan, P. J. (2017). 'Air pollution and health. *The Lancet Public Health',* Vol. *2, No.*1.

Laxmi, V., Parikh, J., Karmakar, S., & Dabrase, P. (2003). 'Household energy, women's hardship and health impacts in rural Rajasthan, India: need for sustainable energy solutions', *Energy for sustainable development,* Vol. *7, No.*1.

Macintyre, S. (1997). 'The Black Report and beyond what are the issues?', *Social science & medicine,* Vol. *44, No.*6.

Makwinja, R., Kosamu, I.B.M., Kaonga, C.C. (2019). 'Determinants and Values of Willingness to Pay for Water Quality Improvement: Insights from Chia Lagoon, Malawi', *Sustainability,* Vol. 11, No. 17.

Manjula, M. (2019), "How Gender-sensitive Are India's Energy Policies? *Economic & Political Weekly*, Vol.*54, No.*3.

Marine Le Gall-Ely. (2009). 'Definition, Measurement and Determinants of the Consumer's Willingness to Pay: a Critical Synthesis and Directions for Further Research', *Recherche et Applications en Marketing* (French Edition), SAGE Publications, Vol. 24, No. 2.

Mayor, S. (2017). 'Pollution is linked to one in six deaths worldwide, study estimates', No.J4844.

McLean, E. V., Bagchi-Sen, S., Atkinson, J. D., & Schindel, A. (2019). 'Household dependence on solid cooking fuels in Peru: An analysis of environmental and socioeconomic conditions', *Global Environmental Change*, Vol. *58*.

Meher, R, (2007). 'Livelihood, poverty and morbidity: a study on health and socio-economic status of the tribal population in Orissa' *Journal of Health Management*, Vol. *9, No.* 3.

Mishra, S.K. (Undated). 'Valuation of environmental goods and services: An institutionalistic assessment', Available at:https://msu.edu/user/schmid/mishra.htm

Mukarati et.al. (2017). 'Determinants of Willingness to Pay for Solid Waste Management in Gweru City, Zimbabwe', *Alanya Academic Review Journal*, Vol. 1, No. 3.

Naanwaab, C., Yeboah, O.A., Ofori Kyei, F., Sulakvelidze, A., Goktepe, I. (2014). 'Evaluation of consumers' perception and willingness to pay for bacteriophage treated fresh produce', *Bacteriophage*, Vol.4, No. 4.

National Sample Survey Office. (2015). 'Key Indicators of Social Consumption in India: Health', Vol. 71st, Report No. 574 NSS KI (71/25.0).

National Sample Survey Origination (NSSO 1993-94). "Energy sources of Indian households for cooking and lighting", 50th Round, Report No.410/2, *Ministry of Statistical & Program Implementation, GOI. New Delhi.*

National Sample Survey Origination (NSSO 1999-2000). 'Energy sources of Indian households for cooking and lighting', 55th Round (55/1.0/6), Report No. 464.*Ministry of Statistical & Program Implementation, GOI. New Delhi.*

National Sample Survey Origination (NSSO 2004-05). 'Energy sources of Indian households for cooking and lighting', 61st Round (61/1.0/4) Report No. 511.*Ministry of Statistical & Program Implementation, GOI. New Delhi.*

National Sample Survey Origination (NSSO 2009-10). 'Energy sources of Indian households for cooking and lighting', 66th Round (66/1.0/4) Report No. 542.*Ministry of Statistical & Program Implementation, GOI. New Delhi.*

National Sample Survey Origination (NSSO *2011-12).* 'Energy sources of Indian households for cooking and lighting', Round. 68th *(68/1.0/4),* Report No. 567, *Ministry of Statistical Program Implementation, GOI. New Delhi.*

Nock, S. L., & Rossi, P. H. (1979). 'Household types and social standing', *Social Forces*, Vol. *57*, No.4.

Ozturk I. (2010). 'A literature survey on energy-growth nexus', *Energy Policy,* Vol. 38, No. 1.

Pachauri, Sonali and Spreng, Daniel. (2004). 'Energy Use and Energy Access in Relation to Poverty" *Economic and Political Weekly*, Vol.39, No.3.

Pachauri, Sonali and Spreng, Daniel. (2004). 'Energy Use and Energy Access in Relation to Poverty', *Economic and Political Weekly*, Vol. 39, No.3.

Palwa, K., & Jain, R. (2016). '*Air Pollution and Health*', No. id: 11464.

Pandey, A. K, (2014). 'Measuring Energy Intensity and Elasticity in India: A Dummy Variable Approach for Unit Level Household Data', *Jindal Journal of Business Research*, Vol. *3,* No.1-2.

Pandey, A. K. (2014). 'Measuring Energy Intensity and Elasticity in India: A Dummy Variable Approach for Unit Level Household Data', *Jindal Journal of Business Research,* Vol. *3, No.*1-2.

Pandey, V. L., & Chaubal, A. (2011). 'Comprehending household cooking energy choice in rural India." *Biomass and bioenergy*', Vol. *35, No.11*.

Pandey, V. L., & Chaubal, A. (2011). 'Comprehending household cooking energy choice in rural India', *Biomass and bioenergy,* Vol. *35, No.*11.

Pantis, J., Togridou, A., Hovardas, T. (2006). 'Determinants of visitors' willingness to pay for the National Marine Park of Zakynthos, Greece', *Ecological Economics,* Vol. 60, No.1.

Parikh, J., Biswas, H., & Karmakar, S. (2003). 'Cooking with biofuels: Risk factors affecting health impact on rural women', *Economic and Political Weekly,* Vol. 38, No. 26.

Parikh, J., Biswas, H., & Karmakar, S. (2003). 'Cooking with biofuels: Risk factors affecting health impact on rural women', *Economic and Political Weekly,* Vol. 38, No.26.

Parikh, Jyoti; Kirk Smith and Vijay Laxmi. (1999). 'Indoor Air Pollution: A Reflection on Gender Bias', *Economic and Political Weekly,* Vol.34, No.9.

Parikh, Jyoti; Kirk Smith and Vijay Laxmi. (1999). 'Indoor Air Pollution: A Reflection on Gender Bias', *Economic and Political Weekly,* vol. 34, No.9.

Parikh, K. S., & Parikh, J. K. (2016). 'Realizing potential savings of energy and emissions from efficient household appliances in India', *Energy Policy,* Vol. *97*.

Patnaik, S. K., Sahu, U. N., & Hathy, P. R. (2011). 'Managing the Human Resources for Poverty and Socio Economic Development of Mayurbhanj District in Orissa, India', *Global Journal of Management and Business Research,* Vol. *11, No.* 3.

Paul, S., & Bhattacharya, R. N. (2004). 'CO2 emission from energy use in India: a decomposition analysis', *Energy Policy,* vol. *32, No.*5.

PEO (2014). 'Programme Evaluation Organisation Planning Commission', *Government of India New Delhi,* Report No. 224.

Prasad, J. (2008). 'A baseline survey of minority concentration districts Of India',

Quevedo, J.F.M., Hernandez, I.C., Espinosa, J.G., Escudero, G.S. (2009). 'The willingness to pay in question', *Rev Saude Publica.* Vol. 43, No. 2.

Ramji, A., Soni, A., Sehjpal, R., Das, S., & Singh, R. (2012). 'Rural energy access and inequalities: An analysis of NSS data from 1999-00 to 2009-10', *TERI-NFA Working Paper,* Vol. 4.

Ramji, A., Soni, A., Sehjpal, R., Das, S., & Singh, R. (2012). 'Rural energy access and inequalities: An analysis of NSS data from 1999-00 to 2009-10', *The Energy and Resources Institute TERI-NFA Working Paper,* No. 4.

Rufael, Y. W. (2006). 'Electricity Consumption and Economic Growth: A Time Series Experience for 17 African Countries', *Energy Policy,* Vol. 34, No. 10.

Salgotra, A. K. (2017). 'Socio-Economic Status of Rural Families: With Special Reference to BPL Households of Pauri District of Uttarakhand'.

Salthammer, T. (2010). 'Air Pollution–Health and Environmental Impacts'.

Samet, J. M., Bahrami, H., & Berhane, K. (2016). 'Indoor air pollution and cardiovascular disease: new evidence from Iran'.

Segel, J. E. (2006). 'Cost-of-illness studies—a primer. *RTI-UNC Center of Excellence in Health Promotion Economics*', Vol.1 (39).

Shahbaz, M., Zakaria, M., Shahzad, S. J. H., & Mahalik, M. K. (2018). 'The energy consumption and economic growth nexus in top ten energy-consuming countries: Fresh evidence from using the quantile-on-quantile approach', *Energy Economics,* Vol. *71*.

Sharma, A., Parikh, J., & Singh, C. (2019). 'Transition to LPG for cooking: A case study from two states of India. *Energy for Sustainable Development'*, vol. *51*.

Sihem, E. (2017). 'Economic and socio-cultural determinants of agricultural insurance demand across countries', *Journal of the Saudi Society of Agricultural Sciences,* Vol. 18, No. 2.

Smith, K. R. (2000). 'Indoor air pollution implicated in alarming health problems In: Indoor air pollution energy and health for the indoor for the poor', *Newsletter published by World Bank*.

Smith, K. R., Samet, J. M., Romieu, I., & Bruce, N. (2000). 'Indoor air pollution in developing countries and acute lower respiratory infections in children', *Thorax,* Vol. *55, No.* 6.

Soytas, U., & Sari, R. (2003). 'Energy consumption and GDP: causality relationship in G-7 countries and emerging markets,' *Energy economics,* Vol. *25, No.*1.

Spear, M. (2013). 'Acute or chronic? What's the difference? *Plastic Surgical Nursing',* Vol. *33 No.* 2.

Stern, D. I., & Cleveland, C. J. (2004). 'Energy and economic growth", *Encyclopaedia of energy,* Vol. *2*.

Sweeney, J. L. (2000). 'Economics of Energy', *Department of Management Science and Engineering, Stanford University,* Vol.*4,* No. 48.

Toman, M. T., & Jemelkova, B. (2003). 'Energy and economic development: an assessment of the state of knowledge', *The Energy Journal,* Vol. *24* No. 4.

United Nations Development Programme (UNDP). (2005). 'Energy Services for the Millennium Development Goals',*United Nations Development Programme, New York.*

Van Leeuwen, M. H., & Maas, I. (2010). 'Historical studies of social mobility and stratification', Annual *Review of Sociology,* Vol. *36.*

Venkatachalam, L. 2004. 'The contingent valuation method: a review', *Environmental Impact Assessment,* Vol. 24, No.1.

Viswanathan, B., & Kumar, K.S.K. (2005). 'Cooking fuel use patterns in India: 1983–2000' *Energy Policy,* Vol. *33,* No.8.

Willis, K. G. (2002). 'Iterative bid design in contingent valuation and the estimation of the revenue maximising price for a cultural good', *Journal of Cultural Economics,* Vol. 26, No. 4.

World Health Organization (WHO 1991). 'Technical bases for the WHO recommendations on the management of pneumonia in children at first-level health facilities', (No. WHO/ARI/91.20. Unpublished) Geneva.

World Health Organization (WHO 2000). 'Addressing the links between indoor air pollution, household energy and human health', Based on the WHO–USAID Global Consultation on the Health Impact of Indoor Air Pollution and Household Energy in Developing Countries (Meeting report), *Retrieved from http://www.who.int/mediacentre/events/HSD_Plaq_10.*

World Health Organization (WHO 2001). 'Infections and infectious diseases: a manual for nurses and midwives in the WHO European Region Copenhagen', *WHO Regional Office for Europe,* (No. EUR/01/5019329).

World Health Organization (WHO 2005). 'Chronic diseases in low and middle income countries', *Geneva:* Switzerland *WHO.*

World Health Organization (WHO 2006). '*Medical records manual: a guide for developing countries* Manila', *WHO Regional Office for the Western Pacific*.

World Health Organization (WHO 2014). '*WHO guidelines for indoor air quality: household fuel combustion*', World Health Organization.

World Health Organization (WHO 2014). 'Burden of disease from household air pollution for 2012', *Geneva:* Switzerland *WHO.*

World Health Organization (WHO 2015). '*Health in 2015: from MDGs, millennium development goals to SDGs, sustainable development goals', No. WA 530.*

World Health Organization (WHO 2018). 'WHO housing and health guidelines", Geneva: World Health Organization', Licence: CC BY-NC-SA 3.0 IGO.

World Health Organization. (2016). 'Burning opportunity: clean household energy for health, sustainable development, and wellbeing of women and children".

Xiong et al. (2018). 'Analysis of the Factors Influencing Willingness to Pay and Payout Level for Ecological Environment Improvement of the Ganjiang River Basin', .*Sustainability*, Vol. 10, No.7.

Yu, H. (2015). 'Energy Consumption and Economy Development: An Empirical Case Study for China', *Handbook of Clean Energy Systems*.

Appendix

Appendix

Appendix 1

Name of Disease	
Neu	Neurological
Inf	Infectious Disease
Inf + neu	Infectious + Neurological Disease
Cd	Cardiovascular Disease
cd + neu	Cardiovascular Disease + Neurological
cd +inf	Cardiovascular Disease + Infectious
Cd + inf +neu	Cardiovascular Disease + Infectious + Neurological
Rd	Respiratory Disease
rd+ neu	Respiratory Disease + Neurological
rd+ inf	Respiratory Disease + Infectious
rd+ inf +neu	Respiratory Disease + Infectious + Neurological
rd+cd	Respiratory Disease + Cardiovascular Disease
rd+ cd+ neu	Respiratory Disease + Cardiovascular Disease + Neurological
rd+cd+inf	Respiratory Disease + Cardiovascular Disease + Infectious
rd+ cd+ inf + neu	Respiratory Disease + Cardiovascular Disease + Infectious + Neurological

Appendix 2

Household Schedule

Poverty and Indoor Air pollution: A Case Study of women in rural Bihar

Ravindra Sah **Department of Economics**
Research Scholar **BBAU, Lucknow, 226025**

Date: ……/……./……..... **SL. No…….....**

Place- Lucknow, Uttar Pradesh

Section A: General Profile

1. Name of the Respondent ……..

2. Name of the Head of the households……

3. Gender: ……4. Age……..

5. Education of head the Households: ……..

6. Relation of Respondent with Head of the Households: ……..

7. Districts: …….....

8. Block/ Tehsil/……..

9. Village ……

10. Sector ☐

Rural-1, Urban-2

11. Religion: ☐

Hindu-1, Muslim-2, Christian-3, Others-4

12. Social Group ☐

ST-1, SC-2, OBC-3, Others-4

13. Nature of Family ☐

Joint-1, Nuclear-2

Section B: Demographic and other Profiles of Households

14. Households Details

S. No.	Name	Relation to HH	Age	Gender	Education	Marital Status	Occupation	Monthly Income
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

Codes: -

Relation to HH: Head of the households-1, Spouse of HH-2, Unmarried children-3, Married son/doughter-4, Others5

Gender: Male-1, Female-2, Transgender-3

Marital Status: -Never married-1, Unmarried-2, Married-3, Divorced/separated-4, widowed-5

Education level: - illiterate-01, Literate-02,

Literate without formal schooling: through EGS/NFEC/AEC-1, through TLC-2

Literate with formal schooling: below primary-3, Primary-4, middle-5, secondary-6, higher secondary-7, diploma/certificate course-8, graduate-9, postgraduate-10, others-11

Occupation: Private Sector-1, Government Sector-2, Self-Employed in agriculture-3. Self-employed in non-agriculter-4 Daily wage worker-5 Students-6, casual labour-7, others-7

15. Consumption Expenditure of households {URP and MRP (MPCE)}

Households Consumption Expenditure		
	Items Group	**Last 30 days Expenditure (In Rs.)** Uniform Recall Period (MPCE)
1.	Non-Durables goods (a) Food grains (b) Non-food grains **Total**	
2.	**Durable**	**Last 365 days expenditure (In Rs.)** Mixed Recall Period (MPCE)
2.1	Clothing and Bedding	
2.2	Footwear	
2.3	Education	
2.4	Medical Expenses	
2.4.1	Hospitalization	
2.4.2	Childbirth	
2.4.3	Entertainment	
2.4.3	Furniture	
2.4.4	Bathroom essential product	
2.4.5	Electrical goods	
3.	**Personal transportation equipment**	
4.	**Cooking & other households appliances**	
5.	**Minor durable goods (**Spectacles, Torch, Lock, Umbrella/raincoat, Lighter (bidi/cigarette/gas stove)	
	Total	

Section C: Households Facility

1. From how long your family living in this village?

In the year

2. Which type of structure of your house?

Pakka-1, semi pakka-2, kacha-3, shelter house-4 Others-5

3. Dose the household possess ration card?

(Yes-1, no-2)

4. If yes, Type of ration card?

Antyodya-1, BPL-2, others-3

4. Main source of drinking water

Govt. hand pump-1, Self-hand pump-2, Pukka/cover well-3, un cover well-4, Govt.Tap water from treated source-5, Tap water from un-treated source-6, Tanker-7, River/Canel-8, Tank/lake/pond-9, other source-10,

5. Have you Toilet in the house

Yes-1 No-2

6. If yes, which type of Toilet?

Service-1, Gaddha/Pit-2, Septic tank/flush system-3, pipe sewer system-4, other system-5

7. If no, where is going toilet?

Public latrin-1, open-2, other source-3

8. Which type drainage system you have?

Kucha open-1, Pukka open-2, cover puckka-3, underground-4, No drainage-5

8. Have you owns land

Yes-1, No-2

9. If yes, which type of land

Agriculture land-1, Non-Agriculture land-2, others-3

Section D: Economic condition of women

1.Are you employed ?

Yes-1, No-2

2. If yes, which type of employee?

Government sector-1, private sector-2

2.1. If government sector, specify the occupation……

2.2. If private sector, what is your occupation

Self-employed agriculture *(vegetable production, horticulture, floriculture, sugarcane)*-**1**, Self-employed non-agriculture-2, homebased worker- ***(fisheries, Boutique, pickle making, Papad making, embroidery)***-2,

Casual labour in: agriculture-3, non-agriculture-4; others-5

Daily wage worker-6, MGNREGA-7, others specify……..

3. If No, what is your source of Income?

Depend on spouse-1, Depend on other family member-2, Cattle-3, Daily wage-4, others

Section E: primary source of Energy for cooking/Fuel characteristics

1. Which type of Chullah using for cooking purpose?

Traditonal-1, Chimney chulha-2, modern chulah-3, others-4

2. Do you have separate kitchen in your home?

Yes-1, No-2

3. If no, where do you cook food?

In livingroom-1, Angan-2, Out of home-3

4. If yes, do you have proper ventilation in your kitchen? ☐

Yes-1, No-2

5. If yes, which type of ventilation in your kitchen? ☐

Window-1, Exaust-fan-2, chimney kuchha-3, chimney pukka-4, others-5

6. First source of energy used for cooking ☐

Coke/Coal-1, firewood/chips-2, LPG-3, Gobar-Gas-4, Agriculture-waste/residues/leaf-5, Dung-cake/patties-6, kerosene-7, Electricity-8, No cooking arrangement-9, others-10

7. Second source of energy used for cooking ☐

8. How much time spending in kitchen for cooking ☐ (in hours)

9. Are you using clean energy? ☐ Years *(if code 3,4and 8in Q6)*

Yes-1, No-2

10. How long you are using clean energy? ☐ Years *(if code 3,4and 8in Q7)*

11. If No, what is the reason, of not using clean energy for cooking?

☐

Lack of money-1, High cost-2, Not aware-3, free availability others unclean source-4 others reason-5

Pradhan Mantri Ujjwala Yojana (PMUY)

12. Are you beneficiary Pradhan Mantri Ujjwala Yojana

Yes-1, No-2 ☐

13. If yes, How many month benefits to Prime Minister Ujjwala Yojana (PMUY)

Specify…….

14. Are continuing the scheme? ☐

Yes-1, No-2

15. If no what is the reason

High cost-1, lack of money-2, not aware to use-3, No suitable place in home-4,

Other specify……

14. Distance from home to collecting energy activities

SL. No. (As per section demographic).	Distance from home to place where are you collecting fuels (in kilometers)	How much time you spend to collect fuels (In hours)	How many days you were engage in collection of fuels- ***last 30 days***	How many days you were engage in collection of fuels- ***last 365 days***

Lighting

15. First source of energy for lighting ☐

Kerosene-1, other oil-2, Electricity-3, Solar-4, Open-fire-5, Candle-6, Gas-7, Bio-gas-8, others -9 & No Lighting arrangement-10

16. If used kerosene what is the reason? ☐

No power connection in the village-1, Lack of money-2, Non-cooperation of the govt.-3, safety purpose-4, others reason-5

17. What is used appliance for lighting? (Kerosene related appliance) ☐

Lamp-1, Lalten-2, Dibiya-3, Mashal-4, others-5

18. What appliance used for lighting (Electricity related appliance ☐

Bulb-1, CFL-2, Mercury Vapour-3, Hylogen-4, others-5

Indoor Air quality

1. Are you aware air pollution? ☐

Yes-1, No-2

2. Are you aware Indoor air pollution? ☐

Yes-1, No-2

3. Are you facing outdoor pollution problem? ☐

Yes-1, No-2

4. Are you facing Indoor Air Pollution related problem ☐

Yes-1, No-2

5. If yes, what is the condition of Indoor air Pollution in your home? ☐

Criticle-1, very serious-2, serious-3, Less sereous-4, you don't know-5

SL, No.	Types of Indoor Air Pollution Problem	Degree of the problem	Times of the year the Pollution occurs (how many year to cooking)

Code:

1. Problems (smoke-1, cooking smell-2, fire-hit-3, others-4)

2. Degree (Most problematic-1, Problematic-2, Less problematic-3, Not problematic-4)

3. Time of the year (summer-1, Winter-2, Spring-3, Autumn-4, Rainy-5, All year -6)

Section F: Health status

1. Are you aware about Indoor Air Pollution (IAP) causes illness? ☐

Yes-1, No-2

2. If yes, are you facing any type diseases related to the Indoor Air Pollution?

Yes-1, No-2 ☐

3. If yes, which are these…

Name	Age/ Gender	Degree of diseases	Respiratory Diseases	Cardiovascular Disease	Infection	Neurological Problem

Code:-

1. Respiratory Diseases: - Asthma-1, Tuberculosis (TB)-2, Pneumonia-3, COPD= (shortness of breath, cough with sputum)-4, lung cancer-5, A**cute upper respiratory infections:-** included cold, runny nose, sore throat with cough, allergic colds & Bronchitis-6, Cough with sputum with or without fever and not diagnosed as TB-7

2. Cardio-vascular Diseases:-Hypertension-1, Heart Diseases: chest pain, breathlessness (ischemic heart disease)-2

3. Infectious Disease: - Eye-1, Nose-2, Throat irritation-3, Skin infection-4

4. **Neurological problem: -** Stroke/ hemiplegia/-1, sudden onset weakness or loss of speech in half of body-2

5. Degree of disease: - Acute-1, Chronic-2

5. Are you taking treatment of these diseases? ☐

Yes-1, No-2

6. If yes, which type of treatment ☐

Allopathic-1, Homeopathic-2, Ayush-3 (Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homeopathic)

7. If no, what are the reason to not taking treatment?

1. Lack of money
2. The long distance of hospital
3. Lack of awareness
4. Heavy work load and time problem
5. Others

Measurement of mortality

8. Any member died in the within one year due to indoor air pollution?

Yes, No

If, yes mention this box

Name of the households	Age	Gender	Name of disease symptom code as mentioned	Causes of Death

Code:

Cause of death: - Disease-1, natural death-2, due to accident-3, lack of money for treatment-3, others-4

3. Have you given birth to any child in the last month?

Yes-1, No-2

4. If yes, where was the child's delivery?

Codes: home-1, private hospital-2 public hospital-3, nursing home-4 others-5

Type of delivery-

Normal-1, ceserian-2

5. If there are any children in your home less than five (<5) year

Yes/ No

6. If yes there is any illness symptom in your child

Yes / No

7. If yes, what are the symptom (COPD)?

Fever-1, pneumonia-2, cough-3, pain in stomach-4, vomit-5, eye problem-6

Section G: Health cost of households

Name	Name of diseases Symptom Code as mentioned	**Number of sick days**	**Medical Expenditure**								**Loss of days × Loss of wages**	
			Non hospitalized cost			**Hospitalized cost**						
			Doctor fee	**Medicine c**	**Travel cost**	**Travel cost of hospitalization**	**Medicine cost**	**Cost of diagnostic test**	**Cost of operation and therapies**	**Cost of blood**	**Days**	**Wage**

Code:-

Total cost (Direct Cost + Indirect Cost)

Direct Cost (Non-hospitalized + hospitalized)

Non Hospitalization (Doctor Fee + cost of medicine = Total Cost) for 15 days

Hospitalization (Travel Cost of hospitalization + Medicines Cost + Doctor Cost + Cost of diagnostics test + Cost of operation and therapies + Cost of Blood= Total Cost) for 16 To 365 Days

Indirect Cost (Loss of day's × Loss of wages)

Section H: Willingness to pay (WTP)

You have not available clean fuel for cooking food so you use dirty fuels. Even unclean fuels not be found in every season, mostly in the houses of the villages not exit to air for smoke out. And you have to face respiratory diseases, as many women are affected by it. In the form of dirty fuels, people use firewood and chips, dung cake, charcoal, coal, agriculture residue, etc. By using these fuels, the environment of the house is polluted, which effected of the women health working in the kitchen. There is a shortage of money in the villages, because of which they cannot purchase clean fuel. The Government of India has launched the Prime Minister Ujjwala Scheme to help people in this regard, under which LPG connections are being given to every family living below the poverty line. The government wants to help you, instead of just a little financial help.

1. Do you pay for clean energy? ☐

Yes-1, No-2

2. Are you paying some money save to your health and our life? ☐

Yes-1, No-2

3. If yes, are you paying some money use to LPG? ☐

Yes-1, No-2

4. How much do you pay for one LPG cylinder per month?

1. Rs……
2. Rs……
3. Rs……
4. Rs……
5. Rs…….
6. Rs……
7. Rs……
8. Rs……

5. If no, who will pay for clean energy?

1. Pay for government
2. Don’t know

6. What is the reason do you willing to pay

1. Reduce the health problems causes by Indoor air pollution (IAP)
2. Improve for air quality

3. Improve environmental quality
4. It is not costly
5. Don't know
6. Others specifics……