

Socio Economic Change After Using Improved Cooking Stoves (ICS)

A Case Study of Deumai Municipality Ward No 9, Jitpur, Ilam, District

A Thesis

Submitted to the Department of Rural Development, Tribhuvan University

MahendraRatna Multiple Campus, Ilam

In Partial Fulfillment of the Requirements for the

Degree of Master of Arts (M.A)

In Rural Development

By

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March, 2019

Declaration

I hereby declare that the thesis entitled **Socio Economic Change After Using Improved Cooking Stoves (ICS): A Case Study of Deumai Municipality Ward No 9, Jitpur of Ilam, District**, submitted to the Department of Rural Development, MahendraRatna Multiple Campus, is entirely my original work prepared under the guidance and supervision of my supervisor. I have made due acknowledgements to all ideas and information borrowed from different sources in the course of preparing this thesis. The results of this thesis have not been presented or submitted anywhere else for the award of any degree or for any other purposes. I assure that no part of the content of this thesis has been published in any form before.

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Recommendation Letter

The thesis entitled **Socio Economic Change After Using Improved Cooking Stoves (ICS)** has been prepared by **Indra Kumar Chapagain** under my guidance and for his partial fulfillment of requirements for the Degree of Master of Arts in Rural Development. This is his innovative work. I therefore, recommend this thesis for its evaluation and approval.

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Approval letter

The thesis entitled **Socio Economic Change After Using Improved Cooking Stoves (ICS): A Case Study of Deumai Municipality Ward No 9, Jitpur of Ilam, District, Nepal** by **Indra Kumar Chapagain** in partial fulfillment of the requirements for the Master's Degree (M.A.) in Rural Development has been approved by the evaluation committee.

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March, 2019

Abstract

The study entitled was carried out in Socio Economic Change After Using Improved Cooking Stoves (ICS) on Rural Community: A Case Study of Deumai Municipality Ward No 9, Jitpurof Ilam, and district. In this topic we try to analyze the analyses financial requirements and cost of ICS, identify health impact on women and children and study the consumption of forest preservation of the study area.

For the study, Improved Cooking Stoves (ICS) installed households were selected randomly including both men and women. The study covers only one ward No 9, of Deumai Municipality Ilam district. The study was based on primary as well as secondary sources of information. The secondary information was collected from previous researches, journals, publications and related materials of ICS. The research technique included household survey, interview with key informants and field observation. The study included the fuel wood consumption at the household level, impact on the health of women and children, time saving on collection of fuel wood and cooking and natural resource conservation for the sustainability in environment.

As the universe of the study, there were 945 households in the study area among the total 95 households (10 percent) were selected to conduct the study. For the research design of the study, exploratory and descriptive research design is used to assess impact of ICS in the sampled household. Household survey, field visit and observation, focused group discussion was conducted to get the actual information from the respondents household to get the primary data. The secondary data was also collected from previous research, journals, publications and related documents related to the study.

Finally, based on the field survey report, people feel that pollution has been reduced such as indoor air pollution due to smoke coming out from traditional stoves. The pots do not get black due to smoke and takes less time to clean. Therefore, mostly women and children are relief from the problem due to smoke, dust resulting good sanitation and reduction in their work without any compromised. Thus, the impact of the ICS has seen

positive in Deumai Municipality Ward No 9, Jitpur of Ilam District, which is the neighboring Municipality Ward of District Headquarter

Impact of ICS on firewood consumption, in cooking time, on health and environment and forest conservation is clearly visible in Deumai Municipal Ward No 9 Jitpur. This directly decreases the collection time of fuel wood. The study revealed that fuel wood collection time was reduced. Time is also saved from improved cooking stoves. The average time saved during cooking was compared to the traditional stoves. The health problems were reduced resulting less medical expenses. Using of ICS has contributed significantly in forest conservation as reduction in fuel wood collection, decrease in illegal tree felling, decreased in fire wood sale and forest was seen denser in Deumai Municipality Ward No 9, Jitpur. People feel that pollution has been reduced such as indoor air pollution due to smoke coming out from traditional stoves. The pots do not get black due to smoke and takes less time to clean. So, women were got relief from the problem of smoke and dust seen good sanitation and reduction in their work drudgeries. Thus, it can be concluded that the positive impact of the ICS is seen in Municipality Ward No 9, Jitpur of Ilam District.

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Acronyms/Abbreviation

ADB/N	:	Agriculture Development Bank/ Nepal
AEPC	:	Alternative Energy Promotion Centre
ARECOP	:	Asia Regional Cook Stove Program
ARI	:	Acute Respiratory Infection
CARE/Nepal:		Co-operative for Assistance and Relief Everywhere
CBS	:	Central Bureau of Statistics
CDM	:	Clean Development Mechanism
CFDP	:	Community Forestry Development Project
COLD	:	Chronic Obstructive Lungs Diseases
CRT/N	:	Center for Renewable Energy Nepal
DDC	:	District Development Committee
FGD	:	Focus Group Discussion
FY	:	Fiscal Year
GJ	:	Giga Joule
GoN	:	Government of Nepal
GOs	:	Government Organization
HHs	:	Households Survey
HMG/N	:	His Majesty Government/Nepal
IAP	:	Indoor Air Pollution
IAEE	:	International Association for Energy Economic
ICS	:	Improved Cooking Stove
ICSPs	:	Improve Cooking Stove Programmes
IEC	:	Information Education and Communication
INGO	:	International Non-Governmental Organization
IUCN	:	International Union for Conservation of Nature
Kcal/Kg Kilo	:	Calorie/ Kilogram
LPG	:	Liquefied Petroleum Gas
MoF	:	Ministry of Forestry
NCDC	:	Namsaling Community Development Center
NGO	:	Non-Governmental Organization

NPC	:	National Planning Commission
PCRW	:	Production Credit for Rural Women
RCUP	:	Resource Conservation and Utilization Project
RECAST	:	Research Centre for Applied Science and Technology
REDP	:	Rural Education and Development Programme
RETs	:	Renewable Energy Technology
SFDP	:	Small Farmer Development Project
SSICDC	:	Shree Swarna Integrated Community Development Centre
TCFDP	:	Terai Community Forest Development Project
TCS	:	Traditional Cooking Stoves
TERI	:	Tata Energy Research Institute
TSP	:	Total Suspended Particle
UMN	:	United Mission of Nepal
UNDP	:	United Nation Development Programme
USA	:	United Nation of America
WDD	:	Woman Development Division
WECS	:	World Energy Consumption

CHAPTER I

INTRODUCTION

1.1 Background of the Study

Fire has been an integral part of human life since its invention. Its invention had to be done due to human needs. Its invention made human life easier and healthier. People had to eat food materials uncooked before the invention of fire. It was fire that made cooked foods possible for human beings. Fire has no doubt made some incredible foods credible ones so that it has certainly added a variety to foods.

As a coin has two sides, fire has both good and bad sides. The way of using it determines its effect on human life. Careless use of fire has been destroying human lives and goods for years. Careful use of fire has played a vital role to enhance a civilized human life. Fire is the foremost source of heat. It is a form of energy made from biomass fuels i.e. firewood, agro-residue, cow dung etc. It is primarily used for cooking food substances and heating purposes. The place where fire is made for its primary purpose is called fireplace, oven, stove etc. People have been using a diversity of stoves at their ease since they started using fire for cooking and heating. The varieties of stoves appeared in the use of fire have been causing different sorts difficulties to human health to changing extents. Traditional stoves have more use of fuels and cause more problems than improved stoves do.

Improved cooking stove (ICS) is a stove than needs far less biomass to cook the same amount of food and to heat the same amount of substances than a traditional one. On the other hand an improved cooking stove (ICS) also emits far less smoke than a traditional stove because it has far better combustion of fuels.

A shortage of fuel for cooking is one of the many problems faced by people in the developing world. Gathering fuel is generally women's work but is fraught with dangers; they gamble with the risk of rape and life threatening attacks during their search for much needed firewood, in order to feed their families. In certain areas, local sources of firewood are completely depleted, leading women to travel further and further afield or to dig up tree roots, eliminating any chance of the trees growing again. Even if women survive this, they are still exposing themselves and their children to potentially deadly smoke fumes.

Due to the lack of advanced forms of energy like electricity, majority of the rural people living in a developing country like Nepal heavily rely on traditional biomass fuels for meeting their basic energy needs for various purposes like cooking, heating and lighting. Nepal is one of the developing countries having a high level of household energy consumption. The consumption is primarily met through excessive burning of biomass fuels. More than two third of the total population residing in rural areas of Nepal have been using traditional stoves for years. One of the causes of the increase in the use of fuel wood in the rural households is the traditional design of the mud stove that does not exploit the end use efficiency of the fuel wood used. In addition, the smoke from the inefficient stoves has also caused health hazards to the users. An improved cooking stove is a simple and low cost technology that offers multiple benefits to the users including cooking efficiency. It certainly mitigates the amount of fuel wood in comparison to a traditional one.

The release of incomplete carbon gas and other harmful particles in the atmosphere due to poor combustion of biomass fuels in traditional stoves results in the emission of Green House Gas (GHG). More than 80% of the energy needs are met by fuel wood thus exerting immense pressure on the forest resources of the country with negative impacts on environment. (Inventory of ICS in Nepal 2000, CRT/N)

More Than 80% of the country's population live in rural areas and are meeting their energy needs from traditional resources (87%), such as fuel wood, agricultural residue, cattle dung (WECS, 2011). Energy supply and balance statistics show that the major consumption of energy in Nepal is in the domestic sector, where as the major supply of energy comes from biomass, of which fuel wood is the dominant energy sources, as it covers 77 percent of the total biomass energy supply in Nepal. The other energy supply sources like non-renewable energy cover 11.76 percent and 0.53 percent respectively of the total energy supply (WECS, 2011).

The annual energy consumption of the Nepal is estimated to be 6,864-7,825 thousand tons of oil equivalents. Looking at total national energy consumption of the last 5 years, the share of the traditional energy is 86%-90% and source of the commercial energy is from 10%-14%. In the overall energy consumption, 77% energy comes from the firewood, 9%

from the agriculture residues and animal dried dung and remaining 14% energy comes from imported petroleum product, coal and electricity. The annual per capita consumption of the commercial energy is 46 kilogram of oil equivalent. Although the rural area consumes 86% of the total energy of the country, share of the biomass energy is the highest. Renewable energy and imported kerosene oil are the two main sources of the energy used in the rural areas. (AEPC, 2003)

The total energy demand of Nepal has estimated to be about 248 million GJ in 1990/91 and this has been increasing by an average of 2.4% per annum during the past 10 years. The total energy consumption in the year 1992/93 has estimated to be about 270 million GJ. In other sector amount 91% of the energy demand is met from traditional sources (i.e. fuel wood 68%, agriculture residues 15% and animal dung 8%).(WECS, 1994/95)

The amount and type of energy consumption also indicates the level of human development and living standard of the people to certain extent (Goldenberg, 1996). Nepal is one of the five least energy-consuming countries in the world (MoF, 2005). In this context Nepalese are not only economically poor but also they are in a state of energy insufficiency for the major part of that is traditional resource like fuel wood that is used in most primitive way.

Energy sources of Nepal can be categorized into three main heads like as traditional, commercial, and renewable energy. In fiscal year (FY 2005/06), traditional, commercial, and renewable energies occupied 85.5%, 13.54%, and 0.61% respectively of the total energy consumption. This indicates that the dependency of Nepalese economy on the traditional source of energy has not changed (WECS, 2003).

Traditional energy includes fuel wood agriculture residues and animal waste and share of consumption was 88.68%, 4.85% and 6.47% respectively, on the commercial energy side share of petroleum products was 68.54%, coal 22.74% and electricity consumption was 8.81% of total consumption of energy in FY 2005/06 (WECS, 2003)

In Nepal Improved Cooking Stove can be main device to reduce the fuel wood problem as well as energy problem for rural people. It can be more effective method than the traditional cooking stove. It can save 30% to 35% fuel wood than TCS and helps to reduce the fuel wood problem (CRT/N, 2003). It also saves time, which can be used in other

earning activities. This technology is simple and not so expensive. It can be installed by using the local available resources so rural people can afford easily. In this way, it can play the vital role to improve the socio-economic condition of rural people.

Overall energy scenario of the country reflects that traditional energy sources (Fuel wood, dung and agricultural residue) constitute about 87%, commercial 12% and less than 1% alternative sources respectively in fiscal year 2008/09. About 89.1% of total energy is consumed in the residential sector, is largely for cooking and heating. The major sources of residential energy are fuel wood (86.5%), animal dung (6.5%) and agricultural residue (3.7%) (WECS, 2010)

The large proportion of the population from rural areas and their massive dependence on traditional energy resources show that the rural sector is the most important sector for the implementation of the concentrating development programs to accelerate the country's development index. The low consumption level of imported energy shows that the industrial activity is very low whereas household energy dominates the major energy portion of the market. Due to the geographical terrain, it will cost massive investment and time to link rural areas with the national grid. Based on this fact, the government started to promote locally available environmentally friendly renewable energy resources in Nepal which are more affordable to those rural populations, helping to raise the rural economy. The National Planning Commission (Nepal National Planning Commission 2008) stated in its report that there is technically feasible potential of 50MW micro hydro power, 1132.7 MW of solar energy (considering 5% of the area potentially suitable 45 kWh/sq.m/day) and 1.9 million biogas plants.

The Government of Nepal (GoN) has established the Alternative Energy Promotion Centre (AEPC) in 1996 for the promotion of renewable energy technologies in Nepal. The main programmes are micro hydro, solar and biomass (bio-diesel, cooking stoves, and biogas). Currently, AEPC is coordinating with Ministries, GOs, donors, INGOs, NGOs, the private sector and stakeholder/user groups to make policy recommendations to the government. For the small scale RE deployment, it acts as a one door channel for the mobilization of funds. There are different programs under AEPC funded via unilateral, bilateral donor organizations (AEPC, 2010) which will be discussed in detail in different journals and booklets.

The GoN has subsidized almost all of these renewable energy technologies through the “Rural Energy Policy 2006” revised in 2006 and 2009. The supporting policies are “Subsidy Policy for Renewable (Rural) Energy” and Renewable (Rural) Energy Subsidy Delivery Mechanism” (AEPC, 2010). The Subsidy Policy defines objectives as well as the types, level of subsidy and the delivery mechanism (AEPC, 2010). Since the programme is running since last 15 years, there is a need for the evaluation and analysis of the Impacts of Subsidies on Small Scale Renewable Energy Technologies Dissemination in Nepal (AEPC, 2010).

The biomass consumption in Nepal is one of the main reasons for deterioration of natural resources and the workload of rural women and girls charged with the responsibility of fuel wood collection. The poor combustion technology of traditional stoves results in a serious negative impact on the health of rural women and small children as cooking traditionally takes place inside houses with very poor ventilation. The high rate of population growth in Nepal has further been worsening the situation. The energy problem in Nepal is the result of the over-consumption of one of the renewable energy sources (fuel wood) while other sources e.g. hydro power is not yet sufficiently developed in order to address the growing energy consumption needs. In this situation, the application of ICSs is a must to mitigate the excessive use of firewood which seems to be the main cause of the forest destruction in Nepal. ICSs help people to be safe from the health hazards caused by the smoke emitted by TCSs. According to Sulpya 1986, ICS saves 18-50 per cent of firewood and provides many more benefits such as saving time, reducing health risk, easy to clean cooking pots, saving firewood so that it is needed to promote in the rural areas of Nepal.

1.2 Statement of the Problem

More than 80 per cent of the total population of Nepal reside in rural areas. The rural areas are beyond the access of modern facilities due to the lack of modern technology. Firewood is the chief fuel in the rural areas because of the lack of infrastructures like transport, electricity etc. TCSs need a huge amount of firewood and the collection of firewood is more time consuming work. It is safer to say that women and girls are mainly responsible for cooking activities and collecting firewood. The collection of firewood is not easy either because most of the forest areas in Nepal are now in the form of deserts. The smoke

emitted by the kitchen fire pollutes the surrounding environment and consequently causes various types of respiratory diseases on one hand and on the other hand the extreme use of firewood is one of the main causes of deforestation. TCS lead an excessive level of indoor air pollution and causes the higher rate of infant mortality and other unhealthy living conditions. The selected Municipality Ward for this study (Deumai Municipality Ward No. 9 Jitpur of Ilam district) was declared as an Indoor Air Pollution Free Ward (Previous VDC) in 2069 B.S. getting all the families living in the Ward to build an Improved Cooking Stove for each family. This is the Third Ward to have been declared as the Indoor Air Pollution Free Ward (Previous VDC) in the district. The programme had been launched by Deumai Municipality Ward No 9 Jitpur (Previous Jitpur VDC) under the technical support of NCDC (Namsaling Community Development Centre) but ICS users don't seem to be large enough in number as they are expected to be so far. The number of dropouts is increasing day by day. It's now necessary to find out the reasons for applying ICSs and abandoning them too.

Due to the rapidly growing population, the demand of the firewood is increasing in the rapid rate. The population growth rate is 1.35 per annum (CBS, 2011). On the other hand fossil fuel are too much expensive and the infrastructure to ensure their availability is lacking increasing the supply the bio-mass fuels, and using them more efficiency will be vital task in the coming years. A rural person in Nepal heavily depends on biomass energy such as fuel wood, agriculture residues, cattle dung etc. to meet their domestic energy needs. The traditional stoves have been observed over consume these low grades but cheap and readily available biomass fuel resulting into excessive population of the indoor environment (air and sanitation) and poor family health especially those of women and children. Incomplete combination in the traditional cooking stoves results into emissions of greenhouse gas, which has adverse effect on human health too. In this context, ICS can play important role for efficient utilization of fuel woods in terms of saving the quantity of fuels and cooking time reduction in health hazard, fire hazard and greenhouse gas emission and lowering the pressure on forest for fuel wood extraction (TRUST 2014). This study focus on these problems and impact of Deumai Municipality Ward No. 9, JitpurIlam district where are as follow,

This, in general, this study has attempts to find out the real sequences of energy crisis and people movements accordingly to the energy demand specially, the present study has tried to explain following research questions.

- a. What is the financial requirements and cost of ICS?
- b. What is the health impact on women and children after installation of the study area?
- c. Why the people need to install the ICS?
- d. How to preserve the forest?

1.3 Objectives of the Study

The general objective of the study is to explore Socio Economic Change After Using Improved Cooking Stoves (ICS), the specific objectives of the study are:

- a. To analyses financial requirements and cost of ICS.
- b. To identify health impact on women and children.
- c. To study the consumption of forest preservation.

1.4 Significance of the Study

The growing scarcity of firewood and other consequences resulting from forest depletion, the search of alternative energy source is seen very crucial. Forest are now being rapidly depleted by indiscriminate and disproportionate felling illegal encroachment for settlements and agricultural purpose. As forest resources become scarce, the balance between what people needs and what they can obtain would shift. As a result people have to struggle to survive that becomes harder. The study is very important for understanding and identifying the changes in the status, way of living and activities of ICS user household in the study area. Assessment of the impact of ICS users, their activities, their capacities and understanding on utilization of ICS will certainly be helpful in clean development mechanism. The outcomes of the study will be of great importance to policy makers to formulate appropriate plan for further development of the appropriate technology that better sots the rural people from is and every aspect.

This study will be related to the Socio Economic Change After Using of Improved Cooking Stoves on the people of Deumai Municipality Ward No 9 Jitpur of Ilam district.

As it is one of the underdeveloped Municipality Wards of the district, the socio economic condition of the people is not good. Many people have still been using traditional cooking stoves. The traditions of using traditional cooking stoves have caused different type of problems to them. They have to collect large amount of firewood. They have been victims of different sorts of respiratory diseases. Working with TCSs is much more time consuming than working with ICSs. The problems caused by the TCSs have to be overcome by using Improved Cooking Stoves (ICSs). Applying ICSs is an impressive means of alleviating the indoor air pollution and deforestation. As this is the following significance:

- a. This study has revealed the advantages of using ICSs so that the rural people will be attracted towards using ICSs.
- b. Deforestation minimized to some extent.
- c. Environment pollution has been mitigated
- d. This study helps the research doers to carry out further research in the field of using stoves.

1.5 Limitation of the Study

The study mainly focuses on assessing impact of ICS on health of women and children, fuel wood consumption, saving of cooking time, impact on environment. The study tried to assess impact on social and economic aspect only so the technical aspect of the ICS is lacking. The study will attempt to assess the impact of Improved Cooking Stove programme in Deumai Municipality Ward No 9 Jitpur of Ilam district socio-economic and environmental aspects. Although this study makes a brief survey of all ICS user households and non ICS user households living in Deumai Municipality Ward No 9, Jitpur, only 10 per cent of the ICS user households will be selected for the study. To be specific, this study has the following limitation:

- a. This study has been conducted in Deumai Municipality Ward No. 9, Jitpur of Ilam representing only ICS user households. Therefore the conclusion of the study may not be generalized in other places.
- b. This study based on primary as well as secondary data. The primary data collected by applying survey, questionnaire, interview and observation and the secondary data collected from journals, reports, newspapers, unpublished theses relevant to the study.

- c. This study deal with only socio-economic impact and environmental aspects but not the technical aspects of ICS.

CHAPTER II

LITERATURE REVIEW

In this part researcher has collected different theoretical literature on improved cooking stove system in Nepal. Literature review gives many information and knowledge about the concerned study field which will be very important guidance to the new researcher to make the study systematic, scientific, objective oriented so it is the back bone of the study.

Literature review is one of the important factors needed for the accomplishment of a research work. The major objective of literature review is to obtain enough knowledge about the subject matter which the research work is carried out on. It also tells the researcher to what extent the subject matter is studied. With a view to grasping the objectives of a research work, the review of the available literature is done. For this research study, the theses by the previous students, reports, journals, books, articles by different writers have been reviewed.

It is simple and cost effective technology which has users multiple benefits i.e. increased thermal efficiency, conservation of forests, cut back in fuel wood consumption, reduction in women's labour, reduction in indoor air pollution and hence smoke released health disorders, prevention of fire hazards reduction of cooking time. It works on the principle of reduction in smoke emission and increased efficiency, flame concentration under first burner and then mangling the heat forward to the second burner to cook two items at a time. In rural areas of Nepal most of the households use biomass resources to fill their required energy consumptions because there is no alternative energy source except fuel wood. (AEPC, 2000)

The efficiency of these improved cooking stoves is found to be 25-40 percent and the potentials fuel saving toward run-backed bricks, slate and small gavel whatever is available in the area suitable for construction. Members of INGOs, NOGs and CBO are working for the promotion, development and dissemination of ICS. Among them Terai Area landscape project has made a slogan “more energy from less firewood” for ICS.

Energy is one of the basic needs of people. It is very important for our daily life particularly for the economic and overall development. In general, the energy consumption

scenario of the world indicates that people largely depend upon non renewable source of energy to meet their energy demand. This scenario is intense in most of the developing countries of the world. However, a positive symptom of using renewable source of energy looks to be developing and it is gradually replacing the use of non renewable source of energy. In this context, the use of alternative technology looks much more relevant for the sustainable use of renewable source of energy for the human betterment. Energy consumption of a nation considered as an indicator of its development. This is because all survival and development activities directly and indirectly depend upon energy. It is an essential of human progress and prosperity. It is clear that the economic development of the country requires access to affordable and sustainable energy. The energy situation in Nepal has characterized by very low energy consumption per capita of 14.06GJ. The developed countries like USA and Canada constitute 5 percent of the world g countries consume energy i.e. less than 1GJ/person/year. This reality shows that the life style and living standard are closely relating to meet their energy needs. Thus, the developing nations have to think about different strategies and method to meet their requirement by utilizing the renewable energy sources available in their geographical area (WECS, 1994), population but consume one fourth of global Energy 300 GJ per person per year.

The total energy demand of Nepal has estimated to be about 248 million GJ in 1990/91 and this has been increasing by an average of 2.4 percent per annum during the past 10 years. The total energy consumption in the year 1992/93 has estimated to be about 270 million GJ 91 percent. In other sector amount 91 percent of the energy demand is meet from traditional sources (i.e. fuel wood 68 percent, agriculture residues 15percent and animal dung 8 percent) the share of petroleum fuel, charcoal, and electricity in the total consumption are estimated to be 7.21percentage and 0.9 percent respectively. Only about 12 percent of the total population have access to the electricity the rural population which comprise about 90 percent of the total population has very limited access to electricity 3 percent (WECS, 1994/95)

The amount and type of energy consumption also indicates the level of human development and living standard of the people to certain extent (Goldenberg, 1996). Nepal is one of the five least energy consuming countries in the world (MoF, 2005). In this context Nepalese are not only economically poor but also their exists a state of energy in

sufficiency, since major part of that is traditional resource like fuel wood that is used in most primitive way.

Energy sources of Nepal can be categorized into three main heads like as traditional, commercial, and renewable energy. In fiscal year (FY 2005/06), traditional, commercial, and renewable energies occupied 85.5percent, 13.54percent, and 0.61percent respectively of the total energy consumption. This indicates that the dependency of Nepalese economy on the traditional source of energy has not changed (WECS, 2003).

Traditional energy includes fuel wood agriculture residues and animal waste and share of consumption was 88.68 percent, 4.85 percent and 6.47 percent respectively, on the commercial energy side share of petroleum products was 68.54percent, coal 22.74percent and electricity consumption was 18.81 percent of total consumption of energy in FY 2005/06 (WECS, 2003)

“Alternative Energy” is a kind of energy (physics) the capacity of a physical system to do work; the units of energy are joules or ergs. Energy derived from sources that do not use up natural resources or harm the environment. There are five types of alternative energy a. solar power b. wind power c. natural gas d. tidal power e. biomass energy etc.

2.1 Introduction to Improved Cooking Stoves

Improved cook stove (ICS) is a device that is designed to consume less fuel and save cooking time, convenient in cooking process and creates smokeless environment in the kitchen or reduction in the volume of smoke produced during cooking against the traditional stove. The direct and indirect benefits of ICS includes: increased thermal efficiency, the conservation of forests by cutback in firewood consumption, reduction in women's labour, reduction in indoor air pollution and hence smoke-released health disorders, prevention of fire hazards, reduction of cooking time.

Among the various technologies introduced in the realm of efficient household heating and cooking methods, stoves are the most popular and widespread in both urban and rural communities. Especially in developing countries, stoves occupy a central place in the health, environmental, economic and social domains of life. By improving the efficiency of wood burning stoves, the amount of toxic smoke produced can be reduced and health

risks to the family be minimized. In view of these and other concerns, a good cooking stove is defined as one that meets technical, scientific and safety standards, and has high combustion quality, technical efficiency, minimal smoke emission, ergonomics and structural stability. Most sources cite the fuel-efficiency of traditional stoves as five to ten percent (Barnes et al., 1994).

Since about 1.5 billion people in the world use traditional stoves for cooking (and heating), efforts to improve the efficiency of cook stoves have been increasingly popular in the developing world. Improved stoves come in different forms and sizes. Improved Cook Stoves (ICS) can be designed and built in various ways, depending on the local conditions. At their simplest, ICS provide an enclosure for the fire to reduce the loss of radiant heat and protect it against the wind. In addition, attention can be given to methods of controlling the upward flow of the combustion gases, so as to increase the transfer of heat to the cooking pot. Many of these stoves are made of mud or sand since both are almost free and readily available.

In the developing countries, energy required for cooking often constitutes the biggest share of the total national energy demand and is normally met mostly by biomass.

Realisation that ICS can relieve pressure on biomass resources led to ICS programmes in most developing countries. A World Bank report cited 137 ICS projects in 41 developing countries initiated during 1981-1991 (Barnes et al., 1994). In spite of the on-going and past projects, an ICS programme still remains important in the context of the developing countries. It is estimated that about 2.4 billion people burn biomass for cooking and heating. About half of these people use traditional stoves (Warwick and Doig, 2004). It is known that pollutants emitted from cook stoves cause serious indoor air pollution and have a negative impact on health of people in rural areas, particularly women and children. It is estimated that indoor air pollution due to combustion of solid fuels causes about 1.6 million deaths annually (Warwick and Doig, 2004).

Although the most effective way to address indoor air pollution created by smoke would be to switch to cleaner gaseous and liquid fuels (such as ethanol/methanol or bio gasification stoves), it is likely that for the vast majority of poor people, improved biomass-fired cook stoves will remain the most important option for many years to come.

It is concluded that “[t]he improved biomass stove should be considered a new stepping stone between the traditional biomass stoves used by rural and urban poor families and the modern fuels and appliances mainly used by urban better-off households” (Barnes et al., 1994).

In Nepal, biomass energy: fuel wood, agro-residue and animal dung is used for cooking and heating purposes. Use of traditional stoves such as "agenu" (open fireplace) and "chulo" (rudimentary stoves) consumes more fuel wood and increases the burden on women. Women are mainly responsible for cooking and collection of biomass, mainly fuel wood from the forest. Use of biomass energy and low-grade biomass fuels lead to excessive levels of indoor smoke/air pollution. Women and children in particular are exposed to the smoke emission. This is one of the reasons for higher rates of infant mortality and morbidity and other unhealthy living conditions. Release of the incomplete carbon gas and other harmful particles in the atmosphere due to poor combustion of biomass fuels in rudimentary stoves results in the emission of Green House Gas (GHG). More than 80percent of the energy needs are met by fuel wood thus exerting immense pressure on the forest resources of the country with negative impacts on environment. In order to achieve reduction in indoor smoke / air pollution and increased fuel efficiency and protect the forest resources and environment, Improved Cook Stove (ICS) development and dissemination activities were initiated in Nepal from early 1950s with the introduction of some Indian models Hyderabad and Magan stoves. Since then, a number of Improved Cooking Stove Programs (ICSPs) have been promoted in rural communities of Nepal. In early 1970s, the focus was on improving the fuel efficiency of stoves. During 1980s, interest and efforts were revived when the National Planning Commission (NPC) included ICS in its development plan as an attempt to address the pressing fuel wood problem. The government's concern for fuel wood conservation was also reflected with the inclusion of ICS dissemination efforts as an important component of Food and Agriculture Organization (FAO) of the United Nations assisted Community Forestry Development Project (CFDP) in 1981. Besides, other donor organizations as well as International Non-Government Organizations (INGOs) initiated promotion and dissemination of ICS in various regions of Nepal with a top-down and supply driven approach. With the combined effort of the government and NGOs, basically through the community forestry

development project, about 57,000 ceramic prefabricated models of ICS were disseminated in different parts of the country.

Biomass energy is one of the most primary sources of energy for the poor people particularly for the forest dependent communities. Similarly, forest dependent communities in Nepal use different types of forest biomass energy (wood, trees, leaves, undergrowth and bamboo) as fuels in the traditional cooking stove which results on continuous forest destruction, incomplete combustion of fuels, and environmental and health problems to the users. To minimize the pressure on forest resources, ensuring efficient use of biomass fuels and conserving forest biodiversity, National Planning Commission plan to technical support for community people to introduced improved cooking stoves (ICS) programme in the country's protected areas. The present study has been carried out to explore the importance of ICS in forest conservation, generating economic benefits, and as a whole, its potential role to climate change mitigation along with scope in carbon credits.

The introduction of a new technology certainly takes a long span of time. It has many causes behind it to be introduced. A new technology is introduced to replace an old one being applied for the same purpose with a view to avoiding the drawbacks caused by an old technology. For the same purpose, Improved Cooking Stoves (ICS) were introduced to replace Traditional Cooking Stoves (TCS). Traditional stoves generally have an unnecessarily large distance between the pots and the fuel bed which leads to heat loss, very low heat transfer to the cooking pot and inefficiency. The fuel gas exits between the cooking pot and the stove are also very large in size, which allows some fuel-gas to escape without coming into contact with the cooking pot, further lowering conventional heat transfer. Apart from this low efficiency, traditional stoves emit smoke high in pollution content, which affects users' health. The smoke exposure is particularly harmful for cooks closest to the fire and others such as children who spend time in the kitchen. Stove-use also dirties the kitchen and soot blackens kitchen walls (Dasgupta *et al.* 2005). Due to incomplete combustion of biomass fuels in traditional cooking stoves, appreciable quantities of irritants, toxins and carcinogens are released into the kitchen environment and these pose a major threat to the respiratory system of the users (Sarkar *et al.* 2006).

In general, the combustion products of wood are carbon dioxide, water vapour and carbon monoxide, particulate and polycyclic organic matters, the last three of which are known to be pollutants hazardous to human health (*Sarkaret al. 2006*).

Improved cook stoves or ICS, instead of traditional biomass cook stoves can ensure efficiency in the use of traditional fuels.

ICS is the reformed device of traditional cooking stove. Comparatively it consumes less fuel wood; it is easy to cook food, keeps the clean environment in kitchen room, and reduces the indoor pollution than the traditional cooking stove. Technically, it is simple and acceptable than the other stove like as LP gas, biogas, kerosene stove etc. The use of low-grade biomass fuel in traditional stoves leads to excessive levels of indoor air pollution. Women and children of rural and poor families are particularly exposed to the smoke emission. This is one of the reasons of higher rates of infant mortality in rural area. Release of incomplete carbon products in the atmosphere due to poor combustion of biomass fuel results green house gas emission too (*AEPC, 2000*).

The amount and type of energy consumption also indicates the level of human development and living standard of the people to certain extent (*Goldenberg, 1996*). Nepal is one of the five least energy-consuming countries in the world (*MoF, 2005*). In this context Nepalese are not only economically poor but also their exists a state of energy in sufficiency, since major part of that is traditional resource like fuel wood that is used in most primitive way.

Energy sources of Nepal can be categorized into three main heads like as traditional, commercial, and renewable energy. In fiscal year (FY 2005/06), traditional, commercial, and renewable energies occupied 85.5percent, 13.54percent, and 0.61percent respectively of the total energy consumption. This indicates that the dependency of Nepalese economy on the traditional source of energy has not changed (*WECS, 2003*).

The smokeless improved chulo can be constructed entirely with local materials for example soil, stone, baked or unbaked bricks, slate and small gravel whatever is available in the area is suitable for construction. .Chulo size depends on the need of the family and can be modified simply by increasing the shape and number of potholes convenient to the family (*Sharma, 2038*).

2.2 History of Improved Cooking Stoves in Nepalese Context

The history of the ICS is not new in Nepalese context. The development of ICS can be divided into three phase. The first phase started in the 1950s by introducing “*MaganChulo*” which originated in India. At that time, the village development services, “*GraminVikashSewa*” started promoting ICS in some areas of Nepal. The program had aimed at uplifting the living conditions of the people and reducing exposure to smoke. However, the program was not successful in terms of wider dissemination because of easy accessibility to the forest nearby as well as the low price of firewood.

In 1980s the National Planning Commission included ICS in a Plan document in attempt to address the pressing fuel wood problem. In 1981 Community Forest Development Project (CFDP) developed prefabricated ceramic ICS. In 1982, prefabricated ceramic stoves were tested, and after some modification, RECAST developed Ceramics Insert Stoves. During 1985 Small Farmer Development Project (SFDP) of Agriculture Development Bank (ADB/N) distributed Ceramic Insert Stoves. Other major organizations and projects which took up further ICS dissemination efforts include United Mission to Nepal (UMN), (Terai Community Forestry Development Project) (TCFDP), Nepal-Australian Forestry Project, (Resource Conservation and Utilization Project) (RCUP), CARE/Nepal etc. RECAST developed a new model of a stove known as "Improved Tamang Stove". They tried to make the stove with cheap readily available local materials. Since early 1990s, new initiatives from various NGOs, INGOs and GOs, for ICS dissemination have been underway. Most of the organizations working on ICS programs concentrate on mid hill and Terai regions, and they are mainly working on Mud Stoves. Very few of them are involved in high altitude places, and very few work on metal stoves. Cost is the factor making it difficult to work on metal stoves.

According to AEPC (Alternative Energy Promotion Centre), which is a government organization, there are no subsidies in ICS programs now. There used to be subsidy programs on ICS a few years ago, but now they only give training on building stoves using local resources and materials.

The development of mud brick stove by Research Centre for Applied Science and Technology, Nepal (RECAST) in early nineties re-launched the stove program. Indeed,

since early 1990s, new initiatives for ICS dissemination create new stoves design, which can be built completely from cheap readily available local materials. The target-oriented approach was abandoned and replaced by a subsidized bottom-up and demand-driven approach. ICS was promoted and disseminated by various organizations with different financial arrangements such as with and without subsidies, equity participation by users etc. ICS became an important and integral component of development initiatives and was supported by quite a number of programs, donor agencies and promoting/disseminating organizations. The collective efforts of over 25 such organizations together promoted about 40,000 improved stoves of various types (mud, metallic) in different districts of Nepal. In 1995, ICS network supported by Asia Regional Cook Stove Program (ARECOP) and managed by Centre for Rural Technology, Nepal (CRT/N) was established. The network is aimed at bringing together various organizations working in ICS promotion and dissemination and expanding the utilization of ICS. The network Inventory of ICS in Nepal 2000, CRT/N has concentrated its effort in bringing uniformity among approaches of various organizations involved by advocating a bottom up and subsidy less approach. His Majesty's government of Nepal (HMG/N) provided policy guidelines to encourage development and application of energy saving devices as well as promotion and dissemination of alternate energy technologies from 9th plan (1997– 2002). HMG/N set a target of promoting 250,000 ICS during the plan period through the collective efforts of government, non-government organizations and the private sectors. However, very little of the target was achieved. Within the present 10th five-year plan (2003-2007) HMG/N has further emphasized ICS dissemination with target to install 250,000 ICS as well as the development of research and development activities. (10th Five-Year Plan, HMG/N)

The second phase started in the early 1970s and focused on improving fuel efficiency. Technological expertise about large mud stoves with a number of rings, known as the “*Lorena*” stove, came from South America (Guatemala). The Women’s Training Centre of Nepal was involved in training women in the construction of Lorena Stoves. The main objective during this period was to find a solution to the fuel wood crisis and accompanying deforestation. In the late seventies, RECAST became involved in the improvement of these stoves and renamed them Nepali *Chulo*.

The third phase, which began in the early 1980s, has taken up by research and development (R&D) and laboratory-based work. This included a detailed assessment of cooking-stove performance, standardized procedures for testing, and design methodologies to obtain higher performance and efficiency. The Lorena Stoves were replaced by ceramic inserted and Double Wall Stoves. These cooking stoves were designed by RECAST under a contract with the HMG/UNDP/FAO Community Forestry Development Project (CFDP). Large scale distribution has carried out by the CFDP. After some years, with support from UNICEF the ceramic cooking stoves and the new Nepali *chulo* were also introduced through the Agricultural Development Bank, Nepal (ADB/N), the Small Farmer's Development Project (SFDP) and the Women Development Division (WDD) through their Production Credit for Rural Women (PCRW) Program. Thousands of these stove were distributed some modifications to ceramic Tata Energy Research Institute (TERI) models were made, especially on the second ring and its size. Distribution was limited and confined only to the field trail. As in the first phase, socio-economic issues once again occupied the centre- stage of activities. ICS Production had reviewed and planned for a self-propelling distribution process. (WECS, 2004)

Later the Tamang Stove (Improved Village Stove) was introduced. It consisted of a mud-brick or mudstone ICS with an iron tripod, which has driven into the combustion chamber to form a better foundation. It is a two-ring stove with a chimney (ceramic or mud-brick). The stove can withstand excessive force. The chimney has been modified for easy cleaning.

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Many researcher and conferences have been done for the promotion, dissemination, and development of Improved Cooking Stove (ICS). According to Joshee 1986, “employed person, educated person, large family, rich person were the users of ICS.

According to Sulpya 1986, “the ICS save firewood about 18%-42% and efficiency is 25%-40%. According to Wood, 1987, “ceramic insert type stove has mostly abandoned in favour of stoves built on the site from locally available materials”.

CFDP 1984 reveals that the most common features of ICS are firewood saving it works on the principle of increasing the concentration of heat directly under the first cooking pot and then channels the heat back to the second burner to cook second pot at once. It conserves heat and reduces heat dissipation with minimum waste 30-50percent firewood could be saved through the proper use of ICS.

The Nada Chulha, could reduce fuel wood consumption and improve the women's quality of life has developed between June 1980 and April 1983. It emerged as a response to the women requests for smoke removal from their kitchen. The experience of working with village women has demonstrated the importance of making technology adoptable to unreliable needs (Clarke, 1985).

Nepal is dominated by rural areas where 85% of the populations living in rural areas are poverty ridden and about 35% of the rural people are poor (CBS 2001). They are living below average life standard without enjoying even the basic amenities. Poverty in rural areas is reflected in low level of income, low level of literacy and poor health status. Poverty is also reflected in low level of energy use. Though total energy consumption is gradually increasing, per capita energy consumption remained more or less constant and it is about 145 Gega joules. Like other developing countries, Nepal is heavily dependent on traditional energy sources.

The heavy dependency on biomass energy, especially fuel wood, agriculture waste and cattle dung, particularly in rural areas has given rise not only to environmental degradation and irreversible consequences in the country, but also has caused the social burden on majority of the rural women and the large number of children who have to allot about 20% of the work time for fuel collection (Joshi et al., 2003). Similarly kerosene has given rise

to economic burden as well as major health and environmental impacts. Therefore, there is a dire need to substitute as well as supplement the traditional energy supply system by modern forms of sustainable energy in terms of resources and technology. Because of the country's dependence on imported fossil fuel, high cost of grid connection and low and scattered population density, a decentralized renewable energy supply system becomes the natural and feasible choice which includes micro hydro, solar photovoltaic, biogas, ICS etc. And fortunately we also have immense opportunities for developing such renewable energy technologies.

2.3 Sources of Energy in Nepal

Nepal has a per capita energy consumption of around 15 GJ, which is one of the lowest in the world. Nepal relies heavily on traditional energy sources to meet its energy requirements. According to the economic survey 2003, more than 85% of the total energy demand has met by traditional sources, of which fuel wood is the main source of energy as shown in (Table no.1). The remaining portion of the energy demand has met by commercial sources and electricity accounts for just over 1%. The 10th five-year plan states that 40% of the Nepali population has access to electricity, however according to the Nepal electricity authority (NEA, 2003) only 22% of households have access to electricity and 7% from alternative source of energy.

The residential sector consumes almost 90% of the total energy consumption of the country. The industrial, transportation, and commercial sectors consume 5.25%, 3.44%, and 1.33% of total energy consumption respectively as shown in the (Table no.2). The agriculture sector consumes less than 1% of total energy consumption. Energy end-uses of the domestic sector in 1992-93 was met mostly 72% by fuel wood, followed by 16.2% agricultural residue. Commercial energy consumption was nominal, with kerosene and LPG making up 2% and 0.1% respectively in that year. About 85% of Nepal's population lives in rural areas where agriculture is the mainstay. The Water and Energy Commission Secretariat (WECS) carried out a detailed study on energy consumption patterns in rural households in Nepal in 1995. As shown in the figure below, fuel wood dominates almost 90% of the total energy consumption in the rural areas of Nepal. Animal dung and agricultural residues provide the second and third energy sources for rural households. The

level of electrification was negligible in 1995 as was the use of appliance. Kerosene lamps are the most common lighting appliances in rural energy is heavily dependent upon biomass. According to the same survey conducted by WECS in 1995, residential cooking is the single largest end use, accounting for about 65% of total energy consumption in rural areas, followed by space heating and water boiling as shown in the (Table no.5). Women in rural areas perform most of the household tasks, from collecting firewood and cooking, to looking after children. On average, hills households (without biogas) in rural areas consume about 6 tons of firewood during summer and 7.6 tons during winter. Households in the Terai consume 3.7 tons of firewood during summer and 5.4 tons during winter (Biogas Support Program, 2002). Wood collection for cooking food is getting rougher as forest has depleted and women have to walk for hours to find wood. The time cost alone can be extreme in rural areas. Estimates range from two to twenty hours per week spent in collecting wood. The distance covered could be significant in difficult terrain (Warwick, H and Doig A, 2004). This level of work and the drudgery of every day chores leave poor women with little time on other activities such as earning money or even taking rest and even further contribute to additional threats on health and well beings. Women are vulnerable to back problems from carrying heavy loads, for instance .In rural areas of Nepal, women spend about six hours of their time on hazardous conditions while cooking over traditional stoves that spew highly toxic materials, giving rise to eye infections and other respiratory problems for them, their children and other family member.(Rural Development Program, GTZ Nepal)

2.4 Review of Literature

Many researchers and conferences have been done for the promotion, dissemination, and development of Improved Cooking Stove (ICS). These are stated here.

-) CFDP 1984 reveals that the most common features of ICS are firewood saving it works on the principle of increasing the concentration of heat directly under the first cooking pot and then channels the heat back to the second burner to cook second pot at once. It conserves heat and reduces heat dissipation with minimum waste 30-50% firewood could be saved through the proper use of ICS.

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- J According to Joshee 1986, employed person, educated person, large family, rich person were the users of ICS.
- J According to Sulpya 1986, the ICS save firewood about 18-42% and efficiency is 25-40%.
- J A health development project estimates about 33% of ICS users in Surkhet District demonstrated changes in work patterns because ICS cooked faster and food is kept warmer for a longer period of time (Health Development Project, 1992)
- J Dahal (2004) states that the use of Improved Cooking Stoves (ICS) helps to reduce pressure on the forest and fuel crisis.
- J Parajuli (2005) has concluded that the households having the TCS inhaled more CO than those having ICS and they have more health impacts than those having ICS.
- J Thapa (2010) has found Improved Cooking Stove (ICS) installation has improved household activities and environment. It has directly addressed the urgent problems of deforestation and rescuing domestic firewood scarcity as well as other health related problems due to excessive smoke inhalation.

J Sunuwar (2011) concludes that the installation of ICS has significantly improved the indoor air quality of houses in the place of rudimentary stoves and that significantly helped to control environmental degradation by controlling deforestation.

2.5 Summary of the Review

Among the different fuels used in Nepal, firewood is the mostly used fuel. The use of excessive amount of firewood in the country is the main cause of deforestation. Firewood is mostly used in the kitchen for cooking purpose. Women and girls are supposed to be working in the kitchen. Because of the smoke caused by the firewood in the kitchen, women and girls are victims of different respiratory diseases. Traditional Cooking Stoves (TCS) cause more air pollution than Improved Cooking Stoves (ICS). The installation of ICS reduces the pressure on deforestation and alleviates environment degradation. The aforementioned literature has shown that the use of ICS has eased human life in many aspects. It helps not only to improve ICS users' individual life but also national assets. It mitigates the degradation of national resources by alleviation indoor air pollution and deforestation. Nepal government started the ICS installation programme almost seven decades ago but it has not progressed satisfactorily. Though the programme is beneficial and essential in Nepalese context, the numbers of ICS users are still very few in number.

Among the various technologies introduced in the realm of efficient household heating and cooking methods, stoves are the most popular and widespread in both urban and rural communities. Especially in developing countries, stoves occupy a central place in the health, environmental, economic and social domains of life. By improving the efficiency of wood burning stoves, the amount of toxic smoke produced can be reduced and health risks to the family be minimized. In view of these and other concerns, a good cooking stove is defined as one that meets technical, scientific and safety standards, and has high combustion quality, technical efficiency, minimal smoke emission, ergonomics and structural stability. Most sources cite the fuel-efficiency of traditional stoves as five to ten percent.

Many people seem to have carried out researches on the impact of ICS on various aspects. No one has carried out a research on socio economic change after using of ICS and environmental impact of ICS on the ICS users of Deumai Municipality Ward No 9, Jitpurllam. Therefore, the topic for the study is new to the selected area.

CHAPTER III

RESEARCH METHODOLOGY

Methodology is the backbone of a research study. Therefore, it needs to be well defined and selected to conduct the study. In this study, the following methodology will be adopted to fulfil the objectives determined.

3.1 Research Design

This study will be based upon the basis of exploratory research design because the study will focus the finding out the impact of ICS on users and its benefits to them. The living standard before and after use of cooking stove of targeted people will be compared to see if there is any improvement in their living standard after using improved cooking stoves. Besides that the study will try to make an attempt to describe the condition of improved cooking stoves and the findings will be described. Likewise, this study will be both descriptive and exploratory for obtaining the objectives of the study.

3.2 Rational of the Selection of the Study Area

The present study will be carried out in Deumai Municipality Ward No 9, Jitpur of Ilam district which is situated in the western part of the district. There is high rate of deforestation and the local people have been facing firewood problems. This particular area is chosen for the study because this study area is heterogeneous in socio economic and cultural structure. Deumai Municipality Ward No 9 Jitpur is one of the Wards (Municipality and Rural Municipality) which have been declared as Indoor Air Pollution Free Ward in Ilam district till now. So, this study will be helpful to study the impact of ICS and effect of environmental degradation. The researcher is very much hopeful to get well knowledge about the advantages of improved cooking stoves that are experienced by the ICS users in the study area.

3.3 Universe and Sampling Procedure

Deumai Municipality Ward No. 9, Jitpur, has selected for the study by using random sampling method. Out of total 945 households in this ward among the total households 10% of 95 households were selected to complete this study.

3.4 Types and Sources of Data

Data is a set of fact, sheets the wholesome aggregate of which gives the information. This information in fact contributes to the inquiry of truth and approaches towards the reality. Both primary and secondary data were used in this study. Data gathered are both qualitative and quantitative in their nature.

3.4.1 Primary Data

The primary data will be collected by using the structured questionnaire given in Appendix-I and the field observation checklist given in Appendix-II. In the due course of my research, primary data were collected through field observation, interview, and through structured and semi structured questionnaire as per the convenience to aid to the study. Questionnaire was the main tool for collecting information in the field survey.

3.4.2 Secondary Data

Since, this research is mounted on the basis of description and analysis, secondary data plays the vital role. The various internal and external sources were used for acquiring the secondary data. The secondary data will be collected from different books, journals, reports, theses related to the topic for this study. The data were collected by the government and non-government offices and their different study has served as secondary data in the study. The unpublished and published reports of AEPC, CRT/N as well as former research were used.

3.5 Techniques and Tools for Data Collection

Household survey will be conducted through the structured questionnaire. With the help of questionnaire primary data will be collected from improved cooking stove user and observation method. And secondary data will be collected from various concerned books, journals, reports and newspaper etc. The researcher will visit the study area for reliable or actual data collection. The data will be collected from the following tools and technique.

3.5.1 Household Survey

A structured questionnaire will be prepared to get the accurate data from the ICS user households in the study area. The structured questionnaire schedule will be developed with an attempt to bring out the different status of respondents' attitudes, perceptions, and

concept upon the utilization of ICS and improvement of their livelihood, socio-economic information and its impact on the rural communities. The respondents will be selected by using simple random sampling method. The researcher will describe the objectives of the study to the respondents so that the respondents will feel no difficulty to get them to work on the questionnaire. The researcher himself will fill the answer at the time of asking the questions to the respondents because all respondents cannot do the work themselves. .

3.5.2 Field Visit and Observation

In any kind of research, field visit and observation is essential for the researcher to obtain reliable data. The population selected from the sampling will be visited and ICS will be observed in the study area. Data will be recorded while observing the ICS user households' environment, burning improved cooking stoves, cooking time, kitchen rooms, cleaning pots, physical health, drinking water and its impact on health.

3.5.3 Key Informants' Interview

Key informants will be interviewed to generate more reliable and confirm the data and information collection. This will help to collect real data on the issues. An unstructured interview will be done with the Ward chairperson; some local experts of ICS and ICS related institutions.

3.5.4 Group Discussion

A group discussion will be organized including the representatives of ICS users and non users, dropout ICS users, members of CBOs, Ward representatives and the representatives of different political parties of Ward for the collection of data.

3.6 Data Presentation and Analysis

Data analysis is the careful study of the available fact. The obtained data will be coded, edited, tabulated and analyzed in appropriate format. Some basic statistical tools will be used to analyze the data. Apart from these tools, maps, tables, charts, figures and percentage will be used for the analysis. Data analysis will be done in close supervision of the guide. In this study descriptive method will be used to present the collected data.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

This chapter is basically consists of the general introduction of the study area which includes area, population, economic condition, educational status, transportation, climate, communication, energy and water supply facilities of the study area, based on analysis and data generation through questionnaire, observations, discussion and personal study of the ICS consumers. The data taken from field visit are presented in tabular forms and they are analyzed in different point of view in order to find the objectives of the study.

4.1 Scenario of ICS and household in the study area

Deumai Municipality Ward No 9 Jitpur is in Ilam district. It is one of the least developed Wards of the district. It lies in the north-west of the district headquarters. It is nearly 19\ km in the west from the district headquarters. It stretches between 26⁰ 49' 37" and 26⁰ 55' 00" north latitude and 87⁰ 46' 30" to 7⁰ 51' 25" east longitude. Deumai Municipality Ward No 9 Jitpur soars from the altitude of 300 meter to 1480 meter of the sea level. This Ward occupies an area of 30 sq km. Awareness among the people in the ward no 9 majority of household are using ICS for the better household environment and sanitation. The scenario of the household in the Ward no 9, Jitpur is presented in the table no 4.1.

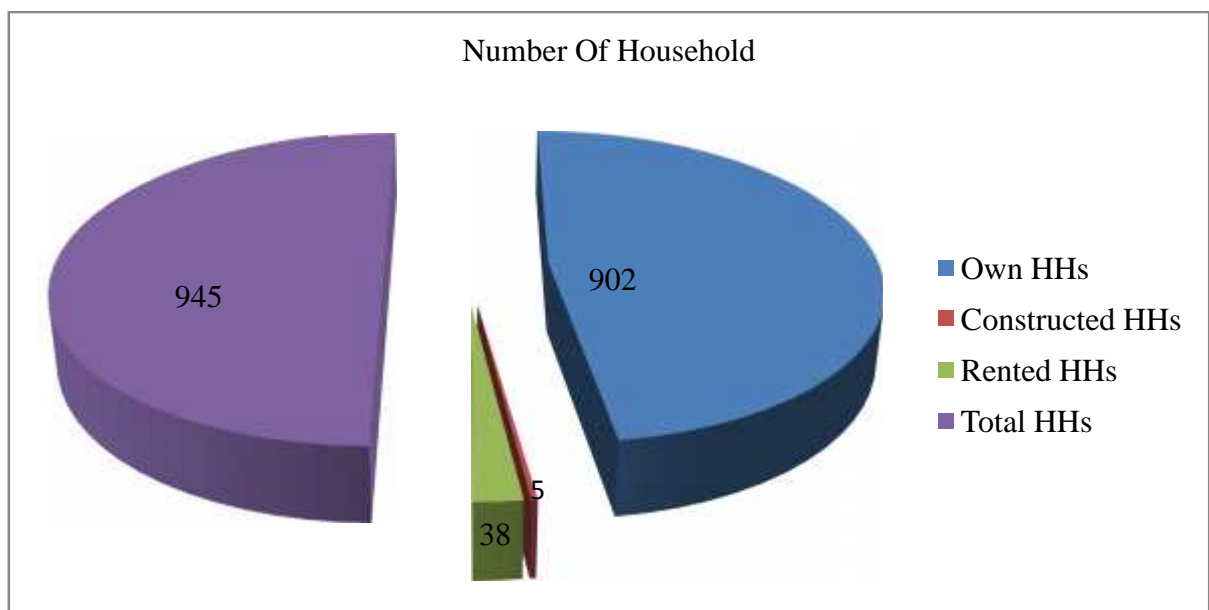
Table No 4.1 Households and ICS status of Deumai Municipality Ward No 9 JitpurIlam

SN	Description	Category of HHs	Number of HHs	Remarks
1	HH information	Own HH	902	
		constructing HH	5	
		Rented HH	38	
		Total HHs	945	
2	Kitchen user	In side of Same House	497	
		Separately with House	448	
3	Improved Cooking Stove (ICS) and status	Traditional	883	
		Electricity	6	
		LP gas	46	
		Bio gas	10	
		Reformed Firewood stove	-	

Source of data: Deumai Municipality Office, Ilam, 2075

The table no 4.1, reveals that out of total 902 HHs have own House, 38 have rented and 5 was constructed. Likewise out of total 497 HHs inside of same house using kitchen and 448 has separately with house by using kitchen. Among which 883 HHs uses firewood for cooking, 46 HHs use LP gas for cooking, 10 HHs use bio gas for cooking and 6 HHs use electricity for cooking (Deumai Municipality Office Housing Survey 2075).

Figure No 4.1 Household and description in Deumai Municipality Ward No 9 JitpurIlam



4.2 Types of family

Family is the universal accepted bond of relationship of the family members in the particular place. In the study area, there are two different types of family size. It has been classified in two family sizes, which are presented in table no 4.2.

Table No 4.2 Family information and classification

S.N	Size of family	No of Households	Percentage (%)
1	Single family	77	81
2	Joint family	18	19
3	Total	95	100

Source: Field survey, 2019.

The table no 4.2 reveals that out of total respondents 81% respondents belongs to the Single family and 19% family belongs to the joint family. This shows that there is tendency of people to live in the single family for the co-operation among the family members.

4.3 Caste Diversity of the Respondents

In this study area of Deumai Municipality Ward No 9 Jitpur is composed of different ethnic groups largest population in the Ward is Janajati, Brahmin and Chettri and Dalit. Most nature of caste diversity of the respondent can be seen living in a harmonious relationship each other that are presented in following ways.

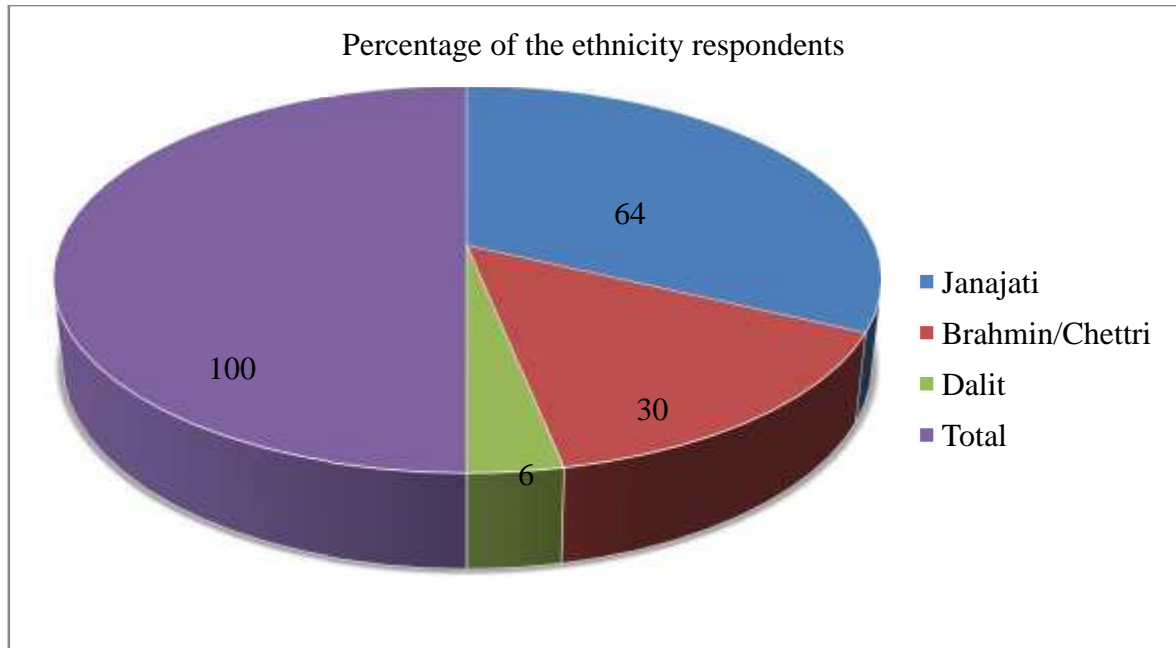
Table No 4.3 Caste diversity of the respondent

Particulars	Number of HHs	Percentage
Janajati	61	64
Brahmin and Chettri	28	30
Dalit	6	6
Total	95	100

Source: Field survey, 2019.

The table no 4.3 reveals of different nature participant form the targeted community which shows that out of total respondents 64% respondents from the Janajati community, 30% from the Brahmin/Chettri community and 6% from the Dalit community. The study is not only heterogeneous from the perspective of ethnicity but also heterogeneous participation from the economic perspective targeted community.

Figure No.4.2 Caste diversity of the respondent



4.4 Educational Status

Education plays vital role in the development of community and it is the key indicator of the development of the nation. It is the back bone of the country. The country can be developed where all the people are educated having technical and practical education. The table 4.3 shows the educational status of the respondent's family.

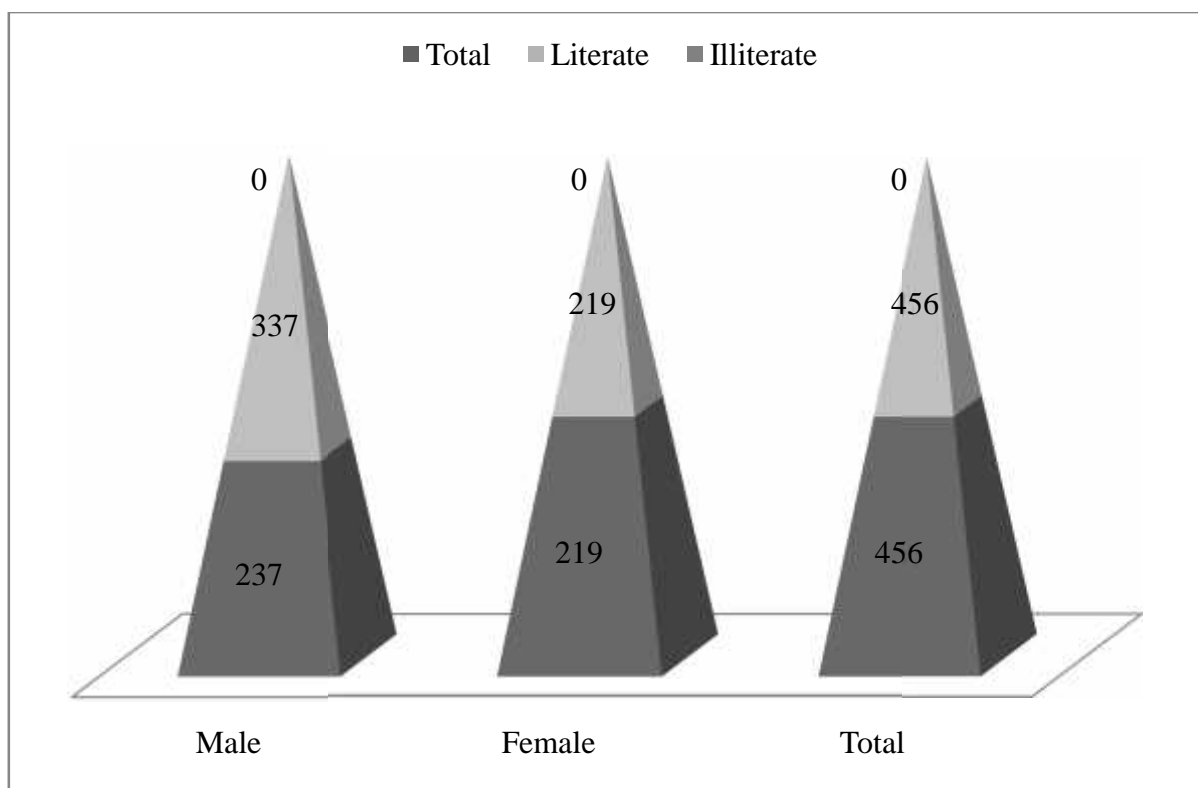
Table No 4. 4 Educational Status of the family members

Description	Male	Female	Total
Literate	237	219	456
Illiterate	0	0	0
Total	237	219	456

Source: Field survey, 2019.

The table no 4.4 shows that respondent household belong to the number of 456 are literate persons and no one person are illiterate in the respondent households.

Figure No 4.3 Educational status of the respondent HHs



4.5 Economic Impact of ICS

Agriculture is the main source of income and way of livelihood among the people of Deumai Municipality Ward No 9, Jitpur of study area. More than 85% of the people still depend upon agriculture for survival. Except that occupation, few people work as teachers and some are employed in foreign labour in Middle East countries. Despite the lack of good and enough irrigation system, farmers produce mainly paddy rice, maize, wheat, millet, ginger, orange, cardamom, broom, milk, tea and kitchen gardening. Occupation play a vital role in the technology installation and the informal utilization of any new trends of technology depends up on the occupation. In the study area most of the respondents are involved in agriculture occupation. So, most of the farmers have installed ICS because they get fuel from their farm. Beside this teacher and business men also installed ICS in the study area.

4.5.1 Motivation to install the ICS

Without motivator most of people do not install ICS because motivator provides information and knowledge about ICS and its benefits. Also Organization play vital role of motivator in installing ICS. So, the Staff of NCDC has played the vital role in related households to make decision in installing ICS. Inspiration by neighbor friend and relatives is also important as non users see and hear the experience of neighboring ICS user household about the function, merits and demerits of ICS. Similarly, the role of promoter as inspirers & motivators is also fairly reflected by the promoter's activities. The role of friends and groups members in inspiring to install ICS was not seen significant role to install the ICS.

Table No 4.5.1 Motivation to the respondent to install of the ICS

Description	Number of HHs	Percentage
Staffs of NCDC	67	71
Govt. agencies	0	0
Self- motivation	25	26
Friends & Relatives	3	3
Total	95	100

Source: Field survey, 2019.

The table no 4.5.1 reveals that NCDC has highly encouraged to the respondent household for the installation of ICS, which indicate 67, out of 95 household, and secondly self-motivation is highly seen in the study area is indicated in the given table. And there is the lower influence of friends and relatives for the installation of ICS in the family.

4.5.2 Reasons to install the ICS

Even though ICS was introduced in the era of 70s, it was not able to gain popularity due to several reasons. Mostly reported reasons were technical problems due to which people stopped using ICS in mid way. This study also tried to examine whether people are giving continuation to use ICS. However, the finding of this study is seen fairly positive. ICS is the most effective way of preventing deforestation and controlling imbalance in environment. Traditional cooking stoves use maximum firewood than the ICS due to the reason of maximum firewood consumption and no sufficient time for to collect the

firewood respondents are interested to install the ICS. Generally, one pot hole and two pot hole ICS is installed by the respondents households in the study area.

Among the various technologies introduced in the realm of efficient household heating and cooking methods, stoves are the most popular and widespread in both urban and rural communities. Especially in developing countries, stoves occupy a central place in the health, environmental, economic and social domains of life. By improving the efficiency of wood burning stoves, the amount of toxic smoke produced can be reduced and health risks to the family be minimized. In view of these and other concerns, a good cooking stove is defined as one that meets technical, scientific and safety standards, and has high combustion quality, technical efficiency, minimal smoke emission, ergonomics and structural stability. Most sources cite the fuel-efficiency of traditional stoves as five to ten percent. The reason for the installation of ICS is presented in the table no 4.5.2.

Table No 4.5.2 Reasons to install the ICS in the households

Particular	Number of HHs	Percentage
Environmental protection	0	0
Cooking	95	100
Time saving	0	0
Total	95	100

Source: Field survey, 2019.

The table no 4.5.2 reveals that most of the respondent mentions cooking facility immersed to the installation of the ICS which has justified by respondent information of the targeted households.

4.5.3 Sources of installation ICS

To install the ICS respondent were interested to install by the self motivation in maximum households. After the many problems related to traditional stoves such as problem of cough, headache, eye problem and smoke environment in the household in one hand and other hand easy and cheapest technology to install respondent household were motivated to install the ICS. The sources of installation ICS is presented in the table no 4.5.3.

Table No 4.5.3 Sources of installation ICS

Particular	Number of HHs	Percentage
Subsidy	6	6
Self- investment	89	94
Joint- investment	0	0
Total	95	100

Source: Field survey, 2019.

The table no 4.5.3 clarifies that most of the respondent mentions interested to the installation of the ICS that is 94 percentages from self investment, 6 percentages from subsidy. This shows that majority of respondent household installed ICS by the self investment that has been clarified by the above table.

4.5.4 Type of energy using

Energy is the necessity for the development that determines the level of development. The level of development determines the measure of energy utilization in the develop country. The country seems to be underdeveloped where there is utilization of poor and traditional technology. Nearly 95 per cent of the households in Deumai Municipality Ward No 9, Jitpur are now facilitated with electricity. Although this is the situation, the households using electricity have not been using electricity for various purposes due to poverty. Some households are still indifferent to using electricity although they have access to the use of electricity. The households mostly use electricity for light. Only few households sometimes use electricity for other purposes like cooking, heating, ironing clothes, sawing wood, drilling etc. In the other hand the fewer rented household and other is use in LP gas for cooking. Firewood is widely used for cooking. As a result, the rate of using firewood is very high. The high rate of consumption of firewood has compelled the households to

adopt an alternative way of cooking so that they need less firewood. The households have started to use improved cooking stoves with a view to being free from the problems caused by the overuse of firewood. They hope to lessen the amount of time used for the collection of firewood and cooking. They also hope the decrease in number of diseases caused by smoke. Now the installation rate of improved cooking stove seems to be increasing but some households seem to have given up the use of ICSs too. Now the support of Nepal Red Cross Society Community Resilience Project, Ilam District Chapter is working to spread public awareness on the use of ICSs. So the table no 4.5.4 shows the uses of energy in the study area.

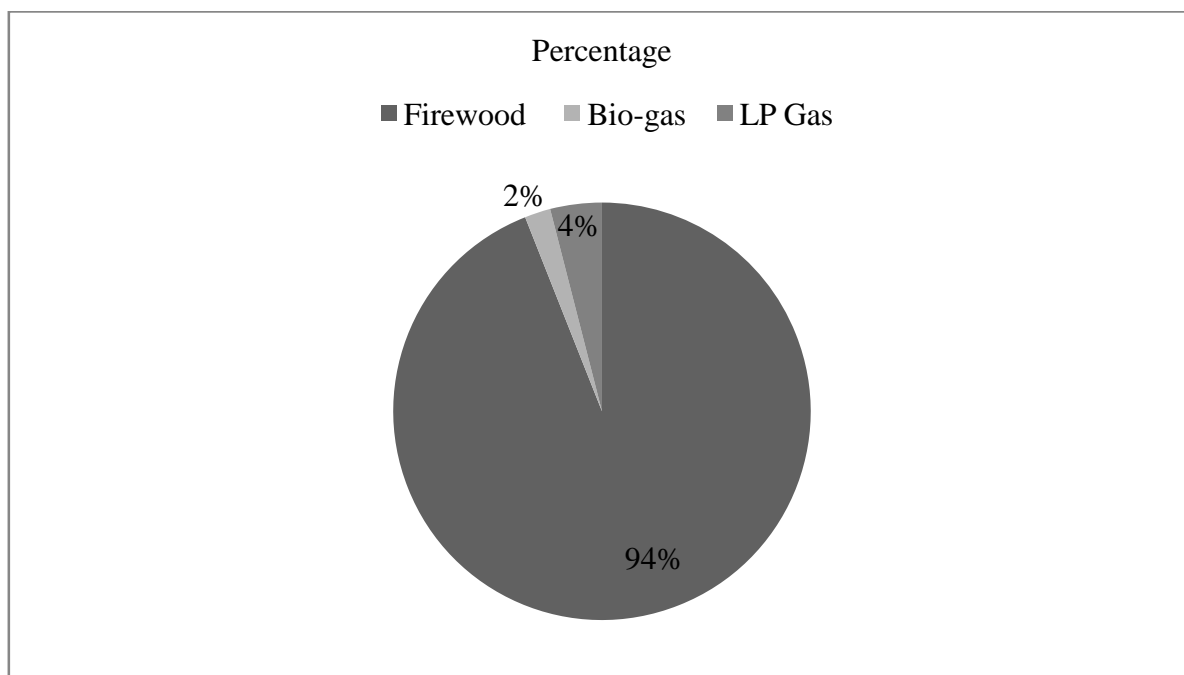
Table No 4.5.4 Types of energy using for cooking and lighting

Particular	Number of HHs	Percentage
Firewood	89	94
Kerosene	0	0
Bio-gas	2	2
Electricity	0	0
LP (Cylinder) Gas	4	4
Total	95	100

Source: Field survey, 2019.

The table no 4.5.4 reveals that type of energy are using mostly in the community that are firewood and LP gas continuously which result has indicated 89 (94%) and 4 (4%) respondent out of 95 household. Though this study area is located in the hilly region, there is tendency among the people to install the ICS and biogas for the easy cooking and develop clean environment of house.

Figure No 4.4 Types of energy using for cooking and lighting



4.5.5 Financial benefit through ICS

Biomass energy is one of the most primary sources of energy for the poor people particularly for the forest dependent communities. Similarly, forest dependent communities in Nepal use different types of forest biomass energy (wood, trees, leaves, undergrowth and bamboo) as fuels in the traditional cooking stove which results on continuous forest destruction, incomplete combustion of fuels, and environmental and health problems to the users. To minimize the pressure on forest resources, ensuring efficient use of biomass fuels and conserving forest biodiversity, National Planning Commission plan to technical support for community people to introduced improved cooking stoves (ICS) programme in the countries. The present study has been carried out to explore the importance of ICS in forest conservation, generating economic benefits, and as a whole, its potential role to climate change mitigation along with scope in carbon credits.

ICS is one of the best local technologies of low price to cooking at home in clean environment. Due to direct benefit among the people for saving of money respondent's household are using ICS. The following table shows the financial benefit pattern through the ICS.

Table No 4. 5.5 Financial benefits through the ICS

Descriptions	Number of HHs	Percentage
Saving expense in soap	86	91
Saving expense in Medicine	0	0
Saving expense in firewood	9	9
Saving expense in kerosene	0	0
Total respondents	95	100

Source: Field survey, 2019.

The table no 4.5.5 shows that financial benefit to the respondent out of total respondents 91 percent household got benefit to the saving expense in soap as financial benefit and 9 percent respondent saved their money for expense in firewood. This shows that there is maximum money is saving to invest for washing clothes and utensils.

4.5.6 Productive benefits through the ICS

In the study area according to the response of the respondent the saving time is utilized in the different sector. The respondent's household spend the time in small business, agriculture and livestock. So, it is benefited to the household and improvement of socio-economic status which is presented in the following sectors.

Table No 4.5.6 Productive benefits through the ICS

Descriptions	Number of HHs	Percentage
Small Business	86	91
Education	0	0
Agricultural & Livestock	9	9
Lending Money	0	0
Total respondents	95	100

Source: Field survey, 2019

The table no 4.5.6 reveals that productive benefit to the respondent out of total respondents 91 percent household started small business and 9 percent respondents engaged in the agricultural & livestock field for the productive benefit. In this study area,

the saving time of collection of firewood and cooking is utilized in small business and agricultural activities. This is the direct benefit to the respondent household.

4.5.7 Improving in health condition

Indoor air pollution (IAP) is a major threat in households using by the traditional stoves. Around more than 80 percent people have been living in rural areas of Nepal, burn biomass (wood, crop residues, and dung) for cooking and heating purposes. Generally, indoor air pollution affects women and small children far more than any other sector of society. Women and children generally spend two to six hours per day for the fire, exposed to smoke. The World Health Organization has documented the significant number of deaths caused by smoke from home fires. The negative impacts can be reduced by using improved cook stoves, improved fuels (e.g. biogas, or kerosene instead of dung), changes to the environment (e.g. use of a chimney), and changes to user behaviour (e.g. drying fuel wood before use, using a lid during cooking). Improved stoves are more efficient, meaning that the stove's users spend less time gathering wood or other fuels, suffer less emphysema and other lung diseases prevalent in smoke-filled homes, while reducing deforestation and air pollution. However, a closed stove may result in production of more soot and ultra-fine particles than an open fire would.

There observed many health problem due to smoke comes from traditional stove. Smoke may cause different health problem like respiratory problem, cough and cold, chest pain, asthma, eye problem, headache etc. Indoor air pollution is a significant threat in households using traditional stoves. Specifically, indoor air pollution affects women and small children far more than any other sector of society. Women typically spend three to seven hours per day by the fire, exposed to smoke, often with young children nearby. This survey also revealed that significant proportion of the households were suffering from various health problems before ICS installation because of smoky environment resulting from traditional stoves. It was observed that biomass fuels were the main cooking source. After the installation of ICS there is a significant improvement in health among the family members that can be presented in the following table.

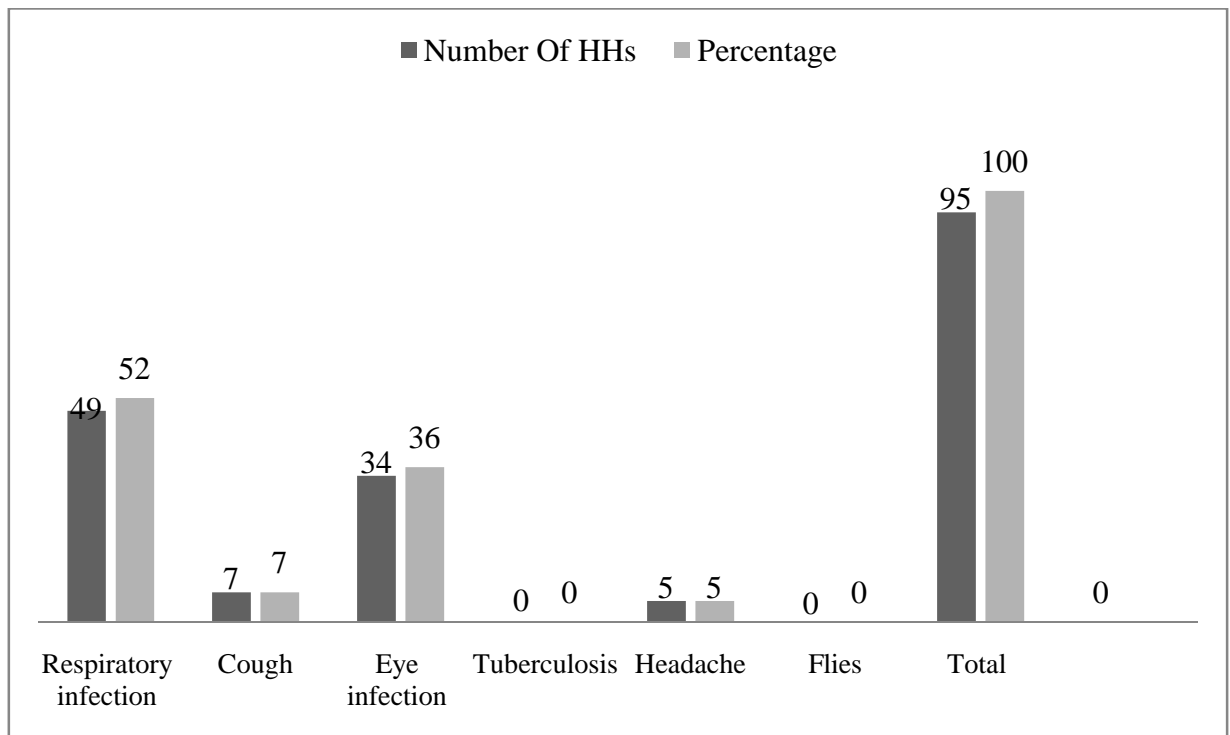
Table No 4 .5.7 Improving health conditions after installation of the ICS

Particular	Number of HHs	percentage
Respiratory inflection	49	52
Cough	7	7
Eye infection	34	36
Tuberculosis	0	0
Headache	5	5
Flies	0	0
Total	95	100

Source: Field survey, 2019.

The table no 4.5.7 reveals that out of total respondents 52% respondents indicate the improving health condition on respiratory infection, eye infection 36%, cough 7% and improving in headache 5% respondent of family by installation of the ICS. After installation of ICS, there are significant changes taken place in health scenario among the ICS users household.

Figure No 4.5 Improving health conditions after installation of the ICS



4.6 Environmental impact of ICS

All the sampled respondents revealed that the use of improved cooking stoves reduced the quantity of firewood they used for cooking and it helped to mitigate deforestation. Saving forests automatically prevents natural disasters like flood, landslide, drought etc. Traditional cooking stoves needed much more firewood than the improved cooking stoves did. There were no smoke outlets in traditional cooking stoves and consequently the kitchen was full of smoke. As the traditional cooking stove burnt more firewood, more smoke was emitted, which was a terrible factor for environment pollution. The use of improved cooking stoves worked as a relief for them to be free from indoor air pollution. There was the reduction of diseases caused by indoor air pollution. All the respondents view that the use of ICS played a role to control environment pollution. By conducting this study it can be concluded that following environment related facts are analyzed according to the information given by the respondent.

4.6.1 Improvement in sanitation and environment

Impact of ICS on environment was analyzed based on the general perception and response of the respondents. Majority respondents opined that ICS is a strategy for reduction in fire

wood collection which helps to pressure in the forest is reduced. The finding showed that it has contributed significantly in forest conservation and help for environmental balance. Similarly, feeling of people about the pollution has been reduced such as indoor air pollution due to smoke coming out from traditional stoves. The reduction in drudgery had been also decreased in cooking time, smokeless environment and clean house environment. In an effort of improve the energy situation as well as to improve the indoor environment pollution. Nepal's government has initiated the adoption and implementation of improved health and sanitation, reduced fuel wood consumption, improved social status. Similarly, use of improved cooking stove can increases the efficiency up to the control of the indoor pollution.

Table No 4.6.1 Improvement in sanitation and environment through the ICS

Situation assessment	Number of Respondent	Percentage
Helped to clean the kitchen	51	54
Control the environmental degradation	44	46
Total	95	100

Source: Field survey, 2019.

The table no 4.6.1 reveals that out of total respondents 54% respondents related to the helped to clean the kitchen and 46% respondents opined that to the control the environmental degradation through after installation of the ICS. The expenses of problem related to the smoke are significantly changed due to the ICS.

4.6.2 Direct beneficiary and benefitted situation through ICS

This study also showed that fuel wood collection time was reduced directly in the respondent's households. During the information collecting time, respondents reported that 'Children are now not engaged in getting fuel wood collection from the community and private forests. This shows that it is a direct benefit to children providing free time for reading. Similarly, women go to community and private forests for fuel wood collection, two times a month spending 3-5 hours each time per month is saving. With the introduction of ICS, the requirement for fuel wood has gone down so the fuel wood

collection time has been reduced. The following table shows the benefits of ICS to the family.

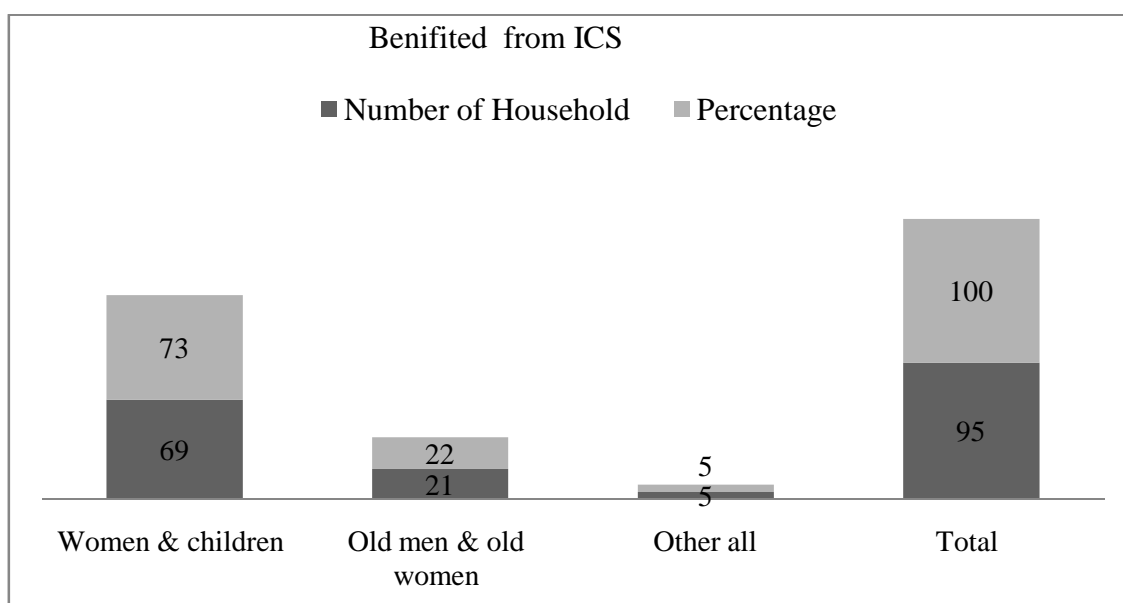
Table No 4.6.2 direct beneficiary and benefitted situation through ICS

Most benefitted from ICS	Number of HHs	Percentage
Women & children	69	73
Old man & old women	21	22
Other all	5	5
Total	95	100

Source: Field survey, 2019.

The table no 4.6.2 reveals that out of total respondents 73% respondents of women & children are must benefitted from ICS installation and 27% other family members which includes old aged man and women has also benefitted from ICS in the household. The direct beneficiaries from the ICS are mostly women, children and old aged family members among the respondent households because of the smokeless kitchen environment.

Figure No4.6 Benefitted persons from the ICS



4. 6.3 Time saving pattern through ICS before installation

The positive impact made by ICS on reducing fuel wood at the household level seems to significant one. Specially, stoves are used for cooking food, heating water and making animal's food. Normally people do not record time for any work they do in the rural areas. Every activity is seen as routine work that is not recorded in the memory of family too. Time saving pattern through ICS before installation is presented in the table no 4.6.3.

Table No 4. 6.3 Time consuming before installation of ICS

Time consuming before installation	Number of HHs	Percentage
Collection of firewood	67	71
Time spend for cooking	28	29
Total	95	100

Source: Field survey, 2019.

The table no 4.6.3 reveals that out of total respondents 71% respondents is time saving for the collection of firewood before installation of the ICS and similarly out of total respondents 29% time saving in the cooking activities in each household. The saving time from the collection of firewood and cooking time is utilized in other income generating activities as well as social works.

4.6.4 Time saving pattern through ICS after installation

Time is important factors for the human beings and every works should be done in time. However, respondents mentioned that there have been decreasing in cooking time after installation of the ICS. Majority of the respondent explained that cooking time has been reduced. Respondents mentioned that there have been decreased in cooking time after installation of the ICS.

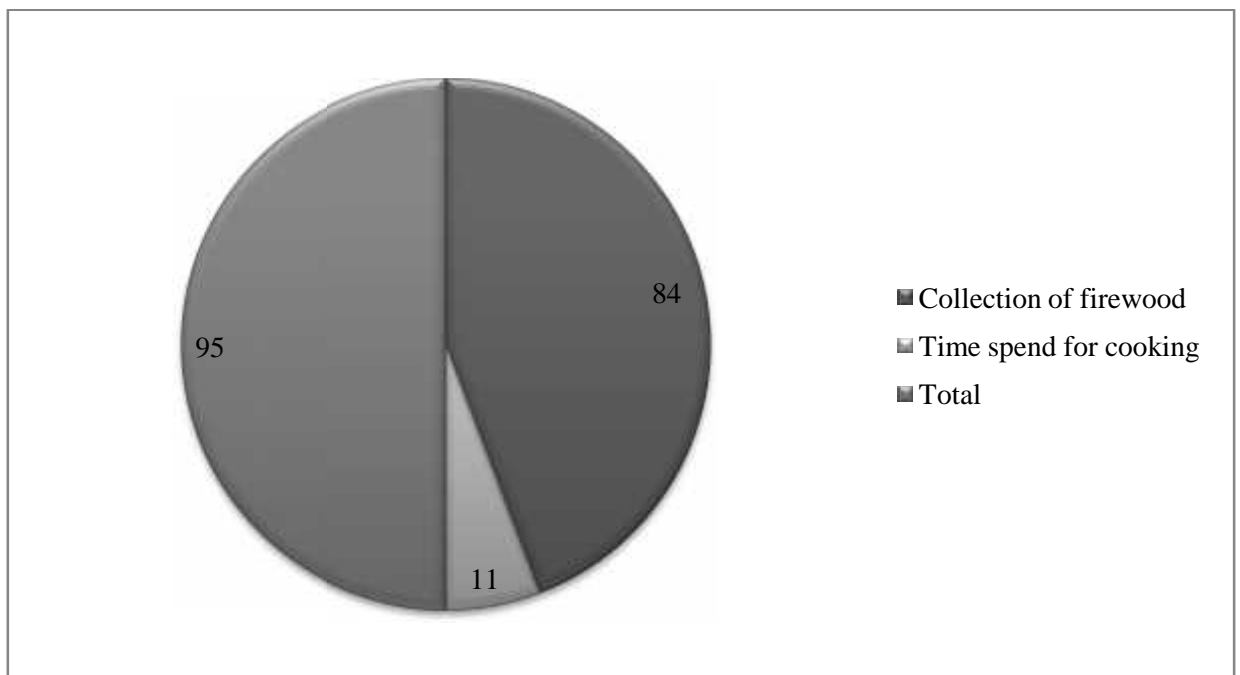
Table No 4.6.4 Time saving pattern through ICS after installation

Time saving after installation	Number of HHs	Percentage
Collection of firewood	84	88
Time spend for cooking	11	12
Total	95	100

Source: Field survey, 2019.

The table no 4.6.4 shows that out of total respondents 88% respondents are times saving for the collection of firewood after installation of the ICS and similarly out of total respondents 12% time is saving in the cooking activities. This shows that maximum time is saved in the respondent's households for the collection of fire wood and cooking purposes.

Figure No 4.7 Time saving status after installation of ICS



4.6.5 Utilization of saving time after installation of the ICS

The cooking time consumption has reduced by more than around 60 percent. A significant reduction in cooking time is seen after the intervention. The saving time is used in the agricultural activities in the field, engaged in income generating activities as well as caring livestock and making house cleaning. After ICS installation, time is saved from two work burden activities such as from fire wood collection and from cooking activities in the kitchen. Likewise, respondents also were involved in Income Generating Activities such as small business activities. ICS empowered the rural women and their life style by giving them to involve in social and organizational activities. After the use of ICS which is presented in the table no 4.6.5

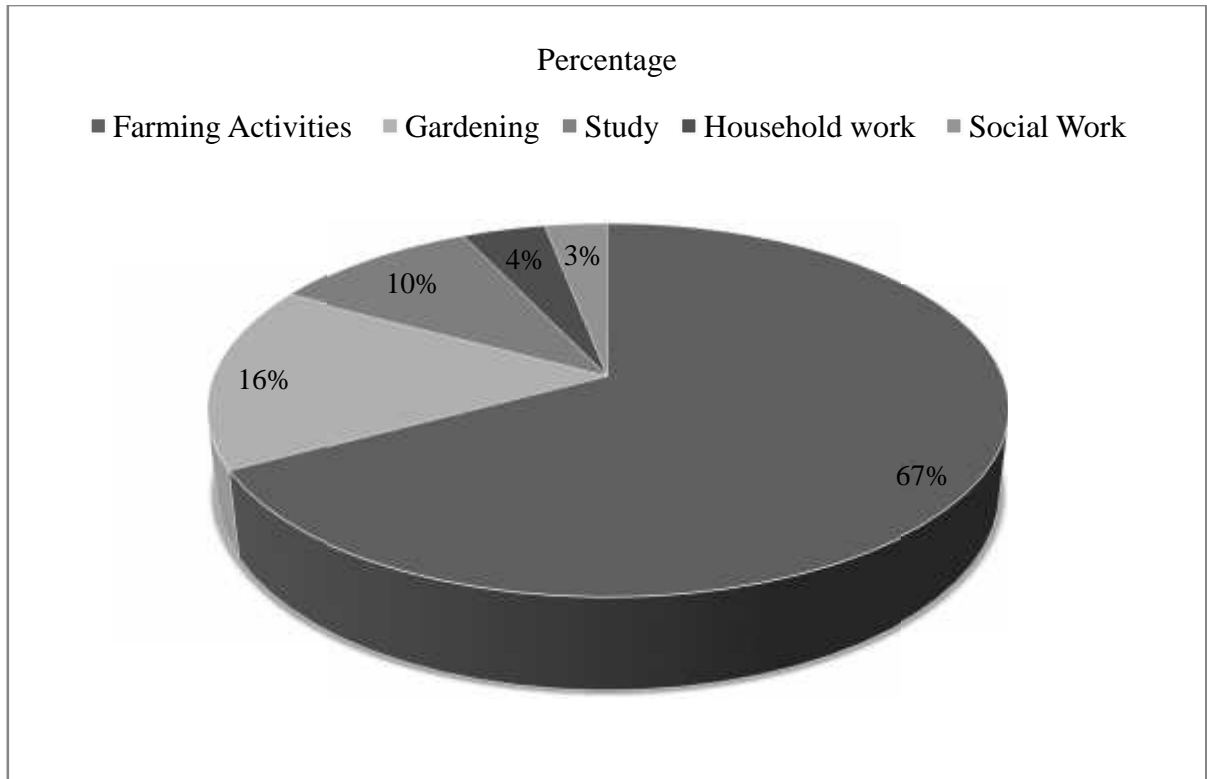
Table No 4.6.5 Utilization of saving time after installation of the ICS

Description	Number of HHs	Percentage
Farming activities	64	67
Gardening	15	16
Study	9	10
Household work	4	4
Social work	3	3
Total	95	100

Source: Field survey, 2019.

The table no 4.6.5 depicts that out of total respondents 67% respondents utilized their saving time in the farming activities, 10% in study, 4% in household work, 16% utilization in gardening and in 3% social work in the community which has saved time by the installation.

Figure No 4.8 Utilization of saving time after installation of the ICS



4.6.6 Cleanliness kitchen after installation of the ICS

For the healthy kitchen environment there should be well sanitation environment in the household surrounding. After adaptation of ICS technology the respondent's household environment is highly improved and health related problem is also reduced. All the respondent households agreed to the fact that the installation of improved cooking stoves helped them a lot to keep the kitchen clean. According to them, the smoke emitted from cooking is not found inside the kitchen because of the use of chimneys and the pots used for cooking are now not so dirty as the pots used for cooking in traditional stoves. The data is presented in the table no 4.5.6.

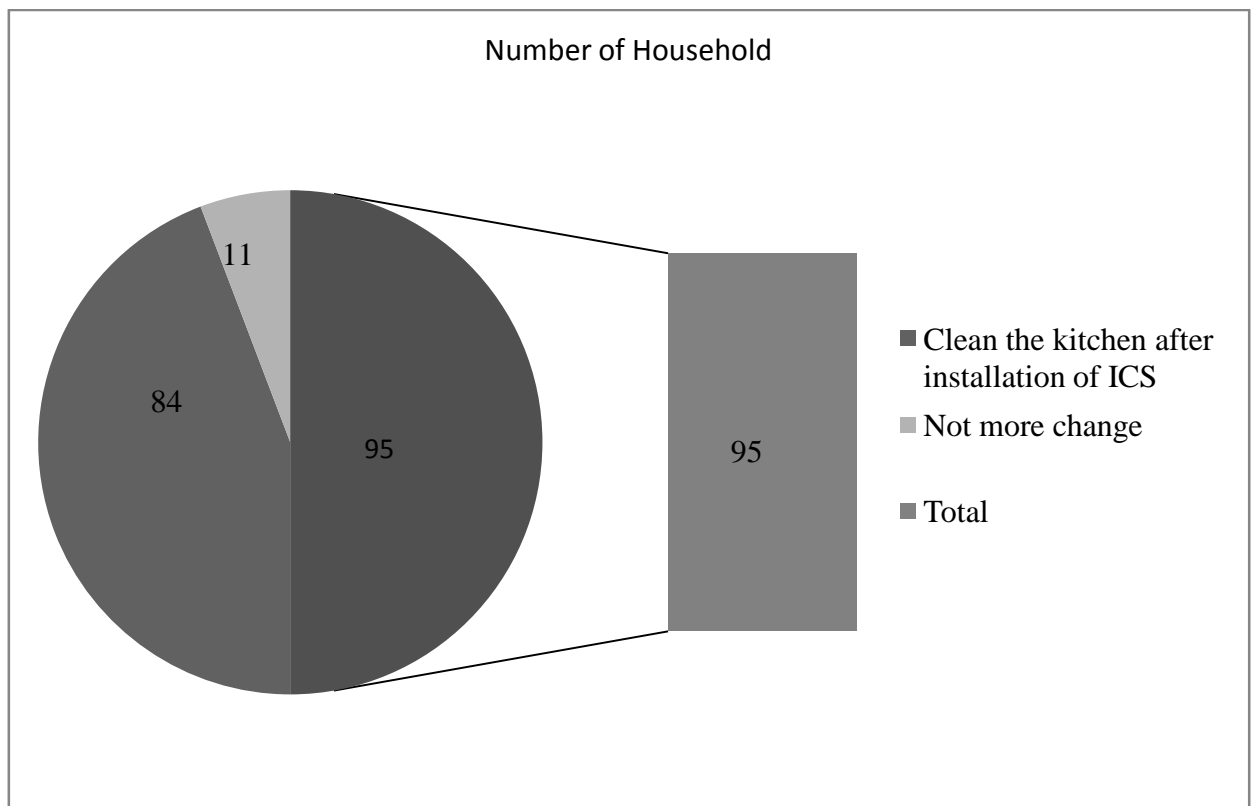
Table No 4.5.6 Cleanness kitchen after installation of the ICS

Particulars	Number of HHs	Percentage
Clean the kitchen after installation of ICS	84	88
Not more change	11	12
Total	95	100

Source: Field survey, 2019.

The table no 4.6.6 reveals that out of total respondents 88% respondents agree to clean kitchen after installation of the ICS and remaining 12% respondent noted it is not more change like as same after and before the installation of the ICS.

Figure No 4.9 Cleanness kitchens after installation of the ICS



4.6.7 ICS installation and environmental impact

A shortage of fuel for cooking is one of the many problems faced by people in the developing world. Gathering fuel is generally women's work but is fraught with dangers; they gamble with the risk of rape and life threatening attacks during their search for much needed firewood, in order to feed their families. In certain areas, local sources of firewood are completely depleted, leading women to travel further and further afield or to dig up tree roots, eliminating any chance of the trees growing again. Even if women survive this, they are still exposing themselves and their children to potentially deadly smoke fumes. The World Health Organization has documented the significant number of deaths caused by smoke from home fires. The negative impacts can be reduced by using improved cook stoves, improved fuels (e.g. biogas, or kerosene instead of dung), changes to the environment (e.g. use of a chimney), and changes to user behaviour (e.g. drying fuel wood before use, using a lid during cooking). Improved stoves are more efficient, meaning that the stove's users spend less time gathering wood or other fuels, suffer less emphysema and other lung diseases prevalent in smoke-filled homes, while reducing deforestation and air pollution. However, a closed stove may result in production of more soot and ultra-fine particles than an open fire would.

All the sampled respondents revealed that the use of improved cooking stoves reduced the quantity of firewood they used for cooking and it helped to mitigate deforestation. Saving forests automatically prevents natural disasters like flood, landslide, drought etc. Traditional cooking stoves needed much more firewood than the improved cooking stoves did. There were no smoke outlets in traditional cooking stoves and consequently the kitchen was full of smoke. As the traditional cooking stove burnt more firewood, more smoke was emitted, which was a terrible factor for environment pollution. The use of improved cooking stoves worked as a relief for them to be free from indoor air pollution. There was the reduction of diseases caused by indoor air pollution. All the respondents put the view that the use of ICS played a role to control environment pollution. Through the study in following sector environment and deforestation is seen that is presented in the table 4.6.7.

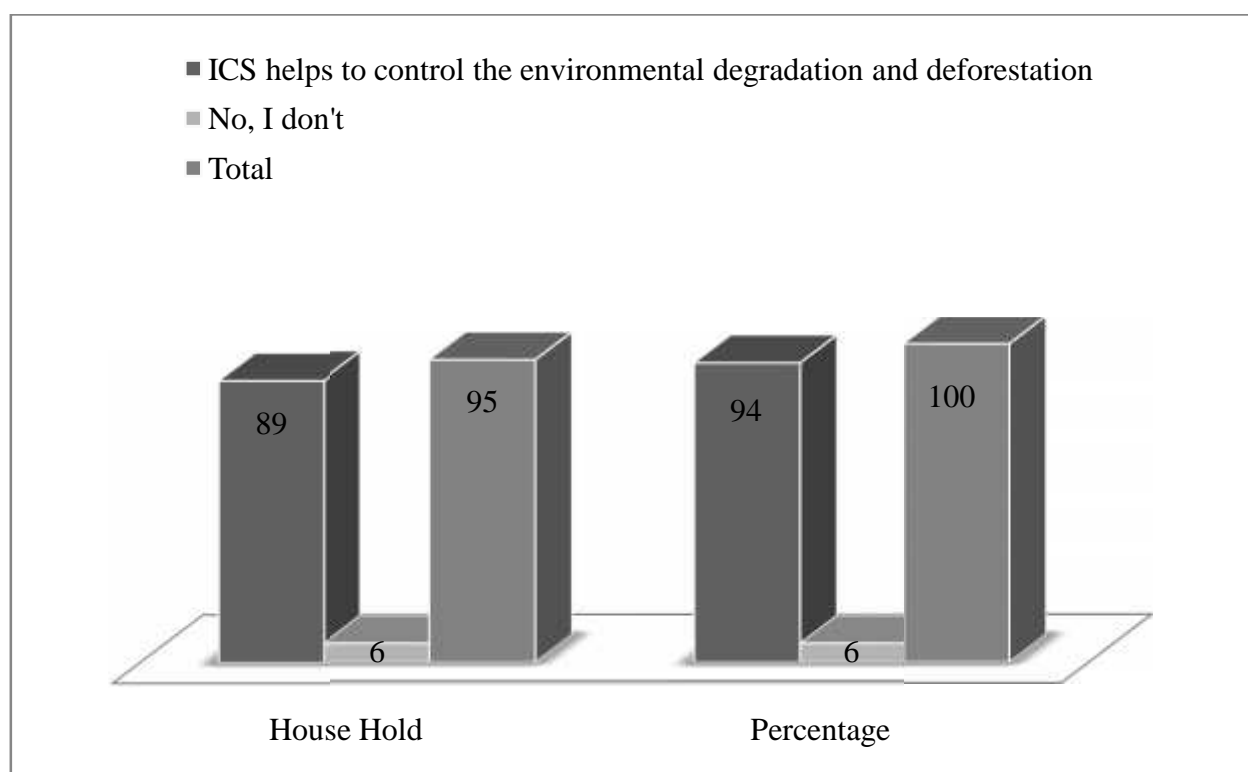
Table No 4.6.7 ICS installation and environmental impact

Particulars	Number of HHs	Percentage
ICS helps to control the environmental degradation and deforestation	89	94
No, I don't	6	6
Total	95	100

Source: Field survey, 2019.

The table no 4.6.7 reveals that out of total respondents 94% respondents agree to help ICS to control the environmental degradation and deforestation after installation of the ICS and remaining 6% respondent only mentions they are unknown about the environmental degradation and deforestation relation in the installation of the ICS.

Figure No 4.10 ICS installation and environmental impact



4. 6. 8 Repair and maintenance skilled among the respondent

The ICS repair and maintenance is one of the perfect utilization of ICS. In this study frequency of maintenance here means not repairing but frequent maintenance like chimney and regular cleaning as well as ICS. As to daubing with cow dung and mud is a daily job to clean the ICS and this is not called maintenance. However ICS needs frequent care taking and maintenance than the traditional stoves for the success.

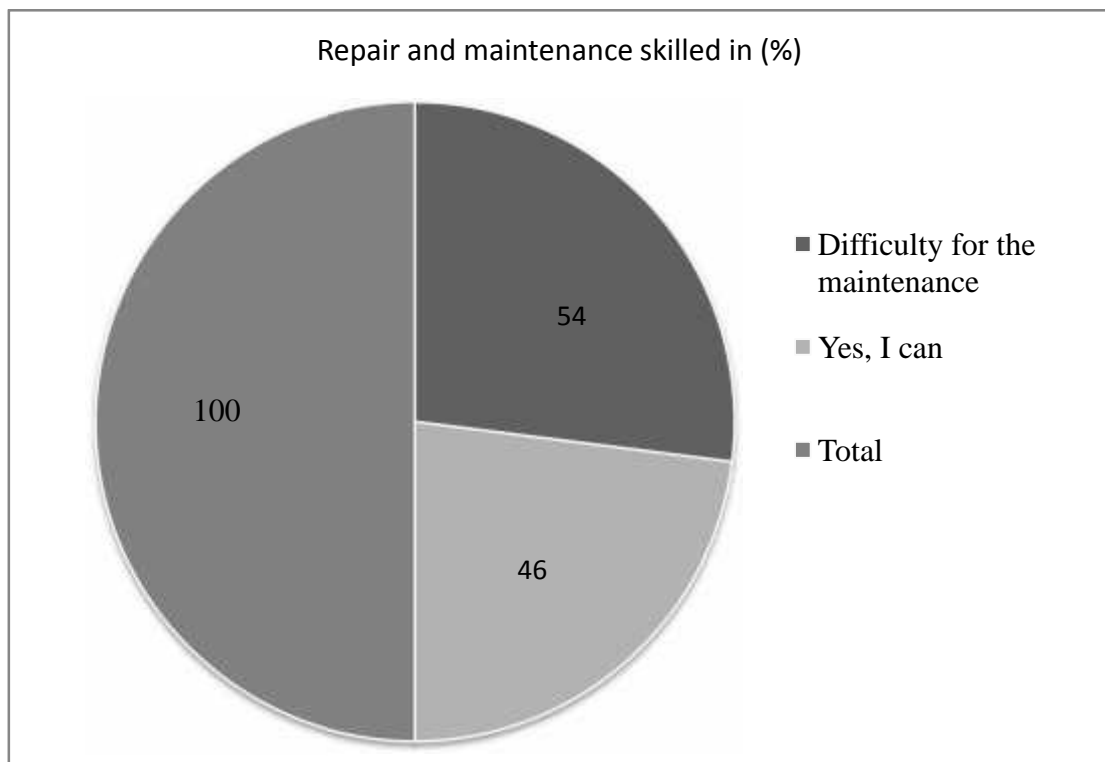
Table No 4.6.8 Repair and maintenance skilled to the respondent

Particulars	Number of HHs	Percentage
Difficulty for the maintenance	51	54
Yes, I Can	44	46
Total	95	100

Source: Field survey, 2019.

The table no 4.6.8 reveals that out of total respondents 54% respondents feel difficulties for the repair and maintenance of the ICS and remaining 46% respondent have skilled for the repair and maintenance to the operating of ICS.

Figure No 4.11 Repair and maintenance skilled to the respondent



CHAPTER V

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

This research has been conducted in Deumai Municipality Ward No 9, Jitpur of Ilam District of Mechi zone having objectives to study the Socio Economic Change After Using of ICS in the Municipal Ward no 9, Jitpur and to assess the condition of health and sanitation among the sampled households. Out of total 945 households, 10 percentages of total 95 households has been selected by using simple random sampling method. Respondents were taken as the sample including different caste, ethnicity, education status, religion as well as income status etc. Respondents have been taken only from 9 no ward of the Deumai Municipality Ilam. Through the minute study of the research, following summary can be drawn which can be summarized in the following ways.

- J Out of total respondents, most of the respondents were selected from heterogeneity in economic background.
- J Almost among the total, 100 percent male is literate and out of total, 100 percentages female are literate and 0 percentage male and female are illiterate.
- J Out of 95 households, 64 percent respondents are from Janajati, 30 percent are from Brahmin and Chhetri and 6 percent are from Dalit households
- J ICS is popular on ethnic community as well as poor people. They take it as scientific invention and feel pride of using it.
- J Larger percentage (40%) have been using the ICS for less than 1 year
- J Out of total 71 percent households are motivated to install ICS due to the counseling of NCDC staffs and 26 percent household are self motivated for the installation of ICS and 3 percents are influenced from friends.
- J Because of the use of ICS, use of firewood is decreased by 66 percent.

- J Likewise, 56 percent of the respondent argued that there was some positive change in health situation after intervention of ICS.
- J Majority of the respondents reported that cooking time has been reduced.
- J Almost 40 percent of the respondents argued that it helps to maintain greenery of the surrounding.
- J In total 40 percent of the respondents use saving time in farming and 20percent use saving time in income generation work.
- J Subsequently after using of ICS 70 percent of the respondents reported that medical expenses were reduced.
- J The researched represented 96 percent respondent households are willing to invest ICS in their household and 4 percent got subsidy to install ICS in the household.
- J After using of the ICS 92 percent household saved their money for the consumption of soap for sanitation due to the installation of ISC and 8 percent respondent saved their money for consumption in kerosene
- J Out of total respondents 50% respondents indicate the improving health condition on respiratory infection and eye infection, 34% improving in cough and 8% improving in headache and 8 percentage respondent of family by installation of the ICS.
- J In the research shows 71 percent women and children are benefited from the smoked environment due to installation of ICS and old aged man and women also benefited
- J Because of the installation of the ICS 84 percent respondent have saved their productive time since they could not collect firewood for cooking and 16 percent respondent save their time in cooking items.
- J The saved time due to the installation of ICS is used for 64 percent for farming activities, 16 percent for gardening and 12 percent for the study.

- J After the installation of ICS 92 percent of respondent have felt that they cleaned environment in the kitchen.
- J According to the report 92 percent of respondent have felt that due to the use of ICS environmental degradation is controlled.
- J It was found that the use of the ICS lessened the indoor air pollution so that there was the reduction in possibility of being infected with the diseases like eye infection, cough, respiratory infection, headache etc. which were likely to be caused by air pollution.

5.2 Conclusions

Through the present study, it can be concluded that the promotion and development of Improved Cooking Stoves (ICS) is having reasonable and favourable positive impact in the every cranny and corner of the country. The local ICS technology is only possible source of energy in the remote areas of Deumai Municipality Ward No 9, Jitpur of Ilam District. ICS is being able to make possible and substantial social impact in this study area. Improved Cooking Stove (ICS) has improved households activities and clean household environment. It is a very useful local technology especially for women and children, who use to remain most of time in kitchen room for cooking and heating activities.

Improved Cooking Stove (ICS) has playing vital role for the short run energy conservation and sustainable uses of energy in Nepal. It has directly addressing the urgent problems of deforestation and reducing domestic firewood scarcity as well as health related problems due to excess smoke in the kitchen environment. ICS is a simple local technology and can operate in low investment. A major problem in the adoption and dissemination for the ICS is local culture and local traditions among the traditional people. If ICS is developing considering user characteristics and regional differences, it can be helpful to reduce pressure on the forest and fuel crisis in the rural areas.

This shows that the benefits from the ICS are visible to the villagers who are accepting it. So that, majority of the respondents is using ICS for the direct benefits. NCDC staffs are working in this area are seen as active player in motivating people to install ICS. Although promoters are trained even in information dissemination, their role was not reported significantly there. Improved Cooking Stoves (ICS) project and programme served large number of beneficiaries in the Deumai Municipality Ward No 9 Jitpur of Ilam district.

In the study area, there are many socio economic advantages of ICS. ICS has many advantages than the traditional cooking stoves. Likewise, time saving, easy to clean utensils, prevalence of fire accidents were reported rarely. After the installation of ICS majority of the households have relieved from health problem such as eye problem and headache and respiratory infection. All of the respondents, those who complained about chest pain and respiratory infections condition improved after ICS installation. To some extend respondents reported that medical expenses were also reduced after using ICS.

The ICS save one third of consumption of firewood, the most important features of ICS is that it is cheapest, efficient in energy use and thereby in eco-friendly technology in the rural area. ICS shows that it can play prominent role to save the energy and environment balance. ICS also saves time spent on collecting firewood and cooking food. The findings of the study show that ICS is effective in reducing forest pressure and controlling deforestation. The study finding concluded that every household saved significant amount of firewood for cooking.

The saving time is used in the agricultural activities in the field, engaged in income generating activities as well as caring livestock and making house cleaning. After ICS installation, time is saved from two work burden activities such as from fire wood

collection and from cooking activities in the kitchen. Likewise, respondents also were involved in Income Generating Activities such as small business activities. ICS empowered the rural women and their life style by giving them to involve in social and organizational activities.

5.3 Recommendations

According to field study and after analyzed the acquired data and experience of the researcher for the sustainability of the ICS and its promotion some of the most necessary steps should be done in future by the concerned authorities and agencies some for the sustainability of ICS Program with effectively in the study area. They are mentioned in the following ways:

-) A wider level promotion for ICS installation, specifically in its technical aspects is required as people are still hesitant to install ICS because of technical issues.
-) Training to build ICS should be provided to the local people, so that they can make ICS themselves and help to build for other local people also. And it seems essential to have the proper knowledge of maintenance and repair in each ICS users household.
-) Though ICS brings improvement in respondents health status there need to increase the access of non-user people.
-) Baseline survey to measure impact of ICS is missing. Therefore, there is need to conduct baseline survey to assess impact at the end of the project. Non users survey should be conducted to help compare in the future.
-) Though ICS brings improvement in respondents health status there need to increase the access of non-user people.

-) Government should run campaign to make people aware about ICS, its use and impact on the users.
-) Effective implementation of clean development mechanism (C.D.M) for ICS should be ensured.
-) Effective monitoring and evaluation of various institutions and programs on ICS should be done in regular basis.
-) Respondent should be give priority for the installation of qualitative ICS than the quantitative of ICS in the study area.
-) Among the respondent household only few users are using the outlet chimney. So priority should be for outlet chimney in the installed ICS households. It might be reduced the smoke back problem in the kitchen.
-) There should be appropriate design of ICS necessary for large size of the family for cooking livestock feed and cooking. ICS dimensions such as height, fire gate size, chimney height should be appropriately managed.
-) According to the study the ICS program has mainly focused on the one pot and two-pot hole ICS for the cooking food in the study area. Therefore it is most necessary to promote the three pot hole ICS for to save energy and fast cooking.
-) Awareness program about the ICS for the promotion of the program should be done for the effective use of ICS in the study area. Because some users are still do not understand the meaning three pot-hole of stove.

- J ICS user households should learn new technology to get the opportunity to share their technical skill to each other about the ICS.
- J Majority of the regular ICS users were accepted that, ICS saved the time but saving time was not properly used in income generating activities. Therefore, it will be better if, income-generating skill should be given to utilize their leisure time.
- J However, government has given some space for ICS promotion, installation and implementation but its implementation in the field is negligible. ICS program is seen as the program of development agencies only. Thus, this should be integrated with Municipal ward level plan and program. This also helps to sustain the program in the long run for the households. And ultimately the government has some provision for the subsidy who wants to install ICS in their house.
- J Government organization (GOs) and NGO implemented ICS activity to reduce pressure in the forest targeting the poor and disadvantage segment of the area is seen. Study should be conducted to assess whether these groups have access to this service or not.
- J ICS is necessary for all people and it is essential to adopt the new technology, the study area is hilly reason so the responded household use the new technology to boil the water joined the GI Pipe in hill tank to ICS Chimney.
- J ICS is necessary for all people, so that the government considerably in maintained and manages in the above recommended point as well as local body should be involved in implementation.

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ANNEX I

Interview Questions

Socio Economic Change After Using of ICS

These questioner are using in the primary data collection for the household survey in the research area on ICS user household only for this research not in the other propose in any survey in the future.

Structured Questionnaire

1. General Introduction:

Name of the ICS owner:

Name of the respondent:

Age: Sex:

Occupation: Caste:

Religion:

1.1. Family size:

(i) Nuclear family (ii) Joint family

Male Female Total

1.2 Status of Education:

Particular	Male	Female	Total
Literate			
Illiterate			

1.3 Economic condition

a. For how many months can farming feed you?

Less than 3 month

3-6 months

6-9 months

9-12 months

12 months and surplus to sell

No land

b. What do you do if it insufficient for consumption from farming ?

-) Wage labour
-) Share crops farming
-) Business
-) Service
-) Foreign employment
-) None
-) Other (specific if any)

c. What are your family's incomes from other professional besides farming?

- Less than Rs. 1000.00
- Rs. 1000 – 3000
- Rs. 3000 – 6000
- Rs. 6000 – 9000
- Rs. 9000 – 12000
- Rs. 12000 – 15000
- Above Rs. 15000

2. Information and Advantages of ICS:

2.1 Who encouraged you to install the ICS?

- (i) Staff of NCDC
- (ii) Govt.-agencies
- (iii) Self-motivated
- (iv) Friends & relatives

2.2 When did you install the ICS at your home?Year ... Month

2.3 For what reason did you install the ICS?

- (i) Environmental protection
- (ii) Cooking
- (iii) Time saving

2.4 What is your source of investment for the installation of ICS?

- (i) Subsidy
- (ii) Self- investment
- (iii) Joint investment

2.5 In your opinion which member of your family is really most benefitted from ICS?

- (i) Women & children (ii) Old men
 (iii) Old women (iii) All

2.6. What type of stove have you installed?

-) One hole
) Two holes
) Three holes

2.7 Do you think that ICS has increased your living standard?

- (i) Yes (ii) No

3. Uses of energy and energy saving pattern

3.1 Which type of energy do you use mostly for cooking and lighting?

Firewood	Kerosene	Bio-gas	Electricity	Solar

3.2 Who usually work to collect the firewood from the forest?

- (i) Man (ii) Women/Girls (iii) Both

3.3 How much fire wood did you require per month before and after the installation of ICS.

Firewood	Before	After
Firewood in (bhari/Kg.)		

(1 bhari = 45 kg.)

4. Time saving pattern of Improved Cooking Stove users.

4.1 How much time did you spend per week to collect firewood before the installation of ICS?

- (i)hour (ii)minutes

4.2 How much time do you now spend per week to collect the firewood?

- (i)hour (ii)minutes
- 4.3 How much time did you spend for cooking before the installation of ICS?
- (i)hour (ii)minutes
- 4.4 How much time now you spend for cooking?
- (i)hour (ii)minutes
- 4.5 If it has saved time in firewood collection and cooking, how are you utilizing the saved time?
- (i) Farming activities (ii) Gardening
- (iii) Study (iv) Household work
- (v) Social work
- 4.6 Who goes to collect fuel wood in your family?
- i. Self ii. Father-in-law
- iii. Husband iv. Wife
- v. Mother-in-law vi. Son
- vii. Daughter viii. Daughter-in-law
- ix. All the family members x. Buy
- xi. None of the above xii. Other (if any specify)

5. Financial benefits after the utilization of ICS.

- 5.1 In your opinion, what is the economic impact of ICS?
- (i) Saving expense in Soap
- (ii) Saving expense in Medicine
- (iii) Saving expense in firewood
- (iv) Saving expense in kerosene
- 5.2 How are you utilizing the savings for the productive sector?
- (i) Small business (ii) Education
- (iii) Agricultural and livestock (iv) Lending money
- (v) If others, specify

6. Impact of improved cooking stove for the following- health, sanitation and environment.

- 6.1 Do you think that health, sanitation and environmental problems have been reduced after the installation of ICS?

Respiratory infection	Yes	No
Cough	Yes	No
Eye infection	Yes	No
Tuberculosis	Yes	No
Headache	Yes	No
Flies	Yes	No

6.2 Do you believe the installation of ICS has helped to clean the kitchen?

- (i) Yes No

6.3 Do you believe the installation of ICS has helped to control the environment degradation?

- (i) Yes No

6.4 Do you believe you and your family health is better than after installation of ICS?

- a) Yes b) No

7. Repair and maintenance

7.1 Do you have any difficulty for the maintenance of ICS?

- (i) Yes No

If yes, specify

7.2 Do you have some suggestion about the Improved Cooking Stove for those people who are willing to install? Please specify.

- (i)

- (ii)

- (iii)

7.3 Are you fully satisfied with the Improved Cooking Stove?

- (i) Yes No

8. Consumption of forest preservation.

8.1 Install of the ICS preserved the forest?

- i) Yes ii) No

8.2 It support to deforestation and environment protection?

- i) Yes ii) No

8.3 What impacts are seen in forest conservation after the use of ICS?

.....

8.5 What other improvements are seen in environment conservation after using ICS?

.....

8.6 Do you have anything else that you would like to share with the researcher about the queries?

.....

.....

ANNEX II

Field observation Checklist

These checklists is using in primary data collection for the research not any other propose.

1. Social Attitude and behaviour:

- a. Food and nutrition:
- b. Personal health:
- c. Toilet use:
- d. Clothing:
- e. Women participation in social activities:
- f. Family behaviour towards women:
- g. Use of improved cooking stoves:

2. Physical observation:

- a. Source of drinking water:
- b. Plantation/Deforestation:
- c. Toilet:
- d. Type of the house:

3. Facilities:

- a. Telephone/mobile:
- b. Radio/tape recorder:
- c. TV/Film hall:
- d. Computer:
- e. Electricity:
- f. Road Access:
- g. Hospital:
- h. +2/Campus:
- i. Market centre:

ANNEX III

Photos



Using of ICS it makes hygiene, clean environment in the kitchen and saving firewood consumption





After Installation of the ICS Women are directly benefited and saving the time



Thank You