FOREST DEPENDENCY AND ECONOMIC VALUATION OF LAOKHOWA AND BURHACHAPORI WILDLIFE SANCTUARIES IN ASSAM

A thesis submitted to Indian Institute of Technology Guwahati in partial fulfillment of the requirements for the degree of Doctor of Philosophy

By

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DEDICATED TO:

PAHI, RIO, PIJU, MUMU, GUNGUN, UDIT, PAPU AND KUHI

(THE NEXT GENERATION CARETAKERS OF FOREST AND ENVIRONMENT)

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Declaration

I hereby pronounce that the thesis entitled "**Forest Dependency and Economic Valuation of Laokhowa and Burhachapori Wildlife Sanctuaries in Assam**" is my original research work carried out in the Department of Humanities and Social Sciences, Indian Institute of Technology, Amingaon, North Guwahati, Guwahati, Assam, India under the supervision of Dr Mrinal Kanti Dutta, Professor (Economics) in the department of Humanities and Social Sciences, IIT Guwahati.

The thesis submitted for the degree of Ph. D. in Economics is entirely my own work and has not been submitted elsewhere for the award of any degree. It is the result of my own investigations and I have duly acknowledged wherever the ideas, works and findings of other research has been referred to.

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This is to certify that the thesis entitled "**Forest Dependency and Economic Valuation of Laokhowa and Burhachapori Wildlife Sanctuaries in Assam**" submitted by Mr Kulen Chandra Das, faculty of Economics of Nowgong Girls' College for the degree of Doctor of Philosophy in Economics in the Department of Humanities and Social Sciences, Indian Institute of Technology Guwahati, embodies bonafide record of research work carried out under my supervision and guidance. The collection of material/data from the secondary and primary sources has also been done by Mr Kulen Chandra Das himself.

All assistance received by the researcher has been duly acknowledged.

The present thesis or any part thereof has not been submitted to any other University for the award of any degree or diploma.

(Mrinal Kanti Dutta)

Supervisor

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Contents

List of Tables

List of Figures

List of Maps

Abbreviation

APFBC: Assam Project on Forest and Biodiversity Conservation.

CPR: Common Property Resources.

CU: Cattle Unit.

CVM: Contingent Valuation Method.

DFO: Divisional Forest Officer.

EDC: Eco Development Committee.

ESS: Ecosystem Services.

FAO: Food and Agricultural Organisation.

FGD: Focus Group Discussion.

FSI: Forest Survey of India.

FW: Fuel wood.

GoA: Government of Assam.

HHs: Households.

IAY: Indira Awas Yojana.

IG: INSPECTOR GENERAL

IUCN: International Union of Conservation of Nature.

JFM: Joint Forest Management.

LBCS: Laokhowa and Burhachapori Wildlife Conservation Society.

LBWLSs: Laokhowa and Burhachapori Wildlife Sanctuaries.

LPG: Liquefied Petroleum Gas.

MEA: Millennium Ecosystem Assessment.

MP: Market Price Method

NBFGR: National Bureau of Fish Genetic Resources.

NGO: Non-governmental Organisation.

NP: National Park

NTFPs: Non-timber Forest Products.

NWFPs: Non-wood Forest Products.

NWLD: Nagaon Wildlife Division.

OBC: Other Backward Classes.

PA: Protected Areas.

PEN: Poverty Environment Network.

PGR: Professional Grazing Reserve.

PRA: Participatory Rural Appraisal.

PS: Provisioning Services.

RF: Reserve Forest.

RGGVY: Rajiv Gandhi Grameen Vidyutikaran Yojana.

RRA: Rapid Rural Appraisal.

SC: Schedule Caste.

SFR: State of the Forest Report.

SOFO: State of the World Forests.

ST: Schedule Tribe.

STW: Shallow Tube Well.

TEV: Total Economic Value.

ToF: Trees outside Forests.

WLS: Wildlife Sanctuaries.

WTA: Willingness to Accept.

WTP: Willingness to Pay.

WWF: World Wide Fund for Nature.

Abstract

The Millennium Ecosystem Assessment has categorised the ecosystem services into provisioning, regulating, supporting and cultural that ensures security, basic materials for good life, good health, social relations, and many more to the human wellbeing. Most of the services people obtain from various ecosystems are intangible but very crucial for the welfare of the human society. Forest is an important ecosystem that plays a very critical role as carbons sink, apart from others, and thus ensures the very survivability of the humans and other life forms on earth. Studies show that use of and dependency on common resource such as forest by the fringe communities is almost a universal practice. People living on the periphery of the forest ecosystems rely heavily on the provisioning services such as food, fuel, fiber, grass, etc. having a serious long term environmental implication. The heavy reliance of the peripheral people on the forests may change forest composition, ecosystem functions and resilience.

However, though the peripheral people rely heavily on the forest ecosystem most of them are unaware about the critical value of forest ecosystem to their lives. Therefore, economic valuation of forest ecosystem services is of utmost necessity. Economic valuation is a process of ascribing monetary values to the unquantifiable social and environmental services of the eco-system. The need for valuation arises from the fact that most of the intangible services enjoyed by the fringe dwellers are not taken into account while making environmental decisions leading thereby to missing markets. The failure to place monetary values on environmental goods and services will ultimately lead to their exploitation and loss.

While the existing studies from different forest areas have widened our knowledge on various aspects of forest-people interaction, there are still many other forest areas where empirical researches on the level of people's dependence on forests and determinant factors of forest dependence are still essential areas of research to be addressed. In other words, each and every forest area is important in its own way and contributes richly towards environment conservation. Against this backdrop the present study takes up Laokhowa and Burhachapori Wildlife Sanctuaries situated in the Central Assam districts of Nagaon and Sonitpur, Assam, India, aiming at quantifying and estimating the income share of the forest products to the total household income of the fringe dwellers. The study further attempts to estimate the value of

the ecosystem services and seeks to assess the willingness of the peripheral people to pay for conservation of these important sanctuaries. Located between Kaziranga and Orang National Park these floodplain sanctuaries were once good repositories of biodiversity. But, presently the sanctuaries are grappling for survival owing to various anthropogenic pressures put by the people living beside the sanctuaries. A wide range of anthropogenic pressures such as illegal collection of forest products, massive cattle grazing, encroachment, etc. have been reported in these sanctuaries.

The study is carried out based on primary data. Empirical results are based on a study of 302 randomly selected households from the communities living in the villages within two kilometres from the edge of the sanctuaries. Moreover, 100 households located beyond two kilometres have also been selected to form a control group. The purpose of forming a control group is primarily to assess their willingness to pay for forest conservation and the factors behind such decision. Three Participatory Rural Appraisal (PRA) methods namely, semi-structured questionnaire, focus group discussion and key informant interviews are administered to collect data from the selected samples regarding their forest extraction. The results show that people collect significant amount of different provisioning services from Laokhowa and Burhachapori Wildlife Sanctuaries. Though these services are extracted primarily for domestic consumption a fair share of it is also sold in the forest gate markets by the poor and destitute to earn a subsistence livelihood. Results further show that about 28 percent of the household income of the respondents is obtained from the forests while individual income share may go up to 74 percent of the total income. In other words, the household dependency of the sample households on Laokhowa and Burhachapori Wildlife Sanctuaries is 28 percent. Results of the Tobit regression analysis carried out to examine the determinants of forest dependency has found the education of the household head, house structure, distance from the forest, cattle unit, household income, people living below poverty line and occupation as important determinants of forest dependency.

The analysis found the value of the provisioning services collected by the sample households from both the sanctuaries to be worth Rs. 8.7 million. The value of the sanctuaries would be much more than presented here if the value of other ecosystem services are estimated. On the other hand, fringe dwellers express their willingness to pay for conservation of the sanctuaries looking into the importance of the sanctuaries on their day-to-day lives. It comes to light during the household survey and focus group discussion that most of the respondents are very enthusiastic about a proposition of restoring the forest ecosystem of Laokhowa and

Burhachapori WLSs. The overwhelming response can be gauged from the fact that besides offering monetary contribution 72 percent (or 187 out of 259) of the respondents, who wish to pay for conservation in monetary terms, also wish to get involved in different ways for conserving the sanctuaries. It is noteworthy that some of the respondents, very compassionate about forest, express their willingness to pay more in future provided the money so generated is utilised to its full. Thus, the mean and median WTP of the samples willing to pay for forest conservation are Rs 352.75 and Rs 100 respectively. The median is lower than the mean indicating that the majority of the respondents are willing to pay less than the mean WTP and that the response distribution is skewed due to a few numbers of high bidders. Results of the Tobit regression analysis for identifying independent variables have shown that family size, household income and cattle unit have a positive association with the willingness to pay of the respondents. On the other hand, forest dependency influences negatively the willingness to pay of the respondents for forest conservation. Since, the benefits of the forest ecosystem spills beyond the locality the willingness to pay of the people living beyond the fringe area (beyond two kilometres) have also been analysed. The analysis found the WTP of the people living beyond the fringe area from the forest boundary to be higher than the people living close to the forest boundary. The WTP for this group of respondents is Rs. 1110 and the analysis confirms that the household income of these respondents is the only independent variable influencing the WTP decisions positively and significantly. A few of the respondents also call for protest bids denouncing that forest conservation is the responsibility of the forest department.

Based on the findings, the study concludes that the immense values of the sanctuaries should not be ignored in designing strategies for conservation. The participatory approach should be encouraged and the local peoples' opinion should be respected and incorporated in decision making by the local forest managers. The study identifies the need of provision of basic education and awareness for the fringe dwellers so as to instil the conservation attitudes. With a view to get rid of the pressure of overgrazing, the huge un-inoculated and low milking cattle population of the fringe villagers are to be replaced with high milking variety.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study:

Concern over the potential for natural resources availability has grown in the past three decades among all stakeholder groups – from experts to civil society actors and policy makers. Natural resources, which are the gift of nature and are utilised for the improvement of the wellbeing of the mankind, has grown particularly acute in the twentieth century (WEF, 2014). The acuteness in the supply of the natural resources generates conflict which, if not addressed properly, shall cause environmental degradation and undermine livelihoods. Natural resources are useful raw materials that human obtain from the earth. It implies to the components of natural environment, which fulfil functions in eco-system processes, and which are also useful or beneficial for humans but cannot be produced by them. Thus, geographical location of a country, its size, topography, climate, vegetation, soil, wind, water, animal wealth, minerals, solar light, etc. are its natural resources (Jat and Mathur, 2007).

The economic growth of a region depends upon proper exploitation of its natural resources. The resources like land; water, minerals, forests, fisheries and livestock are the natural gifts and are transformable into tangible wealth on exploitation to produce agricultural, industrial and energy outputs. These are the most significant ingredients for stimulating the economic growth of the region (Pannerselvam, 2008). Given the harnessing process of natural resources and the characteristic pattern of their exploitation and use, the interaction between human society and nature has thus unveiled three aspects of the man-nature problem (Mishra and Bajpai, 2001). Firstly, the technological and economic aspects relating to the depletion of natural resources; secondly, the ecological aspects, concerning environmental pollution and disturbance of biological balance; and thirdly, the socio-political aspect relating to conservation and management of natural resources, and to the preservation of irreplaceable resources.

With population and consumerism growing all over the world, the stock of natural resources has severely been affected. Therefore, the question of natural resource adequacy is gaining momentum. However, Field (2001) observes that it is not a new concern. Before the industrial revolution, when economies were tied more closely to the local resource

endowments, fear of local shortages of items such as food, fodder, fuel wood, and water were very common. With the industrial revolution arriving, with its heavy reliance on coal, concern shifted to the possibility that the resources, since it was non-renewable, would grow scarce. Looking into the finite nature of the resources we, therefore, need to understand that extraction of resources beyond a certain limit creates problems like depletion of the resources culminating into environment pollution and ecological imbalance.

Forest is one of the most important components of natural resources and is the precious gift of nature (Ramakrishnan, 2004). The State of the World Forest (FAO, 1995) explains forests to be a complex ecosystem capable of providing a wide range of economic, social and environmental benefits. The forests are intricately connected to the livelihoods of rural people. They provide food, fuel wood, timber, non-timber forest products (NTFPs), and a host of non-forestry services - climate control, water recharge, storm protection, fertility and nutrient balance, etc. - that are commonly termed as 'ecosystem services' (MEA, 2005). The benefits of ecosystem services can be classified into four categories namely, provisioning, regulating, cultural and supporting services. The forest eco-system services (ESS) control floods, filter pollutants, assimilate waste, recycle nutrients and regenerate soil. The NRC (2005) also apprises that forests provide a wide range of assets including household goods, cultural values, physical and biological products, and other services that are vital to the livelihood of many forest and fringe dwellers and the economy as well. Thus, the forests are sources of food, fuel, fibre and income of millions of people globally living in close proximity to the forests. In other words, forest ecosystems play a pivotal role in the wellbeing of the resource poor fringe dwellers in the form of both provisioning and regulating services and, thus, are vital to our economies. However, the important trade-off is that a country can raise supply of different goods and services by converting forests to agriculture. But, in doing so it decreases the supply of services that the forest would generate and which may be of equal or greater importance for the very survival of the humanity. The state of the forest report, (FSI, 1987) explains that excessive grazing, frequent fires and other biotic pressures have eliminated the probability of natural regeneration to a considerable extent. It further tells that the extraction of fire wood goes generally unrecorded and lead continuously to the depletion of forests. Therefore, the study of ESS and its importance has gained enormous prominence and attracting the environmental scientists, managers and policy makers (Muller and Burkhard, 2012).

Various countries presently are attaining rapid economic growth at the cost of already depleting natural resource base of which forest is a vital component. However, there is always a limit for physical conversion of environment beyond which it will create more problems than opportunities. Since, the forest ecosystem plays a very crucial role in the wellbeing of the poor fringe dwellers the worst sufferers of such physical conversion, or depletion and degradation, of forest resources will invariably be the forest dependent people who not only supplement their domestic requirement but also earn their subsistence income by selling some of their daily collection (Handique, 2004; Saikia, 2000). Panta et al. (2009) in a study in Central Terai of Nepal found the rural poor to be disproportionately dependent on forest resources in the sense that a higher proportion of their total income comes from forest resources. The study further notices that lack of alternative energy sources and high profit margins of fuel wood economy are important causes of deforestation. Hegde and Enters (2000) in a study at Mudumalai Wildlife Sanctuary observe that the poor fringe villagers depend on forest mostly due to non-availability of any meaningful alternative sources of livelihood. Nadkarni (2001) in this regard writes extensively in "Poverty, Environment and Development in India" that continued poverty makes people dependent heavily on the available natural resources. Despite being various poverty alleviation policies are on board a significant portion of India's population still live in abject poverty which will continue to put pressure on these resources.

Millennium Ecosystem Assessment (MEA, 2005), a monumental work involving over 1300 scientists from 95 countries, estimates that more than 1.7 billion people live in the 40 nations with critically low levels of forest cover, in many cases hindering prospects for sustainable development. World Resource Institute (2013) states that more than one billion people worldwide depend on forests for their livelihoods. FAO (2016) reports that there are more than 1.25 billion people, mostly poor, living in the fringes of forests and depend on various forest products. Human population growth has drastically shrunk the forest-to-people ratio from 1.2 hectares per capita in 1960 to 0.6 hectares per capita in 2005. By 2025, the ratio is predicted to decline further, to 0.4 hectares per capita (MEA, 2005). In India, more than 41 million tribal and forest dwellers derive their earnings from forest products after consuming about 60 percent of their collection (Das, 2005). The quantum of people depending on forest found to vary across space as reported by various researchers, e.g., 22 percent (Shylajan and Mythili, 2003); 54 percent (Das, 2005); 88 percent (Dash, et al., 2016).

Shylajan and Mythili, (2003) and World Bank (2006) points out that the intensity of extraction and thus the forest dependency may vary among different communities, among household within communities and between locations in the forest. The dependency varies in the ranges of 10 percent to 90 percent usually characterised by a higher share enjoyed by the poorer households (Cavendish, 2000; Davider et al. 2010). Various researchers have estimated different degree of dependency across localities, e.g., Dash et al. (2016) estimates it to be only 6 percent while Fikir et al. (2016) calculates it to be 21.4 percent. There are many studies showing different degree of dependency of the forest fringe dwellers on the forests.

The heavy dependence along with the unsustainable collection is one of the vital factors of decimation and degradation of forests. Maikhuri (1991), in a study carried out in Arunachal Pradesh, blames the use of fuel wood as a factor primarily responsible for deforestation in the region. Thus, analysing the status of the forest in the Asia and Pacific region the State of the World's Forest (FAO, 2009) predicts forest areas of developed countries to remain stable or increase slightly while it will deplete and degrade in the low and middle income forest rich underdeveloped countries as a result of expansion of agriculture, including production of bio fuel feedstock. Different State of the Forest Reports published by Food and Agricultural Organisation show a gloomy picture of the forest cover of the world stating that the overall rate of deforestation is still alarmingly high, although the rate is slowing down. Demand for food and wood products will continue to increase in line with the growth in population and income. Growth in the demand for primary commodities owing to rapid industrialization of emerging economies is likely to result in forest conversion in other countries within and outside the region. High food and fuel prices will favour continued forest clearance for production of livestock and agricultural crops. It is very much understandable here that the economic growth of the emerging economies are associated with increased environmental impact especially forest degradation. Musavi (2015) echoed in this regard that uncontrolled human activities and massive grazing by domestic livestock are two of the major causes of forest degradation in India.

India fares very poorly as far as forest cover is concerned. There is a decrease of 281 sq km forest area in India (FSI, 2013) in between 2009 and 2011. Such loss of forest cover can be attributed to a variety of anthropogenic and other factors such as extraction of huge forest goods, such as fuel wood, by the fringe people and poor maintenance of forests by the forest department (Dev, 2001). Despite various forest policies and acts came into force, post-independence India is still losing a million hectares of forests per year (Ranjitsinh, 1984). NE

India also witnesses a decrease in forest cover which is mainly attributed to the Jhum Cultivation practiced by the indigenous people of the region. For example, quoting the FSI report, Ranjitsinh (2017) says that Mizoram had its forest cover reduced by nearly 844 sq. km. between 1999 and 2004. It further says that about 400 sq. km. of forest is annually brought under Jhum cultivation aggravating the already decimated forest per capita in the country. Apart from Jhuming, strong biotic pressures such as collection and extraction of different forest products, extensive grazing, encroachment for cultivation and house construction due to increased population and their ever increasing demands, logging, etc. can be attributed for extensive forest cover loss.

Assam is highly rich in forest covers consisting of large numbers of floras and faunas and other valuable forest products. Forest ecosystem of the state includes the National Parks (NP), Biosphere Reserves, Wildlife Sanctuaries (WLSs) and Reserve Forests (RFs). The Protected Area (PA) Network consists of three tiger reserves; five national parks and eighteen wildlife sanctuaries make it convenient for sheltering large numbers of birds, mammals, reptiles, primates, etc. But, the rich forest cover and valuable forest resources of the state are disappearing rapidly particularly from the last few decades due to massive anthropogenic pressures such as deforestation, illegal felling and collection of forest produces, forest fragmentation, encroachment in the fringe areas for human habitation and cultivation, poaching and other unplanned developmental activities. The total forest cover of Assam was 39 percent in 1987 which came down to 35 percent in 2016 (FSI, 2016). Since independence 2200 sq. km of prime habitat mostly tropical rain forest have been cleared for tea plantations in Assam. Most of the protected areas of Assam, except a few like Kaziranga, are under pressure of encroachment. For e.g., 12 sq. km out of 24 sq. km of Bhairabkunda RF and 100 sq km out of 188 sq. km of Balipara RF has been encroached upon. Similar is the case for Gohpur RF and Gali RF where almost entire forests measuring 133 sq. km and 106 sq. km respectively have been encroached (SoEA, 2004). Grazing is another area of concern as far as the forests of Assam is concerned. In the absence of any professional grazing reserve the domestic stock are let loose into the forests creating an unholy competition between the domestic and forest ungulates for food. Unregulated and excessive grazing in forests degrades the forest soils and hampers the natural regeneration (FSI, 1987). Moreover, the loss of forest cover can also be attributed to the political environment of the state. Since the beginning of the foreign national deportation movement in 1979 till date, the political situation of the state has remained far from peaceful. The anti-socials, smugglers and

poachers are taking the advantage of such a disturbed situation and its impact clearly revealed in the rapid depletion of valuable forests and wildlife. This is responsible for virtual elimination of the rhino and tusker in Manas NP (SoEA, 2004). In Laokhowa and Burhachapori WLSs, almost all the rhinos fell to poachers in the early 1980s due to the turbulent situation arising out of foreign national deportation movement in the state (Bora, 2004: Phukan and Sarma, 2004).

It is now quite explicable from the above discussion that the forest cover is losing across countries of the world (FAO, 2011, 2015; FSI, 2011, 2013) with serious long term implications for the overall environment and especially for the resource poor fringe dwellers. But, who is responsible for loss of forests – the poor or the rich? There is no straight forward answer to this question. The relationship between poverty and environment is complex, subject to extensive debate and varies according to the local socio-economic and larger macro-economic policy context (Bucknall et al. 2000). The predominant school of thought argues that poverty is a major cause of environmental degradation while the other school of thought views the direct link between the two is too simplistic and believe the nexus is governed by a complex set of factors. Duraiappah (1998) wrote the Brundtland Commission report to have accepted poverty to be a major cause of environmental problems. He further quotes Asian Development Bank and World Bank upholding similar views. However, he also puts into record other studies stating the problem to be a multidimensional and opined that simple generalisation of it will often be erroneous. Nadkarni (2001) writes about the widely held view in west, of regarding poverty as the main cause of environmental deterioration. But, he fears that it would lead to further aggravation of the poverty completing the vicious cycle. He, of course, goes further saying that it is not always the poor for which the forest degrades, rather, he holds wood requirements of the urban areas, their changing consumption behaviour as well as the developmental projects responsible for wanton destruction of forests. Angelsen (1995) in this regard writes that environmental degradation and poverty reinforces each other: the poor are both agents and victims of environmental destruction. Gray and Moseley (2005) state that the notion that the relationship between poverty and environmental degradation is long-standing, yet constantly being re-discovered and re-invented. Therefore, there is a pressing need to understand this issue and make policy suggestion.

Taking part in the poverty environment debate Hope (2007) in a study in Africa report that the convergence of population growth, poverty, the rising demand for lumber and fuel wood and the conversion of forests to agriculture are expected to put massive pressures on the

continent's forests in the coming years. The resultant destruction and loss of forest cover will further destroy the environment and the way of life of the poor. On the other hand, Nwagbara et al. (2012) state that poverty is closely linked to environmental degradation. They opine that the poor are both victims and agents of environmental damage. Poring through literature the authors observe three distinct schools of opinion regarding the poverty environment discourse. One, those who argue that the poor is the major cause of environmental degradation due to their high population and increased pressures; those who contend the high consumption intensity of the rich to be the major cause of environmental degradation and the third view both rich and poor as the contributor to the environmental degradation. The bottom line, the study concludes, is that both are differently affected by the environmental problems resulting out of it. In a study across Latin America by Swinton et al. (2003) also suggest that the non-poor and the poor are both at fault. Bucknall (2000) therefore state that the specific ways in which the poor people depend on natural resources and are affected by environmental changes is not universal, but country and region specific. It is, thus, evident that any simple conclusion or easy synthesis of these relationships is further confounded by the quantity of evidence and counter-evidence favouring or undercutting different hypothesis.

However, the depletion of forest cover and forest degradation (Lanely, 2003; Nandy et al. 2011) is of great concern to the people of the present day world. Panta et al. (2009) also revealed that the forest dependent people suffer from geographical isolation and social exclusion and thus disproportionately dependent on forests. The study further showed that these people are the worst sufferers of forest degradation. Moreover, the resource poor fringe dwellers are facing severe isolation as a result of implementation of various forest policies and in the process get deprived of the easy access to forest and forest goods and services which for years they were enjoying. It creates a hostile attitude among the fringe dwellers and thus contributes to the forest degradation. Degradation of this important natural capital has many causes and challenges the ecosystems' resilience, which is its capacity to absorb disturbances without undergoing fundamental changes. It is to be understood that the ecosystems have limited resilience and once if they lose it, a small disturbance can change it into a fully new state (Samal, 2007).

Thus, the people-forest interface is gaining importance in the forestry development discourse over the last several years due to its significance from the view point of community welfare and sustainable forest management (Panayotou and Ashton, 1992). Shylajan and Mythili (2007), in this regard, also acknowledge that the interaction between forest and forest

dwelling communities have received increasing attention from social scientists and policy makers. Assam Forest Policy (MoEF, 2004), thus, gives emphasis on inculcating in the people an awareness of the value of the trees, forests and wild life and their contribution towards not only a healthy environment but also towards their poverty alleviation. It, therefore, needs extensive and reliable qualitative and quantitative knowledge about each forest ecosystem and forest and peoples interface for developing appropriate strategies and programme to conserve and manage the forest. Kothari (2001) emphasises that the forest managers should gain an ecological understanding of the concerned forest area especially the impact of various human activities on elements of local biodiversity and on the ecosystem in order to manage it sustainably. The data and knowledge of status of deforestation, forest dependency, perception and attitude of the settlers and their willingness to participate or pay for conservation are also necessary for sustainable management of the forests. The forest managers need to realise and make the fringe community aware and understand about the environmental services and true value of forest ecosystem.

Therefore, in making a choice between conservation and development the economic values of the ecosystem goods and services must be known so that they can be compared with the economic values of human activities. Failure to place monetary value on environmental goods and services, according to Costanza et al. (1997), is the primary cause of loss of large area of forest. Though the immense values the society derives from the forest ecosystems are very crucial for the very survival of the human kind (Daily, 1997) however, the value of such services are ignored in environmental decision making leading to mismanagement and loss in the long run (Voeks and Rahmatian, 2004; Jantzen, 2006; MEA, 2005). It is interesting to note that the people, by and large, and especially in the rural area, have been ignorant about the benefits from forests, even though their lifestyles are intimately linked with the forests for long. This is primarily due to the fact that most of the forest goods and services have no market and hence people don't realize the immense value of such services. Therefore, all such benefits derived from the ecosystem services of forests need to be demonstrated and captured (Pearce, 1996) though it is very difficult to realise and capture the true values of these services. Brander et al. (2010) also talks about capturing the true values of the forest goods and services in order to offset the misguided policy and therefore misallocation of scarce resources. Thus, to justify the spending on management and preservation of forests there is a need of economic valuation of forests. Such an exercise of forest valuation would assist in developing strong cases about the need to finance forest protection and management.

The various forest policies implemented by the government starting from creation of the forest department in 1864 by the British has been served to isolate the people from using forest resources which till then was easy to access (Kothari, 2001). The resultant deprivation and alienation are the factors behind the outbreak of conflict or tension between the fringe community and the local forest managers. The forests, a common pool resource, have long been recognised as the store house of biodiversity and serving as the source of livelihoods of hundreds of millions of rural residents (Agrawal, 2007). The rural residents are generally poor and poverty ridden and the questions arises if their poverty is responsible for their greater reliance on the commons (Jodha, 1986) and therefore incentivises the conservation or for higher levels of harvesting and degradation, or do increasing levels of wealth, at least initially, lead to greater degradation of commons? Here comes the question of sustainable management of the commons and Ostrom (1999) points out, unlike Hardin (1968), that local groups have created wide diversity of institutional arrangements, in the absence of effective governmental initiatives, for coping with the commons. There may be literally hundreds of different rule combinations from which decision makers can choose the most suitable one to fit into local conditions and therefore, she argues that there is no necessity of imposing regulation from outside. Ostrom (2005) in this regard analyses that local groups of resource users, sometimes by themselves and sometimes with the assistance of external actors, have managed to create viable institutional arrangements for coping with common-pool resource problems. In India there are many such examples of institutional arrangement for forest conservation. Ghate and Nagendra (2005) and Ghate and Mehra (2003) find three such arrangements where community are in the forefront of forest management and considered such participation as relevant and consistent with India's overall development strategy and reducing poverty and protecting environment. Similarly, Baland et al. (2010) argue that the performances of the Van Panchayats in sustainable management of the forest in Uttarakhand are far more efficient in conserving than the state forest department. Somanathan et al. (2009) in a study in Uttarakhand find the forest in the Indian Central Himalayas to be better conserved under decentralised management and also at much lower cost. In a similar study conducted in Nepal by Nagendra et al. (2008) find that community based institutions are capable of halting or even reversing trends in deforestation and forest fragmentation.

1.2 Statement of the Problem:

The protection and improvement of the forests, against the trend of continuous forest degradation, is of paramount importance to the very survival of the humanity. The forests of

Assam can contribute hugely to the rich heritage of our composite culture besides protecting the natural environment. The need of the hour is to examine the role of the forests in various walks of human life living close to the forested zones and to elicit their value from the perspective of those peripheral communities. It is further felt and realised that a rigorous and in-depth investigation into the socio-economic aspects of the fringe communities is required to elicit the true values of forests.

It appears, from the literature, that poorer households living close to the forests are dependent more on forest and consequently derive higher income from these resources. Their life is intimately connected with the forests, which is their sources of livelihood. Assam is known for its extensive forest areas and availability of rich floras and faunas besides other valuable forest products. In terms of forest resources it is one of the richest states in India. The recorded forest area of the state is 34.21% of its geographical area. The protected area (PA) network of the state includes 5 national parks and 18 wildlife sanctuaries. Having massive fringe population in and around these PAs along with their increased demand, the forests of Assam are being overexploited and encroached upon for both agricultural and settlement purposes. Livestock in the fringe areas are raised and their numbers are increasing over the years since rearing does not involve any cost and it encourages further increasing their numbers. People don't practice stall feeding and let their livestock free into the forest land in the absence of grazing reserves putting huge pressure and affecting the carrying capacity of the forests.

The loss of forest cover results into soil erosion, floods, droughts, climatic change, the elimination of many species of animals, plants, etc. leading to loss of biodiversity, and ecological balance culminating finally to environmental crisis (Sengupta & Paul, 2007). Forest degradation, thus, can substantially impair an array of ecosystem services. This is because of failure to understand the economic contribution of forests ecosystem and to quantify it (Samal, 2007). Therefore, obviously, question arises about the sustainability of this renewable resource in the coming days.

Jasmin and Chakraborty (2007) conclude that the environmental challenge that North-Eastern India is facing today are greater than any other time in the history of the North-Eastern region. Managing sustainably the forests of the region is thus a challenge. Kothari (2001) in this regard says that vast majority of management decisions including to curb human use have been done the basis of assumptions and generalisations, not solid research or evidence

from site specific circumstances. In other words, he emphasises in carrying out one to one rigorous research in each protected areas to manage it sustainably. Fikir et al. (2016) also opined in this regard that though the forests across places are facing almost similar problems but each and every individual forest area needs separate and special attention. He says, "While the existing studies from different forest areas have widened our knowledge on various aspects of forest-people interaction, there are still many other forest areas where empirical researches on the level of people's dependence on forests and determinant factors of forest dependence are still essential areas of research to be addressed".

The extraction of products from the forest depends on a number of factors relating to households and village characteristics. Some factors relating to demographic features like population growth, size of the households, sex composition, availability of working population etc.; some are economic, e.g., individual landholding pattern, livestock unit, occupational structure, transaction costs, opportunity costs, economic status, the existence of market and the technology of harvesting; some are social like education, male headed households, etc.; some are geographical like the size of the village, distance from the residence to the resource field, distance to nearest markets, etc. and some are institutional like customary extraction rule, civil law, etc. (Kuri, 2007).

It is to note that to our knowledge though there is no dearth of literature on forest dependency and forest valuation across different countries of the world or even different states of our country, dependency of the peripheral communities on the forest and the valuation of forest eco system services are largely remaining neglected in Assam. Against the backdrop of above discussion the present study is designed to attempt to estimate the degree of dependency of the peripheral people of forests along with the key factors influencing such dependency taking Laokhowa and Burhachapori Wildlife Sanctuaries (Laokhowa and Burhachapori WLSs) of Assam as a case.

Laokhowa and Burhachapori WLSs represent unique floodplain forests ecology in the Brahmaputra floodplain ecological zone[1]. It is, in fact, one of the important flood plain forests in Assam and the only degraded sanctuaries among them (Bora, 2004; Phukan and Sarma, 2004; Choudhury, 1998). State of Environment Assam (2004) reports in this regard that Laokhowa and Burhachapori wildlife sanctuaries are by far the most disturbed and degraded sanctuaries which can be gauged from the fact that the one horned Rhinoceros and Bengal Florican, two critically endangered species, once abundant in the sanctuaries, have

been wiped out from here. 35 rhinos were poached in a single year in 1983 compelling the rest to take refuge in other nearby rhino bearing habitats. Large scale felling, illegal collection of forest products, massive unregulated grazing even by establishing cattle camps inside the sanctuaries, encroaching the forest land for cultivation are some of the major pressures exerted by the huge population inhabited in the fringe villages (Bora, 2004; Phukan and Sarma 2004; Sivakumar, et al. 2013). The pressure seems unabated and is demonstrated from the fact that fourteen Himalayan Griffon Vultures (a near threatened species) have been poisoned to death on 25 March, 2018 (informal telephonic talks with the DFO, Nagaon Wildlife Division). Though degraded the sanctuaries are of vital importance for the overall environment as emphasise by many researchers.

1. Laokhowa and Burhachapori Wildlife Sanctuaries are the floodplain forests of Assam (Choudhury, 1998; Bora, 2004; Phukan and Sarma 2004). The floodplain forests are unique and endangered ecosystem in the sense that these forests are biologically more productive and diverse. Despite having many stresses such forests consist of diverse species and by far the most species rich forests among all other types of forests. During past few years growing objections have been raised to the destruction of floodplain forests (Junk and Welcomme, 1990).
2. Both Laokhowa and Burhachapori WLSs are part of the Kaziranga-Orang riverine landscape, which has been identified as a major gateway for straying animals within the protected areas of Central Assam. The sanctuaries are critically located and are of vital importance since they act as a migratory corridor for the wild animals between Kaziranga and Orang National Park (Borthakur, 2011; Ojah, 2016).

Therefore, on the basis of the above facts, the current study wants to estimate the dependency of the people on Laokhowa and Burhachapori Wildlife sanctuaries so as to understand the degree of disturbance exerted by the fringe dwellers. The study further strives to identify the important drivers and their inevitable pressures on forest ecosystem along with the associated impacts. Thus, holistic actions are expected from the local forest managers as well as other important stakeholders for rectifying the past damages.

In the face of the larger scenario of massive grabbing of forest land the conservation of forests can be justified by estimating their true value which is generally ignored in the policy decision (Pearce, 2001). The study, therefore, aims to estimate the values of provisioning services of Laokhowa and Burhachapori WLSs which are collected illegally by its fringe

dwellers. It further takes into account the locals' perspective towards conservation of the sanctuaries and thus assesses their willingness to pay for its conservation. Moreover, the ecosystem services derived from the sanctuaries and the livelihood linkage is one of the important aspects to be analysed in the study. The dissertation attempts further to estimate the value of the forest provisioning services and to assess peoples' willingness to pay for the conservation of these hitherto bio-diverse sanctuaries.

The findings of this study are anticipated to be very suitable and crucial for formulating policies for sustainable forest resource management. It may help formulating evidenced based strategies for forest conservation at local level. The management requires the local data besides regional and national for putting a sustainable management regime in the specific areas of forests. In the face of the present scenario of massive grabbing of forest land for various developmental projects, one is repeatedly told that conservation of any species or area can only be achieved if that conservation can be justified by a tangible monetary benefit to the stakeholders, especially the local communities. Ranjitsinh (2017) strongly opines that the valuation studies are of vital importance which calculates the values of our parks and sanctuaries and establish that the forests are not merely environmental but economic assets as well and hence to be conserved.

1.3 Research objectives:

The broad objective of the study is to determine the characteristics of the households living in the periphery of the forest and their resultant dependence on it along with the impact besides assessing their willingness for forest conservation.

Based on the broad objective the following specific objectives are set:

- **To examine the degree of dependency of the fringe people on forests.**
- **To quantify and estimate the value of provisioning services extracted from the forest and assess fringe peoples' willingness to pay for forest conservation.**

1.4 Research questions:

- What are the household characteristics of the forest fringe people and how it is linked with forest dependency?
- What are the tangible benefits extracted by the forest fringe people and their economic value?

- What roles do the forest ecosystems play in the wellbeing of the fringe people?
- Are people aware about the intangible services of forests?
- What are the attitudes of the forest fringe people towards forest conservation?

1.5 Data and Methodology:

The present study is based on the use of both the primary and secondary sources of data. Secondary data relating to the forest cover of India including Assam are collected from various forest survey reports estimated by Food and Agricultural Organisation and Forest Survey of India. The information related to the history and the states of the study area are collected from the Management Plans of the concerned sanctuaries and various scientific studies carried out by both individuals and government and Non-government Organisations.

However, the study is based mainly on primary data collected from the households living in the periphery of Laokhowa and Burhachapori Wildlife Sanctuaries. A two – stage sampling design was followed for conducting the in depth study. In the first stage, sample villages were selected purposively on the basis of some pre-determined criteria such as communities living, proximity to the forest and anthropogenic pressures in the form of human and livestock population. As such nine villages (four from Burhachapori and five from Laokhowa Wildlife Sanctuary) within two kilometre periphery from the sanctuaries have been identified in consultation with the key informants from both Nagaon Wildlife Division (NWLD) and Laokhowa Burhachapori Wildlife Conservation Society (LBCS). After selecting the villages, the census data are consulted for selecting the number of households to be studied and surveyed. Looking into the heavy population of the villages and homogenous households only 10 percent of the households of a village are selected randomly for final household survey. However, to assess if the beneficiaries of the forest ecosystem services only wish to contribute towards forest conservation a group of 100 respondents, termed as control group, is also selected from beyond two kilometre hypothesising the households have no forest interaction. Thus a total of 402 sample households are interviewed for generating primary data. The data are collected using a semi-structured question schedule covering various aspects of their forest interaction relating to their forest produce collection and willingness to pay for forest conservation. The question schedule is finalised after field testing among thirty households in two villages. The primary data are collected in two different phases in the year 2016. Besides, the market survey in the forest gate markets have been undertaken to obtain the market prices of various forest produces collected and transacted in the markets.

The data generated from the field survey are analysed using appropriate statistical tools. For examining the determinants of the dependency of the fringe people and the willingness to pay for the conservation of Laokhowa and Burhachapori Wildlife sanctuaries the Censored Regression (Tobit) model is employed. The analytical techniques have been elaborated in the concerned chapters.

1.6 Organisation of the thesis:

The remainder of the thesis is as follows:

Chapter two presents a review of available literature carried out by various scholars on the ecosystem services and the level of dependency on it, valuation of such services, willingness to pay for forest conservation and the determining factors for such willingness. This chapter is important since it lays the foundation for analysing the context of other studies and comparison thereof with the present studies. This chapter gives an insight for selecting the methodology regarding primary survey and analysis of the survey information to be adopted for the present study.

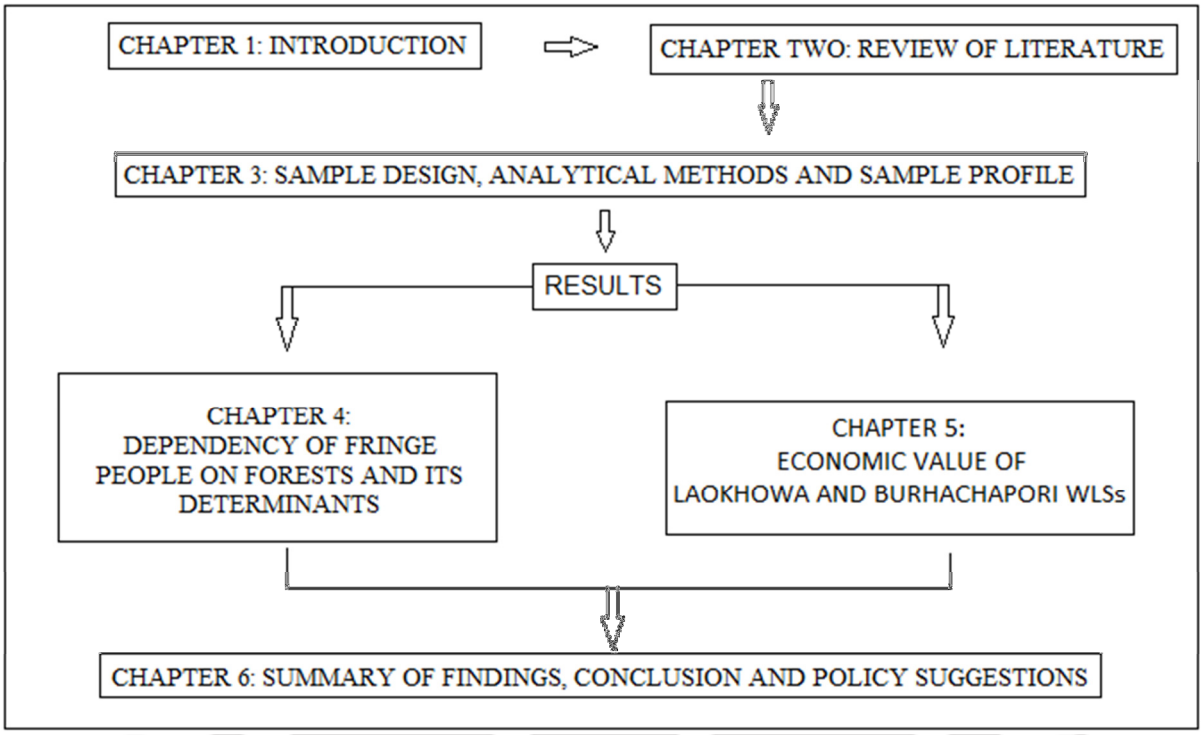
Chapter three provides the methodological framework adopted for the present study such as sampling procedure, data collection and data analysis. It also describes the location of the study area, the demographic profile of the sample households taken for detailed study, the resource base of the households and most importantly the account of forest extraction by the households.

The actual discussion begins with the fourth chapter. It discusses the degree of dependency of the peripheral communities on Laokhowa and Burhachapori WLSs. It further elaborates various kinds of forest products people harvest from the forests and underlying causes of such dependency.

The fifth chapter gives a detailed analysis of the value of the provisioning services extracted by the fringe dwellers from Laokhowa and Burhachapori WLSs. It further presents the result of the estimation of the willingness to pay exercise of the fringe people for the conservation of the forests. Most importantly the chapter gives a comparative picture of the willingness to pay of the people residing in close proximity with that of the people living away from the sanctuaries. The last chapter presents the summary, conclusion and policy suggestions.

Figure 1.1 represents the organisation of the chapters of the dissertation:

Figure 1.1
Organisation of the thesis



[1]The Laokhowa and Burhachapori are the two most important floodplain forests of Assam. The floodplain forests of Assam are unique and endangered ecosystem. Such forests are unique because of their periodic flooding. The regular disturbances, which deposit silt and sand along the banks of waterways, help create and maintain unique communities of plants that tolerate flooding and requires nutrient rich soils. The forests grow in areas that are annually flooded by large rivers during mean periods up to four/five months and at depths of up to 6 m. Despite the severe stress these forests consists of diverse species and are by far the most species rich forests in the country. The damp soils create rich habitat for various insects and amphibians. Floodplain forests provide refuge, food and water to migratory and resident waterfowls, mammals, fishes, amphibians and reptiles and therefore given top priority for conservation, management and restoration (Stella et al., 2013). Floodplains provide corridors that allow wildlife to move from one habitat to another (Junk, et al., 2010). Until about 1972, Assam was very rich in floodplain forests, characterised by the existence of large number of wetlands, grassland, woodland and fresh water mangrove, however it decimated in the later years. Junk and Welcomme (1990) state that growing objections have been raised to the destruction of floodplains for last few decades.

CHAPTER TWO

REVIEW OF LITERATURE

Any research review of existing literature becomes imperative to have a clear understanding about the issues to be undertaken and the exiting related works. Keeping in view such importance this chapter aims to give a comprehensive outline of theoretical and empirical literature analysis of forest dependency, monetary value of forest ecosystem services and willingness to pay of the fringe dwellers for forest conservation. The review focuses primarily on current literature on these issues. To carry forward the study of forest dependency and estimation of the value of forest ecosystem services of the study area, various published and unpublished documents have been reviewed and cited. The literature reviews have been presented in sub-headings like forest dependency, ecosystem services of forest and their value.

2.1 Forest Dependency:

Forests are vital sources of foods (plants and animals), medicines, and a range of other products and services and are important as a means of generating cash income. More than 1.25 billion people, mostly poor, live in proximity to the forests and depend on forests for various products (FAO, 2017). These forest products play a significant role in rural livelihoods, particularly for the rural poor (CIFOR, 2008). At the global level, five major categories accounted for 90 percent of the total value of NWFP removals: food (51 percent), other plant products (17 percent), honey (11 percent), ornamental plants (6 percent) and exudates (4 percent) (FAO, 2010). Thus, the forest products earn the resource poor fringe people a good income which help alleviate poverty from among many of such households (Angelsen and Wunder, 2003; Cavendish, 2000; Vedeld et al., 2007; Abdulla, et al, 2016). Thus, the forest resources act as a safety net for the poor to relieve the 'hunger period' in the agricultural cycle and in smoothing out other seasonal fluctuations (Heubach et al., 2011; Kamanga et al., 2009, Illukpitiya and Yanagida, 2010). Globally, the dependence on forests for livelihoods tends to be highest in areas with high forest cover and pervasive poverty (Sunderlin et al., 2008).

Forests provide a wide range of natural assets, including household goods, cultural values, physical and biological products, and other services that are vital to the livelihoods of many

people (USDA, 2007). Thus, the forests are sources of food, fuel, fiber and income for millions of people globally living in close proximity to the forests. Studies conducted by different researchers found peoples' dependency on the forests to be because of fuel wood, fodder, timber, raw materials for forest based industries, small timber for agricultural implements and other NTFPs, food and land on which to grow crops, etc. (Reddy and Chakravarty, 1999; Malik et al., 2014). Forests are also used extensively for grazing the domestic stock of cattle in the absence of professional grazing reserve. Forest-based industries provide employment and revenue for many others (Angelsen et al., 2014). Forest income, mostly from NTFPs, is an important source of both subsistence and cash particularly for low income groups as it provides the opportunity to diversify their livelihoods (Adhikari et al., 2004).

It is to be noted here that the existing forest policies of India don't allow the peripheral people to enter the parks and sanctuaries for collection of forest products. Even though such restrictions are in force, the asset poor fringe dwellers collect various products illegally in the absence of any other means of survival. However, many of them have ceased to sell the NTFPs owing to the restriction and the forest products are now consumed locally (Dash, et al., 2016).

In fact, peoples' lives have been intimately associated with the forests as they collect fuel wood, building materials (such as timber, bamboo, cane, grass, etc.) for dwelling houses, materials for construction of agricultural implements, furniture, utensils, besides many other useful articles (Ganguli, 2006). It is, thus, clear that the fringe dwellers across countries of the world rely on forests for variety of goods and services. Thus, studies conducted by various researchers have confirmed that the NTFPs play a key role in the economic development of local communities and sustainable forest management (Panayotou and Ashton, 1992; Gunatilake, 1993 & 1998; Arnold and Perez, 2001; Shylajan and Mythili, 2003; Adhikari *et al.,* 2004; Das, 2005; Quang, 2006). The extent of dependence on forest resources around the world among households with access to forests varies from 6 to 65% depending on local circumstances (Shackleton et al., 2007; Illukpitiya and Yanagida, 2008; Kamanga et al., 2009; Heubach, et al. 2011; Kar and Jacobson, 2012; Angelsen et al., 2014). However, studies have estimated that the income from the NTFPs are very significant ranging between 10% to 90% and usually characterised by a higher contribution for poorer households than wealthier ones (Cavendish, 2000; Davidar et al., 2010). For example, Dash et al. (2016), report that 88% of the people in the fringe of Simlipal Tiger Reserve in Orissa depend on the

forest though their share of forest income is very low, i.e., 6% only owing to less market interaction and also the low price. The study by Abdullah et al. (2016) estimate 74% and 48% of the total income coming from forest resource for the lower income and middle income households in Sundarban which is 25% for the higher income households. The study in south eastern Ethiopia by Fikir et al (2016) found that income from forest products contribute 21.4% of the total household income. Thus, it can be concluded that there is significant variations in dependency of the fringe dwellers on forest.

In an attempt to identify the role of NTFPs in the peripheral communities Gunatilake et al. (1993) reports that the villagers in the fringe of Knuckles National Wilderness Areas of Sri Lanka use forty seven plant species (NTFPs) for food, medicine, spices and construction materials. The study concludes that the share of NTFPs decline as income of the people increases. It, thus, indicates a greater role of NTFPs for the income poor villagers. Using market price method the study has found 63% of the total income of the peripheral community here to have obtained from forests. In another study by Chopra (1994) conducted in Raipur district of Madhya Pradesh by using MP (Market Price) method infers that 40 percent of the household income is contributed by the NTFPs harvested by the villagers.

In a similar study in 26 villages of three Indian states, viz, Madhya Pradesh, Orissa and Gujrat, Bahuguna (2000) accounted that the fringe dwellers depend on forest resources for meeting their energy needs, forest products and employment. A two part questionnaire is designed to collect data on land and other resources, forest types, distance from the forests, etc. Details of human and cattle population are also collected apart from the information on all their income sources. He finally concluded that the income share of the forest products vary from 37 to 76 percent.

NTFP collection is an important source of income for forest dwellers and rural poor. In order to assess the role of forests among forest villagers a study was conducted by Das (2005) in Buxa Tiger reserve. The result reveals that half of the total families are dependent on NTFPs to supplement their daily requirements. With the reduction of other employment opportunities as a result of ban on many forest activities and crop depredation by wild animals the dependency on NTFPs has been increasing. Consequently, the forest villagers in Buxa Tiger reserve regard NTFPs as more consistent and stable income source. The study reveals that more than 54 percent of total families sustain their livelihoods from sell of NTFPs here. At

least 33 species of NTFP are collected for sale which contributes about 40 percent of the total annual household incomes of these villagers.

The results of a World Bank study on eight villages of Assam have found the villagers to be small-holder farmers, shifting cultivators and landless people. Across all the villages, 76% of households reported agriculture as the primary occupation. All the villagers use forest primarily for subsistence fuel and fodder. Fuel wood supplies an average 79% of energy needs. Fodder from the forests provides about 64% of the feed requirements for domestic livestock. Gross values were Rs 2,440 for fuel wood and Rs. 10,992 for fodder per household per year. Poles play a minor role in forest livelihoods since bamboo occupy a significant role in domestic construction. Most communities collect a variety of non-timber forest products, mainly for subsistence use (World Bank, 2006).

Belaluddin and Mukul (2007) in a study conducted in Satchari National Park estimated that 13 percent of the villagers in the study area are highly dependent on the forest for their livelihood while others are moderately dependent. They further reported that 27 percent of the sampled households obtain at least some of their income from selling of NTFPs and it contributes about 19 percent of the cash income of these households.

Restrictions and regulations sometimes cannot refrain the fringe dwellers from harvesting forest products on the face of abject poverty. This is substantiated by the study of Shylajan and Mythili (2007) in the forests of Waynad district lying in the sub-region of Western Ghats in Kerala. The major products collected are honey, various types of medicinal plants, spices, seeds and gooseberry. 22 percent of the peripheral people and 46 percent of the interior people extract various NTFPs here. Different edible products collected for commercial purpose and honey for domestic consumption purpose contributes the highest to the household income. Using market price method, the authors calculated the gross (mean) value of the collected NTFPs to be Rs. 9542. The study further reports that alternative income source would greatly reduce the dependency of the people on the forest.

The forest dependency study conducted by Lepetu et al (2009) in Botswana accounts that 54 percent of the household collect fuel wood and other NTFPs for domestic consumption and income generation as well. The study further implies that the asset rich households are less likely to put pressure on the forests. The educated and employed households are less dependent on the forest the study elaborates.

In order to examine the heterogeneity of the NTFPs use by the local tribal communities in Northeast India Saha and Sundriyal (2011) recorded 343 diverse NTFPs used by the local communities. A majority of such NTFPs are used for medicinal purposes. The study further estimated the household dependency for fuel wood and house construction materials to be 100 percent. The overall contribution of the NTFPs to the total household income is calculated to be in between 19 – 32 percent.

In an attempt to assess the dependency of the fringe dwellers on forests in Southern Ethiopia Fikir et. al. (2016) found that the people depend on forests for variety of goods and services such as honey, fuel wood, gum and resins, and crafts and construction materials. Using market price method the study estimated the forest dependency of the fringe people to be 21.4 percent. The study is reported to have found significant variation on dependency based on annual household income, the lower income groups depending more on the forest than the people of higher income groups. The dependency varies across space and it is thus 34 percent in South-eastern Ethiopia (Worku, et al. 2014) and 39 percent in North-western Ethiopia. Fikir says, "While the existing studies from different forest areas have widened our knowledge on various aspects of forest-people interaction, there are still many other forest areas where empirical researches on the level of people's dependence on forests and determinant factors of forest dependence are still essential areas of research to be addressed".

Langat et al. (2016) aiming to determine the role of forest resources in the livelihood of the local communities in Kenya found significant dependence of the fringe dwellers on the forests. He administered a market price method to estimate the value of the forest products and thus calculated the household forest dependency. Food, fuel wood, construction materials, fodder and thatching materials are found to be the major products collected by the fringe people. Forest income is significant to household contributing 33 percent of the total household income in the study area.

A recent study conducted at Jharkhand by Islam and Quli (2017) reports that NTFPs accord a very viable livelihood support to the local communities. Though collection and sale of NTFPs are not the prime livelihood option of the fringe dwellers however, the income contribution of the NTFPs is significant which is 17 percent in the study area. Fuel wood, tooth brush, fodder, mahua flower, oilseeds, fruits and vegetables and ethno-medicine are the major products the fringe dwellers harvest from the forest in the study area.

Tropical forests are exceptionally rich in biodiversity and therefore, the current rate of tropical forest clearance is certain to have a profound impact on global biodiversity. The reliance of poor people on natural resources for survival leads to depletion of resources and exacerbating environmental stress. The dependence on the forest for fuel wood, construction poles, expansion of agriculture and other NTFPs has led to degradation, depletion of forest cover and loss of biodiversity, declining farm productivity, increasing hydrological imbalance and soil erosion and the like (Chipika and Kowero, 2000; Malik et al, 2014; Chan, et al. 2015). There has been extensive debate on the conservation impact of people located within protected areas. In a tiger reserve in Central India Nagendra et al. (2006) find that the densely populated villages located outside the park boundary are better connected to regional markets by road networks, and are associated with greater deforestation rates and more forest fragmentation compared to the more isolated villages in the park interior. Forest areas in the proximity of population centers or villages are reported to be shrinking and degrading faster due to collection of fuelwood and cattle grazing, etc. A study in rural Nepal by Baland et al. (2010) find the household firewood collection as one of the possible causes of degradation apart from timber felling or conversion of forest into agricultural or pasture land. The study further finds that in the Indian Himalayan region, timber use and encroachment are found to be much less severe causes of forest degradation compared with firewood collection by the neighbourhood residents. The heavy dependency on the forests lead to decline in the forest ecosystem services and this decline of the ecosystem services further stress the wellbeing of the locals and also the local economy. By decreasing the adaptive capacity of the locals it makes the population more vulnerable and traps them into poverty (Choudhary et al. 2016).

In quoting the Anthropological Survey of India report Madhab Gadgil says that fringe people have substantial dependency on the forest biomass. The report says, as quoted, that 5% of the communities being engaged in hunting-gathering; 7% in fishing; 2% in trapping birds; 2% in woodwork; 7% in basket and mat weaving; 3.5% in shifting cultivation; 20% in animal husbandry; and 50% in settled cultivation (Gadgil, 1993). Such dependency is basically due to the absence of gainful alternative sources of livelihood. A seminal study by Narain and others (2005) in the Jhabua district measures specific components of annual household income and subsequent dependence on natural resources, including forests. As household income increases, the share of income from agriculture declines, offset by increases in wage employment and home enterprise income. As a percentage of income from natural resources, income from fuel wood declines as household income increases. This is due largely to the

fact that other forms of energy becomes more affordable as income increases and the opportunity cost of the time spent collecting fuel wood becomes too high. The share of fodder income from natural resource income increases with household income largely because richer families own more assets in the form of livestock (World Bank, 2006).

Researchers across various countries of the world also have identified rapid population growth, agricultural development and timber production, rural poverty and open access to the forest sources as the primary factors responsible for forest dependence (Reddy and Chakravarty, 1999; Beyene, 2011). Case studies conducted by Gunatilake (1998) reveal that the opportunities of income generation from non-agricultural and non-forestry activities reduces forest dependency though variables such as distance to the forest and debt level produce different results. Hegde and Enters (2000) indicate education to be one of the important variables influencing the forest dependency of the peripheral communities. Shylajan and Mythili (2007) also maintain the distance to the forest is one of the most influential factors of forest dependency. The analysis indicates that more the people live in interior areas more is their dependency and vice-versa. It is because the people living in the interior most areas are less likely to expose to diverse livelihood opportunities. It is worth mentioning that the State of the World Forest also recognises the fact that the environmentally fragile areas tend to be isolated and economically marginalized. Under such conditions, people generally have a relatively high dependence on local forest resources for various goods (FAO, 1999).

Studies conducted reveal that dependency is reduced, in some instances, as a result of providing alternative sources of income and livelihood (Gunatilake, 1998; Shackeleton, et al., 1998). This suggests that locals' dependency must not be overlooked in protected areas management. In particular the identification of the factors affecting forest dependency is an initial step towards formulating policies that are conducive for an equitable sustainable resource management (Gunatalike, 1998; Hedge and Enters 2000). Moreover, decreasing forest dependency with rising total household income has been documented in many studies across the globe (Fisher, 2004; Mamo et al., 2007; Narain et al., 2008). Dash, et al., (2016), therefore, concluded that if the households are provided with better income-earning opportunities, the dependency on forests will decline considerably and thereby improve the overall biodiversity conservation in the study area.

The forests, thus, provide different and diverse kinds of services to the peripheral people and the fringe dwellers remain dependent for such services on the forests.

2.2 Ecosystem services (ESS) of forest:

The history of civilization is, at its most basic, a story of people trying to access resources and seek protection from the elements. Around 10,000 years ago when we began to domesticate nature, the story changed a bit. Through husbandry and agriculture we were managing nature's services more directly in order to increase productivity. In this way humans have always recognized the importance of what we now call ecosystem services (Fisher et al, 2009).

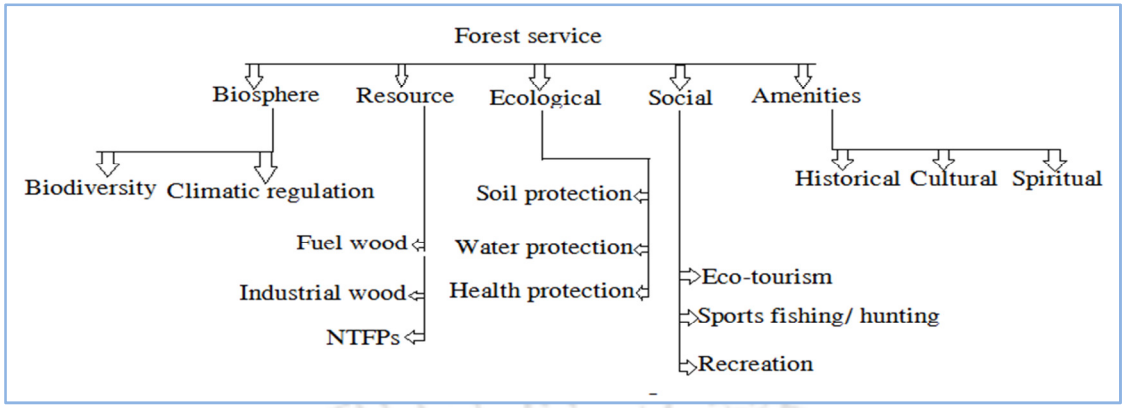
Ecosystem services research has become an important area of investigation over the past decade. The significance of the concept is witnessed by the publication of the Millennium Ecosystem Assessment (MEA), a monumental work involving over 1300 scientists from 95 countries. One of the key results of the MEA was the finding that globally 15 of the 24 ecosystem services investigated are in a state of decline (MEA, 2005), and this is likely to have a large and negative impact on future human welfare. One of the clarion calls of the MEA was for increased and concerted research on measuring, modelling and mapping ecosystem services, and assessing changes in their delivery with respect to human welfare (Carpenter et al., 2005). Muller and Burkhard (2012) opine that the concept of ecosystem goods and services has gained an enormous and steadily rising attractiveness for environmental scientists, managers and decision makers. As ecosystem services can be understood as the direct and indirect contributions of ecosystem structures and functions in combination with other inputs to human well-being. MEA (2005) defines an ecosystem to be a dynamic complex of plant, animal, and microorganism communities and the non-living environment interacting as a functional unit. It says that humans are an integral part of ecosystems. The benefits that the ecosystem provides to the human are called the ecosystem services (ESS). MEA classifies the ESSs into provisioning, regulating, cultural, and supporting services. Provisioning services are the products people obtain from ecosystems, such as food, fuel, fiber, fresh water, and genetic resources. Regulating services are the benefits people obtain from the regulation of ecosystem processes, including air quality maintenance, climate regulation, erosion control, regulation of human diseases, and water purification. Cultural services are the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic

experiences. Supporting services are those that are necessary for the production of all other ecosystem services, such as primary production, production of oxygen, and soil formation.

Forests and woodlands supply essential services to human wellbeing across the world, and human-forest interactions manifest themselves in many direct and indirect ways, each depending variously on the amount of forest, its condition, and its distribution over the landscape. Forests can serve as reservoirs, sinks and sources of greenhouse gases and thus have a significant role in moderating the flux of greenhouse gases between the land and the atmosphere (FAO, 1999). Forests help in balancing oxygen and carbon dioxide level in atmosphere, regulate earth's temperature regime and hydrological cycle. Forests increase local precipitation and water holding capacity of soil, thus, preventing drought situation. Vegetation cover provided by forest impedes the velocity of runoff on soil surface checks soil erosion, silting and landslides, thus reducing the danger of flood. The litter derived from fallen leaves maintain fertility of soil by returning the nutrients. Forests also act as a refuge to wild animals and provided protection to them against strong, cold or hot and dry winds, solar radiation, rain and enemies (Trivedi et al., 2005). Forests not only provide for timber and fuel wood and other material resources, but for a wider set of public goods and services such as water retention, soil erosion prevention, biodiversity conservation, carbon sequestration, recreation etc. It is further estimated that more than 1 billion people, mostly poor, depend on forests in varying ways for their livelihoods (Kamanga et al, 2009).

Müller and Burkhard (2012) state that the concept of forest ecosystem goods and services is widely accepted by forest policy makers and forest managers. The acceptance is due to the complex forest ecosystem functions and processes and their linkages to human wellbeing through providing timber, non-timber forest products (NTFPs), and a host of non-forestry services - climate control, water recharge, storm protection, fertility and nutrient balance, etc. - that are commonly called 'ecosystem services' (see Figure 2.1). The eco-system services control floods, filter pollutants, assimilate waste, recycle nutrients, regenerate soil. They also pollinate crops, operate the hydrological cycle, and maintain the gaseous composition of the atmosphere. Forest ecosystem provides the raw materials for housing. Wood products are extracted from the forests. Wood, in many parts of the world, is an important fuel. Paper products are derived from wood fiber. Moreover, they play vital role in controlling and regulating climate, water runoff, providing shelter and food for wildlife and also purify air. Furthermore, forests have scenic, cultural and historic values that deserve to be protected.

Figure 2.1:
Ecosystem services of forests



Source: Trivedi et al., 2005

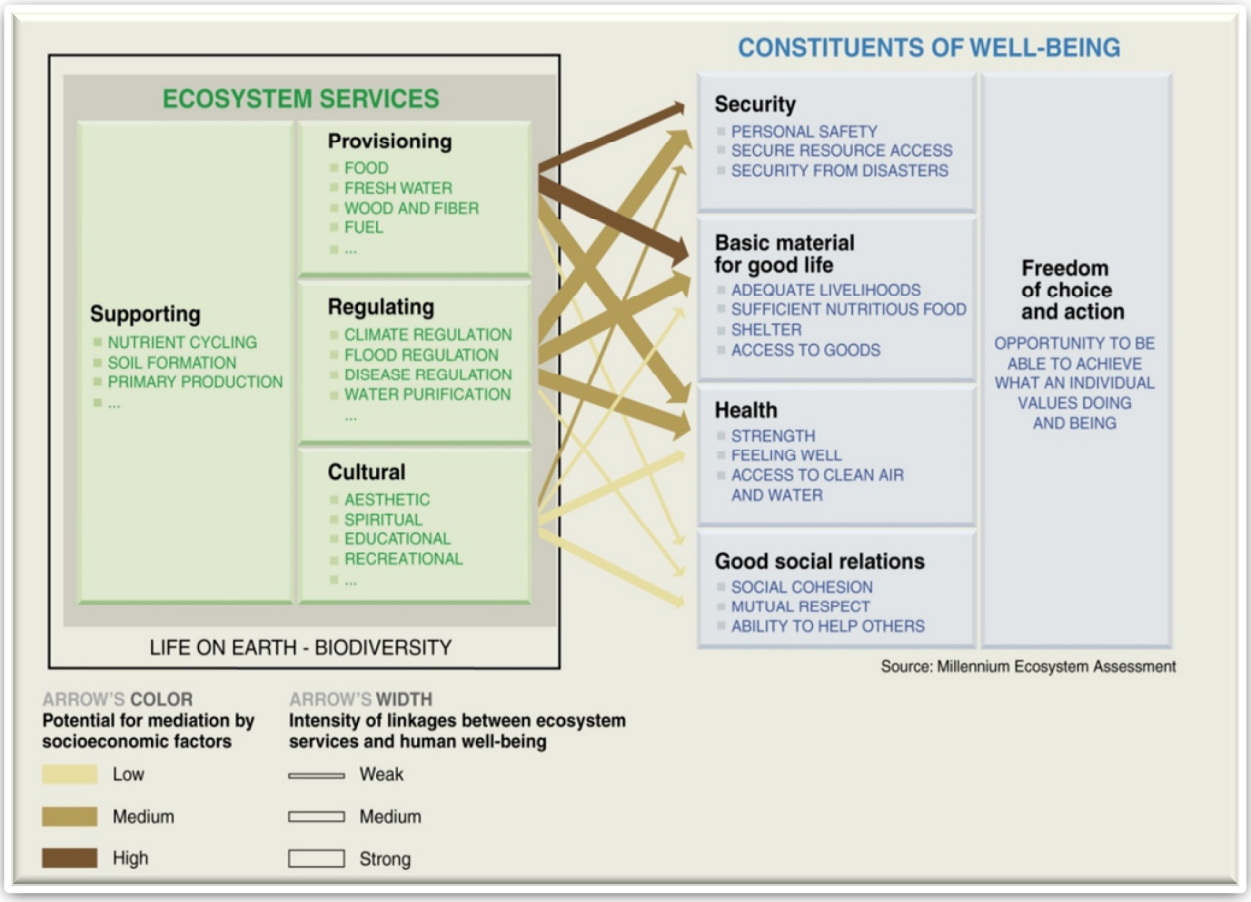
2.2.1 Demand of ESS is increasing and generating a trade-off:

Lan (2002) says that the increasing demand of the Ecosystem Services (ESS) can be attributed to the rapid increase in human population. He further says this formidable increase in demand for and consumption of biological and physical resources would put massive pressure on ecosystems and the services they provide. The capability of the ecosystem to provide the desired services has been dwindling and is exacerbated by the loss of traditional knowledge system. The trade-off among services therefore appears to be very important (Carpenter, 2005). A country can increase food supply by converting a forest to agriculture, for example, but in so doing it decreases the supply of services that may be of equal or greater importance, such as clean water, timber, ecotourism destinations, or flood regulation and drought control.

2.2.2 Ecosystem Services and human well-being:

Human well-being and development strongly depend on biodiversity and ecosystem services. The importance of the ecosystem services can be gauged in the light of the linkage between it and the human wellbeing. The Millennium Ecosystem Assessment analysed how ecosystem services and constituent human well-being are interlinked. This can be shown with the help of Figure 2.2 where the left panel represents the ecosystem services and the right panel shows the constituents of well-being. The arrows width indicates the intensity of linkages between ecosystem services and human well-being.

Figure 2.2
Ecosystem services and human wellbeing



Source: MEA, 2005

2.2.3 Beneficiaries of ecosystem services:

Kathuria (2011) explains that many of the ecosystem services benefit not only the local people living around the ecosystems but the benefits also spills and accrue to a larger audience beyond a particular locality or region and sometimes it go global. The resources are available locally and need to be managed locally though the benefits accrue to a much larger scale. He shows the ecosystem services of forests and their likely beneficiaries (Table 2.1) and thereby making, at the end of the day, a strong case for its conservation and if required contribution for its conservation from the beneficiaries cutting across physical boundaries.

Table 2.1
Ecosystem services – types and likely beneficiaries

Sl no	Type of value	ESSs	Scale of area benefited			
			Local	Regional	National	Global
1	Use	Grazing	Y			
2	Non –use	Succession (Land slide/ slip stabilization)	Y			
3		Protection from Sun's harmful ultraviolate rays	Y			
4		Control agricultural pests	Y			
5		Nutrient cycling and movement	Y	Y		
6		Purification of water and air	Y	Y		
7		Regulate disease carrying organisms	Y	Y		
8		Soil formation / fertility maintenance	Y	Y		
9	Use/ non use	Hydrological regulation	Y	Y		
10	Non-use	Climate moderation	Y	Y		
11		Seed dispersal	Y	Y		
12		Drought and flood mitigation	Y	Y		
13		Pollination	Y	Y		
14	Use	NTFPs	Y	Y	Y	
15	Non – use	Carbon sequestration				Y
16		Protection of streams, rivers channels and coastal shores from erosion	Y	Y	Y	Y
17		Maintenance of biodiversity	Y	Y	Y	Y
18		Recreation/ landscape beauty	Y	Y	Y	Y

Source: Kathuria, 2011.

2.2.4 Degradation of Ecosystem Services:

Millennium Ecosystem Assessment (2005) report reveals that despite the vital importance of the ESS in our lives these are being lost due to multiple and interacting pressures. The report further explains that the most important pressures on biodiversity and ecosystem services are habitat change (such as land use changes, physical modification of rivers or water withdrawal from rivers, and loss of coral reefs), climate change, invasive species, overexploitation, and pollution. Driving forces behind those pressures are among others demographic, economic, socio-political, cultural, religious, scientific, and technological changes. Although biodiversity may also change due to natural causes, current change is dominated by the anthropogenic driving forces.

Various State of the Forest Report (FSI, 1987, 1997, 2011; FAO, 2010, 2011) states that excessive grazing, frequent fires and other biotic factors have eliminated natural regeneration of tree species in forests to a considerable extent. Two major products for which the people depend overwhelmingly on forests are fuel wood and green fodder. The fire wood consumption is more than its production creating a huge gap between the two. Thus, in order to fill up the gap dry wood is extracted from forests by the forest fringe dwellers. This extraction, which goes unrecorded, leads to continuous depletion of forests. On the other hand, the pasture and grazing land are also depleting as a result of continuous encroachment for agricultural and settlement purposes. The remaining pasture lands are not in a position to supply the required amount of fodder resulting into unlimited and unrestricted grazing in the forest lands. The report puts on record that 83 percent of the forest land in UP and 87 percent in West Bengal, 85 percent in Meghalaya, 70 percent in Orissa, 75 percent in Sikkim are grazed gratis. Quoting livestock census 2007, the report (FSI, 2011) says that about 39 percent of the livestock of the country are partially or completely dependent on forests for feed, either through stall feeding or grazing. Such excessive grazing has degraded forest soils and hampers the natural regeneration of forests. Thus, the report identifies excessive grazing and overdependence on forests for fire wood to be the factors most responsible for rapid depletion of forests in our country. MEA (2005) states that dwindling forest cover is reflected in the fact that more than 1.7 billion people live in 40 nations with critically low level of forest cover in many cases hindering the prospect of sustainable development. MEA further says that the human population growth has drastically shrunk the forest-to-people ratio from 1.2 hectare per person in 1960 to 0.6 hectares at present and further to decline to 0.4 hectares in 2025.

The other important threats, as Daily et al. (1997) reports, to the ecosystem services are the invasion of non-native species, alteration of the Earth's carbon, nitrogen, and other biogeochemical cycles through the burning of fossil fuels and heavy use of nitrogen fertilizer; degradation of farmland through unsustainable agricultural practices; squandering of freshwater resources; toxification of land and waterways; and overharvesting of fisheries, managed forests, and other theoretically renewable systems.

2.3 Value of Ecosystem Services:

Kumar & Kumar (2008) and Adenkule (2005) define the economic valuation to be an attempt to assign quantitative values to the goods and services provided by ecosystems. It is generally measured in terms of what one wishes to pay for the commodity less the costs of its supply. Economic valuation is the process of ascribing monetary values to the unquantifiable social and environmental services of the eco-system. It advances the knowledge about the broad range of values associated with eco-systems and thereby providing decision makers with useful information for making choices among alternatives.

Daily (1997) points out that human society would indeed cease to exist in the absence of ecosystem services and therefore their immense value to humanity is unquestionable. Though the importance of ecosystem functions and services are growing over the years and ESS are regarded as the lifeline of human beings nonetheless they are often taken for granted and overlooked in environmental decision-making (Daily, 1997; Voeks and Rahmatian, 2004; Jantzen (2006). The primary reason, says Pearce (1996), is the missing markets for most of such forest functions. Kumar et al (2000), in this regard says that several thousand tons of NTFPs are removed annually from the forests of India most of which are consumed or bartered away leading to the creation of missing markets. Appasamy (2000), in a similar note, says that fuel wood and timbers and also enormous amount of NTFPs are harvested illegally by the rural poor do not enter into the system of national accounts. Chidumayo (2011) also raises a similar point saying that the portions of benefits from goods and services which are legally allowed to be collected from the forests are only taken into account for national accounts. This, of course, forms a very small portion of whatever is actually collected. The value of the forest goods and services, thus, collected, traded and consumed by the local population outside the cash economy are generally ignored and is not included in the state income. MEA (2005) in this regard comprehends that there has been no serious effort to evaluate the intangible contribution of forests to ecological security. It is because the current

markets shed light only on the value of a small subset of ESS that are transacted in the markets and thus creating a case of missing markets (for intangible services) and thereby market failure. The implicit ruling price is zero in missing markets and there is a possibility that forests with high non-market value will lose out in the long run. Therefore, in making choices between the conservation and restoration of ESS and expansion of human activities, the economic values of the ecosystem goods and services must be known so that they can be compared with the economic values of human activities (Daily, 1997; NRC, 2004). Costanza et al. (1997) opines that failure to place monetary values on environmental goods and services will ultimately lead to their exploitation and loss.

Kulkarni (2016) and Cavatassi (2004) state that despite offering a wide range of products having significant economic value the forest cover over the years is dwindling in terms of both area and productivity. Depletion is mainly because of underestimation of benefits arising out of forests and its sustainable management. Concerns have arisen, therefore in the recent decades, about proper valuation of the world's forests, which is one of the vital components of nature. While some of these concerns have to do with market distortions for timber products or inadequate data on non-timber forest products, an additional issue, as Kramer et al. (1992) say, has been the challenge of uncovering the economic worth of non-market services provided by forest ecosystems. The forest resources, thus, need to be valued for better management and protection of forests. This would lead to more budget allocation as opined by Kulkarni (2016). NRC (2005) states that the information about the relative values of the alternative uses of forests resources can lead to better informed and more defensible choices. Thus, valuation provides a rational basis for directing funding for conservation of forests. It is a way of demonstrating the importance and so to arrest their displacement. People will remain indifferent if they don't know the proper value of the forests.

Brander et al., (2010) says that depreciation or degradation of the ESS and biodiversity has associated social costs and if not imputed the policy would be misguided and the society would be worse off due to misallocation of resources. Therefore, he believes ostensibly in the actions of demonstrating and capturing the ESS values of forest eco system so as to bring to the notice of policy makers about the inherent and often significant intangible values of forests. NRC (2005) also emphasises the quantification of such values on the ground of incorporating environmental assets and services into national income accounts is of paramount importance. Thus, to justify the spending on management and preservation of forests there is a need of economic valuation of forests. Such an exercise of forest valuation

would assist in developing strong cases about the need to finance forest protection and management.

Thus, the need to estimate the economic value of the forest goods and services or more specifically of NTFPs has been gaining importance in both conservation and development phenomena (Cavendish, 2000; Heubach, 2013; Balama et al., 2016). Jantzen (2006) places two reasons for monetary valuation for forest conservation. One, quantification of the economic value associated with the protection of biodiversity can provide suitable evidence for habitat conservation. Two, by assigning monetary values to biodiversity, the benefits of biodiversity can be compared with the economic value of alternative resource use options.

The valuation of forest resources, consequently, has been a central issue in forestry for quite a long time. There is an extensive literature in environmental economics regarding assigning economic values to the environment on the basis of the Total Economic Value (TEV) concept. TEV is a concept in cost benefit analysis that refers to the value derived by people from a natural resource, a man-made heritage resource or an infrastructure system. It encapsulates the full range of economic values that people attach to each type of land use (Cavatassi, 2004). The components and different values of forest ecosystem can be shown with the help of Figure 2.3.

Figure 2.3
The components of total economic value

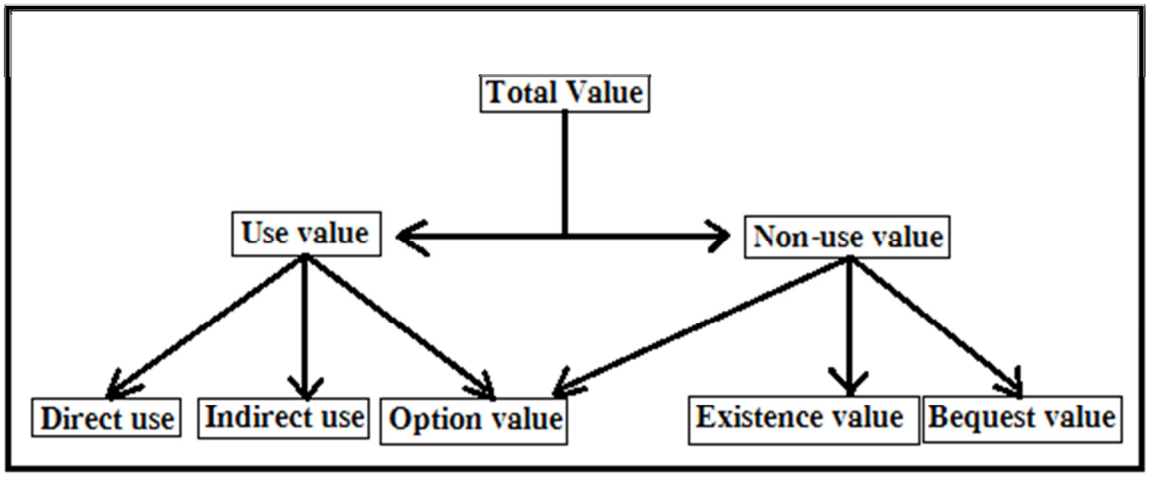


Figure 2.3 indicates that the economic value of environmental resources is built up of use and non-use values. Use values, which consists of direct, indirect and option values are often easier to assess than non-use values which comprise of existence and bequest value.

2.3.1 The economic approach to valuation:

However, the concept of forest value has a much broader scope than the commercial or financial value. It encompasses all values, tangible as well as intangible that contribute to human welfare and satisfaction. This is reflected in the "total economic value (TEV) framework" which is used to value the ecosystem services. Table 2.2 classifies the kinds of benefits that (theoretically) can be distinguished, when valuating environmental resources.

Table 2.2
Resource taxonomy for environmental resource valuation

Total economic value				
Use values			**Non-use values**	
Direct use	Indirect use	Option value	Bequest value	Existence value
Outputs directly consumable	Functional benefits	Future direct and indirect values	Use and non-use value of environmental legacy	Value form knowledge of continued existence
Food, biomass, recreation, health, increased living comfort.	Flood control, storm protection, nutrient cycles, and carbon sequestration.	Biodiversity, conserved habitats.	Habitats, prevention of irreversible change.	Habitats, species, genetic, ecosystem.

Source: RIVM (National Institute of Public Health and Environment, Netherland), 2000. Adapted from Jantzen, 2006.

Total Economic Value (TEV) comprises use and non-use values and is summarised in the Figure 2.3. Use values are relatively easier to measure and include direct (both consumptive and non-consumptive), indirect and option values while non-use values which include bequest and existence values are harder to measure. The non-use values, thus, involve greater challenges since they are related to moral, religious and aesthetic properties for which there is no market. This is different from other services that are associated with the production and valuation of tangible things. Cultural services and non-use values in general involve the production of experiences that occur in the valuers' mind. Therefore, these services are said to be co-produced by ecosystems and the people (Defra, 2007). However, the current study will deal only with the use values of the forests.

Direct use values**:** Direct use values are derived from ecosystem services that are used directly by humans. They include the value of consumptive uses, such as harvesting of food products, timber for fuel or construction, medicinal products, and hunting of animals for consumption, and of non-consumptive uses, such as the enjoyment of recreational and cultural amenities like wildlife and bird watching, water sports, and spiritual and social utilities that do not require harvesting of products. Direct use values correspond broadly to the MA notion of provisioning and cultural services. They are typically enjoyed by people located in the ecosystem itself (Jantzen, 2006).

Indirect use values**:** Indirect use of natural resources relates to functional benefits, the outputs provide a social benefit from ecosystem functioning. These values are derived from ecosystem services that provide benefits outside the ecosystem itself. Examples include the natural water filtration function of wetlands, which often benefits people far downstream; the storm protection function of coastal mangrove forests, which benefits coastal properties and infrastructure; and carbon sequestration, which benefits the entire global community by abating climate change. This category of benefits corresponds broadly to the MEA notion of regulating and supporting services.

Option value**:** Option values are derived from preserving the option to use in the future services that may not be used at present, either by oneself (option value) or by others or heirs (bequest value). Provisioning, regulating, and cultural services may all form part of option value to the extent that they are not used now but may be used in the future.

Non-use values**:** Non-use values refer to the value people may have for knowing that a resource exists even if they never use that resource directly. This kind of value is usually known as existence value (or, sometimes, passive use value). The non-use values are of two types:

Existence value**:** This non-use value reflects the "moral" or philosophical reasons for environmental protection, unrelated to any current or future use.

Bequest values**:** This reflects the publics' willingness to pay to ensure future generations to enjoy the same environmental benefit in the years to come.

The TEV framework does not have any direct analogue to the MEA notion of supporting services of ecosystems. Rather, these services are valued indirectly, through their role in enabling the ecosystem to provide provisioning and enriching services. Valuation is usually

relatively simple in the case of direct use value, and then increasingly difficult as one moves on to indirect use value, option value, and non-use value.

2.3.2 Understanding forest ESS through both TEV and MEA framework:

MEA is a socio-ecological framework for assessing and valuing ESS and biodiversity. MEA classifies the ecosystem benefits into four categories, i.e., provisioning, regulating, supporting and cultural, which can in some cases be monetised. On the other hand the TEV is a conventional economic approach to valuing Ecosystems in monetary terms.

The TEV and MEA framework is indeed complementary in practical field. Table 2.3 shows how the two frameworks can be combined. The TEV framework is a useful tool for exploring what types of values for each ecosystem service we are trying to elicit. This further helps in deciding the valuation methods required to capture these values.

Table 2.3
Valuing Ecosystem Services through the Total Economic Value framework

Millennium Ecosystem Assessment framework		**Total Economic Value framework**			
Ecosystem services Group	**Service**	**Direct use**	**Indirect use**	**Option value**	**Non-use value**
Provisioning	Food, fuel wood, construction materials, natural medicine	*		*	
Regulating services	Maintaining CO2, local precipitation, temperature, productivity of soil; preventing soil erosion, checking siltation & floods, conserving water; storehouse of biological diversity; natural healing for diseases, etc.		*	*	
Cultural	Cultural heritage, recreation and tourism, aesthetic values	*		*	*
Supporting	Primary production, nutrient cycling, soil formation	Supporting services are values through the other categories of ESS.			

Source: www.defra.gov.uk, 2007.

Table 2.3 is more an illustrative than a definitive guide to the classification of values arising from different ecosystem services. It illustrates and helps deciding which valuation method is the most appropriate for which ecosystem services.

2.3.3 Methods of measuring forest values:

Various techniques have been developed in order to determine the appropriate measure of value for each forest product. However, Wunder et al. (2011), states that the choice of valuation method should be based on the specific characteristics, including the objectives of the study. The main types of economic valuation methods available for estimating public preferences for changes in ecosystem services are Revealed Preference (RP) and Stated Preference (SP) methods. Revealed preference (RP) methods rely on data regarding individuals' preferences for a marketable good which includes environmental attributes. These techniques rely on actual markets. Included in this approach are: market prices, averting behaviour, hedonic pricing and travel cost method. On the other hand, Stated preference (SP) methods use carefully structured questionnaires to elicit individuals' preferences for a given change in a natural resource or environmental attribute. In principle, SP methods can be applied in a wide range of contexts and are the only methods that can estimate non-use values which can be a significant component of overall TEV for some natural resources. The main options in this approach are: contingent valuation and choice modelling. Table 2.4 shows common valuation methods applicable for valuation of different ecosystem.

Table 2.4
Commonly used valuation methods with different benefit categories

Benefit category	Examples of service flows	Commonly used valuation methods
Mortality and morbidity risks	Reduced risk of cancer, asthma, etc.	DC, HPM, CM, BT, CVM
Amenities	Taste, odor, visibility	DC, HPM, CVM, BT
Market: products	Food, fuel, fibre, timber, fur, etc.	MP
Non-market: recreation and aesthetics	Recreational opportunities (viewing, fishing, boating, swimming, hiking)	HPM, TCM, CVM, CM, BT
Indirect: Ecosystem services	Climate moderation, flood moderation, ground water recharge, sediment trapping,	CVM, CM, BT.

	soil retention, nutrient cycling, pollination, biodiversity, genetic library, water filtration, soil fertilization, pest control.	
Non-use	No associated services	CVM, CM, BT.

DC: Discrete Choice, HPM: Hedonic Price Method, CM: Choice Modeling, BT: Benefit Transfer, CVM: Contingent Valuation Method, MP: Market Price, TCM: Travel Cost Method.

Some valuation methods may be more suited to capturing the values of particular ecosystem services than others. For example, market prices are often used for valuing provisioning services, while stated preference studies are well suited to capturing non-use values (e.g. existence value of a rare species). In many valuation contexts, more than one technique is likely to be employed. The method(s) used will very much depend on the services being valued and their context (DEFRA, 2007).

2.3.4 Valuation methods used in other studies:

Table 2.5 and 2.6 reveal different methods used by various studies for household survey and estimation of forest dependency and valuation of forest ecosystem services.

Table 2.5
Methods applied for household survey

Type of income described	Location	Sample	Identification of products used or collected	Reference
Monetary and non-monetary household income, NTFP focus	Bocay River and Eastern territory of Somu in Nicaragua	1 – 5 households from each of 11 Somu communities	Recall interviews of male household heads with list of product collected, hunted, cultivated or raised. Recall estimates of goods extracted or produced	Godoy et al. (1995)
Monetary and non-monetary	Knuckles National	60 households, stratified	Structured questionnaire	Gunatilake et al. (1993)

household income, NTFP focus	Wilderness Area, Sri Lanka	random sampling	and checklist for prompting	
Monetary household income from acai, cacao and rubber	Combu Island, Brazil	5 households over 5 years (1984 - 88); 87 HH from community of 98	Production records of landowner (half of all production given to landowner by users) for five households. General questionnaire for 87 households.	Anderson and Ioris (1992)
Monetary household income, forest and fallow goods	Iquitos market area, Peru (Amazon)	13 Villages surveyed, 5–10 households in each	Recall interviews. Products classified by origin from forest/fallow.	Padoch (1988)
Use value of woodlands	Chivi Communal Area, Zimbabwe	213 Households from 29 Shindi villages, random sample	Quarterly recall interviews of income, consumption and expenditure on a quarterly basis, plus beginning- and end-of-period surveys over 1 year.	Cavendish (1996) and Cavendish in Clarke et al. (1996)
Use value of wild foods to households	Amazonas State, Venezuela	1 and 3 Households from two Huottuja villages: 100% & 10% sample; observed over 12 months	Direct observation of food products collected; alternated between villages; 3 weeks per village with 4–5 days with each household in second village.	Melnyk and Bell (1996)
Value of	Chimanimani	23 and 36	Identification by	Campbell et al.

woodland to households	District, Zimbabwe	Households from 2 villages; random sample stratified by wealth; 12 products	participatory mapping of land use types and non-timber forest products by land type. Recall interviews of households.	(1995) and Campbell et al. (1997)
Value of marketable products from 1 hectare	Mishana, Peru (Amazon)	7 Edible fruits, 4 palms, rubber, 60 tree species in 1- hectare plot	Botanic inventory, market verification.	Peters et al. (1989)
Value of marketable products from 3 hectares	Jatun Sacha Biological Station, Ecuador (Amazon)	7 Fruits, 3 medicinal barks, and 1 resin species from three 1-hectare plots	Botanic inventory, market verification. Interviews in forest with 8 local collectors to estimate annual yields.	Grimes et al. (1994)

Adapted from Wollenberg (2000).

Table 2.6
Methods applied for household survey and valuation of the forest products

Type of research	**Location**	**Sample**	**Methodology**	**Reference**
Contribution of forests to rural economy	Villages of MP, Orissa and Gujrat	26 villages	Two part questionnaire – Part I: socio-economy of the families, Part II: Regarding all of their income. Market Price method.	Bahuguna, 2000
Contribution of	Siberut,	500	Questionnaire	Pattanayak et al.

tropical forests to rural economies	Indonesia	Households' random sampling	survey. Market Price method.	2003
Livelihood trends of forest fringe communities in response to climate change	Offin Basin		Reconnaissance survey, desk studies, stakeholder interviews & on field observation	Amisah et al. 2009
Monetary and non-monetary household income, NTFP focus	Knuckles National Wilderness Area, Sri Lanka	60 households, stratified random sampling	Structured questionnaire and checklist for prompting. Market Price method.	Gunatilake et al. 1993
Methods for estimating the value of non-marketed wild edible plants	Thung Yai Naresuan Wildlife Sanctuary in western Thailand	Gomongta (150 HH) and Sanepong (90 HH) villages. 35 HH from both the villages were selected and interviewed.	Recall interview method with semi structured questionnaire. Market price method for marketed products and five methods to value non-marketed products.	Delang, 2006
Extent and nature of dependence on the forest	Wayanad district of Sri Lanka	194 households (8% of total households) Kuruman, Pariyans and Kattunaikkan community	Structured and unstructured questionnaire for household survey. Market price method to value NWFPs.	Shylajan and Mythili, 2003

Trade-off between agriculture and NTFPs extraction	Badulla district of Sri Lanka	23 villages (within a periphery of 3 kms from the forest boundary). 467 households.	Structured questionnaire. Market price method to value the forest products.	Illukpitiya and Yanagida, 2010.
Socio-economic and socio-ecological study	Sambalpur Forest Division of Orissa. Jharuguda, Bargarh and Suvarnapur district	600 respondents	Structured questionnaire. Market price method.	Mishra et al. 2008
Extent of dependency, trend and dynamics of NTFP collection within PA	Buxa Tiger Reserve of West Bengal	11 forest villages. 1 village for in depth study.	Structured and unstructured questionnaire. Data were collected through group discussion.	Das, 2005
Quantifying the exploitation of forest products to calculate the productive use values	Bach Ma National Park in Central Vietnam	4 villages and 70 households.	Semi structured questionnaire to gather information on the utilization of forest products, seasons and frequencies of entries into the protected area for collection purposes, and a	Lan et al., 2002

			rough estimate was given on the quantity of forest products harvested and collected.	

There are several methods to calculate the value of environmental goods and services of the forest although according to Godoy et al. (1993) the best method for valuation depend on the cultural background of the people studied, the level of literacy and the settlement pattern. It is observed that researchers generally use market price method to estimate the value of provisioning services and contingent valuation method is a good tool to estimate the non-market value of the ecosystem services. A detail of both the methods have been given below.

2.3.5 Market Price Method:

Market price method is applied to calculate the provisioning services of ecosystem. Nearly all kinds of timber, poles, fuel wood and other NTFPs are marketed and have market prices (Cavatassi, 2004). Thus, the most obvious way of measuring the value of nature is to see how much crop, fish, wood, livestock, etc. can be obtained by sustainable use of the natural habitat (Jantzen, 2006). By surveying crops, woodcutting, cattle breeding, etc., in combination with (local) market prices, the direct use value can be measured. Chopra (1993) in this regard says, "Whenever a good is marketed, as is the case of fuel wood, fodder and other minor forest products, its exchange value, approximated by market price, can be used as a measure of value". Godoy et al. (1993) also says, "The best method of valuation is to make use of the prices that exist of the commodity concerned, or that prevail in related markets". They further emphasise that it is the most sought after method by the researchers whenever there is need to estimate the value of the provisioning services of eco-system. Both Chopra (1993) and Godoy and Bawa (1993) further state that in case the product does not have a market then the price can be taken of the product with which it is bartered. If this too is not available a CVM can be applied. There are several other studies which have administered this method for valuing the direct use value of the value of the provisioning services of the forests such as Gunatilake et al. (1993); Adhikari (2004); Das (2008); Bahuguna (2000); Brander (2010).

Brander et al., (2010) says that market price-based approaches are most often used to obtain the value of provisioning services since these services are often transacted in markets. In well-functioning markets preferences and marginal cost of production can be taken as accurate information on the value of commodities. Therefore, market prices can be good indicator of the value of the provisioning services that are being studied.

2.3.6 Contingent Valuation Method (CVM):

The name 'contingent' valuation is based on the characteristic feature of this method as it works on asking people to state their willingness to pay, contingent on a specific hypothetical scenario and description of the environmental goods and services. The CVM is used to estimate economic values for all kinds of ecosystem and environmental services. It is the most widely used method for estimating non-use or non-market values (Yoo and Kwak, 2009; Mitchell and Carson, 1989; Pearce, 2001).

The contingent valuation method is a versatile method which can be applied to value any kind of environmental goods and services irrespective of their being marketed or not marketed. Spash (2005) opines CVM to be a nonmarket valuation technique which has received considerable attention over the last three decades. Spash further says that although no single method or technique can be adopted for all the goods and services and each of the methods have been widely criticized for their inherent weaknesses, nevertheless, techniques such as CVM provide a strong conceptual basis to elicit from individuals the values they place on such goods and services. The CVM can be used to estimate use value, non-use (passive) value, option value (reserved for one's future use) or bequest value (reserved for the use by the future generation). Spash (2005) has given a good notion of the CVM on the ground that it has great flexibility, allowing valuation of a wider variety of non-market goods and services than is possible with any other non-market valuation technique. The main advantage of this tool, Spash says, is its ability to estimate what are termed as option, existence and bequest values in addition to direct use values. The popularity of the CVM is also based upon the apparent simplicity of asking members of the general public the maximum they are willing to pay (WTP) for an environmental improvement or, less commonly, the least they would be willing to accept (WTA) in compensation for environment degradation. Willingness to pay (WTP) and Willingness to accept (WTA) are two standard measures of economic value. According to Carson (2000) whether WTP or WTA is the correct measure depends on the property right to the good. If the property right is

with the consumer WTA should be the actual methodology for eliciting the value of that good or service and vice-versa. The most commonly used CV format generally offers a binary choice specifying two alternatives: one is status quo and the other is non-status quo policy involving a cost greater than maintaining the status quo.

Thus, according to Pearce (2001) contingent valuation is essentially a questionnaire based approach in which individual is asked attitudinal questions about the forest good and is then asked their willingness to pay to conserve the good or improve its quality. In other words, CVM uses questionnaire to obtain responses from the respondents in a changed hypothetical situation. The questionnaire presents the respondents with a market like situation where they can express monetary value for a carefully described non-marketed good or service (Krieger, 2001). Instead of relying on observed behaviour, the CVM asks people what they would be willing to pay for an ecosystem good or service (Mitchel and Carson, 1989) and this approach is known as contingent valuation procedure. Through the 1980s and 1990s, the quality and extent of contingent valuation studies appear to have increased steadily (NRC, 2005).

Economists consider the appropriate value of environmental amenities to be what an individual would be willing to pay to preserve it. Willingness to Pay (WTP) can be estimated using the contingent valuation method (CVM). The CVM is used when the market data are unavailable or unreliable. Surveys are employed to inquire about individual's willingness to pay for some environmental policy initiative. According to Voeks and Rahmatian (2004) this method is widely used due to its applicability to variety of environmental goods and services and because of its capacity to assess existence and option value. Most of the estimates are based on the assumption that a hypothetical market exists where these environmental amenities are exchanged and the population is being charged for its use.

Forests values are basically of two types: use values and non-use values. Use values are both direct and indirect in nature. Direct uses are meant basically to extractive uses and indirect uses are such as watershed protection, carbon storage, etc. (Pearce and Pearce, 2001). The methods adopted for the economic valuation of forest goods and services which don't have a market generally include direct methods. The present study administers a direct method called Contingent Valuation Method for valuing the non-market benefits derived by the fringe dwellers in the study area. It is a direct way of capturing consumer surplus by means of eliciting the willingness to pay value for the preservation of a resource (Dlamini and Geldenhuys, 2012).

Lehtonen et al. (2003) in a study in Southern Finland attempted to analyse the Finnish citizens' valuations of forest conservation programme. According to the CV results, 74% of respondents were prepared to pay for increased conservation. Average WTP for increased biodiversity conservation ranged from € 60 to 223 per household per year.

A study by Heide et al. (2008) in Veluwe, the largest forested area in the lowland of North-western Europe, offers an economic value assessment of a nature protection programme. The valuation is based on a questionnaire that was administered during face-to-face interviews in the area and through the Internet. The study employs a contingent valuation approach to assess the respondents' willingness to pay for the realisation of the defragmentation scenarios. It appears that the mean willingness to pay (WTP) for the two defragmentation scenarios is € 162.2 per respondent.

Faham (2008) did a study in the forest areas in west Mazandaran of Iran aiming to investigate the links between forest dwellers participation in reforestation and development of forest areas. Based on a sample of 110 forest dwellers selected randomly the study used a questionnaire to collect required data. The findings of the study reveal that age, level of literacy, level of forest dependency, social participation, economic and social motivations are positively and significantly associated with level forest dwellers participation in reforestation programme.

Lo and Jim (2010) in a study to assess the willingness to pay and motives of conservation of urban green spaces in the city of Hong Kong interviewed 495 urban residents from different neighbourhoods and socio economic group. The results found 80 percent of the respondents willing to pay for the conservation of the urban green spaces which they use for exercise and to avail clean air. The respondents show overwhelming support and express to pay an amount of HK$77.43 monthly for the purpose for five years. Non-instrumental aspects played some role in the respondents' bidding decision. The findings could assist green space planning and nature conservation, and hinted the need to consider the pluralistic community views and expectations in relevant public policies.

Majumdar et al. (2011) did a study in the city of Savannah, Georgia, USA in order to estimate the monetary value of urban forests. For the purpose they collected data of the tourists' willingness to pay by face-to-face interview from the tourists. The results found mean WTP to be $11.25. The study further found income and education to be most important independent variables influencing the tourists WTP.

In order to determine the factors that affect the farmers' WTP Yoeu and Pabuayon (2011) undertook a study for the conservation of flooded forest in the Tonle Sap Biosphere Reserve, Cambodia. The primary data were collected from 157 farm households from 3 villages by using semi-structured questionnaire. The study shows that the sample farmer-respondents have a very high awareness on the benefits and functions of flooded forest. 82 percent of the respondents expressed their willingness to pay for the conservation of the flooded forest. The mean WTP is found to be 2357 riels per month. The respondents' WTP is affected by their age, income and participation in training programmes.

Tao et al., (2012) attempted to estimate the economic value of forest ecosystem services in a typical deforestation afforestation area represented by the Heshui watershed in Jiangxi province. A contingent valuation survey was conducted by the authors among 200 households in three counties in order to estimate the values of the forest ecosystem. The results of the study found to have calculated the WTP of the respondents to be 238 yuan yearly for the restoration of the watershed area. The WTP of the respondents are found to be associated with the household and socio-economic characteristics such as income, education level, household population, off-farm work, etc.

Kamri (2013) designed a study by involving local and international visitors in order to estimate the WTP for the conservation of the Gunung Gading National Park of Sarawak in Malaysia. The study interviewed 270 randomly selected respondents, consisting of 170 international and 100 national visitors, who expressed their willingness to pay for the conservation of the park. The study found the average willingness to pay of the respondents to be RM 16.14 of international visitors and RM 7.38 for the national visitors. The WTP was strongly influenced by gender, education and income. The study demonstrated that CVM method can be a useful tool to guide decision makers regarding policy purposes and natural resources management of protected area in developing countries.

In order to estimate the willingness to pay for wetland conservation Siewa et al. (2015) conducted a study at Paya Indah Wetlands using contingent valuation method. 350 samples were randomly selected (with 279 valid samples) for face-to-face interview. The study found the mean WTP of the visitors to be RM 7.12. The study results further indicate that the level of income is the most important independent factor for determining the WTP of the respondents.

Tolunay and Başsullu (2013) prepared a study for identifying maximum willingness to pay in relation to forests to be established in Turkey to reduce air pollution around cities. 524 samples from 46 cities were finally selected out of 591samples selected initially using simple random sampling method. 67 questionnaires were rejected as a result of non-response. The required data, i.e., per capita consumer surplus or maximum WTP in relation to forests to be established in Turkey, were elicited through e-mail and face-to-face interview. The study found the average WTP of the respondents to be US$23.52.

Conservation of biodiversity, especially forests, depends to a great extent on support of the fringe communities around protected areas. However, large scale human interventions in the protected areas have resulted in biodiversity loss necessitating relocation of the people from the core of these protected areas. In a study to analyse the willingness for relocation of the local communities living in the Critical Tiger Habitat of Sariska Tiger Reserve Jain and Sajjad (2015) selected 10 villages using purposive sampling considering variations in location, relocating priority and livelihood sources. Both semi-structured and structured questionnaire were administered for collecting quantitative and qualitative data from 146 households selected randomly. The results of the study found 'restriction of access' and 'market access' to be the most influential factors and positively associated while forest dependency is negatively associated with local communities' willingness.

Siew et al. (2015) conducted a study in Paya Indah wetland in Malayasia in order to estimate the willingness to pay for its conservation. Looking into the non-marketed characteristics of the services provided by the wetland the authors used a contingent valuation approach. The questionnaire survey was administered on 350 randomly selected visitors. The result of the study shows that 62.3 percent of the respondents expressed their willingness to pay for the conservation of the wetland. The analysis found bid price, income, distance and education to be important influencing variables determining the visitors' willingness to pay. As bid prices increase the visitors are less likely to pay for conservation. Income of the visitors showed a positive sign indicating increased willingness along the line of increased income. The mean WTP of the respondents here is found to be RM 7.12.

Singapore is one of the most severely affected countries due to haze pollution which is a result of forest and peatland fires in Indonesia. Lin et al., (2017) in a study to estimate the Singaporeans' WTP for haze mitigation undertook 390 onsite samples. The result found the mean WTP for these samples to be a mere 0.97 percent of their annual income. Lin et al.

further apprehended that the results may be useful for future cost-benefit analyses of the fires and mitigation strategies.

2.4 Summing up:

It is now clear from the above discussion that the local or fringe communities of a wilderness area are dependent on forest resources in a myriad of ways. The characteristics and degree of dependencies, indeed, is site specific. This dependency has significant bearings on the available forest and other natural resources on the earth. High food and fuel prices, which are the result of increasing population and their ever increasing demand, will favour continued forest clearance for production of agricultural crops and livestock for food, feed and bio-fuel to meet the global demand. At this juncture how the remaining and the scarce resources are to be managed sustainably is a million dollar question. Many governments or individual officers realize, Nadkarni (2001) says, that the survival needs of communities must be allowed to be met from PAs or acceptable alternatives must be provided in place. This realization motivated Mr A. K. Banerjee, a government forest official, to carry out the Arabari experiment of West Bengal in the 1970 which culminated into a new management structure for the forest resources in the form of Joint Forest Management (JFM). However, Nadkarni states that many officials are sharply critical of traditional resource uses of villagers, and do not understand the cultural significance of the event. On the other hand, villagers universally label the forest department as corrupt and inefficient, and are not fully conversant of the pressure under which the department staff has to work. This happens so because the protected areas have maximum restrictions on the use of forests by local people. When the people live in an isolated and self-contained economy, there was no problem. However, when outside markets forces penetrate these economies and start hiring the forest dwellers as agents for poaching and smuggling, human habitation begin to be seen as a nuisance. Even if one or two of the forest dwellers are so used for illegal purposes, the entire groups come under suspicion. Zealous foresters try to relocate the forest dwellers on the fringes of natural parks, which deprive even the innocent forest dwellers of their rights to traditional sources of livelihood. Concern for conservation here conflict with local interests of the poor people aggravating their poverty resulting into intolerance and conflicts. This intolerance between the department and the fringe people has its own history and the present form of prejudice is the legacy of this history.

Nadkarni (2001) writes extensively on how the forest dwellers are in tussle with the department for years and how it culminates into forest degradation and different policy as such. He writes that the British government went about systematically to establish control over forests and isolate local people from forest and their control over forests as far as possible. The forest department was formally created in 1864 with Dietrich Brandish, a German, as the first IG of forests. The Forest Act of 1865 empowered the government to declare any forest as government property. The forest legislation was made more comprehensive and stringent through the Indian Forest Act of 1878, classifying the forests into Reserved, Protected and Village forests. The government held absolute right of ownership in the Reserve Forests. Protected forests were those which were yet to be surveyed, but the local people's access and privilege were permitted for the time being. It was in case of village forests that the rights of locals were conceded in respect of grazing. Though the local people had full access to village forests and limited access to protected forests, the area under both was very limited. The bulk of forests area was placed under the reserved category. This meant extreme pressure on village forests and alienation of local people from forests. The alienation of the locals led to serious discontent and protests movements as it adversely affected the local economy. They did not have any responsibility in the management of forests, especially the reserve forests. To compensate for the loss of rich forests, the government began to transfer huge areas from revenue department to the forest department. This did not necessarily increase the actual forest, but led to deprivation of locals of their grazing areas and pastures.

This deprivation and alienation are still the factors behind the outbreak of conflict or tension between the fringe community and the department. However, it is realised that without the cooperation of the fringe community the sustainable management of the forest resource is a distant dream. Eventually, there needs to be a gradual shift towards participatory management institutions, which involves the Forest Department and local communities as equal partners in decision making and implementations.

As such, the interaction between forest and forest dwelling communities received increasing attention from social scientists and policy makers due to its significance from the view point of community welfare and sustainable forest management. Even this has been conceded by government policy document also. Assam Forest Policy, 2004 says forest conservation programmes shall remain a myth without active support and co-operation of the people. It is therefore, essential to inculcate in people an awareness of the value of the trees, forests and

wild life and their contribution towards not only a healthy environment but also towards their poverty alleviation.

Kothari (2001) says a centralized bureaucracy-dominated approach to conservation is doomed to failure in the new circumstances that India finds itself in. firstly, new macro-economic policies responding to the globalization process that is sweeping the world are essentially in contradiction to conservation and sustainable use of natural resources. The same government which declares a PA is now willing to sacrifice it at the altar of 'development' and 'economic growth'. Moreover, the local communities everywhere are no longer willing to take things as lying down. They want a voice in making the decisions that affect their lives. Similar view is expressed by Baland et al. (2014) in a deforestation study in Nepal. The study attributes economic growth, local poverty and inequality as the most important determinants of forest degradation and forest loss. It, therefore, emphasises in giving property rights to the local communities for arresting deforestation. By delving deep into the reasons of deforestation and ecological degradation Somanathan (1991) in a study in Central Himalayan region identifies the prevailing system of property rights to be the primary cause of deforestation. According to him, the existing property right regime denies the local people the benefits from the forests. This has destroyed, he further claims, the incentive to use forest sustainably and therefore the existing system of ownership be changed. It is prescribed by Somanathan that a reform of property rights is the need of the hour for halting the ecological deterioration. Community control and villagers' rights of user have to be ensured in all forests that are near enough to villages to be used by the local people. For the purpose it is prescribed to extend the Van Panchayats to all villages.

Consequently, the concept of participatory management of forest has been gaining popularity in the last part of twentieth century. The State of the World's Forest 2009, says in the same spirit that as income rise the demand for forest environmental services will rise along with the demand for conservation involving the local communities. The essentials of participatory management are that the fringe or local community should not be ignored in decision making along with their essential needs that have been fulfilled from the nearby forest area. In other words, the economic needs of a rural community in a developing country would make it difficult to set aside a forest without allowing its resources to be used.

Managing the forests is no easy task. An ecological understanding of the area especially the impacts of various human activities on elements of local biodiversity and on the ecosystem as

a whole is also weak in most areas especially amongst the managers of PAs. Indeed vast majority of management decisions, including those to curb human use, have been done on the basis of assumptions and generalizations, not solid research or evidence from site specific circumstances. That is perhaps why, research (especially long term) has often shown these decisions to be mistakes and to have caused unintended negative consequence. The manager must decide not only how to maximize yields on a given amount of land, but also when to harvest and replant and Tietenberg (2004) says that a delicate balance must be established among the various possible uses of forests. For designing an incentive based mechanism for the conservation of forest which benefits the forest depending communities, it is crucial to know the benefits that accrue to the society from the extraction of NWFPs.

The literature so far discussed above gives an idea that though the forest products collection is not a primary livelihood activity for most of the fringe dwellers however the income share of forest goods to the total household income is quite significant. The literature further reveals that forest dependency has deleterious effect on the forest cover and thereby the habitat of the wild lives and thus, one has to find out measures to reduce dependency so as to conserve the remaining forest cover. There are studies which indicate that the dependency varies across spaces and provisions of alternative sources of livelihood have significant bearing in reducing the dependency on the forest. The overall dependency of the fringe dwellers and their attitude towards conservation along with their willingness to pay for forest conservation has been dealt with in great detail in the subsequent chapters.

CHAPTER THREE

SAMPLING DESIGN, ANALYTICAL METHODS AND SAMPLE PROFILE

The literature review carried out in chapter two reveals that forests provide an array of ecosystem services that are crucial to the livelihood of many of the peripheral people. In other words the rural poor living in the fringes of forests are disproportionately dependent upon forest resources. The literature shows that dependency of these poor people on forests varies according to space. Fuel wood is one of the most important items of forest provisioning services which the fringe dwellers collect in the absence of other cleaner energy sources. Fodder collection and open grazing by the domestic stock are other important activities which put enormous pressure on the forest ecosystem. The discussions in the previous chapter also reveal that such dependencies on forest resources lead to severe adverse impact on the environment culminating into problems like deforestation and forest degradation, climate change, etc. However, the socio-economic heterogeneities of the poor fringe dwellers are said to be responsible for influencing their forest use decision. Moreover, it is also discussed in the previous chapter that capturing the real value of the forest ecosystem services is vital for initiating and undertaking the much needed conservation measures. The tremendous importance of each forest ecosystem can be understood by estimating its proper value.

Thus, a field study was carried out in order to understand the role of the forest ecosystem services in the economy of the poor fringe dwellers taking Laokhowa and Burhachapori Wildlife Sanctuaries as an example. The field study further intends at eliciting the perspective of the peripheral people for forest conservation in terms of their willingness to pay. Finally the field study proposes to identify the socio-economic heterogeneities of the people as influencing factors of forest use and willingness to pay decision. This chapter of the dissertation presents the methodology applied for the entire study along with the broad profile of the study area, sample villages and the sample households.

3.1 Methodology:

The study is based on both primary and secondary data that has been collected to accomplish the objectives set out for the current study. The secondary information is collected for the study from books, journals, government and non – governmental documents (both published

and unpublished), census data, etc. The management plans of the sanctuaries and the previous research carried out in the sanctuaries is of great help.

Primary data have been collected in two different phases spreading over a period of eight months in 2016. A semi-structured questionnaire is designed for eliciting the desired information related to various issues of a household economy and demography and other related and relevant issues. Focused group discussion and key informant interviews are two other PRA methods administered in the course of the study.

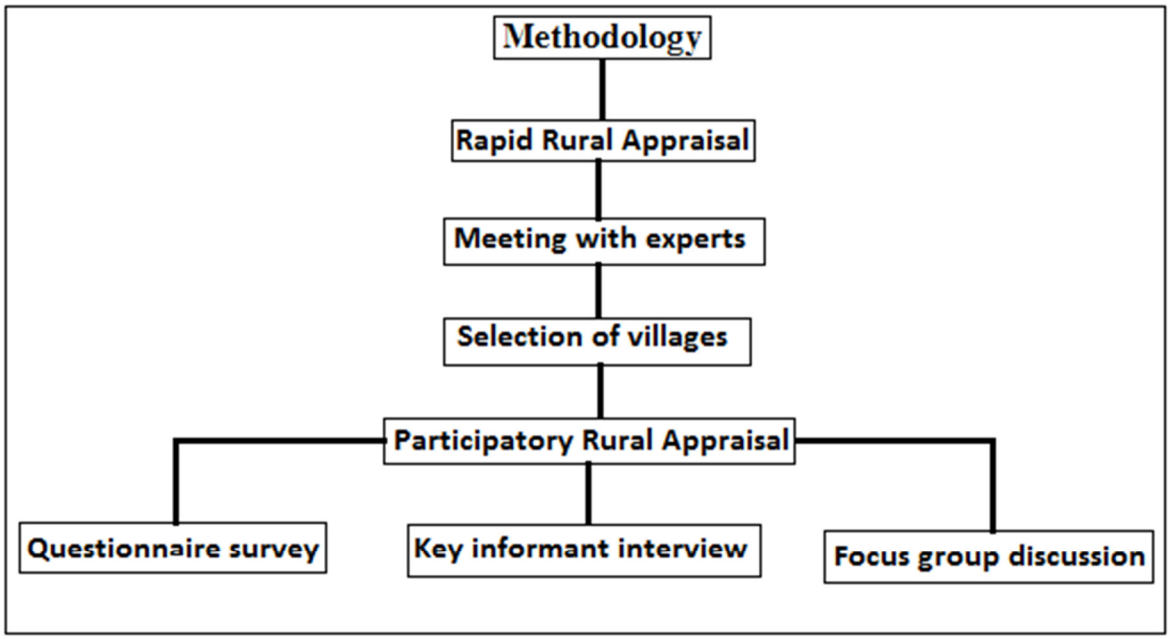
3.1.1 The Methodology for field study:

A household survey is carried out to elicit the required information and prior to that a Rapid Rural Appraisal (RRA) has been conducted to obtain a general overview of and a birds' eye view of the entire fringe area of both the sanctuaries. For eliciting primary data three PRA techniques are used, as discussed earlier, namely, a semi-structured questionnaire, Focused Group Discussion (FGD) and Key Informants interview. Apart from the RRA, the Management Plans of both the sanctuaries are studied in detail along with thorough discussion with the key persons, i.e., the range officers and the Member Secretary of Laokhowa Burhachapori Wildlife Conservation Society (LBCS), the only stakeholder organization working with profound impact on the conservation of the floras and faunas of the sanctuaries, for sample selection. The overall methodological framework has been presented in Figure 3.1.

At the outset a Rapid Rural Appraisal (RRA) was carried out in order to get an overview of the study area and to learn from local people about various issues of forest people interlinkage and the resulting implications. RRA is a process of learning about rural conditions in an interactive and expeditious manner. On the basis of the information so collected and in consultation with the local forest managers along with the NGO representatives the sample villages were selected. Three Participatory Rural Appraisal (PRA) techniques, namely a questionnaire (semi-structured) survey, focus group discussion (FGD) and key informants' interview, were then utilised to elicit the required data of forest people interface. Key informants can be a good source of information. People from the community who, because of official position or informal leadership, have access to information about the community are good resources. Key informants can be government officials, local personnel, local shop owners and members of non-governmental organisations. The data, thus obtained, have been analysed in order to achieve the objectives of the study.

Figure 3.1

Methodological framework



3.1.2 Sampling Procedure:

A two – stage sampling design is followed for conducting in depth investigation. In the first stage, sample villages are selected on the basis of some pre-determined criteria, such as communities living in the villages, proximity to the forests from the villages, anthropogenic pressures put in the form of human and livestock population and location of the villages.

There are 39 revenue villages, seven *Taungya*[2] and one forest village within a radius of two kilometers from the boundary of both the sanctuaries. These revenue villages are resided and dominated by the immigrant Muslim[1] besides people of Bengali Hindu and Bihari community. Three villages inhabited by Nepali community are relocated to the east of Burhachapori WLS as their villages were eroded away by the mighty Brahmaputra in the late eighties. The forest and *taungya* villages are inhabited by Bodo and Tiwa tribes. Care has been taken during sampling to include all these communities residing in the fringe villages of the forest. Apart from the communities, proximity of the villages to the forest is another important criterion for selecting the villages. The distance from the forest can be one of the important factors influencing the forest use decision. Apart from these, the anthropogenic pressure exerted on the forest is another important factor considered for selecting the villages. Considering all these factors 20 percent of the fringe villages (villages within a radius of 2 km from the forest boundary) have been selected for further study. Thus, a total of nine

villages, i.e., five from the fringes of Laokhowa WLS and four from the fringes of Burhachapori WLS, have been selected for detail investigation. Table 3.1 shows detail of the sample villages along with the number of households according to 2001 and 2011 census.

Table 3.1
Total households (TH) in the sample villages according to 2001 & 2011 census

	Village	2001	2011	Sample households (10% of TH)
1	Dhania	NA	89*	9
2	4 No Bhogamukh	159	272	27
3	5 No Bhogamukh	111	221	22
4	Chitalmari Pathar	401	643	64
5	Sunchahar Nalkata Taungya Village	NA	51*	5
6	Pub Futaljar	868	1229	122
7	Sutirpar	247	379	38
8	Sutirpar Taungya Village	NA	83	8
9	Laokhowa Taungya Village	NA	70*	7
	Total		3037	302

Note: NA – Not available. * Enumeration done by Laokhowa Burhachapori Wildlife Conservation Society (LBCS), 2014.
Source: Census of India 2001, 2011.

Looking into the homogeneous character of the households only 10 percent of the total households of each village are taken as sample for detail survey. In selecting households the heterogeneity of distance (from the households to the forests) is given due importance. The key informants, village headman in this case, are consulted for selecting the sample households. Thus, a total of 302 households have been chosen as sample (see Table 3.1) for detailed investigation in order to address the research questions and to examine the objectives of the current study.

Section 2.2 (Table 2.1) of Chapter two discusses that the ecosystem services not only benefit the people living in the surrounding of a particular ecosystem but the benefits accrue to the people residing beyond the immediate surroundings. Therefore, it is anticipated that people living far from the forest boundary also may wish to contribute financially for the conservation of forests. Consequently, the current study wants to compare two groups of population, namely the beneficiaries living close to the forest boundary and the non-beneficiaries living relatively far from the forest boundary and see their willingness to pay.

The samples representing similar socio-economic background but living relatively far from the forest are included into a group termed as *Control Group* and the others (direct beneficiaries) are included in a group termed as a *Treatment Group*. 100 samples from various communities living between three to seven kilometres from the forest boundary have been taken up to form the Control Group. Using the same questionnaire the household survey is administered for eliciting their willingness to pay for forest conservation along with other household characteristics.

The primary objective of incorporating a control group into the present study is to compare the households and other socio-economic characteristics of the control group with that of the treatment group (the samples residing within 2 km from the forest boundary in this context) in order to identify the factors influencing the willingness to pay for forest conservation. This will help the government in future management of the forest eco-system as well as fund raising activities for its conservation.

As mentioned earlier, 100 households have been taken to form the control group from seven different villages situated in a radius of 3-7 km from the forest boundary. Both the treatment and control group are akin in their socio-economic and other household characteristics. The sample households of the control group also have been chosen from different communities, i.e., Bengali Muslim, Bengali Hindu and Assamese Bodo and Tiwa to make the study representative. Same questionnaire has been utilised for eliciting information such as the willingness to pay (WTP) from the constituent households of the control group.

3.1.3 Questionnaire for data collection:

A semi-structured questionnaire is designed and administered to obtain information from the sample households regarding their socio-economic condition besides assessing their willingness to pay to restore the ecosystem services of Laokhowa and Burhachapori WLSs. It has three parts namely, general information, household information and valuation information. The general information deals concisely with drawing the very basic information of the respondents such as the name and address. On the other hand, household information deals largely with the socio-economic and demographic information of the respondent's family. This part consists of questions relating to land and other resources of the households, details of human and cattle populations, their income sources, the forest use information, etc. The third part of the questionnaire is meant for assessing primarily the respondent's willingness to pay for the forest ecosystem services he/she is drawing whatsoever from the

Laokhowa and Burhachapori WLSs. This part of the questionnaire also maintains question to assess physical or other contribution of the respondents apart from monetary contribution for the improvement of the forest eco system services. Moreover, it also tries to assess the respondents' awareness regarding the intangible services she/he is acquiring from the sanctuaries.

Questions are asked to obtain information on household size, land and livestock holdings, quantity of firewood, grass and tree fodder collected from the forest, and on issues relating to household level awareness and their willingness to pay for the conservation of the eco-system services. Labour allocated for collection, average hours spent in collecting the forest provisioning services are recorded. The time spent in collecting the provisioning services, thus, is utilised to calculate the annual man-days generated (spent) and the opportunity cost of the labour. The household characteristics are taken for the regression analysis in order to identify the drivers of forest dependency of the fringe people.

The questionnaire is pre-tested in a few randomly selected households. Minor changes are made accordingly on the basis of the responses. For example, a few questions are removed from the questionnaire for the purpose of greater understanding by the respondents.

The field survey is administered in two phases. The first phase has been completed during the month of April, 2016 and the second phase has been completed within October, 2016.

3.1.4 Methods for analysis:

The collected data are coded and entered into the excel sheet and various analysis is done using the Stata 14 software. The data generated from the field survey are analysed using appropriate statistical tools like range, frequency, mean and percentage. A regression analysis is carried out for determining the driving forces of forest dependency and the factors influencing the willingness to pay decision of the respondents. Identification of the influencing factors is traditionally done by using ordinary least square method. But, in case of both forest dependency and willingness to pay a number of zero values corresponding to the households not choosing to collect forest products or not choosing to pay for forest conservation is anticipated. In such case Ordinary Least Square (OLS) estimation by omitting the limiting observations will create bias while including limiting observations will result in inconsistency (Shylajan and Mythili, 2003). Therefore, following Shylajan and Mythili, 2003 and Haddak et al. 2016, the current study has undertaken to administer Censored Regression

Model (Tobit model) to identify the extent of influence of various factors on forest dependency and the peoples' willingness to pay for forests conservation. The *t*-test has been administered to examine for possible differences of various parameters determining WTP between the control and treatment groups at baseline.

3.1.5 Total Household income calculation:

The task of estimating the degree of dependency of the local people on the forests necessitates the information of income of the sample households since household forest dependency is calculated as the share of forest income to the total annual household income. If asked to state, there is always a tendency, on the part of the respondents, to underestimate or overestimate the total household income. Therefore, in order to get a more accurate account of total annual household income the income of the households is estimated based on all source of their income. Following Gunatilake et al. (1993) the forest income has been estimated without deducting the cost of family labour. In calculating income, farm and forest gate (market located in the boundary or nearby the forests) prices of agricultural and forest products are used. Unlike Gunatilake et al. (1993), livestock in the area is considered as one of the important sources of annual household income.

Agriculture income: Income from agriculture is calculated by multiplying total agricultural products with the market price fetched by each product. Data on land under different crops are obtained through the questionnaire during household survey. For e.g. the respondents are asked to state the total land under cultivation and what crops are being cultivated on that land. The price of each item is obtained from the respondents and cross checked later on with the market price obtained from market survey. Thus, the incomes from all the major crops such as paddy, jute and mustard are estimated using this method.

Wage income: About a quarter of the sample households are engaged in wage earning activities. Annual income from daily wages has been calculated by multiplying the number of days worked by the prevailing (local) wage rate. (Musavi, 2015).

Salary: It's relatively easy to obtain income of a salaried person. The sample includes only a few persons engaged in government services, majority of whom are school teachers.

Remittances: Remittance is also one of the major sources of income in the villages of the study area as a number of youths of the respondents' families migrate seasonally in search of job and send money back home in intervals.

Livestock selling: Selling of livestock, such as cow, bullock, pig, etc., is one of the livelihood activities of the respondents' families. The data regarding the sale of livestock and their sale price has been collected during household survey. The number of livestock sold is multiplied by the price of one unit of livestock in order to obtain the total annual income from livestock.

Fishing: In order to calculate the income from fishing the required data are collected through questionnaire. In case of forest collection of fish the respondents are asked to state the quantity of fish collected at one go and for how many days in a month and how many months in a year he collects fish to obtain the total annual collection of fish from the forest. The selling price of the fish has been obtained from the market through market survey in the forest gate markets.

In some cases, the fishery is leased out for a period of three to five years by the owners. In that case, the respondent is asked to state the amount of lease and thus estimated the total amount obtained from the fishery activity annually.

Trade: Similarly, the income of petty trade has also been estimated by asking the traders to state their daily average income and then multiplied by the number of days the shop is open in a year.

The information, thus obtained, is further verified with the key informant(s) of the particular locality to make the income estimation more accurate. The income for the sample households, thus, has been calculated to be the sum total of various income as shown below:

Household (non-forest) income (HI) = $\sum (I_A + I_S + I_W + I_R + I_L + I_F + I_T)$

Where, I_A is agriculture income, I_S implies salaried income, I_W indicates wage income, I_R refers to remittances, I_L means income from selling livestock, I_F is income from fishing activities and I_T means income from trade]. (Lepetu et al. 2009; Musavi, 2015).

Total forest income (TFI) = $\sum (I_P + I_G)$

Where, I_P means income derived from provisioning services collection and I_G implies income from domestic grazing.

The information about forest products collection and selling is obtained from each household through the semi structured questionnaire. Total forest income here includes the income

derived from the forest provisioning services and the value derived from grazing livestock in the forest. The income from forest has been estimated by using market price method. In order to estimate the grazing benefits it is necessary to find out the total amount of fodder consumed by the cattle from the forest. For the purpose, a concept called Cattle Unit (CU) is used. A cattle unit is a standard unit frequently used to compare feed requirement of different classes of livestock. The system is only an approximation. The feed requirements of livestock vary with their weight. The CU is an estimate of average feed requirements and is based on energy requirements of animals.

The livestock in the study area are of different types, ages and sizes requiring different amount of forage. In order to estimate the total amount of fodder consumed daily by these animals it is necessary to convert the livestock into a standard cattle unit. The conversion of the livestock into a standard cattle unit (CU) is done in the current study by using the conversion measures suggested by Ghule et al. (2012) and Patel et al. (1983). The conversion measures used in the present study is shown in Table 3.2.

Table 3.2
Conversion measures of livestock to cattle unit (CU) adopted for the study

Classes of livestock	**Value of CU**
Matured cow and buffalo (more than 3 years of age)	1.0
Cow and buffalo calf (below the age of one year)	0.33
Cow and buffalo calf (between the age of 1 and 2 years)	0.50
Cow and buffalo calf (between the age of 2 and 3 years)	0.75
Goat and sheep	0.20

It is worth mentioning here that the daily forage requirement of livestock depends primarily on its body weight, forage quality and stage of production. Daily intake of a full grown cow is around 2 per cent of her body weight and thus an average cow eats around 10 kg of an average quality feed (www.beef.unl.edu). On the basis of this the total daily forage consumed by the livestock of the sample households is estimated. The total volume of green grass then is multiplied by the market price to obtain the total value of grazing derived by the sample households.

Thus, the total household income is composed of the household income from all sources mentioned above including forest income derived from Laokhowa and Burhachapori WLSs and is expressed as:

Total household income (THI) = $\sum$ (HI + TFI) (Jain & Sajjad, 2015, Lepetu et al. 2009)

Where, THI implies Total Household Income, HI indicates Household Income and TFI refer to Total Forest Income.

3.1.6 Forest dependency – definition and calculation:

Forest dependency is measured as the proportion of income derived from the forest to the total household income. Researchers (Velded et al. 2004; Narain, 2005; Heubach et al. 2011; Angelsen et al. 2014 and Jain and Sajjad, 2015) have defined forest dependency as the share of the forest income in total household income. The income from forest is calculated by multiplying the total volume extracted by each household with the market price per unit of each type of provisioning services. Thus the total income from forest is estimated and the forest dependency is computed by finding out what amount of the total income comes from the forest product. We define forest dependency as the share of the forest income in total household income (Angelsen et al. 2014). Thus, household forest dependency in this study is explained as:

Household Forest Dependency = Total Forest income / Total HH income.

The mathematical formula for estimating forest dependency is as follows:

$$FD_j = \frac{\sum_{j=1}^{m} Vj}{\sum_{j=1}^{m} V_j'}$$

Where,

FD_j = Forest dependency of sample household j

$\sum_{j=1}^{m} Vj$ = Sum of the value of forest products harvested from forests and consumed by sample household j.

$\sum_{j=1}^{m} V_j'$ = Sum of the annual income from all sources of the sample household j.

3.1.7 Valuation Method:

Though a number of valuable ecosystem services are extracted the fringe people of forests across the world don't realise the intrinsic value of such goods and services. A number of independent studies have been carried out using various techniques to estimate the economic values of forests and thereby helping greatly in bringing environmental considerations into

economic planning (Verma, 2008). Intensive literature review has been carried out and presented in Chapter two for choosing the appropriate methods to be used for the present study in order to estimate the value of the provisioning services elicited from Laokhowa and Burhachapori WLSs by the fringe people. However, it is found that some valuation methods are more suited to capturing the values of particular ecosystem services than others. For example, market prices are often used for valuing provisioning services, while stated preference studies are well suited to capturing indirect or non-use values (e.g. existence value of a rare species). In many valuation studies more than one technique is employed, for example, the direct-use values of cultural services may be captured by revealed preference methods such as travel cost, while stated preference methods will capture the non-use values associated with cultural services. Wollenberg (2000) in a study about the methods for estimating forest income reports that most of the case studies used market price method for valuation of forest income. Net income for the marketed forest products is calculated by multiplying the quantity of the products with the sale price less the cost of collection and transportation expenses. The study by Bahuguna (2000); Beyene (2011); Adhikari (2005); Chopra (1993); Gunatilake et al. (1993); Soltani et al. (2014) also use Market price method for assessing the monetary value of the forest goods removed by the fringe dwellers. Various methods used for valuation by different studies as examined by Wollenberg (2000) have been presented in Table 3.3.

Table 3.3
Methods applied in other studies for valuation of forest ecosystem services

Valuation Methods used	**Costs included and their calculation**	**References**
Combination: village retail prices of good or asking "how many pounds of beans" respondent willing to exchange; fuel wood valued according to labour to cut and transport wood; wages calculated from actual value.	Labour: Nominal wage determined by calculating the sum of typical local wages and food, cigarettes and drinks provided, collection time not reported Other: No transport costs	Godoy et al. 1995
Combination: Farm and forest gate prices used; where no local price available, used price from nearest market centre and deduct transport	Labour: Not deducted Other: Transportation costs where market price used	Gunatilake, 1993

costs; where no market price available, used price of substitutes; where neither possible used WTP.		
Market price: Monthly revenues from sales, based on production records of landowner.	Not reported	Anderson and Ioris, 1992
Market price: Income realised from sales.	Labour: Not measured Other: Transport costs of goods	Padoch, 1988
Combination: Market price from local trading prices or household reported price; for products not marketed, used market prices of close substitutes; where no substitute, asked value of good in Zimbabwean dollars.	Labour: Not measured Other: Production inputs such as fertilisers, crop inputs, firewood, purchased goods	Cavendish, 1996 and Cavendish in Clarke et al. 1996
Combination: Market prices from monthly market surveys; substitute prices for products not in market; products without market price or substitutes not included; prices were applied on monthly basis to products collected.	Labour: Collection and transportation time, using local wage rate. Other: Shotgun shells and fishhook costs, but no guns, machetes or fish lines. transport cos not included since food is for consumption	Malnyk and Bell, 1996
Combination: Market price from survey for 9 products; calculated product values in relation to range of labour and market prices; use of role play and ranking of non-market values.	Labour: Collection time, using range of local wages, constant of 5 km/h used to determine travel times. where times not available used 40% of market value	Campbell et al. 1995 and Campbell et al. 1997
Market price: Average retail prices collected by monthly market surveys, information from bank for rubber prices and 4 sawmills for timber prices	Labour: Collection time based on interview and direct observation; used minimum daily wage in Peru Other: Assumed transport costs of 30% total market value for fruit and latex; used FAO estimate of 40% of timber value for timber extraction	Peters et al. 1989

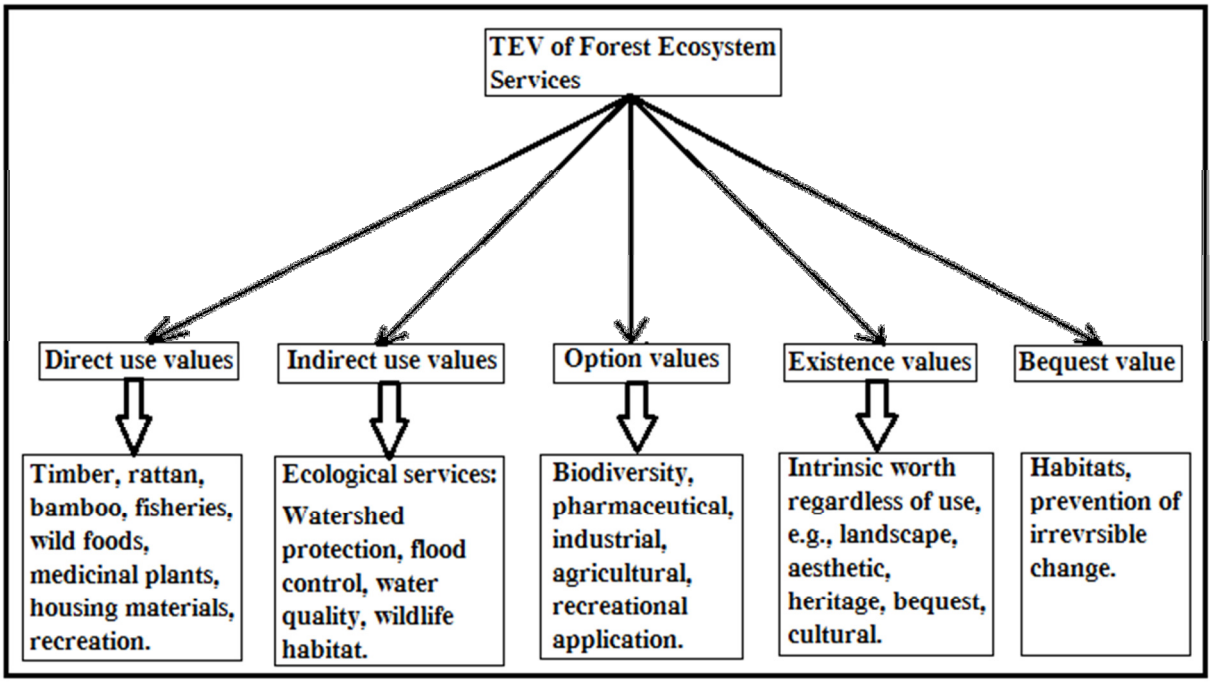
	costs.	
Market price: Observations, interviews with buyers and sellers; visits to 4 markets over 2 years	Labour: Estimated collection, transport and sales time from on-site interviews of collectors; examined as a function of harvest amounts; used local wages Other: processing and packaging costs	Grimes et al. 1994
Market price: Current market price of equivalent food	Labour: Collection time based on recall interviews about hunting trip; calculated average of 13.4 man hours per animal killed; assumed 30% wastage for bearded pig and 45% for other species	Caldecott, 1988

Source: Adapted from Wollenberg, 2000.

So far it has been realised that forest provides an array of critical but undervalued goods and services. However, the values of these products are ignored in the course of planning for conservation of the forests due to its non-market characteristics. Pearce (1996) comprehends, therefore, that there is a possibility of forests with high non-market value will lose out. This shortcoming often predisposes forests to wanton destructions. Valuation, however, he says, increases the available knowledge about the broad range of values associated with the forests and hence providing decision makers with useful information for making choices among alternative uses of the forests.

Voeks and Rahmatian (2004), in this regard, also state that the economic benefits of development, such as replacing forest with pasture or draining wetland for agricultural expansion, nearly always appear to outweigh the costs of environmental protection. Further, forest ecosystem valuation provides mechanism for policy instruments, allocation of public spending on forest & environmental conservation, optimize forest goods & ecological services values of forest ecosystem. Therefore, there is a paramount need of valuing such ecosystem services in the context of developing countries. Figure 3.2 furnishes different services of forest ecosystem according to the total economic value framework.

Figure 3.2
Forest Ecosystem Services according to Total Economic Value framework



Source: Jantzen, 2006.

It has been discussed above the necessity of valuing both market and non-market products from the view point of policy making. Forests are valued along diverse dimensions – nutritional value, economic security, environmental services or spiritual value – that bear no relation to market prices (Wollenberg, 2000).

Wunder et al. (2011), states that the choice of valuation method should be based on the specific characteristics, including the objectives of the study. According to Godoy (1993) the best method to be administered for valuation depends on the cultural background of the people studied, the level of literacy and the settlement pattern. The present study focuses on the ecosystem services enjoyed by fringe households and their value. Following Godoy et al. (1993); Chopra (1993); Gunatilake et al. (1993); Jantzen (2006); Brander et al. (2010), thus, two methods of forest valuation have been applied for the present study (see Table 3.4). Market Price method is used for valuation of the provisioning service (i.e., direct use values) while for valuing the intangible and non-market benefits the Contingent Valuation method (Willingness to pay) is used. In estimating the value of the forest products through Market Price method the forest gate price is taken as appropriate price following other studies (Godoy et al. 1993; Gunatilake et al. 1993; Shackleton et al. 2004; Wunder et al. 2011; Angelsen et al. 2014).

Table 3.4
Ecosystem services valued and valuation methods used.

Valuation method	Elements of Economic Value captured	Ecosystem services valued	Benefits of approach	Limitations of approach
Market prices	Direct use	Provisioning services such as fuel wood, fish, construction materials, wild fruits, edibles, etc.	Market data readily available and robust	Limited to only those services for which a market exists
CVM (WTP)	Indirect use	Regulating services such as air, water & climate regulation, maintenance of biodiversity, wildlife habitat, mitigation of flood, soil conservation, etc.	Add to capture the value of non-marketed goods and services.	Bias in responses, hypothetical nature of market.

3.1.7.1 Market Price Method:

By surveying crops, woodcutting, cattle breeding, etc. of the fringe population, in combination with (local) market prices, the direct use value for the inhabitants can be measured (Brander et al. 2010). Although, the most scientific method to value the NTFPs, as suggested by Godoy (1993) is to identify, count, weigh and measure them as they enter the village over all the seasons of the forest cycle but, due to time constraints the present study, like many others, relies on the recall method to estimate the quantity of NTFPs collected.

Keeping in view the objective to estimate the value of the provisioning services (PS) of the sanctuaries, the survey questionnaire elicits the information of collection of floras and faunas by the sample households of Laokhowa and Burhachapori WLSs. The semi-structured household questionnaire is used to collect details of the PS extracted, retained for domestic consumption and sold. The respondents are asked to furnish details of their recent collection. They are further asked to furnish how much do they collect in one go and how many days in a year. The price realised, quantities retained for domestic consumption, marketing of the provisioning services is also elicited during the survey.

In order to compute the value (price) of the forest provisioning services harvested by the sample households, the forest gate prices (following Gunatilake et al. 1993; Godoy et al. 1993; Shackleton et al. 2004; Wunder, 2011; Angelsen et al. 2014) of different items are collected through conducting market surveys. For the products that don't come into the market the price quoted by the samples has been taken as final. Market surveys have been carried out in two of the forest gate markets of Laokhowa and Burhachapori WLSs. The information, thus collected, has been used to extrapolate and arrive at the total collection in a year and multiplying with the market price we get the total value of the provisioning services collected.

In order to estimate the value of the provisioning services of Laokhowa and Burhachapori WLSs the following equation has been used:

$$\sum_{i=0}^{n} Qi\ (Pi)$$

Where,

Q_i = is the quantity of provisioning services extracted,

P_i = is the forest gate prices of the provisioning services,

i = is the set of provisioning services.

The main advantage of using this approach is that it uses data from actual markets, and thus reflects actual preferences or costs to individuals. Moreover, such data, i.e. prices, quantities and costs exist and thus are relatively easy to obtain. The method is not free from flaws which arise basically out of missing market and distorted market due to existence of tax or subsidy (Brander et al. 2010). Fortunately, both these limitations are absent in case of the present study.

3.1.7.2 Contingent Valuation Method (Willingness to pay or WTP):

WTP is a "stated preference technique" which aims at measuring the willingness of individuals to pay for environmental services, nature protection, etc. It is said that the most obvious way to measure non-market values is through directly questioning individuals on their WTP for a good or service. In other words, it is a questionnaire based approach to the valuation of non-market goods and services. It has great flexibility, allowing valuation of a

wider variety of non-market goods and services. It is, in fact, the only method currently available for estimating non-use values. In such studies it derives values through the elicitation of respondents' WTP to prevent injuries to natural resources (Rahim, 2008).

The CVM poses a hypothetical question in order to gauge the maximum amount individual would be willing to pay to ensure that the prospective change take place. There are four different formats for eliciting the WTP of the respondents as suggested by Whynes et al. (2003) which are as follows:

Open ended: The subject here is invited to choose a willingness to pay value, unbounded or unprompted.

Payment Scale: The subject chooses a value from a pre-specified and ordered list. All subjects choose from the same list.

Close ended: The subject is offered a 'yes/no' choice at a pre-determined offer value. Different subjects receive different offers.

Bargaining or haggling: The investigator offers willingness to pay values which the subject accepts or rejects and continues to make higher or lower offers depending upon whether the subject accepts or rejects the previous offer.

It is stated that each of these four formats elicit different WTP results and there are no theoretical guidance as to which of these four formats is the best or correct (O'Brien and Gafni, 1996; Smith, 2000). Therefore, looking into the poor socio-economic background of the respondents an open ended format is thought to be suitable. The open ended format has been selected since it is convenient for the respondents to decide upon his/her maximum/minimum WTP. Moreover, considering the socio-political situation[3] of the state it is anticipated that any question that seems imposing or dictating a price would invite large scale rejection or protest bid and even boycott the investigator.

The application of CVM always follows five steps. Defining the valuation problem is the first step in order to elicit the WTP. It is easier and more natural to express one's willingness to pay for a good or service which one is concerned with than for those goods and services one has no concern, relevance or even meaningfulness. In the second step, the nature and procedure of survey are decided. Who will be surveyed? What would be the sample size? Which questions are to be asked? What would be the mode of obtaining the replies or 'data'

on the expressed willingness to pay? And such details about the instrument, respondent and procedure of the survey must be carefully determined. The instruments and the procedure of survey are to be tested and perfected before they are finally executed. In the next step the actual survey is implemented on the sample respondents chosen by a well-designed sampling method. Finally, the data obtained through the surveys are analyzed to estimate the expressed willingness to pay. In the analysis one may deal with the non-responses suitably.

3.2 The outline of the study area along with the socio-economic characteristics of the sample households:

Chapter two has elaborately discussed the contribution of the forest and its ecosystem in the lives and livelihood of the peripheral people of forests across different countries of the world. It also states that the removal of forest provisioning services by the fringe dwellers put massive pressures on the forest ecosystem and thus contributes greatly in its degradation. The literatures further confirm that there are several other factors of forest and its ecosystem services degradation. The forest provisioning and regulating services are the lifeline of the poor fringe dwellers and thus degradation of it implies an impending hazard for them and the human beings as well. It is observed that though the lives and livelihoods of the fringe dwellers are linked with the protected areas (PA) they are ignorant about the value of these important services due to a phenomenon called 'missing market' by Pearce (1996) and Costanza (1997). It is, therefore, of utmost necessity to capture and demonstrate the true value of the forest and its ecosystem services before both the fringe dwellers and the policy makers (Pearce, 1996, Brander et al. 2010). Fikir et al. (2016) in this regard feels a necessity of undertaking both qualitative and quantitative analysis of each individual forest area for it will, he argues, reallocate the scarce resources efficiently for sustainable management of the forests. Thus, it is vital to know the benefits the peripheral people enjoy from the forest ecosystems and what would be the value of the goods and services extracted. This would, consequently, make strong arguments for conserving and managing the forests sustainably. Sustainable management of the forest necessitates a peripheral community perspective regarding their dependence on the forest ecosystem services, the fringe peoples' attitude towards environmental conservation, their willingness to participate and pay for the conservation of the forest and its ecosystem services, etc. These pertinent issues call for a detailed investigation into the household characteristics and its influence into the forest use decision of the forest fringe dwellers of each individual forest area. In order to obtain a comprehensive understanding of all these issues the present study has carried out a household

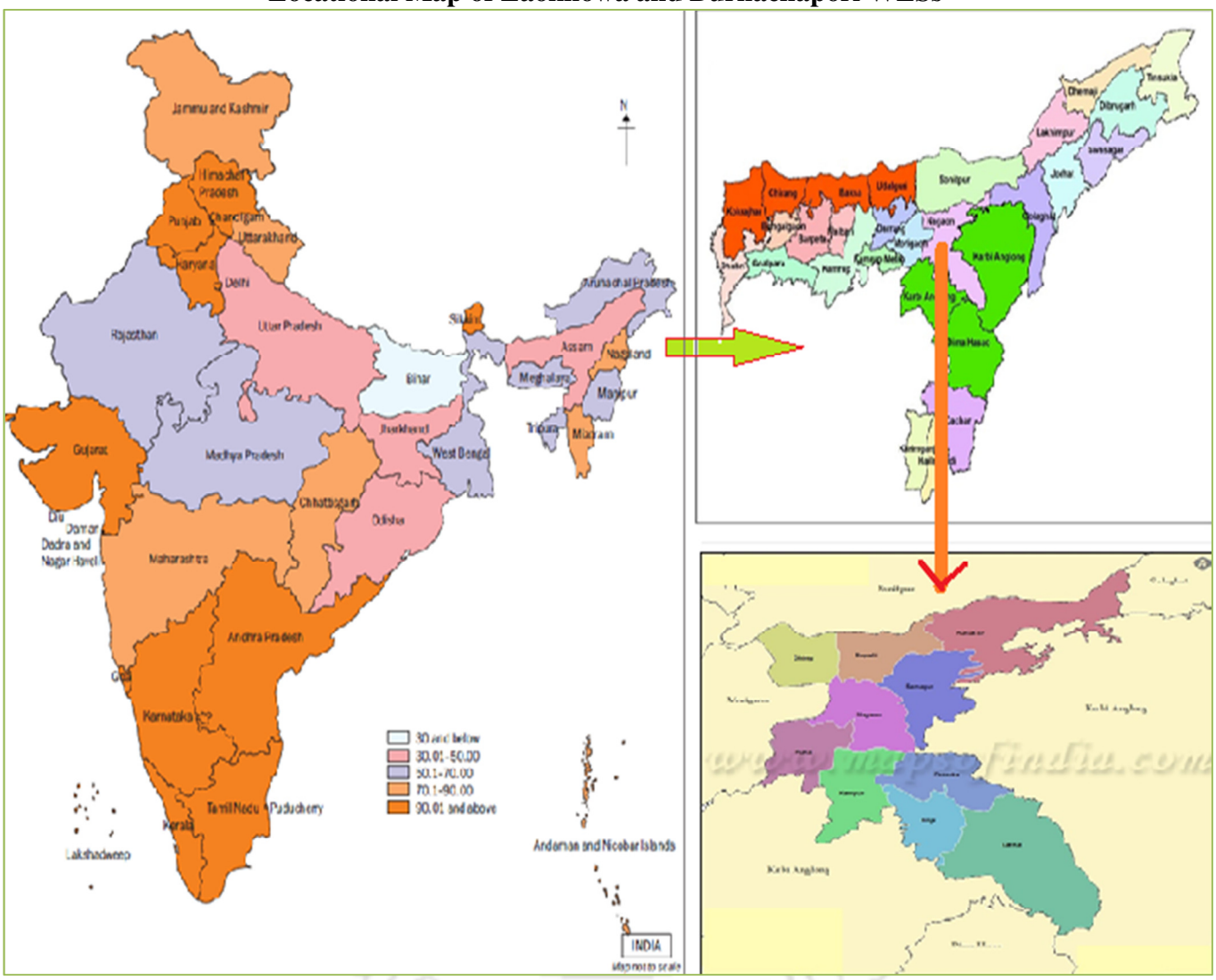
survey in the nine selected villages at the periphery of the Laokhowa and Burhachapori Wildlife Sanctuaries. The backgrounds of the sanctuaries along with the socio-economic and households characteristics of the nine villages studied are provided below.

3.2.1 The location and concise history of Laokhowa and Burhachapori Wildlife Sanctuaries:

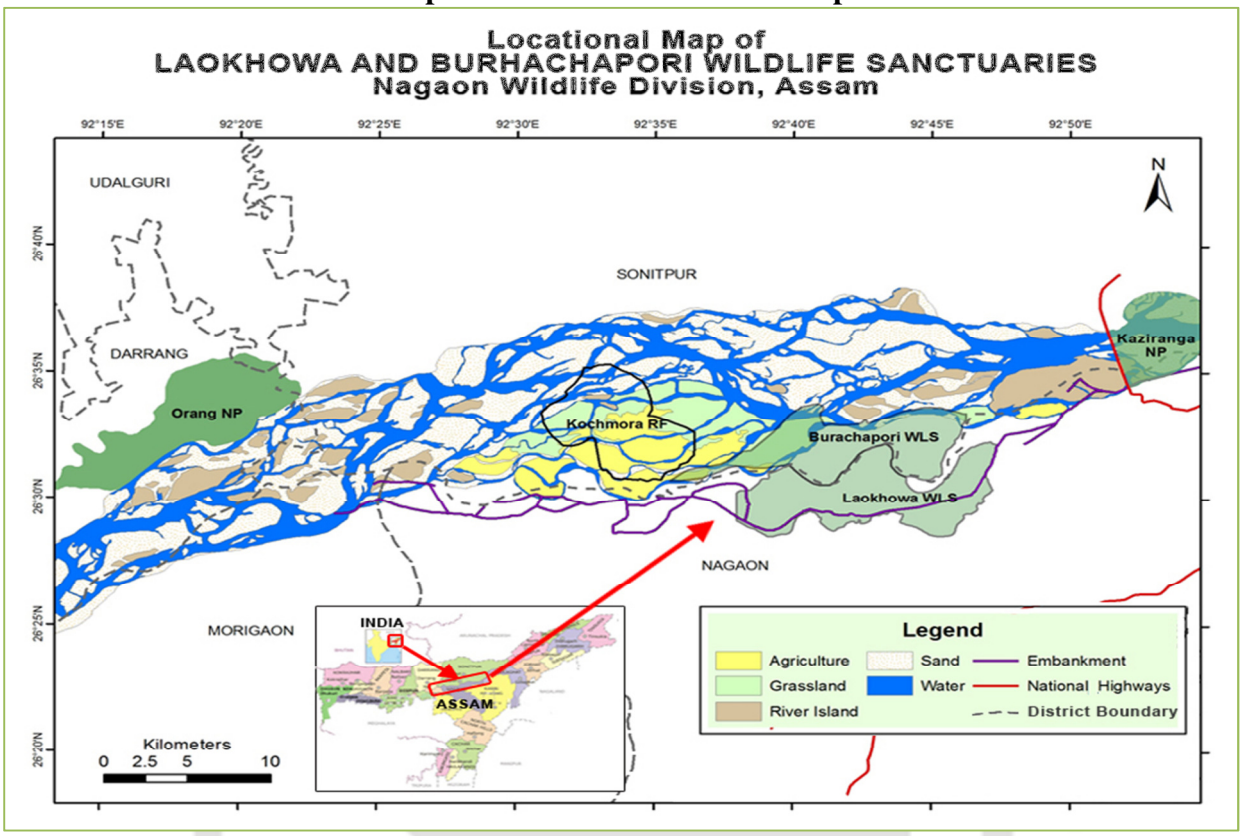
Laokhowa and Burhachapori WLSs, once good repository of floral and faunal diversity, situated in the Central Assam districts of Nagaon and Sonitpur respectively, have been passing through very disturbing phases for more than three decades now. Laokhowa WLS (LWLS) is located between latitudes 26°28'31.85" N to 26°32'13.95" N and longitudes 92°37'57.91" E to 92°47'23.27" E in Nagaon district while Burhachapori WLS (BWLS) is located between latitudes 26°30'34.16" N to 26°33'48.96" N and longitudes 92°34'27.31" E to 92°46'10.667" E in Sonitpur district (Bora, 2004; Phukan & Sharma, 2004).

The sanctuaries (Laokhowa and Burhachapori WLSs) are strategically located (see Map 1, 2 and 3) in between Kaziranga and Orang National Park of Assam and identified as an important wildlife corridor (Borthakur, 2011; Ojah et al. 2015, Ojah, 2016). Laokhowa, a game sanctuary, sprawling over an area of 70.1 sq. km is declared Wildlife Sanctuary in the year 1979 while Burhachapori, a professional grazing reserve (PGR), with an area of 44.06 sq. km are upgraded to Wildlife Sanctuaries in 1996. Both the sanctuaries are ideal habitat for various key species of plants, endangered mammals, reptiles and birds like Rhino, Wild Pig, Asiatic Wild Buffalo, Royal Bengal Tiger, Elephants, and Bengal Florican etc. The natural and perennial wetlands function as feeding and breeding ground for various fish species that attract enormous avifauna to the sanctuaries. These birds along with other species of wild lives are the prime attractions for the tourists (Bora, 2004). However, with the increased population and resultant pressure, the forest ecosystem of Laokhowa and Burhachapori WLSs has been degrading for last three decades.

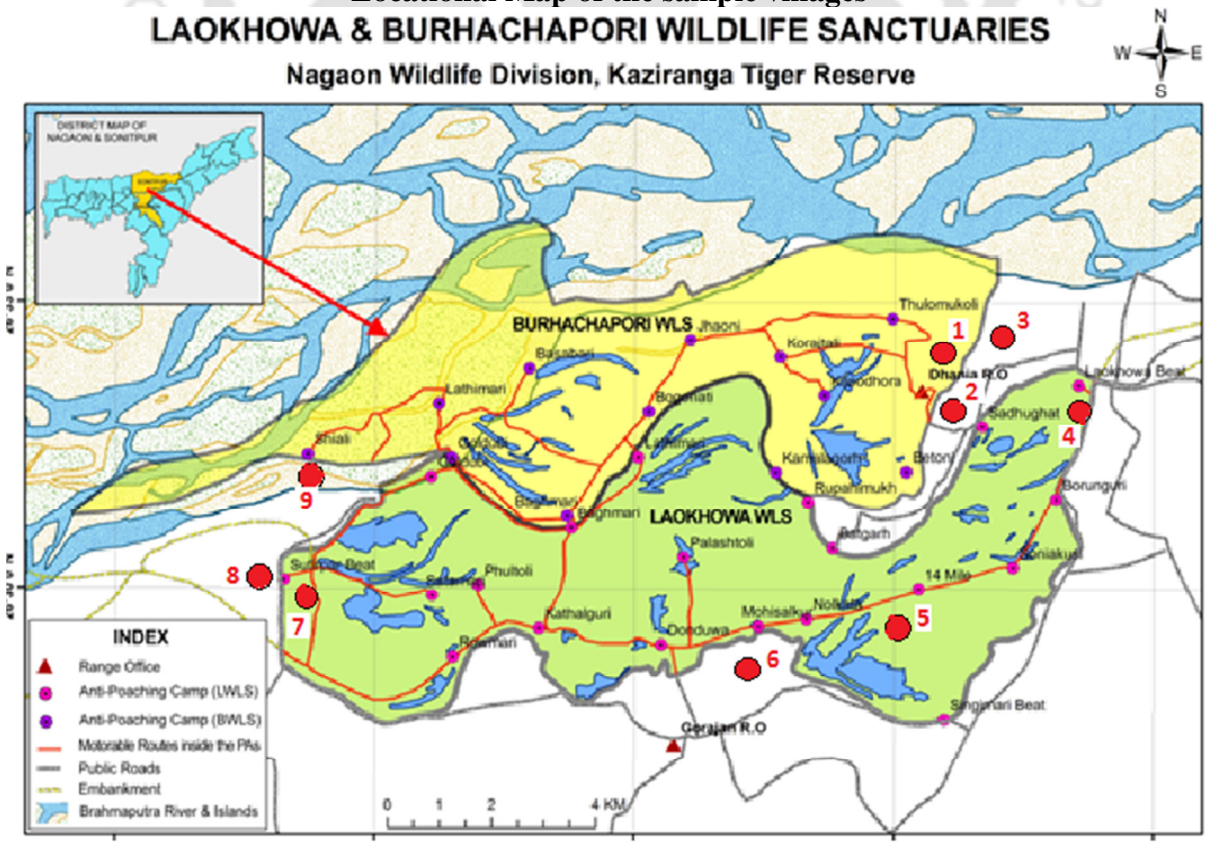
Map 1
Locational Map of Laokhowa and Burhachapori WLSs



Map 2
Locational Map of Laokhowa and Burhachapori WLSs



Map 3
Locational Map of the sample villages



There were more than 60 rhinos in the sanctuaries in the early part of the eighties of the last century. But, taking advantage of the political unrest in the state of Assam 35 rhinos were poached in a matter of a few months in 1983. Consequently, the remaining rhinos fled to other nearby rhino bearing areas. Massive anthropogenic pressures, in the aftermath of this political mayhems, emanating from the huge population in the fringe villages, such as encroachment of huge tract of forested land for both settlement and cultivation, unregulated livestock grazing, indiscriminate felling of big trees, illegal fishing, hunting of small animals for domestic consumption, etc. exacerbated the health of already disturbed sanctuaries (Bora, 2004 and Phukan & Sarma, 2004). This set the degradation in motion and with the passage of time pushed both the sanctuaries into the brink of destruction.

At this juncture, therefore, the most important and pertinent work to be done is to capture the true value of the sanctuaries in order to demonstrate the role of and importance of the sanctuaries in the lives of the fringe dwellers and for the overall environment as well. Such exercise makes a strong case for the conservation of forests.

3.2.2 Location of the sample villages:

It has been stated earlier that nine villages situated within a radius of two km from the forest boundary have been selected for in depth study (Map 3). The basic information of the selected villages has been presented in Table 3.5.

Table 3.5
Location of the sample villages

Sl no	Villages	Post office	Police station	Development Block	Sanctuaries
1	Dhania	Burhachapori	Tezpur	Gabharu	Burhachapori
2	5 No Bhogamukh	Bhogamukh	Laokhowa Chapori	Laokhowa	Burhachapori
3	4 No Bhogamukh	Bhogamukh	Laokhowa Chapori	Laokhowa	Burhachapori
4	Laokhowa Taungya Village	Bhogamukh	Rupohi	Laokhowa	Laokhowa
5	Sunsahar Nalkata Taungya Village	Salpara	Rupohi	Laokhowa	Laokhowa

6	Futaljar East	Pub Futaljar	Rupohi	Rupohi	Laokhowa
7	Sutirpar Taungya Village	Sutirpar	Juria	Juria	Laokhowa
8	Sutirpar	Sutirpar	Juria	Juria	Laokhowa
9	Chitolmari Pathar	Chitalmari Beel	Juria	Juria	Burhachapori

Source: Primary Survey, 2016

Five out of nine villages belong to Laokhowa and four belong to Burhachapori WLSs. Dhania village of Burhachapori is a relocated one. The original settlement has been eroded away by river Brahmaputra in the eighties and consequently three villages resided by Nepali community had to be relocated to its present location. Futaljar East and Chitolmari Pathar villages are inhabited solely by the migrant Muslim community whereas 4 and 5 No Bhogamukh and Sutirpar villages have mixed population. Bengali speaking Hindus and Muslims along with people of Bihari community lives in these villages. On the other hand, the *taungya* villages are inhabited by both the Bodo and Tiwa community.

Two categories of villages, namely, revenue and *taungya*[2] villages have been selected for study in order to include different communities. Out of nine villages studied six are revenue villages while three are *taungya* villages. The people have been residing the revenue villages for long. The key informants and the Focused Group Discussion (FGD) reveal that though some people started residing these villages before independence while most of them come after independence. For example, the Nepali community have been living here since about 1880s while the Bihari people (people from the Indian state of Bihar) who came for earth cutting in the early sixties and settled these fertile lands in the later period. Some of the Bengali Muslim migrated to these areas during the thirties.

On the other hand, the history of the forest and *taungya* villages is a bit different. These categories of villages were created to withdraw as much labour from the villagers in order to utilise them for forest plantation. The forest and *taungya* villages of Laokhowa WLS are resided by Bodo and Tiwa community. The people are and were employed by the forest department for various purposes. The people needed to do free work for the department and in reciprocation they were allowed to stay in the forest temporarily and also enjoyed free access to collect different NTFPs from the forest. Plantation was raised with Koroi, Simul, Sissoo and Ajhar before the Laokhowa is declared a wild life sanctuary. Initially though the people were permitted to stay temporarily but later on they were allowed to settle

permanently by establishing villages. In Laokhowa WLS such villages were created officially during 1959 to 1972. The studied villages, namely, Laokhowa, Sunsahar Nalkata and Sutirpar TV were established by the government in the year 1959, 1969 and 1959 respectively (Bora, 2004).

3.2.3 Profile of the sample households:

This section presents various characteristics of the sample households selected for the study.

3.2.3.1 Demographic details of the sample households:

Table 3.6 presents some of the demographic details of the sample households.

Table 3.6
Demographic details of sample households

Total households	302
Total population	1639
Total male	876
Total female	763
Female per 1000 male	871
Total literate population (number)	1225
Mean household size (number)	5.42
Mean age (years)	46.2
Mean education (year of schooling)	3.34

Source: Primary survey, 2016

302 households are taken as sample out of 3037 households from the nine villages selected. Total population of the sample households are 1639 out of which 53.4 percent are male and 46.5 percent are female. Analysis of the inputs elicited during the questionnaire survey regarding the demographic details shows that the average size of the household is 5.42 with a minimum family size of 2 members and a maximum of 18 members. The female per 1000 male is far below the state average of 958 (national average of 933) according to 2011 census.

3.2.3.2 Profile of the household heads:

It is indeed very important to analyse the profile of the household heads since he/she is the person who takes all major decision regarding all household matters. The information

presented in this section has been elicited through the questionnaire during the household survey. A very brief profile of the sample heads has been presented below.

There are seventeen female headed households and rest are headed by male. The household heads have different educational status. 47.6 percent of the sample heads are illiterate while the remaining 52.4 percent have attained some education. There are 21 heads that have educational experiences of more than 10 years. The average years of schooling of all the sample heads are only 3.34 years with the highest of 17 years. The age of the heads ranges between 22 to 105 years mean being 46.19 years. Majority of the heads are in the age group of 41 to 50 years followed by the group of 31 to 40 years.

3.2.3.3 Educational Profile of the household heads:

Table 3.7
Educational profile of the household heads

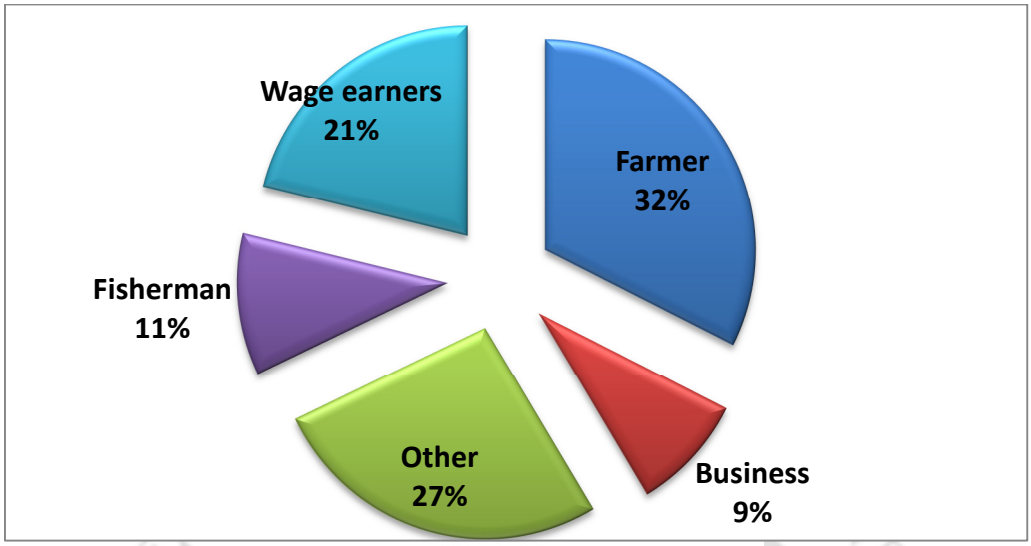
Educational status (Numbers of years of education)	**Household head (in number)**
4	65
5 - 10	72
11 - 12	13
13 – 17	8
Illiterate	144 (47.%)

The information on education of each member of the sample households have been collected through the household survey. The education is provided by government school systems in the area. Table 3.7 shows that 47 percent of the household heads are illiterate and 53 percent have attained different level of education mostly the lower primary.

3.2.3.4 Occupational pattern of the household heads:

Occupational pattern is a key component of population composition. Occupational structure influences the socio-economic development of an area. The following pie diagram (Figure 3.3) represents the occupational pattern of the heads of the sample households.

Figure 3.3
Occupational pattern of the household heads



Source: Primary Survey, 2016.

Owing to widespread poverty and high illiteracy among the fringe people the prime livelihood activities in the study area are limited mainly to small agriculture and agricultural and wage labourers. While a few are engaged in government services some others are engaged in petty trades. Owing to the low education and skill people are more likely to engage in primary activities. Across all sample villages 32 percentage of the household heads report agriculture as their primary occupation. 21 percent of the household heads are engaged in daily wage earning activities. 11 percent of the sample heads manage their livelihood from fishing activities. It is worth noting here that fishing, in most of the cases, is primarily undertaken in the *beels* and rivulets of the forest. Driving, mason, carpentry, hair cutting, tailoring, etc. are some of the other activities people get involved for their subsistence. However, it has been found during the household survey that the members of most of the families resort to more than one activities including collection of provisioning services from forests to generate subsidiary income to the family. Both food and non-food items are collected by the fringe dwellers among which fuel wood and fish are two of the important forest products.

It is worth mentioning here that about 10 percent of the household heads are living away from their families. In fact, a sizeable number of youths migrate out of their villages to places like Kerala, Bangalore, Mumbai, etc. and even abroad in the absence of any meaningful job in their locality and send remittances regularly. Unlike in other parts of the country, here the migration is not driven by drought and other climatic vagaries. It is worth quoting Sainath

(2000) here who wrote that there are millions of Indians being forced to leave their villages for cities and towns because there aren't enough jobs at home and farm incomes are drying up. The factors responsible for such outmigration are identified as high population growth along with the density, limited livelihood opportunities, limited skills in secondary and tertiary sectors, etc. Though agriculture is practised round the year nevertheless it is not a viable option due to poor land man ratio. Moreover, these unorganized farmers are exploited by the organized middlemen depriving them for the actual profit of their produce. Therefore, the familiar world of the village no longer offers the assurance of a stable livelihood. The disguised unemployment is widespread in the villages which compel the youths to migrate outside the state. This widespread and large-scale migration is essentially towards meagre, subsistence living in unknown and unfriendly destinations.

3.2.3.5 Working population:

Working population is that segment of population which is economically active and express their willingness to work. Thus, the people above 15 years of age but less than 65 years who wish to work are termed as working population. Information on working population in the study area are elicited through the household survey in order to obtain the data on the working and dependent population. Table 3.8 represents the population according to different age category and it indicates that 64 percent of the total population of the sample households are working population, i.e., in the age group of 15 – 65 years.

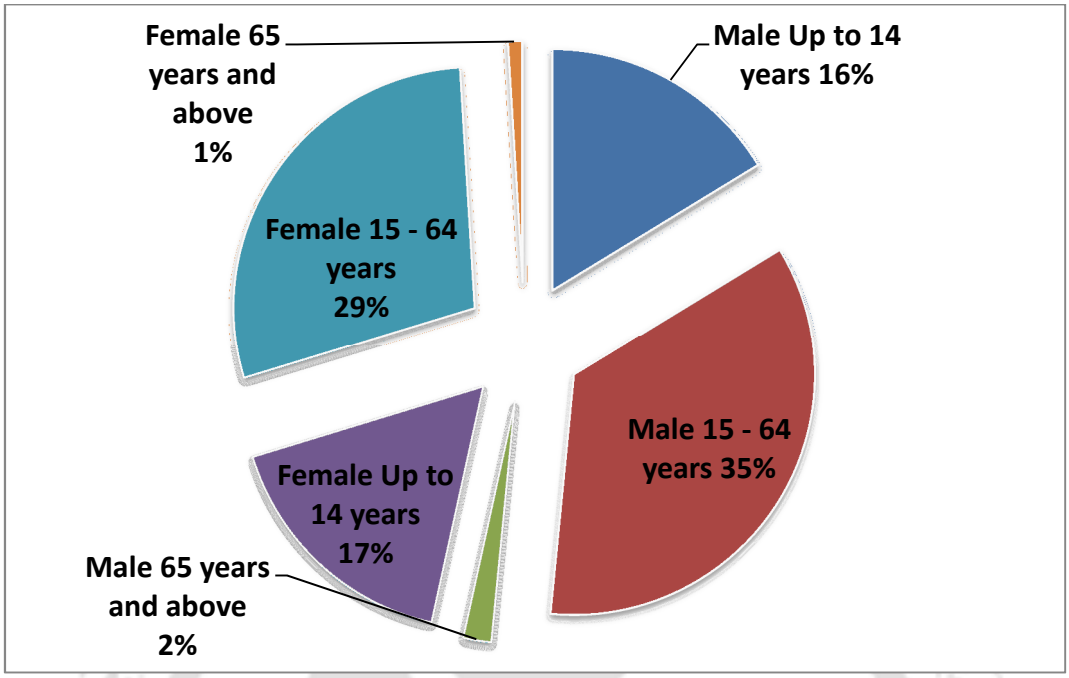
Table 3.8
Details of working and dependent population

Male			Female		
1 – 14 years	15 – 64 years	65 years and above	1 - 14 years	15 - 64 years	65 years and above
267 (16.2%)	578 (35.2%)	31 (2%)	276 (16.8%)	471 (28.7%)	16 (1%)

Source: Primary survey, 2016

33 percent sample population belong to the age group of below 15 years and 3 percent belong to the age group of 65 and above. There are 590 people in these age groups constituting the dependent population to be 36 percent. The population of different age category has been presented through the following pie diagram.

Figure 3.4
Population of different age group



Source: Household survey, 2016.

3.2.3.6 Religious profile of the sample households:

It is mentioned earlier that the study area is dominated by Bengali speaking Muslim population. 80 percent of the sample households are found to be Muslims whereas the rest 20 percent belong to Hindu. In other words, 242 out of 302 households belong to Muslim having a total population of 1288. Table 3.9 presents the religious population of the sample households.

Table 3.9
Religious composition of population of the sample households

Category	Total Household	Total Population	< 15 years		Adult		65+ years	
			Male	Female	Male	Female	Male	Female
Hinduism	60	351	42	44	127	116	14	8
Muslim	242	1288	225	232	451	355	17	8

Source: Primary survey 2016.

3.2.3.7 Caste categorisation of the sample households:

Regarding caste composition of the sample households, it has been found that 84.4 percent belong to general category while 6.6 belong to Schedule Tribe. 5 percent belong to Schedule

Caste and 4 percent belong to OBC category. Table 3.10 indicate that most of the sample households belong to general category and the sample living in the forest and taungya villages belong to scheduled tribes. The caste wise population break up the sample households is also furnished in Table 3.10.

Table 3.10
Caste composition of population of the sample households

Category	Total Households	Total Population	<15 years		Adult		65 + years	
			Male	Female	Male	Female	Male	Female
General	255	1375	237	238	484	383	22	10
Schedule Caste (SC)	15	109	17	22	33	30	3	4
Schedule Tribe (ST)	20	98	9	11	37	37	3	1
Other Backward Classes (OBC)	10	57	3	5	24	21	3	1

Source: Primary survey 2016.

3.2.3.8 Educational profile of the sample population:

Education is considered as the most important and crucial factor for human development. By bringing awareness education can work as a catalyst in inculcating personal and environmental hygiene into the attitude of the masses. It also has a direct bearing with the productivity of the people which in turn will improve the socio-economic condition of the rural masses. The information of education (number of education in years) of each member of the household has been collected during household survey. Details of educational profile of the sample households are shown in Table 3.11.

Table 3.11
Distribution of sample population according to their level of education

Educational status (Numbers of years of education)	Number of people
4	432
5 - 10	641
11 - 12	95
13 – 17	57
Illiterate	414 (25%)

Source: Primary survey, 2016

The information of education of each member of the sample households have been collected through the household survey. On the other hand, the table further shows that 1225 out of 1639 people have attained different level of education. Most of the people have attained only primary education. Only 9 percent of total sample population has education attainment of more than 10 years. It is evident from the table that about 25 percent of the sample population are illiterate. Thus, it is apparent from the table that majority of the population have attained lower level of education.

3.2.3.9 Livestock population of the sample households:

Livestock is domesticated animals raised in an agricultural setting to produce commodities such as food, fiber and labour. It is an age old practice and has been embedded in rural life since the very beginning of the human civilisation. Livestock are generally raised for profit. Raising animals is a component of modern agriculture. It has been practised in many cultures since the transition to farming from hunter-gatherer lifestyles.

Distribution of livestock population among the sample households has been presented in Table 3.12. The table shows that there are altogether 4887 different domesticated animals in the sample households. The table furnishes a detail account of the livestock population in the sample households. While hens and ducks comprise a big share of the livestock populations, fourteen tribal households keep a small stock of pig. However, these livestock don't affect in any way the forest eco system and the poor households use them as a supplementary income to fall back upon during slack period.

Table 3.12
Livestock population in the sample households

Types of livestock	No of households possessing livestock	Total number	Cattle unit
Cow	203	1731	1377.61
Goat	148	555	111
Sheep	15	113	22.6
Buffalo	15	272	242.58
Total	230	4887	1753.79
Average cattle unit per sample household			7.6

Source: Primary survey 2016.

Table 3.12 shows that cows constitute the largest share of the livestock population of the sample households. The sample households have 1731 numbers of cows which is 1377.61 cattle units average being 6.78 units. Similarly, fifteen sample households keep large stock of buffalo average being as high 16.17 cattle units. There are 111 and 22.6 units of goat and sheep respectively. Out of 302 sample households of the village 230 households keep different animals mean being 7.6 cattle unit. There are 72 households who don't possess any kind of livestock.

Since the livestock are composed of different types of animals and age group it has been converted into standardised livestock or cattle unit (CU) using the conversion measures suggested by Ghule et al. (2012) and Patel et al. (1983). The conversion process has been discussed elaborately in section 3.1.5 of this chapter. The concept of livestock unit is used here to calculate the daily consumption of forage and by calculating the amount of such forage determine the value of the forage consumed by these animals. Understanding the feed requirements of different classes of cattle is essential to ensure the carrying capacity of the pasture land. It is also essential to estimate the feed budget, pasture growth and pasture utilisation.

Open grazing in the absence of stall feeding by the cattle of the peripheral people is a common practice in the study area. It is done for about seven months in a year. Flood is an annual phenomenon and the cattle cannot be brought into the forest for grazing for about five months in a year. Thus, domestic livestock graze the forested land of Laokhowa and Burhachapori WLSs for about seven months deriving immense benefits from the sanctuaries.

Two points worth noting here: first, all the cattle are low milking variety and secondly they are not vaccinated and both are against the notion of sustainable forest management. It is important to note that livestock selling gives the people a reasonable amount of income. No or low rearing cost arising out of free grazing in the forest perhaps act as a strong incentive to rear large herds by the fringe dwellers.

3.2.3.10 Agricultural land holding of the sample households:

The distribution of the households according to their operational land holding is shown in Table 3.13. The farmers in the study area have a practice of taking and giving land on lease and therefore, it is pertinent to look at their size of operational holding which determine their production.

Table 3.13
Operational land holding of the sample households

Category	No of Households	Amount of land (in Hectare)
Marginal (Below 1 hectare)	253 (83.7%)	68.4 (43.4%)
Small (1 – 2 hectares)	34 (11.2%)	47.6 (30.2%)
Medium (2 – 10 hectares)	15 (4.9%)	41.62 (26.4%)
Average land holding size		0.52
Highest land holding size		4.66
Smallest land holding size		.01

Source: Primary survey, 2016

It is evident from the Table 3.13 that the distribution of land holding of the sampled households is very uneconomic and skewed (the range being .01 hectare to 4.66 hectare). The table further shows that the concentration of the sample farms is in the category of below one hectare. The table shows that 83.7 percent of the sample households account for 43.4 percent of the total operational holdings of the sample households. This is followed by the size category of 1 to 2 hectares constitute 11.2 percent of the samples who hold 30.2 percent of the total operational land holding. Similarly, 4.9 percent of the total sample households hold 26.3 percent of the total operational holding of the sample households. Key informant interview reveals that there are households residing very close to the forest boundary that encroaches large tract of forest land primarily for agriculture nevertheless it is difficult to account since they never reveal the truth. The household survey reveals that the tribal households are the large holders of land among all the sample households with an average

land holding of 1.19 hectare for the samples in comparison to others (with average land holding being only .48 hectare) which is due to the implementation of the Forest Right Act, 2006, under which the forest and taungya villagers have been given the land title.

The entire land of the sample households are under agriculture. There is no fallow or waste lands as multiple cropping is very much prevalent in the study area. Summer paddy is predominant crop for the sample households followed by jute. Apart from summer paddy and jute people also grow different vegetables such as potato, brinjal, ladies finger, bean, bitter gourd, cabbage, cauliflower, peas, etc. People also cultivate mustard on commercial basis. Jute and mustard are the cash crops for the samples.

3.2.3.11 Irrigation facilities of the sample households:

Irrigation is a must for practising multiple cropping. In the absence of any institutional mechanism many of the farmers have installed Shallow Tube Well (STW) individually. 88.6 percent of the farming households have access to provision of irrigation water for their agricultural fields. 37 percent of 88.6 percent of the farming households have their own STW installed in the agricultural fields and the rest (63 percent) of the farmers buy water on mutual arrangement by paying an amount of 80 – 120 kg paddy per bigha (.13 ha) land.

3.2.3.12 Sources of drinking water for the sample households:

The state of drinking water facility is quite good in the sample households. 92 percent of the total sample households have their own tube wells installed in their compound while the remaining samples need to carry water from their neighbours. There are government water supply facilities in some villages though no sample household has access to it. The *beels* and *sutis*[4] of the forest cater to the drinking water need of the livestock population.

3.2.3.13 Energy status of the sample households:

The rural India is still inhabited by about 70% of its total population and use different types of energy for cooking as well as for heating and lighting. Fuel wood, agricultural residues, dung cake, etc. are the prime sources of energy for this vast majority of rural population despite the availability of clean energy sources. The study area also shows a similar picture so far as the energy use is concerned. Diverse sources of energy namely, fire wood, LPG, electricity, kerosene, etc. are used by the sample households for cooking, lighting, heating,

etc. The overall scenario of energy consumption by the sample households is presented in Table 3.14.

Table 3.14
Energy use by the sample households

Type of fuel	Primary purpose	Number of sample households depending on	Number of months of major dependency
Fuel wood	Cooking	243 (80.4%)	Dec & Jan
LPG	Cooking	33 (11%)	Dec & Jan
Both Fuel Wood & LPG	Cooking	26 (8.6%)	Dec & Jan
Electricity	Lighting	280 (92.7%)	Jun – Aug & Dec & Jan
Kerosene	Lighting	22 (7.3%)	Jun – Aug & Dec & Jan

Source: Household survey, 2016.

The inputs recorded during the field survey regarding the energy use scenario among the sample households has been furnished in Table 3.14. It is apparent from the table that 80.4 percent of the sample households rely absolutely on fuel wood as their primary energy for cooking while 10.9 percent of the sample households have LPG connection and don't rely on other energy sources for cooking. 8.6 percent households depend both on the fuel wood and LPG. The demand for fuel wood soars high during the month of December and January since the fuel wood is used for house and water heating too besides cooking. Fuel wood is also used for some other purposes like wine brewing by the tribal households, cooking of community feast, etc. The household survey confirms that the lion's share of the fuel wood is collected from the forest. However, agricultural residue such as rice and jute straw, cow dung and fuel wood from home garden also fulfils the demand for fuel wood to some extent.

92.7 percent of the sample households have been connected through electricity for lighting. Some of the households have availed the electricity under the '*Rajiv Gandhi Grameen Vidyutikaran Yojana*' (RGGVY) meant for the BPL family. The households having water pump for irrigating the agricultural fields too use electricity to run the water pump. Therefore, the electricity demand peaks during June – July and again in Jan – Feb, each year. But, since

the power supply in the rural areas is very erratic and frequent power cut during prime time is very common, people mostly have to rely on kerosene. The demand for kerosene, therefore, is very high and cannot be fulfilled by the government procurement centre, i.e., the fair price shop, alone. The kerosene is purchased from the open market at a very high price.

3.2.3.14 Socio-economic status of the sample households:

Table 3.15 shows some of the probable indicators of the socio-economic condition of the sample households in the study area:

Table 3.15
Socio-economic status of the sample households

Indicators of Socio-economic status	Description	Number of households
Living in Kutcha house	Thatched roof and wall and mud floor, etc.	207
Living in Pucca house	RCC/ tin roof, cement floor, concrete walls	62
Living in Semi pucca and semi kutcha	Semi pucca: Cement floor and tin roofed but thatched wall. Semi kutcha Mud floor, thatched walls but tin roofed.	33
Households connected through Electricity		280
Households own livestock		230
Households having a lavatory		279
Lavatory	Kutcha	245
Lavatory	Pucca	33
Households Possess fishery		51
Provisioning services collection		207
Average annual household income (Rs.)		86887
Average income derived from forest (Rs.)		29011
Household living below poverty line		147 (48.6%)

Source: Household survey, 2016.

Most of the households live in *kutcha* houses made of mud floor, bamboo wall and thatched roof. The raw materials for construction of the *kutcha* houses are readily and abundantly available in the sanctuaries. It comes into light during the household survey and FGD that most of the households of the study area have shifted to tin roof during last few years looking into the increasing maintenance burden on the one hand and paucity of the construction materials on the other due to restricted access to the forest. Many of the *pucca* houses have been constructed under the Indira Awaas Yojana (IAY) scheme meant for the BPL families. 92 percent of the total samples have latrines while the rest 8 percent still defecate in the open. About 12 percentages have pucca latrines while the others have temporary makeshift for the purpose. 48.6 percent of the total sample households live below the poverty line and almost all have been benefited by one or more schemes meant for the BPL people. People spending equal to or less than Rs. 32 per day in rural areas are termed as living below the poverty line as per the standard set by the Rangarajan Committee, 2014.

3.3 Summing up:

It is apparent from the analysis carried out so far that the fringe areas of the Laokhowa and Burhachapori WLSs are thickly populated and there are large numbers villages within the periphery of two kilometres from the boundary of the sanctuaries. The resource poor villagers also keep large stock of domestic cattle which are let loose in the sanctuaries. The poverty ridden people in the area mostly live in *kutcha* houses and use fuel wood and agricultural residues as the primary source of energy.

Thus, the methodology and the broad profile of the sample households presented in this chapter is meant for more intensive analysis of the kind and degree of dependency of the fringe villagers on the Laokhowa and Burhachapori Wildlife Sanctuaries. It also sets the ground for detail analysis of the conservation attitude of peripheral people and thereby their willingness to pay for the conservation of the sanctuaries.

Notes:

[1]Availability of cultivable land in Assam for settlement on easy terms and conditions induced migration of landless peasants, mostly Muslims, from the districts of Eastern Bengal and in particular from Mymensingh. The first two decades of the twentieth century saw an exponential growth of immigrants in Nagaon district which was accentuated as a result of extension of the Assam Bengal Railway into the district (Ganguly, 2006). The immigrants, mostly Muslims, settled in the South Bank of Brahmaputra by clearing the forest areas.

[2] *Taungya*, a Burmese word meaning Hill cultivation, was introduced in India by Dr Brandis in 1980. It consists of land preparation for tree plantation, growing agricultural crops for 1 to 3 years after the tree plantation and moving on to another area to repeat the cycle (www.agriinfo.in). The *Taungya* system is a complex combination of both artificial regeneration and shifting cultivation. *Taungya* became an integral feature of Assam forests when acute labour scarcity became an obstacle for the expansion of the Simul plantation.

[3]One important socio-political factor need to be taken into consideration while choosing the WTP format and that is the eviction drive in Kaziranga National Park. It is alleged that a large tract of forested land of Kaziranga National Park has been encroached upon by illegal settlers restricting the free movement of the wild animals of the park. The honourable High Court ordered these settlers to evict from the forested land of Kaziranga National Park and the order was executed by the park authority. The fringe people in Laokhowa and Burhachapori WLSs also have been encroaching large tract of the sanctuaries. The Nagaon Wildlife Division (NWLD), after the eviction in Kaziranga National Park, served (eviction) notice to the illegal settlers of Laokhowa and Burhachapori WLSs and therefore the people were very apprehensive and tight-lipped. People took each and every outsider with suspicion are not at all ready to open and answer any questions to the outsiders.

[4]A *beel* is a lake-like wetland with static water, in the Ganges - Brahmaputra flood plains of the Eastern Indian states of West Bengal, and Assam and in the country of Bangladesh. *Suti*, on the other hand, implies to small rivulets.

CHAPTER FOUR

DEPENDENCY OF FRINGE PEOPLE ON FORESTS AND ITS DETERMINANTS

A concise background of the Laokhowa and Burhachapori Wildlife Sanctuaries and their importance along with the broad profile of the villages and the sample households selected for in depth investigation have been presented in Chapter three. It has been found from the household survey that the people living in the periphery of the sanctuaries are poor and about 49 percent of the people are living below poverty line as per the standard set by the Rangarajan committee 2014. Most of the people are engaged in the primary sector to earn subsistence livelihood. Majority of the sample household heads are engaged is agricultural farming, wage earning activities and fishing. In order to supplement their meagre earnings most of these households rely on forest product collection. Thus, the livelihoods of these resource poor fringe dwellers are linked to forest ecosystem of Laokhowa and Burhachapori Wildlife Sanctuaries. Dependency literatures also state that the people living in the forest fringe villages depend upon forest for a variety of goods and services. These includes collection of edible fruits, flowers, tubers, roots and leaves for food and medicines; firewood for cooking; materials for agricultural implements, house construction and fencing; fodder (grass and leave) for livestock and grazing of livestock in forest; and collection of a range of marketable non-timber forest products (CIFOR, 2008; Panta et al. 2009; FAO, 2015). The products so collected act as safety net to fill in the gaps during agricultural failure and other adversities and also act as an economic buffer (Angelsen and Wunder, 2003; Arnold and Perez, 2001).

The analysis of the broad profile of the samples considered for the current study, as carried out in Chapter three, most importantly, brings to light the socio-economic heterogeneity which may influence the fringe dwellers' decision of forest use and thus their forest dependency. One of the objectives of the current study is to estimate such dependency of the fringe people and this chapter deals largely with assessing the degree of dependency of the fringe people on the Laokhowa and Burhachapori WLSs and the factors influencing such dependency. The rest of the chapter is organised as follows: sections 4.1 and 4.2 deal with the estimation of the provisioning services of the sanctuaries collected by the sample households and village wise appropriation of these services. Section 4.3 analyses the general dependency of the sample households on Laokhowa and Burhachapori WLSs. Sections 4.4 and 4.5

discuss and present relative composition and contribution of the forest products to total forest income and the composition of the collectors as per their profession. While section 4.6 scrutinises the opportunity cost of collection of forest provisioning services section 4.7 discusses the seasonality analysis. Section 4.8 examines in detail the factors influencing the forest dependency of the fringe dwellers. Finally, section 4.9 sums up the whole chapter.

4.1 Estimates of Provisioning Services (PS) in the study area:

Millennium Ecosystem Assessment (MEA, 2005) classifies the Ecosystem Services into provisioning, regulating, cultural, and supporting services. As already discussed in Chapter two provisioning services refers to the products people obtain from ecosystems, such as food, fuel, fiber, fresh water, and genetic resources. The sample households in the study area depend on the forest for both food and non-food needs and collect a wide variety of provisioning services such as fuel wood, fodder, simul cotton pods, fish, wild edible tubers and green leaves having medicinal values, etc. The forest goods are the sources of basic necessities of the fringe people and to some extent their income as well. Forests here can, thus, be regarded as the purveyor of many provisioning services.

The household survey has been conducted at the fringe villages of Laokhowa and Burhachapori WLSs to elicit information both on flora and fauna extracted, marketing of these products, prices realised and the quantities retained for household consumption. While collecting data during household survey the respondents are also asked about their perception of forest products collection. Majority of the respondents opine that the volume of forest products collected by the fringe people are dwindling over the years due to unsustainable harvesting and resultant degradation of the forest ecosystem. The status of forest goods collection along with the perception of the fringe dwellers regarding forest extraction from both the sanctuaries are presented in Table 4.1:

Table 4.1
Status of collection of provisioning services of forest (N = 302)

Number of households collect forest provisioning services	207
No of households who feel forest collection is increasing	5
No of households who feel forest collection is decreasing	200
No of households who feel forest collection is remaining stagnant	2
No of households who don't collect	95

Source: Primary survey, 2016.

Table 4.1 shows that 68.5 percent of the sample households (207 out of 302 sample households) collect forest provisioning services from Laokhowa and Burhachapori WLSs while the rest (95 households) don't gather any. 96.6 percent of the collectors believe that the collection is dwindling over last several years. The respondents during the household survey and the key informants as well express that the availability of various products in the forest are depleting probably due to continuous and unsustainable practice of extraction. Secondly, the laxity, they opine, shown earlier by the forest frontline staffs in vigilance has been done away with and protection regime has been strengthened. Both these result in significant reduction of forest collection. It is worth mentioning here that lion's share of the provisioning services (PS) collected is retained for household consumption and a tiny portion of it only enters the market. Table 4.2 shows details of the provisioning services collection by the fringe dwellers.

Table 4.2
Types and collection of provisioning services by the sample households (N = 207)

Types of Provisioning services	Number of households	Total amount	Average time spent (hours)	Amount sold in market
Fuel wood	198	554290 kg	4.29	64970 kg
Fodder	24	5680 bundle	3.37	0
Wild edibles	12	453.5 kg	1.25	0
Wild fruits	39	2573 kg	2.74	1240 kg
Leafy vegetables	48	78915 bundle	1.85	61500 bundle
Simul cotton pods	51	9713 kg	4.08	6940 kg
Fish	85	15395 kg	4.52	9836 kg
Thatch (Imperata)	42	19170 bundle	4.04	11970 bundle
Vetiver	18	8230 bundle	3.27	2750 bundle

Source: Primary survey, 2016.

Table 4.2 shows the magnitude and variety of provisioning services collected by the sample households from Laokhowa and Burhachapori WLSs along with the amount transacted in the market. The figure furnished in the table is arrived at by asking the sample households during the household survey. Fuel wood is among the most important forest products collected by majority of the (65.5 percent) sample households of the study area. It is the sole source of energy upon which majority of the sample households in the study area depend. The household survey made it apparent that the initial 'investment barrier'[1] and lack of local

market for distribution of the refilled cylinders act as major deterrents for the households here to climb up on the energy ladder on the one hand and easy accessibility to forests act as an incentive to stick to the fuel wood as their primary source of energy for cooking, heating, etc. Though collected primarily for domestic consumption purpose a tiny part of the collected (11.72 percent of the total collection) fuel wood is sold in the markets. Each collector spends a little more than 4 hours per trip to collect the fuel wood from the forest.

Similarly, 28 percent of the sample households (85 households) catch fish from various wetlands situated inside the forest. There are several wetlands rich in aquatic diversity along with various endemic fish species both in the buffer and core areas of the sanctuaries. These *beels* are important fishing and breeding ground for both local and migratory birds that feed on the abundant fish and aquatic foodstuffs and thus regarded as the prime attraction of the sanctuaries. In most of such wetlands fishery *mahals* were allotted prior to the declaration of wildlife sanctuaries. The status of the forests has been changed with the passage of time without a change in the attitude of the fringe people and thus exerting enormous pressures in the form of catching fish illegally in the forest. The *beels* are the guaranteed source of income for the fishermen living around the forest. Thus, the fishing provides employment during slack season of the agricultural cycle and ensures a buffer against risk and household emergencies. Looking into the high demand and thereby high price 63 percent of the fishes caught is sold in the market to earn considerable amount of cash income.

Similarly, Simul cotton pods is collected by 16.8 percent of the total sample households followed by leafy vegetables, thatch, wild fruits, fodder, construction materials and wild edibles by 15.8, 13.9, 12.9, 7.9, 5.9 and 3.9 percent of the sample households respectively.

The forest products harvested can provide both assured subsistence and cash income to the households depending on it. While the forest products are harvested for domestic consumption some of the products representing a tiny portion of the total harvest are sold in the market to generate cash as well. Forest collection here, though, not a major source of income for the people but is an important supplementary source. Such findings are also reported by Patnaik (2003) in a study in Orissa. In a study in Bangladesh Kar and Jacobson (2012) reported that one third of the surveyed households sold their NTFPs for cash incomes which is found to be about 70 percent for Laokhowa and Burhachapori WLSs.

4.2 Appropriation of provisioning services of Laokhowa and Burhachapori Wildlife Sanctuaries:

This section examines the appropriation of each item of forest provisioning services by the sample households of each village.

4.2.1 Estimation of the quantity of Fuel wood collected by the sample households:

Out of various provisioning services for which the fringe dwellers depend on Laokhowa and Burhachapori WLSs fuel wood is the predominant one. Sample households living in the fringe villages of the sanctuaries use fuel wood for cooking, water heating, wine brewing and house heating during winter. A lion's share of the fuel wood used for the purpose by the fringe dwellers is extracted from Laokhowa and Burhachapori WLSs. Fuel wood gathered by the households from the sanctuaries is the most important source of domestic energy. In our country fuel wood is an important item collected by people and communities living within and near forests (Ninan, 2007) despite having negative environmental impact (Musavi, 2015). In a report, World Bank estimates that fuel wood is a source of livelihood for more than 11 million people in India, making it the largest employer (formal and informal) in the Indian energy sector (World Bank, 2006). Sedai et al. (2004) in this regard reported that traditional use of fuel wood has long term environmental implication like land degradation and pollution since 70 percent of the wood fuel requirement is fulfilled from the forests. Bhatt and Sachan (2004) also maintain that it is the second largest cause of deforestation throughout the developing world and is exacerbated by the hitherto increasing population. In Assam too people have traditionally been relying on fuel wood as a primary source of domestic energy which in turn is responsible for rapid deforestation in the state (Deka, 2004). There is paucity of studies on the subject in Assam. A study carried out by Chandra et al. (2004) at Titabor in Jorhat district of Assam reports that 96 percent of the fuel wood is used for cooking. The positive aspect of the situation is that around 77 percent of their demand for fuel wood is fulfilled by homestead while only 9 percent of the demand is met by the forest. Another study by Chandra and Kalita (2011) at Majuli found that 89 percent of the total fuel wood need is for cooking. 88 percent of this demand is fulfilled from homestead while only 5 percent comes from the forest source.

The present study finds fuel wood to be the predominant source of energy in the sample villages and most of the fuel wood is collected from Laokhowa and Burhachapori WLSs.

Legal access to forest, though, is restricted however, illegal collection which is quite high in the study area is seen as the single most important cause of forest degradation in the study area (Bora, 2004; Phukan and Sarma, 2004; Sivakumar et al. 2013). Most of the respondents hesitated initially though later revealed reluctantly about their collection of forest products. The quantum of demand and supply of fuel wood in the study area has been represented in Table 4.3.

Table 4.3
Village-wise demand for fuel wood and collection from the forest (N = 302)

Villages	**Total demand for Fuel Wood (in kg)**	**Average demand for Fuel Wood (in kg)**	**Collected from forest (in kg)**	**Demand supply gap (in kg)**
Dhania	16425	1825	10880 (66.24)	5545
5 No Bhogamukh	99280	3677	61120 (61.56)	38160
4 No Bhogamukh	97090	4413	5960 (6.13)	91130
Laokhowa Taungya Village	31025	4432	30660 (98.82)	365
Sunsahar Nalkata Taungya Village	16425	3285	10600 (64.53)	5825
Pub Futaljar	342005	2803	207400 (60.64)	134605
Sutirpar Taungya Village	14235	1779	9720 (68.28)	4515
Sutirpar	99645	2622	0 (0)	99645
Chitalmari Pathar	258055	4032	217950 (84.93)	40105
Total	974185		554290 (56.89)	419895
Average		3225	1835	1390

Note: Figures in parenthesis indicate percent of the total demand.
Source: Primary survey, 2016.

Table 4.3 indicates a very high dependence of the sample households on the forests for fuel wood. A whopping 554290 kg or 56.89 percent of the total requirement of 974185 kg is

found to be collected from Laokhowa and Burhachapori WLSs. Annually each family is found to be using an average of 3225 kg of fuel wood for various purposes out of which 1835 kg are collected from nearby forests. This figure is almost similar to the findings of Musavi (2015) who carried out a study in Bori WLS and Melaghat Tiger Reserve in the state of Maharashtra and reports annual fuel wood use by each fringe household to be more than 30 quintals (3000 kg). The gap between the demand and supply which is 416975 kg is met from the trees outside forest (ToFs). The table reveals that Laokhowa Taungya village has the highest dependency on the forest for fuel wood (a massive 98.82 percent of total demand is fulfilled from the sanctuaries) followed by Chitalmari Pathar with a dependency of 84.93 percent of their total demand.

The study further reveals that 66 percent of the sample households (198 households) depend solely on Laokhowa and Burhachapori WLSs for their fuel wood requirement. The total dependency of these households on the sanctuaries for fuel wood is a massive 78.35 percent (Table 4.4).

Table 4.4
Village-wise demand, collection from forest and sale of fuel wood by the dependent households (N = 198)

Villages	Total demand for Fuel Wood for the collectors (in kg)	Collected from the forest (in kg)	Sold (in kg)
Dhania	12775	10880 (85.16)	0
5 No Bhogamukh	73365	61120 (83.30)	9000
4 No Bhogamukh	44530	5960 (13.38)	0
Laokhowa Taungya Village	31025	30660 (98.82)	3380
Sunsahar Nalkata Taungya Village	16425	10600 (64.53)	0
Pub Futaljar	285065	207400 (72.75)	10700
Sutirpar Taungya Village	13140	9720 (73.97)	0
Chitalmari Pathar	231045	217950 (94.33)	44820
Total	707370	554290 (78.35)	67900

Note: Figures in parentheses indicate percent of the total demand.
Source: Primary survey, 2016.

While sample households of eight villages have been found to be collecting fuel wood and other provisioning services the households of Sutirpar village have refrained from such activities. 14 out of 38 sample households of Sutirpar investigated have access to LPG. Per capita average demand of fuel wood for the households of Sutirpar is found to be 3985 kg. This demand is said to have been fulfilled by the ToFs and agricultural residues like jute straw and cow dung. It came out during the household survey that people of this village prepare a traditional fuel cake locally called *muthia* by pasting cow dung in the jute straw of about one meter in length which fulfils their fuel wood need to a large extent. Bamboo of the homestead also satisfies the fuelwood requirement to some extent.

The reliance of the respondents of Bhogamukh 4 on the forest for fuel wood is relatively nominal, i.e., only 13.38 percentage of their total requirement. Proximity to the forest, the average of which is 1.63 km, perhaps plays a major role in determining their low dependency. The collectors of four out of nine villages studied, sell part of their collected fuel wood in order to earn a meagre income. 12 percent of the collectors sell a tiny portion of their collection in order to generate subsistence cash income. It is important to note that about half of the wage earners income is supplemented by the income generated from selling of fuel wood.

Data on distribution of forest collectors across space is useful for many purposes. The survey finds dependency of the households living close to the forest boundary is more on the forests for fuel wood. Table 4.5 presents the data of fuel wood collection by the households living within and beyond one kilometre from the forest boundary.

Table 4.5
Spatial analysis of fuel wood collection

Distance (kms)	Number of fuel wood collectors	Total demand for Fuel Wood (kg)	Collected from the forest (in kg)	Demand supply gap (in kg)
< 1	183	782560	536130 (68.5%)	246430 (31.5%)
1 – 2	15	191625	18160 (9.5%)	173465 (90.5%)
0 – 2	198	974185	554290	419895

Note: Figures in parentheses indicate dependency for fuel wood.
Source: Primary survey, 2016.

The household survey confirms that 92.4 percent of the total fuel wood collectors live within one kilometre from the forest boundary and 68.5 percent of their fuel wood demand is met from the sanctuaries (Table 4.5). On the other hand, only a meagre 9.5 percent of the total requirement of fuel wood demand of the respondents living between one and two kilometres is met from the forest. Thus, proximity to the forest seems to be a vital factor determining the collection of fuel wood from the sanctuaries in the study area.

4.2.2 Estimation of the Fodder collection and consumption:

Domestic livestock grazing is another form of forest dependency and considered as one of the major causes of forest degradation (Musavi, 2015). In an article on reduction of cattle population from the protected areas of India, Das (2008) maintains that protected areas in India are characterised by human settlement and their dependency on the forest for many goods and services which they extract free of cost. These people also raise large number of cattle and let loose them into the forest. Quoting Kothari (2001) he says that half of the livestock population graze freely in the forests. 67 percent of the national parks and 83 percent of the sanctuaries have incidences of grazing, he further quotes. The present study also finds similar results.

Livestock rearing is one of the major economic activities for the sample households in the study area. It is an integral part of the household economic activities and provides meat and milk to all households for daily use and in the process try to mitigate the effects of poverty. It would be worth mentioning here that the Burhachapori WLS was a professional grazing reserve (PGR) prior to its up-gradation to reserve forest in 1979 and subsequently to wildlife sanctuaries in the nineties of the last century. Some of the fringe people used to set up cattle camps inside the forests. The cattle population of these camps along with large number of cattle of the fringe dwellers put enormous pressure on the grassland aggravating the overall health of the already degraded sanctuaries (Bora, 2004; Phukan & Sarma, 2004). However, it is to be noted that grazing is an indirect dependency on the forests. Instead of collecting fodder directly, the people let their cattle graze in forested land (World Bank, 2006). Table 4.6 represents details of livestock units owned by households in each village studied.

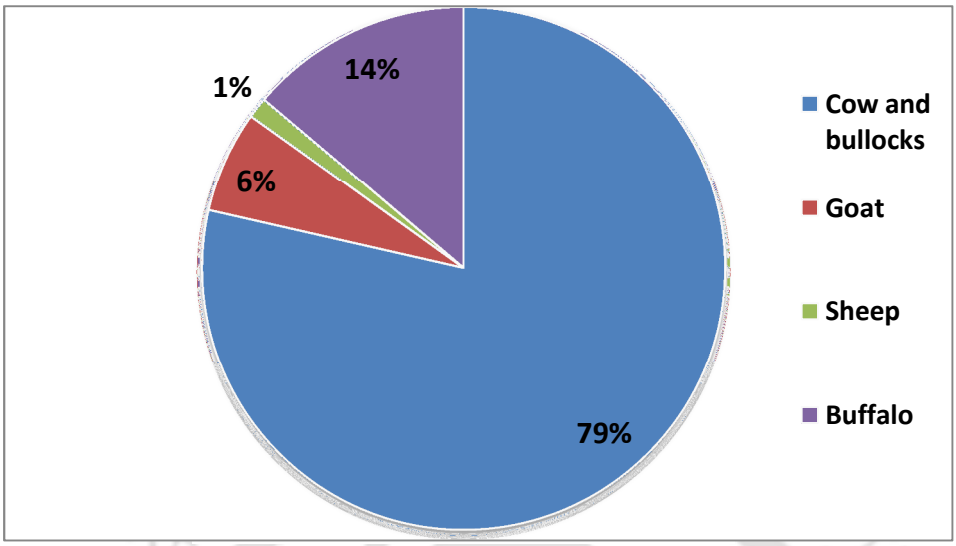
Table 4.6
Cattle population (expressed in cattle unit) in the sample villages

Village	Cow & bullocks	Goat	Sheep	Buffalo	Total
Dhania	436.85	15	9.6	112.41	573.86
5 No Bhogamukh	88.04	9.4	2.2	2	101.64
4 No Bhogamukh	83.39	10.6	0	0	93.99
Laokhowa Taungya Village	14.58	2.2	1.2	0	17.98
Sunsahar Nalkata Taungya Village	10.16	2.6	0	0	12.76
Pub Futaljar	419	31	2	41.56	493.56
Sutirpar Taungya Village	13.99	2.4	0	0	16.39
Sutirpar	79	4.2	0	0	63.3
Chitolmari Pathar	252.5	33.6	7.6	86.61	380.31
Total	1377.61	111	22.6	242.58	1753.79

Source: Primary survey, 2016

The sample households keep 2671 numbers of livestock comprising of 1731 cows, 272 buffalos, 555 goats and 113 numbers of sheep. All these livestock, have been converted, for the convenience of the analysis, into a standard 'cattle unit', as discussed in Chapter three, by using conversion measures suggested by Ghule et al. (2012) and Patel et al. (1984). 76.15 percent of the sample households maintain some kind of cattle. Thus, on an average, each family owns 7.62 cattle unit. Out of the total livestock population, 79 percent consist of cow and bullocks, about 6 percent is goat, 1 percent sheep and 14 percent is buffalo. Dhania village that has the highest cattle population among the surveyed villages, i.e., 32.7 percent of the total cattle unit, followed by Chitolmari Pathar, with 21.68 percent. Ownership of livestock is considered to be an indicator of wealth and the cattle owners often sell their cattle to obtain a sizeable income apart from selling milk and milk products. Figure 4.1 depicts the composition of the livestock of the sample households and their cattle unit.

Figure 4.1
Composition of cattle unit by cattle types



Source: Primary Survey 2016.

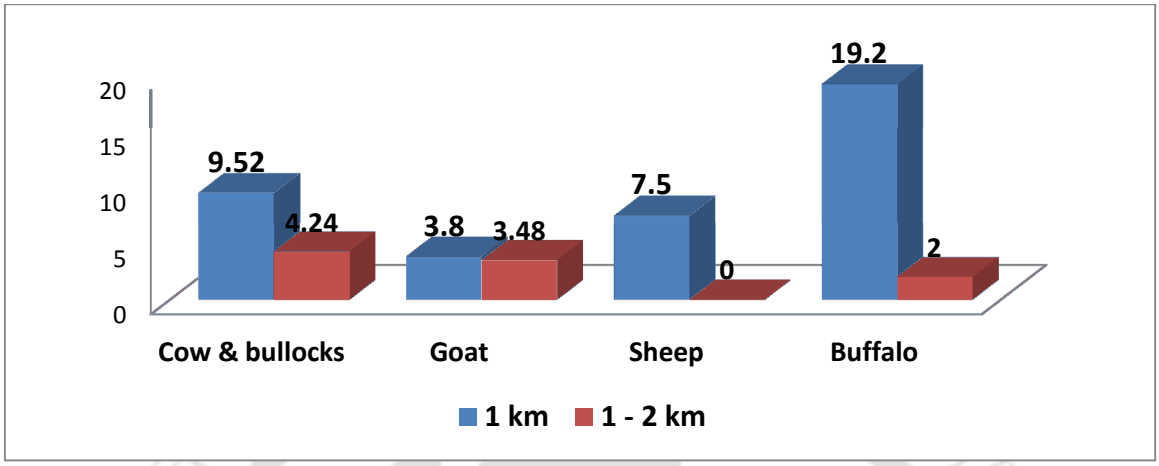
The cattle, which have multiple uses, are an integral part for the livelihood of the fringe communities. The total cattle population of the sample households in the study area is 1753.79 cattle unit. Forest provides all these animals space for grazing making it a major biotic interference for the sanctuaries. It is revealed during the focused group discussion and household survey that grazing is possible for about seven months a year and the rest of the time the cattle are stall fed or managed in other way at home. Annual flood is a common phenomenon in the study area and therefore the cattle need to be stall fed for about five months of the year. People use to collect palatable grasses or tree leaves from the sanctuaries during the flood. Rice pounds, rice straw and other cow feed purchased from markets also cater to the need of the cattle during these five months.

The household survey confirms that only 24 sample households collect palatable tree leaves during flood. The per capita collection time is about three hours per trip and total collection is about 5680 bundles. It is noteworthy that the fodder so collected is absolutely for domestic purpose and never enters into market.

It is quite often alleged by the forest managers that the fringe people keep large stock of cattle population due to zero cost of rearing as the cattle are let loose into the forest for grazing. The allegation seems to be true by looking into the distribution of the cattle population across distance (Figure 4.2). The average cattle unit per household living within one kilometre from

the forest boundary is found to be 9.52 cattle unit while it is only 4.24 cattle unit for the households living between one and two kilometres of the forest boundary.

Figure 4.2
Spatial analysis of cattle unit



Source: Primary survey, 2016.

Table 4.7 reveals that households living close to the forest raise large no of cattle and vice-versa. 1571 out of 1731 cows and bullocks, i.e., 90.75 percent of the total cow and bullock population are reared by the people residing within a kilometre from the forest. Similarly 84.3 percent of goat, 100 percent of sheep and 99.2 percent of buffalo are reared by the households residing very close to the forest. Thus, it is clear that distance plays a pivotal role in deciding whether to keep large livestock or not.

Table 4.7
Spatial distribution of sample households keeping livestock population

Animals	Number of cattle			
	< 1 km		1 – 2 km	
	Cattle number	Cattle unit	Cattle number	Cattle unit
Cow & bullocks	1571	1241.94	160	135.67
Goat	468	93.6	87	17.4
Sheep	113	22.6	0	0
Buffalo	270	240.58	2	2
Total	2422	1598.72	249	155.07
Grand total (cattle population)	2671			
Grand total (cattle unit)	1753.79			

Source: Primary Survey, 2016

4.2.3 Wild edible and fruits:

Hundreds of edible products are available in different forested areas. These are known to the tribal people living in or in the fringe of the forests and termed as traditional knowledge. Some of these are eaten raw while others are cooked to eat. Men from the earliest time have been using medicinal herbs to get relief from various diseases. Roots, tubers, stems, barks, leaves, fruits and flowers of various medicinal plants are used as curative of different diseases (Patnaik, 2003). It is observed and also has been elicited during the household survey that a number of the wild edibles and other green leaves are gathered by the tribal people living in the fringe villages of Laokhowa and Burhachapori WLSs.

The sample households collect a variety of wild edibles and fruits which grow in abundance in different seasons. The household survey reveals that wild edibles are generally collected by the tribal households whereas the fruits are collected by both tribal and non-tribal households. The fruit called Ziziphus (locally called *Bogori*) grows in abundance and remains available for collection for about three/four months in a year. It is collected both for domestic and commercial purposes by the fringe people. On the other hand, the tribal people collect variety of wild edibles of biological origins, like *Samuk* (snail), *Kekora* (crab) and other insects like *Amroli, Kodoborol, Uisiringa*, (all are local names) etc., which are available during some part of the year for about four/five months. The first two items namely, *Samuk* and *Kekora* are collected along with fish. These edibles, which are very rich sources of protein, are collected by the tribal households perhaps because the traditional knowledge is primarily associated with them. In other words, these people can only identify the edible variety of such products. A total of 453.5 kg of such wild edibles are collected by the sample households of the Taungya villages (average is 37.79 kg per household) for which they spent an average 1.25 hours per trip. A complete list of the wild edibles extracted by the sample households has been given in Annexure I.

On the other hand, 39 sample households collect wild fruit from the forest. A tiny portion, after retaining lion's share of the collection for domestic consumption, is sold in the market to supplement the meagre income of the poor collectors. An average of 2.7 hours per trip is spent for the collection of this wild fruit.

Table 4.8 furnishes the collection of wild fruit as per the distance from their respective households from the forest boundary.

Table 4.8
Spatial analysis of wild fruits collection

Distance (km)	Total collection (kg)	Total sale (kg)	% of collectors who sell
< 1	2323 (90%)	1240 (53.3%)	29.4
1 – 2	250	0 (0%)	0
0 – 2	2573	1240	29.4

Note: Figures in parentheses represent percent of sale of total collection.
Source: Primary survey, 2016

90 percent of the wild fruits are collected by the people residing within one kilometre from the forest boundary while only 10 percent are collected by the people residing beyond one kilometre. More than half of the collections are sold in the market for generating supplementary income. It is clear from Table 4.8 that the people living beyond one kilometre collect only for domestic consumption.

4.2.4 Leafy vegetables:

Barua et al. (2007) reports that the NE region is bestowed with enormous plant resources especially in terms of wild species of various indigenous crops. Natural vegetation of Assam has a great variety of herbs, shrubs and trees with edible leaves and these possess high nutritional value, in addition to medicinal properties. Some of these wild species are used as indirect foodstuffs as favourable additions to various traditional delicacies. These are also being widely used as ethno-medicine or in other form. Some of these plants possess ritualistic values in society. Likewise, Laokhowa and Burhachapori WLSs are also good repositories of various wild green edible leafy vegetables. Among all *dhekia* or fiddleheads is the only item available seasonally and is both foraged and commercially harvested by the fringe dwellers. Household survey reports that 48 sample households collect about 78915 bundles of *Dhekia* from the forests. The average collection for each household was 1644 bundles whereas each household spent an average 1.85 hours per trip for its collection.

It was evident during the field survey that the tribal people have the expertise and thus collect a number of edible green leafy vegetables from the forest such as *kalmou, bhedailota, botatenga, khasengtenga, titaful, soratful, manimuni, changoitenga*, etc. Such vegetables are cheap sources of nutrition for the resource poor tribal people of the area. These items are collected once in a while and solely for domestic consumption purpose. Though some of

these leafy vegetables have very good market value nevertheless they are not sold in the market. It is found during the survey that the tribal people collect more than 40 varieties of leafy vegetables from the forests which possess some medicinal values. The complete list of the wild green leafy vegetables extracted by the fringe people have been listed in Annexure II.

Table 4.9 furnishes a spatial analysis of leafy vegetables collection by the sample households.

Table 4.9

Spatial analysis of wild leafy vegetables collection

Distance (km)	Total collection (bundles)	Total sale (bundles)	% of collectors who sell
< 1	76395	61500 (80.5)	20.5
1 – 2	2520	0	0
0 – 2	78915	61500	20.5

Note: Figure in parenthesis indicates percent of sale from total collection.
Source: Primary survey, 2016.

It is apparent from Table 4.9 that about 97 percent of the leafy vegetables are collected by the people residing close to the boundary. The collectors sell a lion's share of their collection in the market in order to generate cash.

4.2.5 Simul Cotton Pods:

Due to sub-tropical climate and heavy rainfall Simul Cotton tree (*Bombax ceiba)* is found in dense population in North East India. It is a multipurpose tree used for agroforestry, providing food, fodder, fuel and fibre. It is widely used in silvi-pastoral system of agroforestry. There was large scale plantation of this species of tree during the sixties and seventies in both the sanctuaries by involving the forest villagers. Besides other use the simul floss is most suitable for making cushions and pillow. Thus, the product has high market demand and hence the fringe dwellers indulge in collection of simul pods from the sanctuaries.

Simul Cotton Pods is one of the important forest products collected by the fringe dwellers of Laokhowa and Burhachapori WLSs. As mentioned above large amount of Simul trees are

found in both the sanctuaries which produce huge amount of cotton having excellent market value. This lures the poor, unskilled and unemployed people of the fringe who can earn a sizeable amount by collecting and selling these pods. Primary survey confirms that 51 households collect 9713 kg, an average of 190 kg per household spending an average 4.08 hour per trip. Simul Cotton fetches a very good market price and hence retaining only a tiny portion the lion's share of it is sold to earn a sizeable cash income.

Collection of Simul Cotton also is determined by the distance of the households from the forest boundary.

Table 4.10
Spatial analysis of collection and sale of Simul Cotton Pods

Distance (km)	Total collection (kg)	Total sale (kg)	% of collectors who sell
< 1	9713	6940 (71.4)	100
1 – 2	0	0	0

Note: Figure in parenthesis represents percentage sale of total collection.
Source: Primary survey, 2016.

People realise that since the collection is illegal they can be caught by the forest frontline staffs without impunity. Therefore, perhaps, the residents close to the forest only indulge in its collection. Covering longer distances always invite danger of getting caught in the hands of the forest guards.

4.2.6 Construction materials – Thatch (*Imperata Cylindrica)* and Khagori-Birina (*Vetiveria Zizanoides)*:

Thatch or *Imperata Cylindrica* is another important forest product collected by the fringe dwellers of the forests. Thatch is primarily used as a construction material. *Kutcha* houses require annual maintenance and thatch is an important raw product for construction and maintenance of these houses. It is used for thatching the roofs of traditional *kutcha* houses in the rural areas. On the other hand, locally known as *khagori,* vetiver is a perennial bunch grass native to India. Though the vetiveria has been used for many purposes but the fringe dwellers here use the erect and stiff stems as construction materials for constructing the walls of the *kutcha* houses.

Both the Laokhowa and Burhachapori WLSs are good repositories of such grasses which are collected illegally by the fringe dwellers. 240 out of 302 sample households live in *kutcha*

and semi-pucca houses necessitating both these grass as construction materials for annual maintenance of their houses. The high prices of these items act as a strong economic incentive for collection which is found in abundance in the sanctuaries. Table 4.11 shows that most of the collected thatch is sold in the forest gate markets to realise a significant income.

Table 4.11
Total collection and sale of Thatch (Imperata)

Village	Total collection	Time spent (per trip)	Sold
Dhania	130	3.5	0
5 No Bhogamukh	4410	5	1900 (43)
Laokhowa Taungya Village	2670	3.1	310 (11.6)
Pub Futaljar	4600	3.8	3600 (78.2)
Chitalmari Pathar	7360	4.4	6160 (83.6)
Total	19170	4.26	11970 (62.4)

Note: Figure in parentheses indicates percentage sale of total collection.
Source: Primary Survey 2016.

Thatch collection per household is 456 bundles per year. Though it is collected primarily for domestic consumption, looking into the high market price, about half of the collection is sold by the collectors in order to earn a good livelihood. Most of the thatch collectors are from Chitalmari Pathar who sells about 83 percent of their collection. Table 4.11 shows that about half of the total collection of thatch is sold after meeting domestic need.

Table 4.12
Total collection and sale of Vetiver

Village	Total collection (bundles)	Time spent	Sold
Laokhowa Taungya Village	3370	3.7	200 (.05)
Pub Futaljar	4650	3.25	2450 (50.5)
Chitalmari Pathar	210	2.3	100 (45.4)
Total	8230	3.2	2750 (33.4)

Note: Figure in parenthesis indicates percentage sell of the total collection.
Source: Primary Survey 2016.

Vetiver is a construction material collected by the fringe dwellers from the sanctuaries. These are used basically to construct the walls of kutcha houses. The *kutcha* houses need annual maintenance and therefore these items are important for the resource poor villagers. Only a small percentage of the sample households collect these items from the forest.

Spatial analysis indicates that both the products, as seen in Table 4.13, are collected only by the households residing close to the forest boundary. No people, residing beyond one kilometre, collect these materials.

Table 4.13
Spatial analysis of collection of Imperata and Vetiver (in bundles)

Items	Distance (km)	Total collection	Total sale	% of seller out of total
Thatch (Imperata)	**< 1**	19170	11970 (62.4)	85.7
	1 – 2	0	0	0
Vetiveria	**< 1**	8230	2750 (33.4)	83.2
	1 – 2	0	0	0

Note: Figures in parenthesss indicates percentage sale of the total collection.
Source: Primary survey, 2016.

Allotment of thatch *mahals*[2] to the highest bidders was a common practice in Laokhowa and Burhachapori prior to up gradation of the forests into Wildlife Sanctuaries (Bora, 2004; Phukan & Sarma, 2004). High demand of these materials, owing to large number of *kutcha* houses in and around the fringe areas of the sanctuaries, call for high prices and thereby high profit. Such high prices motivate the collectors to collect more than they require for their personal use and sell a part of their collection in order to earn a handsome income. It is apparent from Table 4.11 and 4.12 that 51.5 percent of the total collection of thatch and 32.5 percent of the total collection of vetiver are sold in the markets by the collectors. The tables clearly show that people beyond 1 kilometre don't enter the forest for collection of such products.

4.2.7 Fish:

Very few studies mention fish as a forest product collected by the forest fringe dwellers. A study at Kalimantan, Indonesia, shows a predominant role of fish in the household income. The study reports the contribution of fish to the total NTFP income to be 45 percent (Lyons,

2003). Similarly, Singh et al. (2010) in a study attempting to find the contribution of NTFPs in the livelihood of Mangrove forest dwellers of Sundarban, found fishing as a major component of NTFP linking to the livelihood of the forest fringe dwellers. They further report that 19-25 percent of the fringe dwellers indulge on fishing as one of their prime sources of livelihoods which contributes 49 percent to the total annual average income per household.

It is said that the NE region is considered as one of the hotspots of freshwater fish biodiversity of the world (Kottelat and Whitten, 1996). A literature review by Sen (2003) confirms 291 species under 119 genera, 38 families and 12 orders are available in NE region. The author further states that 107 threatened species are occurring in this region. Many researchers report that the fish biodiversity of India and especially of NE region has been dwindling over last couple of decades (Bagra et al. 2009) due to increasing degradation of inland water. Sarkar and Poniah (2000) attribute habitat modification, over exploitation and manmade interventions to the drastic reduction in the abundance and distribution range of fishes.

Fish is the second most important forest products, after fuel wood, collected by the fringe dwellers from various wetlands located in the fringe and also in the core of the Laokhowa and Burhachapori WLSs. Both the sanctuaries are bestowed with unique wetland ecosystems which serve as important nurseries for numerous fish population of the state. These wetlands are ideal breeding grounds for large fish population. When the forests get submerged during the annual flood, fishes from these *beels* and *sutis* disperse inadvertently to recharge the fish stock in the Brahmaputra and its tributaries.

Household survey and Management Plans of the sanctuaries confirm that selling of fishery *mahals* was a common practice before Laokhowa and Burhachapori were declared wildlife sanctuaries. Thus, the lives of people are very intimately connected with the fish since long past and therefore, though fishing in forest fisheries is banned now as per the Wildlife Protection Act 1972, it is ubiquitous and many persons partake in fishing activity. Such illegalities lead to tension between the fringe people and the forest managers taking toll of even human lives of the fringe villages. Since there is a huge fish market in the state as well as in the locality the demand and therefore the price of fish is very high luring the professional fishermen to manage anyway to fish inside the forests. It is worth mentioning here that the beels of the forests are important breeding grounds of the endemic freshwater

fishes of the region that also attract large number of local and migratory water fowls who feed on to these enormous fishes available in these water bodies.

Fishing is also one of the most important livelihood activities in the fringe villages of the forest. People are interested both in the culture and capture fisheries. Culture fisheries include- ponds, tanks, canals, etc. whereas capture fisheries comprises- the riverine fisheries constituted by the mighty Brahmaputra, *beel* fisheries, forest fisheries, swamps, low lying paddy fields, etc. The culture fisheries are to rear the Indian Major and Minor carps and consequently all such fishes are abundantly available in the area. Since, the indigenous fishes fetch high market price and also it breeds naturally in the wetlands of the forest and hence the poor fishermen always try to get hold of such fishes resorting to various illegal means. Table 4.14 furnishes fish collection by the sample households:

Table 4.14
Total collection and sale (in kg) of fish by the sample households

Village	Total collection	Time spent (per trip)	Sold
5 No Bhogamukh	392	3.72	170 (43.3)
Laokhowa Taungya Village	580	3	16 (0.02)
Sunsahar Nalkata Taungya Village	103	4	0
Pub Futaljar	8360	5.24	5850 (69)
Sutirpar Taungya Village	362	3.28	0
Chitalmari Pathar	5598	4.77	3800 (67.8)
Total	15395	4.52	9836 (63.8)

Note: Figures in parentheses imply percentage sale of the total collection.
Source: Primary Survey 2016.

28 percent of the sample households catch fish in the capture fisheries of the forest both for domestic consumption and commercial purposes. The per capita catch is 181 kg per year. Looking into the high market price of fish 80 percent of the fishermen sell their catch after retaining small portion for domestic consumption. 63.8 percent of the total catch is sold in the market. The endemic fishes fetch very high market price making the fish trading a lucrative one. Fish is the only forest product which can be harvested round the year. Household survey and focus group discussion reveal that the most alarming and disturbing fact is the use of

banned and destructive fishing methods (gears) by the illegal fishermen inside the forest leading to depletion of entire fish stock of endemic variety. An exhaustive list of the fish species caught by the villagers in the capture fisheries of the forest and in the locality along with their conservation status has been listed in Annexure III.

Fish is one of the important sources of protein in our state and so in the study area as well. 82 out of 302 sample households collect fish in the wetlands (*beels, sutis*, etc.) in and around the forests.

Table 4.15
Spatial analysis of collection and sale of fish

Distance (kms)	Total collection (kg)	Total sale (kg)	% of seller out of total
< 1	14975	9586 (64)	67
1 – 2	420	250 (59.5)	100
0 – 2	15395	9836	

Note: Figures in parentheses indicate percentage sale of the total collection.
Source: Primary survey, 2016.

Spatial analysis presented in the Table 4.15 shows that 97 percent of the fishes are caught by the fishermen residing close to the boundary (within a kilometre from the forest boundary) while only three percent are caught by the fishermen living between one and two kilometres from the forest boundary (see Table 4.15). Owing to its high demand the fish here fetch a very high price that motivates the fishermen to sell lion's share of their collection in the market. It is apparent from the table that 64 and 59.5 percent of the fishes caught by the fishermen living within one kilometer and beyond two kilometer from the forest boundary respectively are sold in the market. The table further indicates that almost all the fishermen indulge in fish selling after keeping some for their domestic consumption.

However, the respondents during household survey reveal that fishing is done in an unsustainable way, by using the destructive and banned fishing gears, leading to dwindling population. There is restriction on fishing during rainy season, i.e., April to July, which serves as a recovery period for fish population and coincides with spawning activities. Almost all the respondents lament on the unabated fishing which is done even during the breeding season using mosquito nets making both the fish stock (quantity) and diversity to decline over the years. However, the traditional fishing gears used by the tribal don't have such adverse impact on the fish stock since these gears set to release the smaller fishes

allowing them to grow. There is a practice of community fishing, called '*Bawa'* in local language, where hundreds of fishermen both from the fringe and distant villages of the sanctuaries fish the wetlands inside the forest. Since, fishing is illegal and there is strict vigilance by the frontline staffs the '*Bawa'* forcibly enter the forest to catch fish culminating into conflict with the local forest managers.

Such illegalities and destructive and unsustainable fishing practices have been proved to be detrimental and have long term environmental implications for the forest ecosystem of the sanctuaries. The respondents have expressed their deepest concern on dwindling fish species which are endemic to the region. The beels and sutis (stream) inside the forests are the repositories and breeding ground of the local and endemic fish species of the state. The abundant fish species in these beels and sutis used to lure large number of local and migratory water birds to the sanctuaries which further attracted many bird lovers. However, the scenario has been changed over the years and it comes out during the household survey that 93 percent of the respondents believe that all the local fish species in and around the sanctuaries have been declining drastically during last 20-25 years. Although, respondents opine, all the endemic fish species have been dwindling, household survey results report that the Pavo (pabda cat fish, *Ompok pabda*), Bhedengi (Gangetic leaf fish, *Nandus nandus*), Sol (Striped sneak head, *Channa striatus*), Cheng (Smooth brassed sneak head, *Channa gachua*), Chengeli (Asiatic sneak head, *Channa orientalis*), Selkona (Large razorbelly, *Salmostomar bacalia*), Sal (Giant snake head, *channa marulius*) are the species witnessed to be fast dwindling. Out of the fishes named above the Pabda is marked as Endangered by both International Union for Conservation of Nature (IUCN) and NBFGR (National Bureau of Fish Genetic Resources). Use of mosquito net (with less than 1 c.m. Bar/2 c.m. mesh *Mosaijal* in size is prohibited in any fishery throughout the year) and fishing during the breeding season, i.e., between fifteenth day of April and last day of July each year (The Assam Fishery Rule, 1953) have been the primary causes of depleting the endemic fish species according to the respondents. Using all kinds of destructive fishing gears and violation of the fishery laws is believed to have considerable impact on the status of the endemic fishes since the capture fisheries are the source of breeding for the endemic fishes.

Dwindling fish species have many negative and long term environmental and socio-economic implications. For example, depleting fish stock is acting as a repellent to the water fowls and thereby the tourists' flow to the sanctuaries. On the other hand, the declining volume of the endemic fishes call for introduction and culture of other fish species like Indian Major and Minor carps along with different exotic fishes such as, Tilapia, Common Carps, Grass carp,

Silver Carps, Big Heads and the dangerous, highly carnivorous and banned Thai Magur with negative environmental implications. These fishes are cultured in the culture fisheries of the area and the supply is increasing over the years despite its genetic, ecological and socio-economic impact.

4.3 General Dependency of the fringe dwellers on Laokhowa and Burhachapori WLSs:

Forest dependency is measured in the current research as the proportion of income derived from the forest to the total household income (Bahuguna, 2000; Velded et al. 2004; Narain et al. 2005; Heubach et al. 2011; Jain and Sajjad, 2015). Angelsen et al. (2014) describes forest dependency as the share of the forest income in total household income. The income from forest has been estimated by multiplying the volume extracted with the market price. The amount which is not sold in the market also has been expressed in terms of market price and calculated as income from forest. Thus, the total income from forest has been calculated by using the Market Price method and the forest dependency is estimated by finding out what percentage of the total household income comes from the forest product.

4.3.1 Forest income estimation:

The process of forest income estimation by using Market Price method is explained below. Forest income has been estimated by multiplying the volume of forest collection with the market price. The volume of collection of forest provisioning services by the sample households is presented in Table 4.16. The market price has been elicited from forest gate markets by undertaking market survey as elaborated in Chapter Three.

Table 4.16
Details of the provisioning services extracted and their aggregate value

Types of provisioning services	**Total collection**	**Value (Rs.)**
Fuel wood	554290 kg	2771450
Fodder	5680 bundle	5680
Wild edibles	453.5 kg	9070
Wild fruits	2573 kg	25730
Leafy vegetables	78915 bundle	15783
Simul cotton pods	9713 kg	582780
Fish	15395 kg	1539500
Thatch (*Imperata Cylindrica*)	19170 bundle	95850
Construction materials (*Vetiveria Zizanoides*)	8230 bundle	82300
Value of provisioning services extracted by the sample households		5128143
Value of grazing razing		3633441
Total value (including grazing) of provisioning services		8761584
Average value per household		33314

Source: Primary survey, 2016.

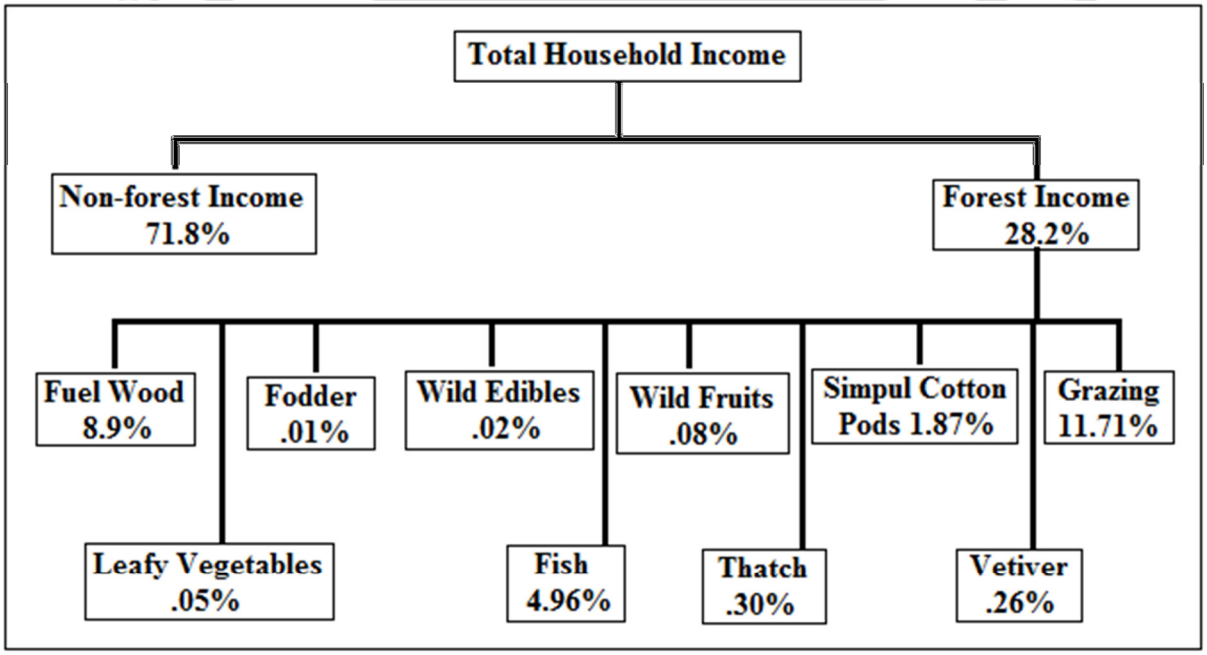
Table 4.16 shows that nine different provisioning services are collected and traded by the sample households. These products are fuel wood, fodder, wild edibles, wild fruits, leafy vegetables, fish, simul cotton pods and construction materials. The units of measurement are different for each of these services. For example, fuel wood, wild edibles, wild fruits, simul cotton pods and fish are measured in terms of kg/year while fodder, leafy vegetables and the construction materials are measured in terms of 'bundle' (a unit used by the local fringe dwellers). The monetary valuation of these services which also indicates the income of the farming household is carried out for all the sample households by using the market price method. Market survey has been carried out to determine the average prices of the collected products. There are variations in the estimated value realised by each of the sample villages. The value of green fodder consumed by the domestic cattle of the sample households is also calculated by using a concept called cattle unit (CU). The total value of all these provisioning services of LBWLSs, thus, is estimated to be a whopping Rs. 87,61,584.

4.3.2 Composition and contribution of forest products to total household income of the sample households:

Pearce and Pearce (2001) said that the benefits of the forest products accrue mainly to the local communities and if the size of the local communities making use of the forest resources is small, then the value of the forests would be small and vice-versa. As such, they are of the view to discern the value of the forest goods and services as a percentage of household income. The dependency of the fringe dwellers of the Laokhowa and Burhachapori WLSs, thus, has been shown as percentage of the total household income and presented in the Figure 4.3 and 4.4.

87 percent of the sample households in the study area are found to be dependent on the forest for various forest products. Figure 4.3 shows the household income dependency of the sample households on the Laokhowa and Burhachapori WLSs.

Figure 4.3
Forest contribution to total household income



Source: Researcher's estimation based in primary survey, 2016.

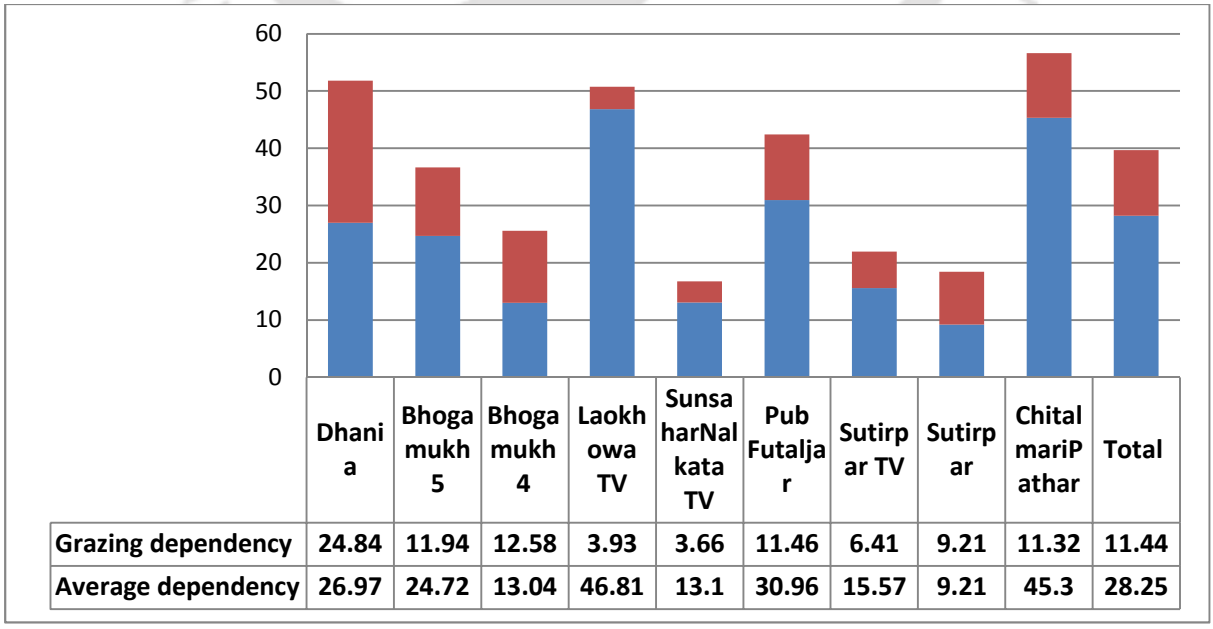
There are different ways to address dependency on forest environmental incomes, as dependency will vary first of all with type of resource and degree of substitutability, but also with space and socio-economic group. Vedeld et al. (2004, 2007), Narain et al. (2005), Heubach et al. (2011), Angelsen et al. (2014), Jain and Sajjad (2015) use the relative share of income from forest related resources as a measure of dependence. Following these literatures

the present study also estimates the relative share of the forest income to the total household income as the measure of forest dependency. The total household income here is composed of the income received from forest and non-forest sources. The non-forest sources include agriculture, business, salary, wage, remittances, etc. while forest sources are provisioning services including grazing benefits. The process of estimation of income and the dependency has been shown in detail in Chapter three. Thus, the non-forest income share to the total household income has been estimated to be 71.8 percent while the rest (28.2 percent of the total household income) comes from various forest collections. The highest contribution to the total household income is from grazing which is 11.71 percent followed by fuel wood, fish and Simul Cotton which is 8.9, 4.96 and 1.87 percent respectively. The contribution of other forest products to the total household income is negligible (as shown in Figure 4.3).

4.3.3 Village-wise estimation of dependency:

Household survey confirms that 207 (68.5 percent) of 302 sample households selected for detail investigation depend on Laokhowa and Burhachapori WLSs for different forest products. If we include grazing the figure goes up to 263 households, which is 87 percent of the total sample households. Grazing has been presented separately in order to show the enormity of its pressure on the forest. The forest dependency of the fringe villages found in the Laokhowa and Burhachapori WLSs has been presented in Figures 4.4.

Figure 4.4
General dependency of the sample households



	Dhania	Bhogamukh 5	Bhogamukh 4	Laokhowa TV	SunsaharNalkata TV	Pub Futaljar	Sutirpar TV	Sutirpar	ChitalmariPathar	Total
Grazing dependency	24.84	11.94	12.58	3.93	3.66	11.46	6.41	9.21	11.32	11.44
Average dependency	26.97	24.72	13.04	46.81	13.1	30.96	15.57	9.21	45.3	28.25

Source: Author's estimation based on the household survey, 2016.

It is clear from Figure 4.4 that the sample households are dependent on Laokhowa and Burhachapori WLSs for their subsistence and appropriate 28.25 percent of their total household income from it. The average dependency on the forest varies from village to village as shown in Figure 4.4. The figure further shows that the sample households of Laokhowa Taungya village, Chitalmari Pathar and Pub Futaljar village are highly dependent on the forest ecosystem of Laokhowa and Burhachapori WLSs with their average dependency being 46.81 percent, 45.3 percent and 30.96 percent respectively.

It is clear from Figure 4.4 that the dependency of the sample households of Sutirpar village on the sanctuaries is the lowest. They are dependent on the sanctuaries only for grazing as they don't collect any other provisioning services from the forest. The unregulated grazing from almost all the villages puts enormous pressures on the forests as is indicative from the figure. The grazing dependency of the samples of Dhania village is found to be the highest on the forest followed by Pub Futaljar and Chitalmari Pathar village. Out of 26.97 percent, the dependency of the sample households of Dhania on account of grazing is 24.84 percent. Likewise, the sample households of 4 Number Bhogamukh also depend on the sanctuaries on account of grazing. Out of 13.04 percent their dependency on the sanctuaries on account of grazing is 12.58 percent.

The 28.25 percent of forest income share found in the current study (see Figure 4.3 and 4.4) is comparable to other studies. Studies conducted by different researchers give different account of forest dependency of the fringe people in their respective study areas. Bahuguna (2000), in a study in three Indian states found that average dependency of the fringe people varies between 37 and 76 percent. Similarly, an early synthesis of 54 studies estimated an average forest income contribution of 22 percent (Vedeld et al. 2007; Angelsen et al. 2014). Angelsen et al. (2014) further state that more recent studies estimate the forest income share to vary from 6 to 44 percent of total income. Belal Uddin (2007) estimated 19 percent share of forest income into the total household income in a study at the Satchari National Park in Bangladesh. The other studies worth mentioning here is 15 percent in Chiradzulu District (Kamanga et al. 2009), Malawi; 21.4 percent in South-eastern Ethiopia (Fikir et al. 2016) and 23 percent in Gore District in South-western Ethiopia; 34 percent in Somali region, South-eastern Ethiopia (Worku et al. 2014), etc. Studies suggest that such dependency varies across the households due to different factors such as wealth status, education, livestock, land

holding, awareness level, age, gender, household size, etc. (Fisher, 2004; Timko et al. 2010; Abebaw et al. 2012; Kar and Jacobson, 2012).

Studies across various countries of the world demonstrate that the proximity of the households to the forested area is one of the important determining factors influencing peoples' decision of forest use. Table 4.17 represents the reliance of the households living at different distances from the forest boundary:

Table 4.17
Spatial analysis of degree of dependency (in percent)

Villages	Average dependency without grazing	Average dependency with grazing
< 1	25.18	29.31
1 – 2	10.56	16.20

Source: Researcher's own estimation based on the primary survey, 2016.

It is evident that the reliance of the people residing close to the forest boundary is more than that of the people residing relatively far from the forest which is 25.18 and 10.56 percent respectively. If grazing is taken into account the respective reliance increases to 29.31 and 16.20 percent.

4.3.4 Village wise appropriation of benefits accrued from the forest provisioning services (in monetary terms):

Forest provisioning services accord viable livelihood support for subsistence, cash income and safety-net to the tribes due to paucity of alternative options, small size of land holding for agriculture and marginal agricultural returns (Maske et al. 2011; Langat et al. 2016.). Table 4.18 depicts the contribution of the forest provisioning services to the income of the sample households of each village in absolute monetary terms. Table 4.18 also analyses the spatial distribution of forest income for the sample households.

Table 4.18
Village-wise average income obtained by the sample villages from Laokhowa and Burhachapori WLSs

Villages	Forest income without grazing (N = 207) (Rs)			Forest income with grazing (N = 263) (Rs)		
	Average	Min	Max	Average	Min	Max
Dhania	6899	40	10100	140033	16673	378020
5 No Bhogamukh	20642	1436	39460	24225	2806	71135
4 No Bhogamukh	2733	40	12896	10462	328	30326
Laokhowa Taungya Village	55274	39616	71794	60668	40156	84982
Sunsahar Nalkata Taungya Village	13520	6990	19260	18879	9825	23775
Pub Futaljar	23744	500	78000	27910	840	87240
Sutirpar Taungya Village	12277	7264	25632	15044	8043	31722
Sutirpar	0	0	0	7582	2100	16779
Chitalmari Pathar	33081	7400	80000	44009	6573	207894
Total	**24773 $360.3)**	**40**	**80000**	**33314 ($484.6)**	**328**	**378020**
<1 km	26414	40	80000	35989	840	378020
1 – 2 kms	7544	40	26000	13288	328	31286

Source: Primary survey, 2016.

The average yearly income (in absolute monetary terms) from forest without and with grazing has been calculated and furnished in Table 4.18. 4 No Bhogamukh has the lowest average yearly income of Rs. 2733 per household while Laokhowa TV has the highest with Rs. 55274 followed by Chitalmari Pathar with Rs. 33081. The mean income if the grazing is included becomes highest for Dhania with Rs. 140033 followed by Laokhowa TV.

It is clear from Table 4.18 that out of 245 sample households within one km from the forest boundary 77 percent (94 percent if grazing is included) of the households rely on the forest for various products. But, it is mere 31 percent (54 percent when grazing is included) for the households living between 1-2 kms from the forest boundary. It implies, thus, the importance of distance driving the forest fringe people to depend on the sanctuaries.

Angelsen et al. (2014) quote a study by Centre for International Forestry Research (CIFOR) in 24 developing countries as reporting one third of the income of the people living in forested area coming from natural forests the average share being US$ 422. Gunatilake et al. (1993) found the forest based activities to contribute an average US$ 253 to the peripheral people in his study area. Similarly, the findings of the current study also underscore the significant role played by the Laokhowa and Burhachapori forest in the lives of its fringe dwellers. Forest, including grazing, provides an average income of US $ 459.6 (or Rs. 33314) per year for the sample households of the study area (exchange rate being Rs 72.48 against one dollar as on 11 November, 2018). This income significantly varies from individual household to household. If we exclude the value of grazing the average income obtained from the forest decreases to US $341.79 (Rs. 24773) per household per year. This is quite significant for the resource poor fringe dwellers in the study area. Thus, forest contributes immensely to the people living close to it.

4.3.5 Spatial estimation of dependency:

Table 4.19 shows the spatial distribution of household dependency on forest. It is very clear that people residing in the close proximity rely more on the forest for various forest goods and services.

Table 4.19
Spatial distribution of forest dependency (in percent)

Forest activities	<1 km	1 -2 km
Total forest dependency	29.3	16.2
Fuel wood	9.4	3.57
Fodder	.01	0
Wild edibles	.03	0
Wild fruits	.08	.09
Leafy vegetables	.05	.01
Simul Cotton	2.01	0
Fish	5.26	1.65
Thatch	.33	0
NKB	.28	0
Grazing	11.79	10.86

Source: Researchers estimation based on Primary Survey, 2016.

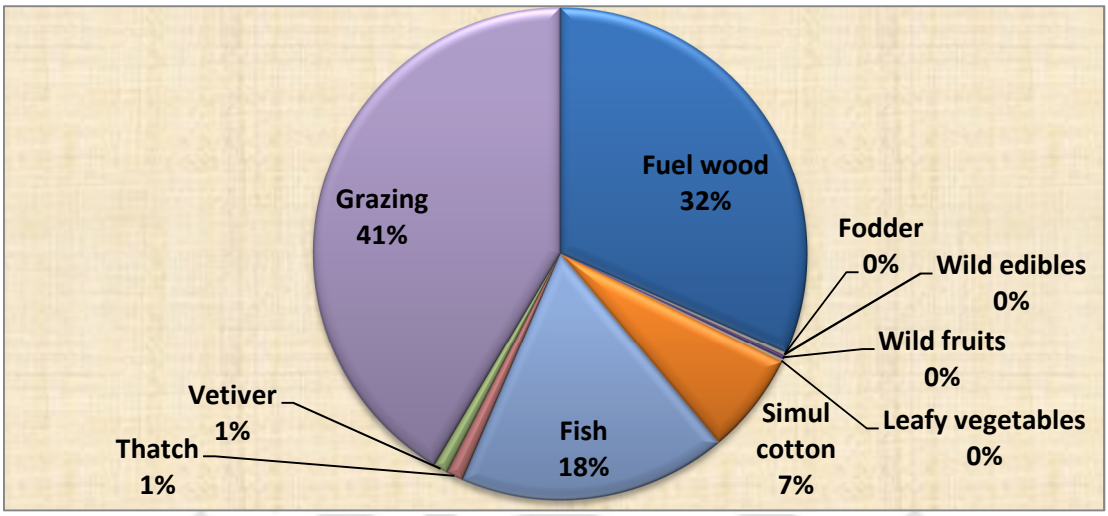
There are 245 households living within less than one km from the forest boundary and the remaining 57 households live between one and two kilometre from the forest boundary. Out

of 245 households living within one kilometre periphery 94 percent (232 households) rely on the sanctuaries while this is 54 (31 households) percent for the sample households living within one and two kilometre from the forest boundary. It is apparent from Table 4.19 that dependency of the households on forest declines with the increase in the distance from the forest boundary. The table further indicates that contribution of the forest income to the total household income of the sample households living close to the boundary is 29.3 percent while it goes down to 16.2 percent as distance increases. The contribution of fuel wood to the total household income declines as distance from the forest increases (9.4 percent for the people living within one km and 3.57 percent for the people living within 1-2 km). Similarly, the contribution of all the other items to the total household income also declines as distance increases. It, thus, tells us clearly that distance plays a pivotal role in deciding the forest use decision.

4.4 Composition and relative contribution of forest products to total forest income:

Forest provisioning services or the NTFPs contribute significantly to the household income of the fringe dwellers of the forest. Figure 4.5 shows that among the provisioning services collected and enjoyed from the sanctuaries grazing procure the maximum income (41 percent) followed by fuel wood (32 percent), fish (18 percent) and Simul Cotton Pods (7 percent). The contribution of other goods is very negligible though they have good nutritional value. Dependency literature also finds grazing or fodder and fuel wood to be the most important forest products to dominate the list of forest collection. A study conducted by ICIMOD in Nepal shows that biomass for animal husbandry consist the highest share of the forest goods and services which is 71.7 percent (Panta et al, 2009). Angelsen et al. (2014) reports the CIFOR's Poverty Environment Network (PEN) study to find fuel wood to be the dominant category accounting for 35 percent of forest income. Fuel is collected primarily for domestic consumption while fish is collected to supplement the subsistence income of the households. Mean forest income for the households in term of cash here is Rs. 33,314 (see Table 4.18).

Figure 4.5
Relative contribution of provisioning services to total forest income



Source: Researcher's estimation based on Primary Survey, 2016.

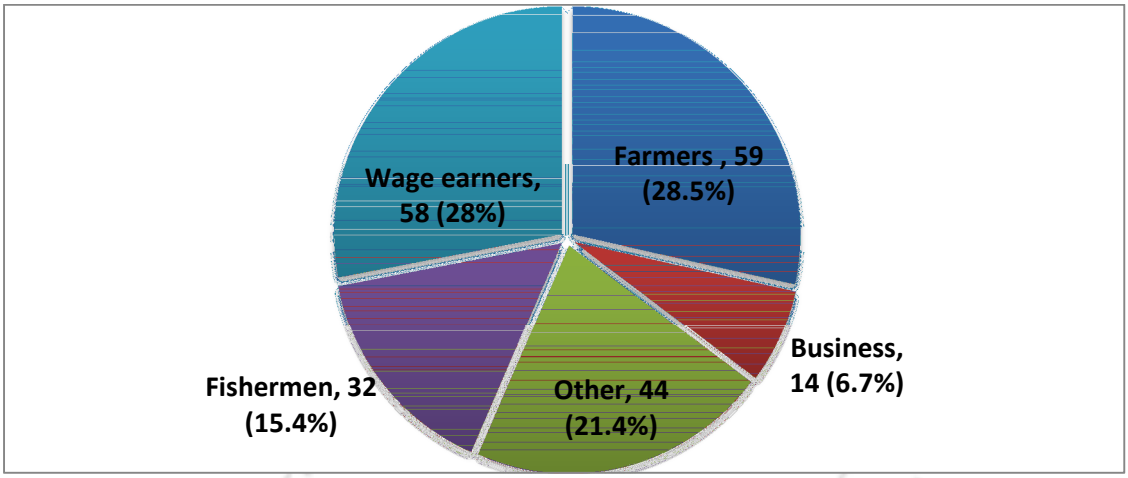
Though the contribution of wild fruits, wild edibles, leafy vegetables, etc. are minimal but their contribution to the household nutrition is significant since these products are full of medicinal properties and of nutritional value. Figure 4.5 depicts the relative share of various forest products into the total forest income appropriated by the fringe dwellers.

4.5 Composition of collectors of provisioning services according to their profession:

Rural households use multiple sources of income and forest provisioning services contribute a substantial share of these resource poor fringe dwellers' income. Household survey confirms that 87 percent (263 out of 302 sample households) of the sample households rely on forest for different kind of provisioning services including grazing while 13 percent don't have any forest interaction. Households sell part of the various provisioning services that contribute to the rural economy. Fish and fuel wood are the two most important forest provisioning services collected and sold by the sample households in the study area. Looking into the tremendous demand, thatching grass and simul pods are also sold in a smaller amount in the market. Irrespective of their occupation the opportunity of earning an extra income acts as an incentive for all the fringe dwellers to indulge in forest collection. Figure 4.6 shows numbers of household heads indulging in forest goods collection as per their occupation.

Figure 4.6

Profession of collectors of forest provisioning services



Source: Researchers own estimation based on primary survey, 2016.

People of the study area, irrespective of their occupation, engage in the collection of the provisioning services from the sanctuaries. Out of 207 households who collect various provisioning services from the sanctuaries, heads of 59 household are engaged primarily on agriculture. Likewise, 28 percent of the household heads collecting forest products are engaged primarily in wage earning activities. While 15.4 percent of the heads whose primary income earning activity is fishing and 21.4 heads who are engaged in various other income generating activities indulge on collection of forest products the involvement of the trading community is the least (only 6.7 percent) as shown in the Figure 4.6.

4.6 Opportunity cost of collection of provisioning services:

So far we have seen that a large number of households in the fringe of Laokhowa and Burhachapori WLSs depend upon forest resources to supplement their domestic requirements as well as to generate a meagre income. The common understanding is that such dependency can be addressed by providing alternative livelihood opportunities to the dependent. But, for now, it seems difficult since the forest product gathering is much more lucrative than the works these unskilled people could be engaged in. The next best alternative for the poor fringe dwellers is wage earning activities since the people are mostly unskilled and illiterate and semi-literate and thus their employability is low. Davider et al. (2010) in a study at the Western and Eastern Ghats in India also report that the forest product gathering is much more rewarding and hence people prefer such activities. The present study also finds a similar result. The people are into forest gathering activities because it is need based, relatively less

time consuming and it gives the harvesters flexibility to harvest whenever required. The opportunity cost of forest goods collection for the resource poor gatherers is much less in the study area. This is calculated on the basis of the time spent and return obtained. The people spend a lot of time collecting forest products which could have been utilised on other gainful available works. Table 4.20 presents the time spent on collecting the forest products, amount of such product collected and income for the people from forest foraging activity along with the opportunity cost of it.

Table 4.20
Opportunity cost of Provisioning services collected by the sample households

Types of forest provisioning services	Total man-days generated in a year	Average man-days generated	Average Income from forest goods (Rs.)	Average Income from next best alternative (Rs.)
Fuel wood	5640	28.48	13997	8544
Fodder	120.87	5.03	236.66	1509
Wild edibles	68	5.66	755	1698
Wild fruits	131.75	3.37	659.74	1011
Leafy vegetables	391.25	8.15	328.81	2445
Simul Cotton Pods	338.37	6.63	11294.70	1989
Fish	2676.12	31.48	18111.76	9444
Thatch (Imperata)	279.62	6.65	2282.14	1995
Vetiveria	188.75	10.48	4572.22	3144
Total	9834.73	105.93	52238.03	31779

Source: Researcher's own estimation based on the primary survey, 2016.

As observed from Table 4.20 the collection of forest provisioning services from Laokhowa and Burhachapori WLSs generated (and spent) total of 9834.73 man-days in a year for the sample households. The man-days are estimated by multiplying the number of working days with the time (hour) spent in a particular day and then dividing it by 8. For example, if a collector spends 4 hours for 40 days in a year to collect fuel wood then the total man hours generated is 4 x 40 = 160 hours. Now, by dividing these 160 hours by the number of hours per man day we get the total man days for the concerned individual, i.e., 160 / 8 = 20 man days. Since time spent by each individual collector varies, thus, the sum of the individual man days of all the 198 fuel wood collectors has been calculated separately and then added to

arrive at the total man days generated (or spent) for fuel wood collection during a year which is 5640 days. The man days generated (or spent) has been estimated for all the other forest products applying the same technique.

The study finds that fuel wood collection produces the highest man-days but collection of fish generates the highest average. 65.5 percent of the sample households collect fuel wood from the forests that generate 5640 man-days in a year. The average man-days generated (or spent) can earn these unskilled people a maximum of Rs. 8544 (multiplying the average man-days of 28.48 by the local wage rate of Rs. 300) from their next best alternative while they are actually earning a whopping Rs. 13997 by engaging themselves in the extraction of fuel wood and thereby earning a surplus of Rs. 5453 per person per year. If the calculation is to narrow down only to cover the fuel wood sellers the average man-days generated rise up to 42.11 that could earn them Rs. 12633 as against their present earning of Rs. 23771.4 per person. Thus, it is quite rewarding on the part of the fuel wood collectors to get engaged in the forest foraging activities.

The simul cotton pod is one of the most valued forest provisioning services in the study area. About 17 percent of the total sample households collect simul cotton. Total man-days generated in the process are 338.37 days/ year, the average being 6.63 days per household. The surplus generated from simul cotton collection is Rs. 9305.70 and seems hugely rewarding for the collectors to entice them time and again to get engaged into forest collection. About 94 percent of the collectors sell their product in the markets after keeping a tiny amount of it for domestic use. Thus, if we consider only the sellers the surplus generated over their next best is Rs. 9839 per seller.

Similarly, the collection of fish generates an income of Rs. 18111 as against Rs. 9444 which could have been earned by the fishermen from their next best alternative. The surplus of Rs. 8667 gives these collectors an extra incentive to go for continuous forest collection of fish. Similarly, the man-days generated for the thatch collectors are 279.62 days in a year average being 6.65 per collector. The surplus over their next best alternative is Rs. 287 per collector. Likewise, the surplus is Rs 1428 for the collectors of the *Vetiver*.

A very few of the sample households collect wild edibles, wild fruits, fodder and leafy vegetables despite having a high opportunity cost. It is perhaps because these products are available only in the forest and there is no alternative source.

It is now clear that the fringe people collect variety of provisioning services from the forest to fulfil their domestic requirement and supplement their meagre income as well. Consequently, the economic incentives for harvesting such forest services are quite strong in the study area, as elaborated above, which acts as a motivating factor to drive the fringe people to harvest different kinds of forest provisioning services available in both the Laokhowa and Burhachapori WLSs. The provisioning services harvested not only fulfil the consumption and other need of the fringe people but also provide substantial financial support to most of these sample rural populace to fall back upon during tough time.

4.7 Seasonality Analysis:

Provisioning services are not domesticated but collected from the wild. These are not available year–round or when available are in limited quantity. Therefore, the extraction of provisioning services is absolutely a seasonal activity. The survey investigated seasonal aspects of forest products extraction in Laokhowa and Burhachapori WLSs. It is found that the collections are dictated both by the period of natural availability of the forest products and the fringe dwellers' annual livelihood cycle, i.e., it is usually harvested during the agricultural slack season starting from September to April.

Table 4.21
Seasonality analysis of the provisioning services collected by the sample households

Items / Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Fuel wood												
Fish												
Fodder												
Simul cotton												
Grazing												
Wild edibles												
Thatch												
Birina/ khagori												
Fruits/ vegetables												
Leafy vegetables												

Source: Primary Survey, 2016.

Seasonality analysis of the provisioning services of Laokhowa and Burhachapori WLSs reveals that most of the products are collected during dry season. Household survey confirms that it is due to easy accessibility and better mobility into the forest. The forests remain inaccessible during monsoon restricting the mobility of the collectors. Only a few leafy vegetables and fish can be collected during monsoon. Fodder is usually collected during monsoon when grazing becomes impossible inside the forests. Some of the wild edibles (biological origin) can also be collected though they are abundantly available during winter. The farmers as well as the wage earners are relatively free from September to November and then again during February and March. Consequently, they find it indomitably lucrative to get engaged in forest collection in order to smooth out this slack period with more supplementary income from selling forest products.

Moreover, this can further be attributed to the fact that most of the forests provisioning services are available naturally during dry season. For example, Simul Cotton Pods are available naturally during March to May. Similarly, the construction materials are available during October to February and wild fruits (*berry*) are available for harvest during December to March. Most of the wild edibles and green leafy vegetables become abundant during dry season only. During winter the water level of the wetlands also go down making it possible for the fishermen to catch fish. Furthermore, the fear of getting caught by the forest guards without impunity also hinders their free movement. Thus, forest provisioning services have inconsistent abundance according to season (Islam & Quli, 2016).

4.8 Factors influencing forest dependency:

Several researchers believe that forest degradation is associated with a high level of dependency on fuel wood harvesting and other provisioning services collection (Panta et al. 2009). While most of the studies single out poverty as one of the root causes of such degradation nevertheless the other socio-economic characteristics may also play an indispensable role in both forest dependency and forest degradation process. Therefore, socio-economic attributes must be considered, according to Panta et al. (2009), in understanding the relationship between rural livelihood and their level of forest dependency.

Thus, the extent of dependency of peripheral people on forest is believed to vary according to their socio-economic status. Most of the dependency literature carried out so far on factors influencing forest dependency (Gunatilake et al. 1993; Adhikari, 2004; Panta et al. 2009;

Illukpitiya and Yanagida, 2010; Jain and Sajjad, 2015; Balama et al. 2016) reflects on a number of factors that determine the forest use decision of the forest fringe dwellers.

To examine forest dependency for the current study a Tobit model has been used where the relative share of forest income to the total household income expressed in percentage constitutes the dependent variable and the variables found on the dependency literature have been taken as independent variables. However, subject to availability of the data and its relevance in the context of the current study, the factors such as, age, education, house structure, proximity to the forest, family size, land holding, livestock population, household income, people living below poverty line and occupation have been hypothesised to be the influencing factors of forest dependency.

4.8.1 Theoretical justification for selecting the influencing factors:

The theoretical justification for the inclusion of these explanatory variables along with their definition and expected sign has been discussed below.

Age of the household head:

Age denotes the actual number of years lived by the household head. It is one of the important factors which is thought to have important influence on the forest use decision of the households. It is assumed that the older household heads are more knowledgeable and experienced and thus realize the importance of the forest ecosystem and its services for the very survival of the human kind. Thus, older heads are hypothesised to have lesser dependency on the forest. The variable is denoted as ***AGE***.

Education of household head:

Education is an indicator of the quality of human capital and is expected to have a significant influence on the choice of livelihood strategy. Previous studies have shown that people with higher levels of education are better equipped to obtain information about jobs and thus can avail greater opportunities. Educated people are more competitive in the job market and find it easier to access short-term non-agricultural work (Xu et al. 2015). Education level is the highest qualification attained by an individual. Education of household head is important as he or she takes all major decisions in the family on all important issues. Household heads with higher education level are less interested in allocating their labour to forest resources

collection (Beyene, 2011). As such, education of the household heads living beside forest in the context of the present study can be treated as an important factor influencing the forest use decision. In the present study, education level is measured as number of years of schooling which is expected to be negatively correlated with the forest dependency. Thus, the hypothesis is that the more years of education (denoted in short as ***EDU***) the household head has, the more likely he or she will work outside and depend less on forest collection.

House structure:

Dwelling houses can be categorised as *kutcha*, *semi kutcha* and *pucca* and *semi pucca* depending upon the use of construction materials. *Pucca* houses are made up of bricks, cement, iron and steel while the *kutcha* houses are built by wood, mud, straw and leaves, etc. Similarly, if the floor is made of cement and bricks and the roof is made up of tin it is considered as *semi-pucca* house. Likewise, the *semi-kutcha* houses are defined if only the roof is made up of tin. The primary purpose of classification of houses is to assess the requirements of the construction materials. All the *kutcha* and *semi kutcha* and *semi pucca* houses need frequent maintenance and thus the owners of such types of houses need construction materials. The poor households living close to the forest generally rely on the forest for construction materials such as wood, bamboo, thatch and other variety of grass, etc. which are abundantly available in the forests. While the household survey gives the exact number of households living in the *kutcha* houses the direct observation and the discussion with the key informants give an impression of forest dependency on account of the *kutcha, semi kutcha* and *semi*-pucca houses. Analysing the household characteristics and looking into the high numbers of *kutcha, semi kutcha* and *semi*-pucca houses in the study area it is hypothesised that the people will rely more on forest for construction materials and thus it is anticipated that there is a positive association of *kutcha* and *semi kutcha* houses with the forest dependency. The role of this variable on the possibility of influencing the forest use decision could be captured by constructing a dummy variable. However, for convenience *kutcha*, *semi kutcha* and *semi pucca* houses are considered to be one category and the variable takes the value "1" for all these three types of houses and "0" otherwise. The variable is symbolized as ***HSTR***.

Distance from forest:

Whether to depend and not to depend on the forest is contingent upon the location of the households. Distance to the forest from the households of the respondents is one of the important factors determining the degree of dependency on the forests. If the households are located far from the forest boundary the people will not be interested on forest foraging activities while the households living close to the forests will show their interest to collect forest goods and services (Heltberg et al. 2000). Greater distance to the forest implies a higher opportunity cost of time for extraction activities and hence a negative relationship is anticipated between distance from the forests and the forest extraction. The variable distance from forest has been referred to as ***DTF***.

Family size:

Family size implies total number of people living within a given household unit. Higher family size is believed to affect demand for forest products positively. Such families are expected to have enough labour for both forest resource extraction and other activities (Beyene, 2011). In other words, households with greater numbers of members tend to extract more forest resources to meet their subsistence needs. A large number of family members often mean more labour and mouths to feed (Gunatilake, 1998; Hegde and Enters, 2000; Jain and Sajjad, 2015). The variable has been indicated as ***FS***.

Land holding:

Land holding is also included as an important factor of forest dependency. In general, households that own more land are less dependent on the forest because they possess alternative means to maintain their livelihood through agriculture. Thus, it is expected that the land holding would be negatively related to the forest dependency. The literatures state that large land holders substitute private fuels generated on the farm for forest fuel wood (Heltberg et al. 2000). Dependency literature (Das, 2005; Fikir, 2016) further substantiates that large landholders always find it easier to keep large livestock without depending on the forests. Landholding is denoted as ***LH*** here and is expected to have a negative relationship with the forest dependency.

Livestock population:

Livestock depicts rearing of livestock for subsistence and to a lesser extent commercial purposes. We have included the amount of livestock owned by the households and is grazed openly in the forests as an influencing factor of forest dependency. Large scale cattle need huge area for foraging and in the absence of grazing ground the sanctuaries fulfil such need (Dayal, 2006) despite having various negative environment implications. Livestock records are elicited from the household survey which includes the type and number of each livestock head. Along with the literature (Jain and Sajjad, 2015) direct observation and discussion with the key informants give an impression of immense pressure of the livestock population in the Laokhowa and Burhachapori WLSs here. The livestock population is converted into a standard unit indicated here as cattle unit (***CU***) in order to obtain the approximate amount of fodder consumed by each livestock from the forests. The relationship is expected to be positive and as such the coefficient of the explanatory variable is expected to bear a positive sign.

Household income:

Household income represents incomes earned by all the members of a family. This includes income from wage and salaried jobs and other sources such as business, remittances and social grants (Garekae, 2017). Household income is anticipated to have a significant bearing on forest dependency of the people living in the periphery of the forests. The forest foraging activities are illegal and arduous and therefore not a preferred occupation of the people. But, in the absence of any gainful job opportunity people engage themselves in forest produce collection. The household income influences differently the forest use decision. While Adhikari (2005) finds the rich to be more dependent on natural resources than the relatively poor in community forests in Nepal, much of the literature (Panta et al. 2009; Reddy and Chakravarty, 1999) find a negative correlation between wealth or income and collection of forest products due to changing preferences, opportunity cost of time, etc. The current study also expects a negative sign of income with the forest dependency. The household income is represented by ***HI***.

Number of People Living Below Poverty Line:

Forest plays a pivotal role in in the life and livelihoods of the people living in its periphery. Reddy and Chakravarty (1999) emphasise that forest contribute significantly to the reduction

of income inequality. The authors further state that the poor would be doubly disadvantaged without access to forest resources. Therefore, people living below poverty line, which is indicated as ***BPL***, are thought to be an important determinant of forest dependency. The standard set by the Rangarajan Committee, 2014 has been used here as a measure of poverty. Thus, people spending an amount equal to or less than Rs. 32 in rural areas are termed as living below the poverty line. The poverty is said to have a direct bearing in the household dependency on the forest. The poor fringe dwellers always want to substitute their meagre income by earning some from the nearby forests. The variable BPL is expected to have a positive association with forest dependency indicating that people living below poverty line are more dependent on the forests. The variable is captured by constructing a dummy variable where the variable takes value "1" for people living below poverty line and "0" otherwise.

Occupation:

Many studies indicate that off farm activities reduce time spent in forestry activities and contribute to the decrease in forest degradation and deforestation (Beyene, 2011). The primary occupation of the fringe people here seems to be diverse such as, agricultural farming, wage earning activities, fishing, driving, petty business, etc. The household survey and the group discussion give an impression that almost all the people irrespective of their main occupation depend on the forest for variety of goods and services. It is anticipated that the people who basically engage in the primary sector depend more on the forest. All the occupations here have been clubbed together to make only two groups (farming and non-farming) and to capture the role of this variable in influencing the forest use decision a dummy variable has been constructed and indicated as ***OCCU***. The variable takes the value "1" if the household head is engaged in farm sector and "0" otherwise. The variable has been indicated here as ***OCCU***. The coefficient is expected to bear a positive sign indicating that a shift from the farm sector to non-farm sector will reduce the forest dependency.

The definition and measurement of the explanatory variables and expected signs of the coefficients of the variables are summarised in Table 4.22.

Table 4.22
Definition and measurement of the explanatory variables influencing the forest dependency

Variables	Type	Definition and measurement	Expected sign
Dependent variable			
Forest dependency	Continuous	Proportion of forest income to total household income	
Independent variables			
AGE	Continuous	Age of the household head in completed years	-
EDU	Continuous	Education in years of schooling	-
HSTR	Dummy	Housing structure of the households. 1 if *kuccha, semi kutcha* and *semi pucca* house, 0 otherwise	+
DTF	Continuous	Distance from the forest in km.	-
FS	Continuous	Number of household members	+
LH	Continuous	Land holding in hectare	-
CU	Continuous	Number of livestock expressed as standard cattle unit	+
HI	Continuous	Household income in rupee	-
BPL	Dummy	= 1 if BPL, 0 otherwise	+
OCCU	Dummy	= 1 if household head is engaged in farm sector, 0 otherwise.	+

4.8.2 Descriptive statistics:

The descriptive statistics of the selected explanatory variables are presented in Table 4.23. As is evident from the table the mean dependency of the peripheral people on Laokhowa Burhachapori WLSs is 26.93 percent with a maximum of 74.41 percent. The mean years of schooling of the household head is 3.34 years with a maximum of 17 years. It is to be noted that 47.6 percent of the household heads are not found to attend school while 21.5 percent of

the total respondents have completed till class V. The mean family size is 5.42 including children with a minimum of 2 and maximum of 17 members in a family.

Table 4.23
Descriptive statistics of the variables determining forest dependency

Variable	Mean	Standard deviation	Min	Max
Proportion of forest income (%)	26.93	21.08	0	74.41
AGE	46.18	13.67	22	105
EDU	3.34	4.23	0	17
DTF	.48	.50	0	2
FS	5.42	2.41	2	18
LH	.52	.70	0	4.66
CU	5.80	15.92	0	176.2
HI	86887.71	88934.71	15000	700000

All the sample households are selected from within a periphery of two km from the forest boundary and the mean distance to the forest from the sample households are 0.48 kilometres which is considered as important factor influencing the decision to the forest use of the peripheral people. Land-man ratio is very poor among the sample households with a mean of only 0.52 hectares. Similarly, the mean household income, across all the sample households, is Rs. 86887.71 per year lowest being only Rs. 15000 per year.

4.8.3 Functional form of the model:

A Tobit regression model (Following Tobin, 1958) is used to examine determinants of forest dependency. Some observations on the dependent variable are censored in a corner solution application and thus are not observed. For instance, suppose the regression model is -

$$Y_i = \beta X + \epsilon$$

We observe Y_i only if $Y_i > 0$. Thus our model is

$$Yi = \beta X + \epsilon = 0 \qquad \text{if}$$

$$\beta X + \epsilon > 0 \text{ otherwise.}$$

In the present study, there are certain sample observations that are not dependent on forest and thus their livelihood impact on forest based resources may be zero. In this situation Tobit

model is appropriate given the situation that there are too many zeros of the dependent variable in the set of sample households in our study.

The dependent variable here is the relative income share of forest products to the total household income of the fringe people. Incorporating the explanatory variables discussed in section 4.8.1 the functional form of the model can be formulated for estimation of the driving forces of forest dependency of the sample households and is presented as follows:

$$Y_i = \beta_0 + \beta_1(AGE) + \beta_2(EDU) + \beta_3(HSTR) + \beta_4(DTF) + \beta_5(FS) + \beta_6(LH) + \beta_7(CU) + \beta_8(HI) + \beta_9(BPL) + \beta_{10}(OCCU) + \in_i$$

$\in_i$= Error term.

4.8.4 Tobit estimates of forest dependency and its results and discussion:

The results of the Tobit estimation of factors influencing extent of dependency of the peripheral people on Laokhowa Burhachapori WLSs are discussed in Table 4.24.

Table 4.24
Tobit estimate for the forest dependency of the sample households

Dependency	Coefficient	Std Error	t-value	Marginal effect
AGE	-.0574	.0837	-0.69	-.0469
EDU	-.5259***	.2362	-2.23	-.4298
HSTR	5.8984***	2.2009	2.68	4.8200
DTF	-17.5087***	1.9099	-9.17	-14.3074
FS	-.0088	.4831	-0.02	-.0072
LH	-1.5761	1.5979	-0.99	-1.2879
CU	.4134***	.0709	5.83	.3378
HI	-.0006***	.0002	-3.37	-.0000
BPL	12.1925***	2.3066	5.29	9.9632
OCCU	10.9675***	2.0176	5.44	8.9622
CONSTANT	25.8921***	4.2217	6.13	
Number of observation		302		
LR Chi^2 (10)		244.21***		
Pseudo R^2		0.0979		
Log Likelihood		-1125.5918		
Left – censored observations at P<=0		39		
Uncensored observations		263		

*** represents significant at 0.01 level.

It is clear from Table 4.24 that the model gives a good fit with highly significant Likelihood Ratio Test (LR Chi^2 value of 244 and pseudo R^2 of 0.0979). The Variance Inflation Factor (VIF) values are used to check the problem of multi-collinearity (shown in Table 4A.1 in Appendix 4.1). In the present model, the value for the variance inflation factor and tolerance of the independent variables demonstrate absence of multi-collinearity, mean VIF being 1.50. The significance of the explanatory variables, direction of change in dependent variables in relation to the explanatory variables, etc. are discussed below.

Education (***EDU***) is found to be a highly significant factor ($p<0.01$) determining the extent of dependency on the forests. The inverse relationship between income from forest provisioning services and education of the household heads indicates that higher the level of education of the household head more will be the possibility to the employment opportunities outside forest. The marginal effect points out that other things remaining same, one year increase in the schooling of the household head results in .429 percent of reduction of the forest reliance. This indicates that education can lead to better opportunities for outmigration and off-farm, high skilled and high-returning employment (World Bank, 2006). Moreover, education opens up wider future prospects (Jain and Sajjad, 2015) and influences the choice of occupation. Besides, more educated households tend to have greater awareness of the value of forest eco system and hence place higher concern for their conservation. This result is similar to Gunatilake (1998), Adhikari (2004) and Illukpitiya and Yanagida (2010) who observed that the increasing education makes forest collection unprofitable while it is contradictory to the findings of the Garekae et al. (2017).

The coefficient of the dummy variable for house structure has expected positive and significant sign. It indicates that the households living in *kutcha* houses are expected to extract more house building materials from the forest and vice-versa. Furthermore, the marginal effect shows that up-gradation of the houses from *kutcha* to *pucca* will reduce the probability of collecting construction materials from the sanctuaries by 4.82 points. There is rarely any study which has taken house structure as an independent variable for forest dependency. Dayal (2006) in a study in order to analyse the household extraction of forest biomass in Ranthambhore National Park takes house structure as an independent variable but unlike the present study finds it insignificant.

The empirical study confirms that the variable distance to the forest, i.e., ***DTF***, is one of the most important independent variables that drive people to extract various provisioning

services from the forests. The result indicates that distance from the forest is negatively and significantly related with the forest income. An increase in the distance by 0.1 km reduces the possibility of forest dependency by 14.30 point. The negative association points out that as distance from the forest increases people are found to be reluctant to take up forest activities and hence the income generated by households' from the forest decreases. The finding of the present study is consistent with the findings of other studies such as, Illukpitiya and Yanagida (2010), Hegde and Enters (2000) which concluded that forest dependency is a function of proximity to the forest. The study by Balama et al. (2016) also reported that increasing distance to the forest hinders rate of collection of NTFPs. But, unlike the findings of these studies Adhikari (2005) finds the distance to be positively associated with the forest dependency. In a study in Nepal Adhikari finds that in the absence of other sources of energy people are ready to go as much as they require for collection of fuel wood which is the only source of energy for the fringe dwellers. Thus, it can be concluded that the distance is one of the most important independent variable influencing the forest use decision of the fringe villagers.

The cattle population or ***CU*** of the sample households could be explained as one of the most influential variables of the forest dependency. Cattle population has a positive and significant association with forest dependency. It indicates that the greater the cattle population of a household, the greater the predicted forest dependency. However, the marginal effect of the variable ***CU*** indicates that an increase in the cattle unit by one point increases, *ceteris paribus*, the chances of forest dependency by .337 point. The expenses associated with cattle rearing are minimal as there are freely available pasture lands and water resources inside the forests, which elsewhere would bear significant costs. Therefore, most of the people of the studied villages keep large number of cattle the average being 11.61 numbers (7.62 animal unit), which consists of cow, buffalo, goat and sheep. The result is consistent with Jain and Sajjad (2015).

Household income as referred ***HI*** from non-forestry activities shows an expected negative relationship with forest dependency. This suggests that the higher the total income the less the people would engage into the forest other things remaining the same. This inverse relationship between the income and forest dependency suggests that the forest foraging activities are not a preferred vocation of the fringe dwellers, but rather taken up in the absence of regular sources of employment. The partial probability or marginal effect of

income is found to be .0006 indicating that an increase in income will reduce forest dependency significantly. Such results are also reported by other researchers such as Hegde and Enters (2000), Illukpitiya and Yanagida (2010). It is also observed that the fringe dwellers are poor, unskilled and the absence of schooling finds them more time to spend comparatively longer hours in collecting forest produces. Reddy and Chakravarty (1999) and Panta et al. (2009) also concluded that the poor people depend more on the nearby forests in order to augment their income. Similarly, the people living below poverty line (***BPL***) are found to rely heavily on the forest. The partial probability of BPL is 9.96 which signify that on the event of a BPL household becoming APL the probability of depending on forest, *ceteris paribus*, becomes less by 9.96 percentage points. The regression result reveals an expected positive significance of the BPL people with the forest reliance. As opposed to this Adhikari (2005) argues the rich to be more dependent on the forest which he found substantiated in a study in Nepal.

The table shows that the variable occupation, as indicated by ***OCCU,*** also is statistically significant and its coefficient found to be positive. The partial probability of the variable is found to be 8.96. Thus, it is indicative from the table that a shift from the farm to non-farm sector employment reduces the probability of forest dependency by 8.96 percentage point. It is observed during field survey that people engaged in farm sector depend more on the forests. It might be because that people are most likely to lack a secure job and thereby depend more on the forests when they don't have any work to do. The result is in consistent with the findings of Kar and Jacobson (2012). The relationship implies that the family with high income loves to move away from forest based activities and diversifies its economic activities to generate cash income. The result is consistent with Godoy and Bawa (1993), Gunatilake et al., (1993).

On the other hand, the estimated results presented in the table confirm that there is a negative, though not significant, relationship between the age and the extraction of the provisioning services of forest. It suggests that younger members are more dependent on forest resources. The possible explanation may be that since the forest extraction activities are illegal, risky and more strenuous hence the elderly people are less likely to take on such risk. Rather, the younger people are more likely to undertake such risky, laborious and arduous activities. Furthermore, with limited off farm economic activities and lesser level of education and skill, these people rely more on forest collection. Thus, it seems that increase in the age of the

household heads have diminishing effect on forest extraction activities. This result is consistent with the findings of Adam (2014), Beyene, 2011, Garekae et al. (2017).

The coefficient of the size of family does not have expected sign. The regression result shows a negative association of the size of the family and the forest reliance meaning more the size of the family lesser is their dependence on the forests. The possible results may be perhaps that the members of large families get absorbed in various productive activities and earn a sizeable income and hence find less time and necessity to rely on the forest.

The table represents a negative association of land holding with the forest dependency. The coefficient indicates that households having more land are less dependent on the forest because they possess alternative means to maintain livelihood. Large size of land holdings appear to act to some extent as a substitute in terms of providing fodder and fuel wood provision (World Bank, 2006). This is similar to the findings of Gunatilake (1998), Adam (2014) and Jain and Sajjad (2015).

4.9 Summing up:

The forest in the study area plays a key role in providing diversified livelihood security to the poor fringe dwellers in the study area 49 percent of whom are living below poverty line. The forest here makes an important contribution to subsistence income and provides substantial cash income during the lean period to fall back upon apart from providing various regulating services. The study substantiates the common understanding that the rural poor resort to diverse livelihood opportunities whenever needed and wherever available forest products are an important element of their overall livelihood portfolio. Among all the provisioning services fuel wood and fish are two of the most important ecosystem services heavily exploited by the peripheral people. All such collections are illegal though the major concern here is the method of exploitation. However, it has been observed that enhanced use of alternative sources such as LPG can reduce the pressure of fuel wood collection on the forests. Qualitative observations in some parts during field survey apparently report unsustainable practices of catching fish. Another area of much concern is the uncontrolled grazing in the forest with adverse implications for wildlife of the area. On the basis of the quantitative analysis of the sample households one can project existence of a huge numbers of cattle population in all the fringe villages of the forests along with its anticipated negative implications for the wildlife. Two things are worth noting here for policy implications: the first, all these cattle are low milking and second, cattle are non-inoculated increasing,

thereby, the probability of emanating the contagious diseases to the wildlife having disastrous results.

Understanding household forest dependency is critical for designing conservation strategies. The current study reveals that the household dependency on Laokhowa and Burhachapori WLSs is driven by many factors. The result shows that proximity of the households to the forest is the most important factor of forest dependency here. It was anticipated that alternative income opportunities (thereby income) will drive the people away from the forest collection though the study finds even the relatively wealthier households gather different products from the forest due to their close proximity to the forests. It is also apparent that large families are more dependent on the forest indicating that the members of such families are more engaged in forest in order to fulfil the growing needs of their family members. Consequently, in the face of social and economic injustice, rural poverty will exacerbate the need for more forest resources and increase the conflict with the management. Therefore, policy measures that aim at increasing household income and generating off-farm employment opportunities for rural communities are needed to reduce the forest dependency and enhance forest conservation. It is of much contentment that the Nagaon Wildlife Division, assisted by various other stakeholder organisations and the local people, is putting lots of effort to reduce the local peoples' dependence on Laokhowa and Burhachapori WLSs and it is, in fact, dwindling for last five/six years.

The study analyses and answers some of the basic research questions posed at the beginning of the study. The first question tries to investigate the household characteristics of the sample households and thus wants to explore if there is any association between these characteristics and the forest dependency. The answer of this question has been analysed in this section in great detail. The qualitative and quantitative analysis suggests that the collection and extraction activities in the forest are linked with the household socio-economic attributes such as education, family size, cattle population, land holding, employment opportunities, etc. These have been elaborated comprehensively and the characteristics are regressed in order to recognise the causal relation between these and the forest dependency, results of which have been reported above.

The second set of the research question, the analysis answers, is what are the tangible goods or benefits extracted by the fringe people. In the course of the analysis it has been observed that forest provides a wide range of benefits to the peripheral people such as safety nets,

support of current consumption in the form of fuel wood, fodder, fish and various wild edibles. Though most of such products are not transacted in the market nonetheless one has to acknowledge the nutritional values of fish and other wild edibles besides other product fulfilling the basic necessities of these rural poor. However most of these products are collected for domestic consumption a part of these are also sold in the market to supplement their meagre income especially during the lean season. This can be gauged from the degree of the peoples' dependency on the forest which soars as high as 74 percent. Thus, it acts as a cushion for the peripheral community to fall back upon during hard time of the year. This quantitative explanation also answers another set of our research question that tries to look into the role played by the forest ecosystem in the wellbeing of the fringe people. The massive amount of the forest products harvested by the fringe people from Laokhowa and Burhachapori WLSs has tremendous market value which has been estimated and elucidated in the next chapter.

It is, thus, apparent from the analysis that Laokhowa and Burhachapori WLSs are playing significant role in the lives and livelihood of the peripheral people. Looking into such role it can be expected that the fringe people must place a high value for conservation of the sanctuaries. All such issues related to the value of the forested ecosystem of Laokhowa and Burhachapori WLSs are analysed in detail in the next chapter.

[1]Heltberg (2005) attributes the 'investment barrier' as a factor to discouraging the use of LPG. The amount required to get the initial connection of LPG is high by standard of the poor rural households. Moreover, LP Gas cooking equipment is both more sophisticated and therefore more expensive. The inability to invest in such appliances is termed as 'investment barrier' which is very critical in making the poor people not to use LPG as a source of cleaner energy in the study area. This is a demand side obstacle and coupled with the supply side factor of absence of local market to supply refilled cylinder it makes the poor fringe dwellers rely more on the fuel wood collection from the nearby forests.

[2]A *mahal* is an agreement under which an area of forest is sold to a person/group of persons intending to collect forest products. The *mahal* is sold for a specified period of time against a specified fee. The person/ group of persons concerned can extract forest products within the stipulated period of time. The upper limit of extraction may be specified under the agreement. Before upgrading to the status of sanctuaries *thatch* and fishery *mahals* of Laokhowa and

Burhachapori WLSs were sold on auction to the public. The practice is no more allowed in protected areas throughout the country.

Appendix 4.1

Table 4A 1
Variance Inflation Factor (VIF) of the explanatory variables

Variables	Collinearity Statistics	
	VIF	Tolerance
Distance to forest	1.09	0.91
Occupation	1.17	0.80
Education	1.24	0.80
House structure	1.27	0.78
Cattle unit	1.37	0.73
Land holding	1.53	0.65
BPL	1.58	0.63
Age	1.59	0.63
Family size	1.63	0.61
Total household income	2.54	0.39

Mean VIF 1.50.

Annexure I

Table 4A 2
Some of the wild edibles of biological origin collected by the tribal households from Laokhowa and Burhachapori Wildlife Sanctuaries.

Sl no	Assamese Name	English Name	Scientific Name
1	*Kodoborol*	Wasp	Polistes Carolina
2	*Kekora*	Crab	Potamonids
3	*Samuk*	Snail	Molluscs
4	*Foring*	Grass Hopper	Chondracris rosea
5	*Uisiringa*	Water bug	Lethocerus indicus
6	*Uipok*	Termites	Macrotermes
7	*Kumoti*	African mole cricket	Gryllotalpa Africana
8	*Kath pok*		
9	*Amroli*		

Annexure II

Table 4A 3
A partial list of the plant species appropriated from Laokhowa and Burhachapori WLSs by the sample households

Sl no	Local name	English/ Scientific name	Uses
1	*Matikanduri*	*Alternanthera sessiles*	Tender shoots and leaves are edible. Leaf juice is good for hair growth and helps in lactation.
2	*Sotomool*	*Asparagus officinalis* Linn.	Young suckers are used as vegetable. Seeds substitute for coffee. Stem is diuretic. Root juice is used to cure urinary disorders, hysteria, epilepsy, nervine disorder.
3	*Ponownowa*	*Boerhaavia repens* Linn	Tender leave are eaten. Used in urinary troubles, anemia, asthma, internal inflammation of intestine. Roots are used for bronchitis, asthma, enlarged liver and antidotes to snake bite.
4	*Leheti Sak*	*Celosia argentea* Linn	Leaves are edible.
5	*Bhotuwa or Jilmil*	*Chenopodium album* Linn.	Leaves are used as vegetables and anthelmintic.
6	*Laijabori*	Drymaria cordata *Willd.*	Leaves used as vegetable and for fever.
7	*Helonchi sak*	*Enhydra fluctuans* Lour.	Young shoots are used as vegetable. Plant juice is used for skin diseases, nervous disorders and high blood pressure.
8	*Meseka tenga*	*Hibiscus cannabinus* Linn.	Sour leaves cooked with pork and fish. Used for dysentery, urinary trouble, and indigestion. Dried stem is

			used as substitute of jute.
9	*Mesandori*	*Houttuynia cordata* Thunb.	Sour leaves have attractive aroma and are edible. Used in asceites, piles, constipation and indigestion.
10	*Kolmow Sak*	*Ipomoea aquatica* Forsk.	Stem and leaves are edible.
11	*Bhedailata*	*Paederia foetida* Linn.	Leaves are cooked as vegetable and used for dysentery,
12	*Bon amlokhi*	*Phyllanthus niruri* Linn.	Leaves are edible and helps to relieve from dysentery.
13	*Modhusuleng*	*Polygonum caespifosum* Bl.	Leaves are used as vegetable.
14	*Malbhog sak*	*Portulaca oleracea* Linn.	Whole plant is used as vegetable and known to cure liver ailments.
15	*Man Dhonia*	*Ranunculus scleratus* Linn.	Leaves are used for flavouring.
16	*Tita bhekuri*	*Solanum indicum* Linn.	Fruits are edible and bitter in taste. Roots used in toothache, asthma, colic pain, cough, catarrhal affection and skin diseases.
17	*Dhekia*		Stem and leaves are edible.
18	*Bota Tenga*		Leaves are edible.
19	*Khasend Tenga*		Leaves are edible.
20	*Tita Ful*		Flowers are edible.
21	*Sorat Ful*		Flowers are edible.
22	*Kachu Ful*		Flowers are edible.
23	*Kachu Thor*		The leaves are edible.
24	*Kachu Loti*		The roots are edible.
25	*Manimuni*		Stem and leaves are edible.
26	*Doron*		Leaves are edible.
27	*Jilmil*		Stem and leaves are edible.
28	*Bongali Bhekuri*		Fruits are edible.
29	*Sojina*		Fruits are edible.
30	*Sojina Ful & pat*		Flower and leaves are edible (said to

			be a good preventive of pox).
31	*Sokota*		Leaves are edible and bitter in taste.
32	*Khutoria*		Stem and leaves are edible.
33	*Dupar Tenga*		Leaves are edible. Curative of kidney stone.
34	*Narasingha*		Leaves are edible.
35	*Morolia*		Stem and leaves are edible.
36	*Dohi Kachu*		Stems are edible.
37	*Ol Kachu*		Leaves, stems and roots are edible.
38	*Nol Kachu*		Stems are edible.
39	*Kordoi Tenga*		Fruits are edible. Sour in taste.

Annexure III:

Dwindling fish species have many negative and long term environmental and socio-economic implications. For example, depleting fish stock is acting as a repellent to the water fowls and thereby the tourists' flow to the sanctuaries. On the other hand, the declining volume of the endemic fishes call for introduction and culture of other fish species like Indian Major and Minor carps along with different exotic fishes such as, Tilapia, Common Carps, Grass carp, Silver Carps, Big Heads and the dangerous, highly carnivorous and banned Thai Magur with negative environmental implications. These fishes are cultured in the culture fisheries of the area and the supply is increasing over the years despite its Genetic, ecological and socio-economic impact.

Table 4A 4

Name of the exotic fish species reared in the study area

English name	**Scientific name**	**Originally come from**
Common carp	Cyprinus carpio	Thailand
Grass carp	Ctenopahryn godonidella	Japan
Silver carp	Hypophthalmichthys molitrix	Hong Kong
Tilapia	Tilapia mossambica	South Africa
Pangasius	Pangasius sutchi	Thailand
Thai Magur	Clarias gariepinus	Africa
Bighead carp	Hypophthalmichthys nobilis	China

Table 4A 5

Name of the endemic fish species found and collected by the sample households in the study area

Sl no	Assamese Name	English Name	Scientific Name
1	*Karoti*	Indian river shed	*Gudusia chapra*
2	*Chital*	Humped feather back	*Notopterus chitala*
3	*Kandhuli*	Feather back	*Notopterusnotopterus*
4	*Selkona*	Chela	*Chela atpar*
5	*Darikana*	Blacklinerasbora	*Rasbora daniconius*
6	*Eleng*	Bengla barb	*Rasbora elanga*
7	*Moa*	Mola/ Indian carplet/ Pale carplet	*Amblypharyngodonmola*
8	*Puthi*	Swam barb/ Chola barb	*Puntius chola*
9	*Cheniputhi/*	Olive barb	*Puntiussaranasarana*
10	*Bhakua/ Bahu/ Dhekera*	Catla	*Catla catla*
11	*Mirika*	Mrigal	*Cirrhinus mrigala*
12	*Lachim*	Reba	*Cirrhinus reba*
13	*Bhangone/ Nara/*	Bata labeo	*Labeo bata*
14	*Bhangone*	Bogalabeo	*Labeo boga*
15	*Mali/ Kaliajora*	Calbasu/ Black rohu	*Labeo calbasu*
16	*Kurhi*	Kurialabeo	*Labeo gonius*
17	*Silgharia*	Kalabans	*Labeodero*
18	*Silgharia*	Brahmaputra labeo	*Labeo dyocheilus*
19	*Rau/ Row*	Rohu	*Labeo rohita*
20	*Common carp*	Scale carp	*Cyprinus carpio* *
21	*Grass carp*	Grass carp	*Ctenopharyn godonidella**

22	*Botia*	Loach	*Noemacheilus beavani*
23	*Gethu/ Rani botia*	Nectie loach/ tiger loach	*Botia dario*
24	*Singorah*	Day's mystus	*Mystusbleekeri*
25	*Barsingorah*	Gangeticmystus	*Mystus cavasius*
26	*Arii*	Giant river cat fish	*Aorichthysseenghala*
27	*Pabhoh*	Pabdah cat fish	*Ompok pabda*
28	*Barali*	Freshwater shark	*Wallagoattu*
29	*Bordaia*	Indian Potasi	*Pseudotropiusatherinoides*
30	*Magur*	Magur	*Clarias batrachus*
31	*Singhi*	Stinging cat fish	*Heteropneustes fossilis*
32	*Kokila*	Freshwater gar fish	*Xenentodoncancila*
33	*Cheng garaka/ Garaka Cheng*	Spotted snake head/ Barcasnake head	*Channa barca*
34	*Sal*	Giant snake head	*Channa marulius*
35	*Chengeli*	Smooth breasted snake head/ Asiatic snake head	*Channa orientalis*
36	*Cheng*	Smooth brassed snake head	*Channa gachua*
37	*Goroi*	Green snake head/ Spotted snake head	*Channa punctatus*
38	*Sol*	Striped snake head/ Banded snake head	*Channa striatus*
39	*Chengeli*	Assamese snake head	*Channa stewartii*
40	*Kuchia/ Cuchia*	Cuchia/ Gangetic mud eel	*Amphipnouscuchia*
41	*Chanda*	India glassy fish	*Chanda ranga*
42	*Dum Vacheli*	Badis/ dwarf chameleon	*Badis badis*
43	*Gedgedi/ Bhetki/ Khaloibhangi*	Mottled nandus	*Nandus nandus*

44	*Patimutura*	Bar-eyed-goby	*Glossogobius gutum*
45	*Kawai*	Climbing perch	*Anabas testudineus*
46	*Kholihona*	Banded colisa/ Striped gourami / Giant gourami	*Colisa fasciata*
47	*Bhasaylee*	Colisa	*Colisa colisa*
48	*Bami*	Spiny eel/ Tire-track spiny eel	*Mastacembalusarmatusarmatus*
49	*Tora/Turi*	White spotted spiny eel/ Striped spiny eel	*Macrognathuspancalus*
50	*Tora/ Tura/ Turi*	One- striped spiny eel	*Macrognathusaral*
51	*Gangatop*	Ocellated puffer fish	*Tetradon cutcutia*

CHAPTER FIVE

ECONOMIC VALUE OF LAOKHOWA AND BURHACHAPORI WILDLIFE SANCTUARIES

Chapter four discusses the role of the forest ecosystem of Laokhowa and Burhachapori WLSs in the local and household economy of the resource poor peripheral people. The chapter deals largely with the massive economic contribution of the sanctuaries and have clearly demonstrated its richness. It has been observed that the sanctuaries have the ability to provide wide range of goods and services to the people living in its periphery. Chapter four has estimated the forest dependency to be quite high, i.e., 28.2 percent. In other words, 28.2 percent of the total household income of the sample households is derived from the forest provisioning services. Thus, the use value of the goods extracted from the sanctuaries has significant impact upon the income and consumption flows in local economy. Moreover, the sanctuaries have great value in ameliorating the poverty of the poor fringe dwellers. It can be gauged from the fact that though 48.6 percent of the sample households live in below poverty line it comes down to only 20.8 percent if the forest income is considered with their household income. It can be inferred, therefore, that the sanctuaries have tremendous importance and have great value for its fringe dwellers and also for the protected area networks of the state as well as the country. The values, thus estimated, are not to be taken for granted rather it should be considered while making a management decision since these values may have strong implications for the welfare of its peripheral communities (Illukpitiya and Yanagida 2010). However, apart from the use values the sanctuaries also offer various regulating services which are intangible in nature and hence not transacted in the market. Therefore, there is an urgent need, as argued by Bahuguna (2000), to assess both the tangible and intangible benefits the communities derive from the forest ecosystem of Laokhowa and Burhachapori WLSs in order to demonstrate its real value to its fringe communities and policy makers as well.

As mentioned above, the explanations in the previous chapter reveal that peripheral people in the study area have been reliant on Laokhowa and Burhachapori wildlife sanctuaries to a great extent and such reliance is putting massive pressures on the sanctuaries (Bora, 2004; Phukan and Sarma, 2004; Sivakumar et al. 2013) and thus causing continuous degradation of the sanctuaries over the years. The household survey confirms that the fringe people have realised the critical importance of the forest ecosystem services and hence want to restore it.

The conservation and sustainable management of forest require a strong and positive attitude of its peripheral people.

The rest of the chapter is organised as follows. Section 5.1 examines the valuation methods applied for the study. Section 5.2 deals with the valuation of the provisioning services or use values of the sanctuaries. Section 5.3 investigates the attitude of the fringe dwellers towards forest ecosystem and assesses their willingness to pay for the conservation of the sanctuaries. Section 5.4 assesses and compares the willingness to pay of two groups, namely treatment (direct beneficiaries of forest provisioning services living within 2 kms from the periphery of the sanctuary) and the control group (people living far from the forest boundary and are not direct beneficiaries of forest provisioning services). Section 5.5 finally sums up the entire discussion of the chapter.

5.1 Valuation method:

It has been widely discussed in Chapter two that the forests are threatened and depleting over the years. With the forestry (degradation and depletion) of underdeveloped countries reaching a level which is unacceptable the conservation and sustainability issues are gaining importance in the social discourse in the developed countries. Forests in different locations support different population and thus valuation provides a rational basis for directing funding for conservation of forests. People will remain indifferent towards forest degradation if they don't know the proper value of forests. The valuation studies, as such, are carried out in order to influence policy and thus conservation of forests. The present study rests its argument for valuation of Ecosystem Services of forest on the following points:

- Valuation can provide useful evidence to support habitat conservation;
- Valuation contributes towards better decision-making;
- The ecosystem services of forest are often not noticed by people until they are damaged or lost, yet they are very important. These services include key global life-support functions, such as climate regulation; water regulation; pollution filtering; soil retention and provision; nutrient cycling; waste decomposition; and pollination.
- Incorporate public willingness to pay in forestry and environment conservation programme.

Thus, this chapter largely engages with both market and non-market valuation. Market valuation is done using the market price method while the non-market valuation is done

through contingent valuation method (CVM) where the willingness to pay for conservation of the forests is estimated. The focus of this chapter is on the valuation of forest ecosystems services of Laokhowa and Burhachapori WLSs, using both market price and contingent valuation method.

5.2 Valuation of provisioning services of Laokhowa and Burhachapori WLSs:

As discussed in Chapter three the present study has administered the Market Price method to estimate the direct use values or the provisioning services of Laokhowa and Burhachapori WLSs. A detailed analysis of the provisioning services derived by the forest fringe dwellers have been presented in the Chapter four. The market price method is also used to compute the value of fodder consumed by the livestock of the fringe villages. In calculating the fodder requirement of cattle, the concept of cattle unit, as discussed in detail in section 3.1.5 of Chapter three, has been applied in order to obtain average fodder consumption by livestock and thereby to obtain the total fodder requirements.

The data of extraction of the provisioning services of the Laokhowa and Burhachapori WLSs have been obtained from the sample households through household survey. Moreover, a survey is carried out in the forest gate markets to obtain the prices of the forest goods transacted. The average price of each category of the provisioning services is then used to calculate the total value of the provisioning services harvested by the fringe community. Similar method is also applied by Delang (2006).

5.2.1 Empirical values of Laokhowa and Burhachapori WLSs calculated using Market Price Method:

The forest ecosystem of Laokhowa and Burhachapori WLSs provide several provisioning services such as fuel wood, fodder and food including fish and other edibles. Details of the provisioning services harvested and the economic values derived by the sample households are presented in Table 4.16 in section 4.3.1 of Chapter four.

It is indicative from the Table 4.16 of Chapter four that fuel wood, fodder, wild edibles, wild fruits, leafy vegetables, fish, simul cotton pods and construction materials (Imperata and Vetiver) are collected from Laokhowa and Burhachapori WLSs. The monetary valuation of these services is carried out for all the sample households by using the market price method. There are variations in the estimated value realised by each of the sample villages. The value of green fodder consumed by the domestic cattle of the sample households is also calculated

by using a concept called cattle unit as discussed in Chapter three. The total value of all these provisioning services of Laokhowa and Burhachapori WLSs, thus, is estimated to be a whopping Rs. 87,61,584.

The table indicates that the fuel wood has a predominant role in the make-up of the incomes from various forest products. It is by far the most important forest product harvested by the villagers of almost all the sample villages. Table 4.2 of Chapter four shows that 65 percent of the sample household collect fuel wood from Laohkowa and Burhachapori WLSs primarily for household consumption and a very small portion of that are transacted in the market. This finding is consistent with the findings of the Poverty Environment Network (PEN) studies where fuel wood emerges invariably as the single most important forest product across a series of cases from throughout the tropics, contributing over 35 percent of forest income on an average (Angelsen & Jagger, 2014; Belcher, 2015).

Wild edibles are basically collected by the tribal households living in the *taungya* villages in the sanctuaries. The edibles are both plant and animal origin and only the tribal people living here have the expertise to identify these forest products. Though these items have high market value but are not sold in markets since these are collected at a very tiny amount. Such products have high nutritious values and are harvested absolutely for domestic consumption purpose only. Collections of these products are important from the view point of the fringe peoples' nutrition.

Similarly, both wild fruits and leafy vegetables are also collected by the sample households in large quantity. Larger proportion of the collected fruits and vegetables are sold while keeping a smaller amount for domestic consumption.

Godoy et al. (1993) speak about a tendency among the researchers to examine flora (mainly) or fauna but not the both. In the face of such tendency this study has attempted to study the extraction of both the flora and fauna. It is important to mention that very few studies have taken fish into account as an item of provisioning services. The study has found fish to be the second most important provisioning services, in terms of value, listed after fuel wood, collected by the sample households.

5.2.2 Village wise consumption of Provisioning Services:

Talking about forest resources immediately brings our attention to the timber resources whereas there are other such resources termed as NTFPs (or provisioning services) which are

much more valuable than the timber resources but remained underestimated. Murthy et al. (2005) reports that the value of NTFPs is, in fact, double that of the timber resources and also it flows directly to the local community. From the viewpoints of economics, therefore, both these resources are equally important. Adepoju and Salau (2007) maintain that there are 150 types of goods which are transacted in the international markets. They further state that 80 percent of the population in developing countries depend on such items for subsistence. NTFPs or provisioning services, thus, constitute a critical component of livelihood security for the poor fringe villagers in many developing countries.

Millions of people throughout the world make extensive use of the provisioning services. They are harvested for both subsistence and commercial use either regularly or as a fall back during times of need. They add to people's livelihood security, especially for rural dwellers (Murthy et al. 2005). Table 5.1 illustrates the village wise value of the provisioning services harvested by the sample households of the fringe villages of Laokhowa and Burhachapori WLSs.

Table 5.1
Value of forest provisioning services appropriated by the sample villages

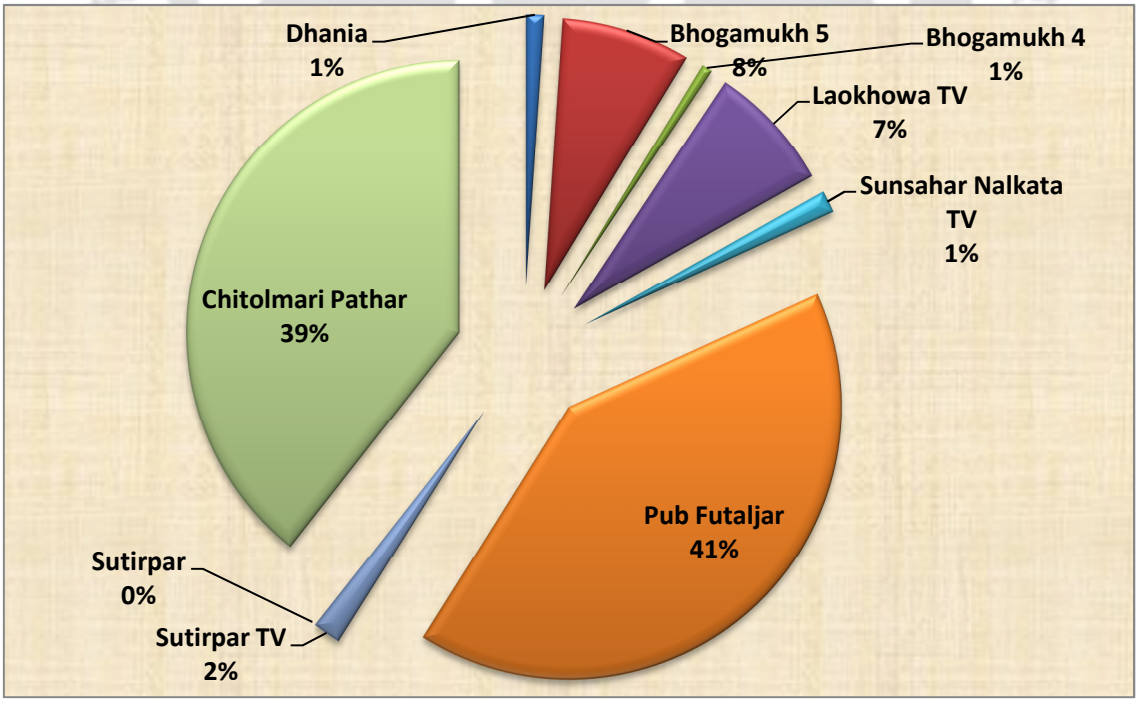
Village	Value (Rs.) of provisioning services	Value (Rs.) of grazing	Total value (Rs.)
Dhania	55198	1205106	1260304
5 No Bhogamukh	392202	213444	605646
4 No Bhogamukh '	32804	197379	230183
Laokhowa Taungya Village	386919	37758	416327
Sunsahar Nalkata Taungya Village	67600	26796	95996
Pub Futaljar	2089500	1036476	3125976
Sutirpar Taungya Village	85940	34419	120359
Sutirpar	0	83412	83412
Chitolmari Pathar	2017980	798651	2816631
Total	**5128143**	**3633441**	**8761584**

Source: Primary survey, 2016

Household survey reveals that 68.5 per cent or 207 out of 302 households investigated gather different provisioning services from Laokhowa and Burhachapori WLSs. Table 5.1 shows that the respondents of Dhania village appropriate the largest amount of grazing benefit from the sanctuaries followed by the respondents of Pub Futaljar village. Table 5.1 further indicates that the households of eight of the nine villages studied extract different kinds and amount of provisioning services from the Laokhowa and Burhachapori WLSs. The total value of the provisioning services harvested by the sample households of these eight villages is estimated to be Rs. 51,28,143. This value is quite sizeable and significant in the face of historical negligence of the NTFPs vis-à-vis the timber resources of the forests (Adepoju and Salau, 2007). The value of fodder consumed by the domestic cattle inside the forest is estimated to be a massive Rs. 36,33,441. If we include both the NTFP and grazing value together the value of the forest is a whopping Rs. 87,61,584. It is evident from the table that the fringe people of Laokhowa and Burhachapori WLSs depend more on forests primarily for grazing, fuel wood and fish.

The relative share of the values of provisioning services appropriated by each village has been presented in Figure 5.1.

Figure 5.1
Village-wise distribution of the values of provisioning services



Source: Primary survey, 2016.

It is seen from the pie graph that the highest benefits i.e., 41 percent are being appropriated by the sample households of Pub Futaljar village followed by the households of Chitalmari Pathar village with 39 percent while the households of Sutirpar village don't extract any provisioning services. The share of provisioning services in terms of percentage is negligible for other villages. As discussed earlier though the provisioning services are collected for subsistence purpose, some people also make a living out of it.

5.2.3 Value of Grazing:

Forests are treated as open access resources and it is used by fringe communities for grazing their cattle (Ninan and Kontoleon, 2016). India State of Forest Report (2011) states that about 40 per cent of the livestock graze openly in the forests in India. Laokhowa and Burhachapori WLSs also can be easily accessed by the livestock graziers for free for about seven months in a year. During the extreme monsoon condition when the area is inundated by the flood water some households collect palatable tree leaves as fodder. The fringe dwellers keep large stock of cattle the average being 7.62 units with as high as 176.2 cattle unit by one household.

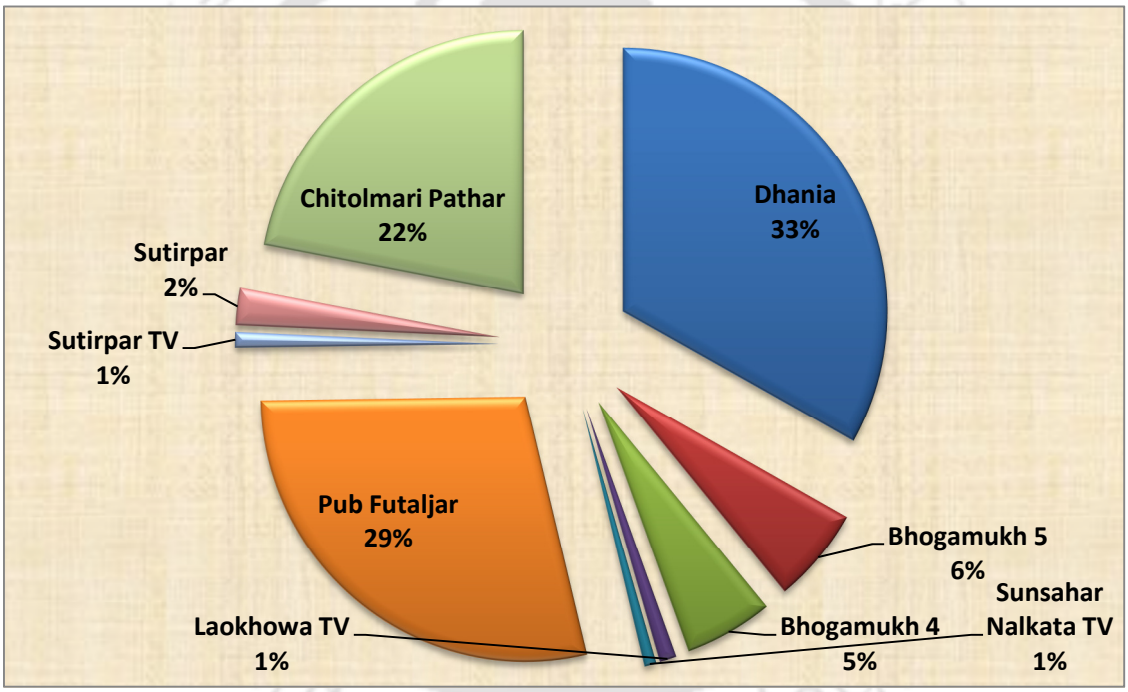
It is observed that livestock comprises of different types of animals and age groups necessitating different quantity of fodder. To make things easier and estimate the grazing values appropriated by the cattle of the sample households from the Laokhowa and Burhachapori WLSs the number of livestock or grazing animals possessed by the households are converted into standardized cattle units (CU) using the conversion measures suggested by Ghule et al. (2012) and Patel et al. (1983). The method of converting the livestock into the CU is described in detail in section 3.1.5 in Chapter three. The concept of cattle unit is used for various purposes though is used in the context of the present research only to find out the amount of daily forage consumption by these animals. Conversion into a standard cattle unit is required since the livestock of different age and of different breed consume different amount of food. Thus, it gives an account of daily forage requirement/ consumption of each cattle unit. Consequently, the total annual fodder requirement of the entire livestock of the sample households is estimated.

It is to be mentioned here that the daily forage intake of livestock depends primarily on body weight, forage quality and stage of production. Daily intake of a full grown cow is around 2 per cent of her body weight and thus an average cow eats around 10 kg of an average quality feed (www.beef.unl.edu). Considering this, the total daily forage requirement of the livestock population of the sample households is 17,537 kg. Thus, the total fodder consumed by the

cattle population in a year becomes 36,33,441 kg. Considering Re 1 is the price of fodder/kg the total value of the fodder of Laokhowa and Burhachapori WLSs consumed becomes Rs. 36,33,441.

The lion's share of the grazing benefit is obtained by the households of Dhania due to huge cattle population owned by them. It is distinct from Figure 5.2 that 33 percent of the grazing value is being realised by the sample households of Dhania whereas the households of Pub Futaljar appropriate 28 percent followed by the households of Chitalmari Pathar with 22 percent of grazing benefit. The shares of other villages are very nominal as is evident from the pie diagram (Figure 5.2).

Figure 5.2
Village wise grazing benefit appropriated by the sample households



Source: **Primary survey, 2016.**

5.2.4 Per hectare value estimation of Laokhowa and Burhachapori WLSs:

In order to estimate the economic value of forest products extracted from Laokhowa and Burhachapori WLSs the values obtained from the household survey has been used to convert to per hectare value term. Thus, it becomes easier to compare the present study with other such studies. The value of the annual flow of provisioning services accruing from a hectare of forested land of Laokhowa and Burhachapori WLSs is shown in Table 5.2.

Table 5.2
Estimated per hectare value of Laokhowa and Burhachapori WLSs (in Rupees and US$ per ha/year).

Assumed catchment area as % of the total area of LBWLSs	**Forest income (excluding grazing) Rs.**	**Forest income (including grazing) Rs.**
10	4498.3	7685.6
25	1799.3	3074.2
50	899.6	1537.1
US $ per hectare per year (@ 72.48 = $1 on 11-11-2018)		
10	62.0	106.0
25	24.8	42.4
50	12.4	21.2

Source: Author's estimation based on the primary survey, 2016.

Ninan (2007) mentions here about the problem of calculation of the catchment area accessible for forest goods collection. The values of provisioning services would be more in more accessible areas and vice-versa. The problems become more intense when the villages are spread across the forest boundary. Keeping in mind this limitation a range of values is estimated based on alternative assumptions, following Ninan (2007), such as 10, 25 and 50 percent of the forest areas to be the catchment area from which the people can access and harvest provisioning services. The value of such goods is expressed in terms of rupees and US dollars per hectare per year and presented in Table 5.2. The provisioning services are valued at Rs. 7685.6 (US$106) per hectare per year assuming that the collectors access 10 percent of the sanctuaries for harvesting the items. The value goes down to Rs. 3074 (US$ 42.4) per hectare per year under the alternate assumption that they access 25 percent of the sanctuaries. This further reduces to Rs 1537.1 (US$ 21.2) ha per year if the collectors access 50 percent of the sanctuaries. This value reported by Ninan (2007) in his study area is from Rs 7212 to Rs.1442/ ha per year (US$33.5 to US$167) ha per year.

5.2.5 Per hectare value calculation as per the opportunity cost method:

Market price may not be a good approximation of the true economic value in case market or policy failure occurs. Therefore, Chopra (1993) talks of various methods of valuation of the use values of the forests, e.g., the provisional services. Opportunity cost of labour time in collection is one of the important methods she uses in her valuation of Indian deciduous

forests to value fuel wood and other NTFPs. For calculation of the value of forest extraction by using labour collection time 'locally paid wage' instead of 'national minimum wage', that serves as 'shadow value of labour', has been administered in the present study as suggested by Chopra, (1993) and Wunder et al. (2011). The value of the provisioning services per hectare of the land of Laokhowa and Burhachapori WLSs by using this method for 10, 25 and 50 per cent (as Ninan, 2007) of the forest area is presented in Table 5.3.

The average income for the fuel wood collector from next best alternative is found to be Rs. 8544 per collector (Table 4.20 in Chapter four). Thus, we arrive at the total income of the fuel wood collectors to be Rs. 16,92,000 by multiplying the average alternative income by total number of fuel wood collectors, i.e., 198. Following Ninan (2007) we can estimate the per hectare value of the sanctuaries for fuel wood to be Rs. 1484, Rs. 593.68 and Rs. 296.84 assuming catchment area to be 10, 25 and 50 percent of the total area of the sanctuaries. The values of other provisioning services have been estimated by applying the similar method. Accordingly, we have arrived at per hectare value of the sanctuaries to be Rs. 5775.31 (if catchment area is 10 percent) by adding up the values of all the provisioning services extracted by the sample households.

Table 5.3
Per hectare value of forest using cost of labour time in collection (in Rs.)

Types of Provisioning services	**Per hectare value of NTFPs**		
	10% of the Laokhowa and Burhachapori WLSs	**25% of the Laokhowa and Burhachapori WLSs**	**50% of the Laokhowa and Burhachapori WLSs**
Fuel wood	1484	593.68	296.84
Fodder	31.8	12.72	6.36
Wild Edible	17.8	7.15	3.75
Wild Fruit	34.6	13.8	6.39
Leafy vegetables	102.9	41.18	20.59
Simul Cotton	89.0	35.61	17.80
Fish	704.2	281.69	107.00
Thatch	73.58	29.43	14.71
Vetiver	49.6	19.86	9.93
Grazing	3187.2	1274.89	637.44
Total	5775.31 ($88.60)	2310.12 ($35.44)	1155.06 ($17.72)

Source: Author's estimation based on the primary survey, 2016.

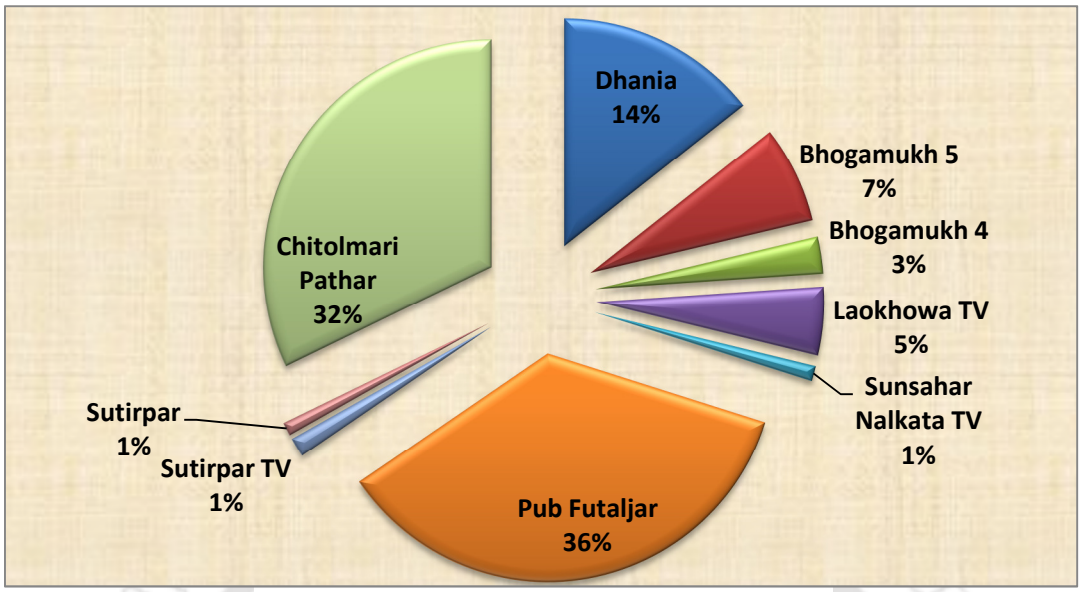
Thus, it is evident that a change in the methodology in estimating per hectare value changes the value of the forest. Taking 10 percent of the total area of the sanctuaries per hectare value becomes Rs. 7685.6 when the market price method is applied (see Table 5.2). The same reduces to Rs. 5775.31 (see Table 5.3) when the method cost of 'labour time in collection' is used.

5.2.6 Total value derived by the sample households:

The importance of forest services' cannot be captured necessarily by the economic value per hectare. This is because the benefits are accrued mainly to the fringe communities. If the size of population making use of the forests is small the corresponding value of the forest will also be small and vice-versa. It indicates that the value of the forest, in such a situation, depends primarily upon the size of population (Pearce, 2001). It is seen from Table 5.2 that that per hectare value of Laokhowa and Burhachapori WLSs is estimated to be quite high. Pearce (2001), however, emphasises, on discerning, as far as possible, the value of the provisioning services as a percentage of household income (see Figure 5.3). This perspective demonstrates the critical importance of these services as a means of income support.

Table 5.3 reveal that the sample households of the study area are deriving huge benefits from Laokhowa and Burhachapori WLSs. The total value of the provisional services is estimated to be a massive Rs. 87,61,584/ year. It is discussed in the previous chapter that most of the benefits are being enjoyed by the households living close to the forest boundary. Figure 5.3 reveals that 36 per cent of the total values derived from Laokhowa and Burhachapori WLSs are appropriated by the sample households of Pub Futaljar village followed by the households of Chitalmari Pathar (32 per cent) and Dhania (14 per cent). The value realised by all other villages studied is nominal as seen from the Figure 5.3.

Figure 5.3
Village-wise total forest value appropriated by the sample households



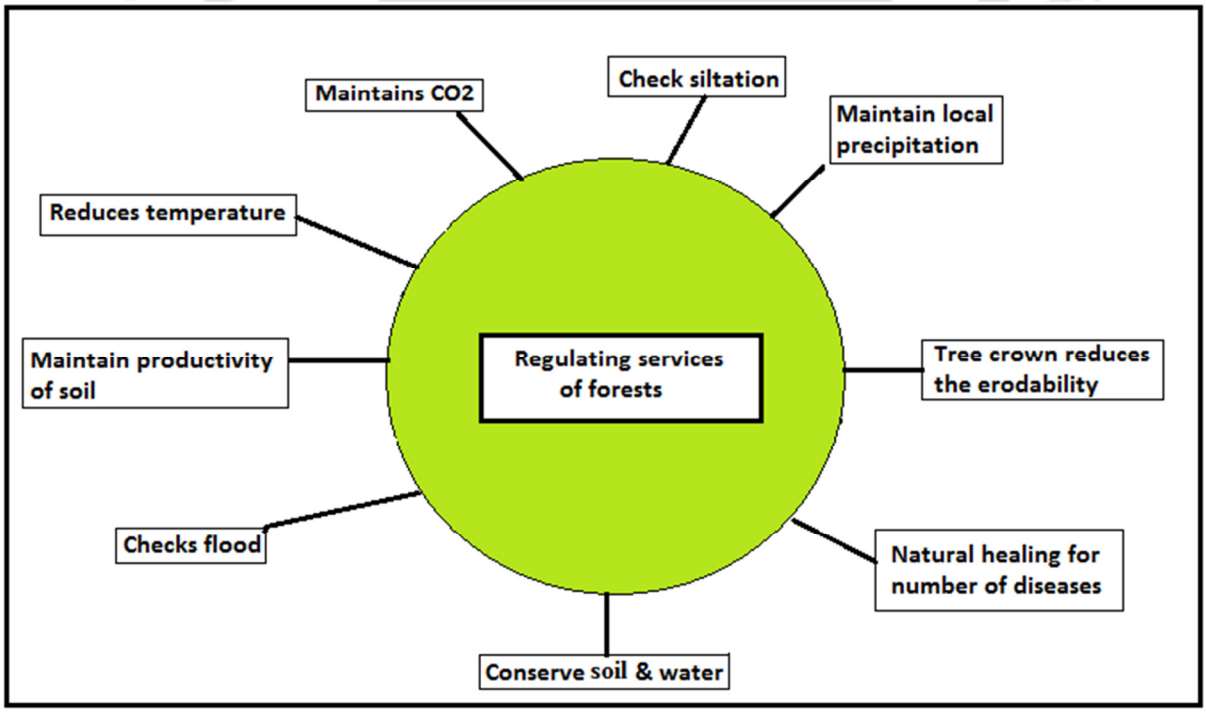
However, it is to be remembered that the forest collection is illegal and thereby there are restrictions on the collection. The forest front line staffs enforce these restrictions in the field. The fringe people might have collected more products from the forests without these restrictions. It is also possible that there is underreporting, arising out of lying by the respondents since forest collection is illegal. Moreover, underreporting may also happen due to faulty memory regarding the past events.

Thus, it is evident that Laokhowa and Burhachapori WLSs possess immense values. Evidence presented here expresses that the value extracted by the fringe dwellers is close to 9 million a year. The total value of the sanctuaries is Rs. 7685 per hectare per year on account of the provisioning services. It is clear from the analysis that the benefits derived from domestic cattle on account of grazing is the highest followed by fuel wood collected primarily to fulfil the domestic demand of energy. The villages are differently benefited though a few of the sample households don't have any forest interaction. Thus, the respondents view both Laokhowa and Burhachapori WLSs to be very important and place a very high value for it. Looking into the roles played by the sanctuaries in the lives and livelihoods of the fringe dwellers and its immense value (expressed in monetary terms) there is an urgent need to beef up the conservation measures in and around the sanctuaries. The following sections attempt to estimate the non-market value of the sanctuaries by using the contingent valuation method.

5.3 Willingness to Pay of the sample households for conservation of the ecosystem services of Laokhowa and Burhachapori WLSs.

The analysis carried out in the previous chapter shows that income from the products harvested from Laokhowa and Burhachapori WLSs appears to account for a significant share of the sample households' total income. It is often important in filling seasonal or other cash flow gaps and provides the fringe people cushion to fall back upon. Moreover, the preceding section has estimated the value of the provisioning services harvested by the sample households to be of sizeable amount. Thus, it is very clear that the lives and livelihoods of the fringe dwellers are very intimately connected to the forest ecosystems of the said sanctuaries. Apart from the provisioning services mentioned above the fringe dwellers also have clear understanding about the importance of the intangible services for their day-to-day lives. Figure 5.4 presents some of the intangible services the sanctuaries are providing the fringe people.

Figure 5.4
Regulating services of Laokhowa and Burhachapori WLSs



Most of the sample households have very clear understanding about the importance of the sanctuaries and hence, place a very high value on them. Using a Contingent Valuation Method (CVM) this section of the dissertation attempts to estimate such values through peoples' Willingness to Pay (WTP) for conservation and preservation of the forest ecosystem

services of both the sanctuaries. Willingness can be defined as readiness, inclination, preparedness, enthusiasm and disposition (Chivheya, 2016). The knowledge, attitude and practice are the pre-requisites for the willingness of the people to contribute.

As mentioned before, people cannot reveal their willingness due to lack of market for goods and services. It is not always possible to impute peoples' willingness to pay by their action or expressed intent to avoid losing those environmental goods and services or replacing them if they are lost. Therefore, in such a situation, an artificial scenario may be created and people are asked through a survey to face that artificial scenario. People may be asked what they would be willing to pay in the case of such a hypothetical scenario. From the data generated by such surveys, peoples' willingness to pay may be estimated.

Valuation of these indirect services has been estimated from the perspective of the fringe dwellers. For the study to be completed a questionnaire survey is administered among sample households. Some sample households, hypothesising non-users of the provisioning services, have also been selected from beyond two kilometres from the periphery. The detail methodology has been presented in Chapter three. Before actual administration of the household survey the questionnaire was pretested among 30 households of two fringe villages and modification was done accordingly. The survey consists mainly of a face-to-face interview with the heads of the selected households with a semi-structured questionnaire in order to elicit the information regarding various household characteristics of the respondents and forest extraction. The questionnaire also meant to provide basic information of the sanctuaries to the respondents and then elicit their willingness to pay for the conservation of the forest. The CVM studies can be conducted as face-to-face interview, telephonic interviews and mail surveys out of which the face-to-face is considered as the best method and therefore it has been administered in the present study. Once the data is collected it is systematically entered in the excel sheet to analyse later on using Stata 14.

The aim of the present study is to investigate the influence of environmental attitudes and social factors in the decision of individuals to pay for forest conservation. Akin to Halkos and Matsiori (2016) the contribution of this chapter to the literature is two-fold. First, it explores the way in which people held economic value to forest ecosystem and investigates the motives behind their attitude. Secondly, it also aims to investigate the determinant factors that affect respondents' willingness to pay for forest ecosystem conservation.

Usually, a CVM survey asks questions to elicit the respondents' WTP for a change in the supply of environmental goods (Halkos and Matsiori, 2016). A carefully designed questionnaire (semi-structured) is constructed and pre-tested according to guidelines established by the NOAA (National Oceanic and Atmospheric Administration). After the desired modification the questionnaire was finally administered to the households.

Since the study area lacks any previous valuation studies it uses an open ended question format as suggested by Halkos and Matsiori (2016) in order to elicit information about households' WTP. An open ended format was selected, out of different formats, given its advantages (Oseni, 2015) in the sense that it has a higher informational content, not prone to anchoring affects and often yields lower divergence between the hypothetical and real WTP compared to the close ended formats. The format is very informative in the sense that it can identify maximum WTP for each respondent (Gate, 2010). Open ended format also suits the present socio-economic and political fabric of the people of the study areas. Respondents are asked a series of questions relating to their socio-economic condition, collection of provisioning services and their WTP.

5.3.1 Procedure followed in conducting the CVM survey:

After being amended by the pre-test the CVM survey has been carried out on a sample of 302 randomly selected households living within two kilometres from the periphery of Laokhowa and Burhachapori WLSs. Face-to-face interviews are conducted on-site. An institutional context is created with a hypothetical change where it is proposed to restore the landscape of both the sanctuaries by embarking upon various activities that will widen up the income generating activities for the fringe dwellers through tourism and other such activities. It will also improve the regulating services of the sanctuaries in order to better serve the need of the fringe dwellers. The hypothetical scenario is presented to respondents who will state the maximum amount of money they are willing to pay to avoid the degradation.

Prior to the WTP questions the respondents are asked whether they would support a programme that would aim to restore the ecosystem of Laokhowa and Burhachapori WLSs. It appears that majority of the people are for restoration of forest ecosystem but at the same time express bluntly their discontentment over the present regime of the local management and hold it responsible for the degradation of once biodiverse sanctuaries. Though the fringe dwellers, especially the elders, reminisce the bygone days with great embellishment but feel very unfortunate to witness the transition of the sanctuaries over the last three decades. They

want to hold encroachment, overgrazing, massive and illegal NTFP collection, use of mosquito net for fishing especially during breeding season (May to July) and above all the shoddy and bias implementation of the forest laws by the local forest managers (staffs) responsible for its degradation. People also expect forest department to make alternative livelihood arrangement for the poor and destitute forest dependent people so as to refrain them from such illegal collection. The respondents, as comes out during the FGD, are even ready to get rid of their domestic and less productive cattle in order to reduce the grazing pressure on the forests provided high milking variety are procured to them.

Having elicited the information of forest collection and other relevant parameters including the cognizance of the people regarding the forest eco system services of Laokhowa and Burhachapori WLSs the specific issue of their willingness to pay for restoration of the ecology is placed before the sample households.

It is important to note here that most contingent valuation surveys open with general (‘‘warm-up’’) questions aiming at making respondents comfortable with their participation in the survey and with answering questions. The first set of questions in the questionnaire is intended to establish a rapport with the respondents. To this purpose, the following questions are structured:

1. Whether Laokhowa and Burhachapori forest is important for your day to day life?
2. What are the benefits that you are receiving from the Laokhowa and Burhachapori WLSs?
3. Would you like to see it conserved?

Almost all, i.e., 300 out of 302 respondents opine that Laokhowa and Burhachapori WLSs are very important for the day-to-day life of the fringe people. They articulate that the sanctuaries are important since it is procuring invaluable services to the fringe dwellers. In this regard 33 respondents speak about the intangible benefit of the sanctuaries while 113 respondents talk about only tangible benefits of the sanctuaries. 156 of the respondents could realise that the forests are contributing both the tangible and intangible benefits to fringe dwellers. Thus, all the respondents express their eagerness to conserve the hitherto bio-diverse sanctuaries otherwise they will be deprived of the invaluable goods and services that the forests procure.

At this point, the benefits in the form of provisioning and regulating services are analysed and the following information are presented before the respondents:

> Apart from the direct benefits in the form of fuel wood and other NTFPs and grazing that you are receiving, Laokhowa and BurhachaporinWLSs have also been playing a pivotal role in regulating air, water and the local climate, maintaining the biodiversity and wildlife habitat, mitigation of flood, soil conservation, etc. It conserves the soil and thus takes good care of siltation of the rivers and thereby floods. Moreover, the Laokhowa and Burhachapori WLSs are storehouse of biological diversity (habitat of floras and faunas) which provides recreational facilities to the tourists. The tourism brings avenues of employment and thus initiates the development of the local economy.

After presenting this information the respondents are reminded of their perception and realisation of degraded landscape of Laokhowa and Burhachapori WLSs and presented further with the following information:

> You do state that you are benefiting from Laokhowa and Burhachapori WLSs and also indicating that the sanctuaries are important for your day-to-day life. Realising that it has been degrading over the past three decades if timely and proper care is not taken the sanctuaries would be destroyed. Therefore, to save the sanctuaries from its impending doom people have suggested remedial measures like awareness generation, plantation, protection and provision of alternative livelihood. Therefore, it is obvious that improving the entire forest eco system will bring all the peripheral people better opportunities of livelihood in terms of employment on account of improved recreational services and other probable activities that will attract more tourists. However, the restoration of the aforementioned eco system services of Laokhowa and Burhachapori WLSs by implementing the suggested measures would involve enormous cost.

Having said this following question is posed before the respondent:

> Would you, in this context, like to participate in a programme of forest conservation as suggested by the respondents and mentioned above that involves huge cost? If so, looking into the paucity of government fund, how much would you like to pay for restoration of the eco system services of

Laokhowa and Burhachapori WLSs provided that the cost will be borne by all the people through monthly/yearly/one time contribution?

A follow up question is also posed before them:

- What else would you like to do, besides your monetary contribution, for the conservation of Laokhowa Burhachapori WLSs?

Before asking their WTP the respondents, of course, were provided with an opportunity to reflect on how they care about the forests. For the purpose, a number of questions were put before them.

5.3.2 Description of the survey results:

The results of the face-to-face interview have been presented in the Table 5.4. Data shows that almost all the respondents are familiar with the status (degradation of the ecosystem) of the Laokhowa and Burhachapori WLSs. Majority of the respondents know that the forests are important for their day to day life since it provides them with the provisioning services but are not aware of other (intangible or regulating) such services of forests. 37 percent of the respondents state that the forests are providing them with the provisioning services like food, fodder, construction materials etc. while only about 11 percent says that it is providing them with the intangible services such as clean air, pollution free atmosphere, soil and water conservation, etc. But, majority of the respondents are in the view that they are enjoying both tangible and intangible benefits from the forests.

Table 5.4
Results of the face-to-face interview with the respondents regarding environment valuation of Laokhowa and Burhachapori WLSs

Questions	Frequency
Are Laokhowa and Burhachapori WLSs important?	
Very important	300
Cannot say	2
What benefits are you receiving from Laokhowa and Burhachapori WLSs?	
Tangible benefits (Fuel wood, fruits, vegetables, grazing, fish, etc.)	113
Intangible benefits (fresh air and water, biodiversity, habitat, reduction of pollution and thereby diseases, etc.)	33
Both tangible and intangible benefits	156
Would you like to conserve it?	
Yes	302
No	0
Would you like to pay for conservation?	
Yes	259
No	43
What else would you like to do for forest conservation?	
Plantation and protection	25
Physical help	133
Awareness	21
Don't know	106
Not interested	9

Source: Authors estimation based on primary survey, 2016.

The first set of questions put is whether Laokhowa and Burhachapori WLSs is important to your day-to-day life. All but two respondents replied positively. Upon getting a positive answer the second set of questions are put that asks what benefits the respondents receive from the Laokhowa and Burhachapori WLSs. The responses are diverse and they talk about both the tangible and intangible benefits of the forests. It appears that for majority of the respondents' fuel wood, grazing and fish is most important since it fulfils their subsistence

livelihood necessity. The elderly people reminisce about the glorious days when the sanctuaries were plentiful of Rhinos, Tigers, and Elephant along with other ungulates and countless avifauna, both endemic and migratory, to prey on the abundant fishes in the wetlands. They realise that many tourists would come with lots of business opportunities to the locals had the forest remained intact as it was three decades ago. Moreover, the respondents feel, the forest is also blessing them with provision of some other important services like clean air and water, protection from river erosion, protection from different kind of diseases due to absence of pollution, local precipitation, refuge to the wild animals, etc. that is important for the very survival of the human folk. The respondents lamented in utter grief that since now some of the most vibrant wild species have locally extinct and most of them are decimating the next generation would have to see them in museum or photos. However, their prognosis is that the degraded sanctuaries could regain its past glory but only lacking is a meticulous plan and a benign but strong departmental initiative buttressed by sincere support of the peripheral people and other stakeholders. Therefore, it is not yet too late to start a restoration programme in order to regain the past glory of the tainted sanctuaries. Upon asking to put forward some set of activities for restoring the forest ecosystem of Laokhowa and Burhachapori WLSs the respondents suggested a holistic measure consisting of plantation, protection (strict vigilance by the forest guards in coordination with the local villagers), environmental awareness especially among poor and illiterate villagers, provision of alternative livelihood exclusively for the fishermen and fuel wood collectors and a blanket ban on illegal fishing and the use of mosquito net. Thus, the respondents are presented an ease with a mutual and meaningful conversation about the present state of the forest and its ecosystem to understand the key issues and why a contribution has been sought from them. People express their willingness to contribute generously to a sincere effort for the improvement to be made. Table 5.5 presents the willingness (and non-willingness) status of the respondents.

Table 5.5
Willingness to pay (WTP) status of the respondents (in number)

Willingness/ non-willingness	**Total respondents**	**Willing in other way to conserve forests**
Willing to pay	240	168
Not Willing to pay	53	19
Not Willing to pay (PB)	9	0
Number of the respondents including those willing to pay in other ways		259
Number of the respondents not willing to pay by any means		43
Mean willingness to pay		Rs. 352.75

Source: Primary survey, 2016.

It appears evident from Table 5.5 that 240 out of 302 respondents want to contribute a part of their annual income for a positive but hypothetical change in the forest ecosystem. 53 of the respondents express their inability to pay due to various reasons. However, 19 out of these 53 respondents express their willingness to pay in terms of physical activities towards conservation of the sanctuaries. Approximately 79 per cent of the respondents express their willingness to pay for the conservation of Laokhowa and Burhachapori WLSs. This figure becomes 85.7 if we include the respondents who want to offer their physical and other help (for activities such as plantation, protection, awareness generation, etc.) for the cause of conservation. It is worth mentioning here the findings of Wilson et al. (2012) and Lehtonen et al. (2003) who report 69 and 74 percent of the respondents in their respective study areas expressing willingness to contribute for forest conservation. Table 5.5 further reveals that 14 percent of the respondents express their inability to pay for conservation of the sanctuaries including nine protest bids. However, all these respondents also want to see the sanctuaries conserved. Among the 43 respondents 18 have directly refused to pay while 25 respondents are undecided due to their paucity of income.

It comes into light during the household survey and FGD that most of the respondents are very enthusiastic about a proposition of restoring the forest ecosystem of Laokhowa and Burhachapori WLSs. The overwhelming response can be gauged from the fact that besides offering monetary contribution 72 percent (or 187 out of 259) of the respondents, who wish to pay for conservation in monetary terms, also wish to get involved in different ways for

conserving the sanctuaries. It is also noteworthy here that some of the respondents, very compassionate about forest, express their willingness to pay more in future provided the money so generated is utilised to its full. Thus, the mean and median WTP of the samples willing to pay for forest conservation are Rs 352.75 and Rs 100 respectively. The median is lower than the mean indicating that the majority of the respondents are willing to pay less than the mean WTP and that the response distribution is skewed due to a few numbers of high bidders.

Table 5.6 elaborates the socio-economic characteristics of the respondents who wish to contribute a part of their income or want to help in other way for conservation of Laokhowa and Burhachapori WLSs along with the others who don't wish to pay for the same.

Table 5.6
Descriptive statistics of the respondents who want to pay and those who don't want to pay for the conservation of Laokhowa and Burhachapori WLSs

Average	Willing to pay		Not Willing to pay		
	Financial contribution (N= 240)	**Physical help (N= 19)**	**Not willing to pay (N= 9)**	**Protest Bid (N= 9)**	**Don't know (N= 25)**
WTP (Rs.)	352.75	0	0	0	0
Age (years)	47.72	38.31	39.8	51.6	37.68
Education (years)	3.65	3.73	2.3	0.33	1.56
Distance to forest (km)	.476	.52	.63	.466	.52
Family size (number)	5.57	4.73	4.44	6.22	4.6
Land holding (hectare)	0.57	.24	.34	0.69	.21
Cattle unit (number)	6.62	2.10	1.99	5.20	2.34
Household Non-forest income (Rs)	94312	46052	54444	125555	44400
Forest income (Rs)	28781	22862	27042	29591	36397
Total household income (Rs)	123093	68914	81487	155146	80797
Forest dependency (%)	25.22	26.71	36	19.90	42.77

Source: Author's estimation based on the primary survey, 2016.

Table 5.6 shows that 240 respondents express their willingness to pay for conservation of Laokhowa and Burhachapori WLSs. Due to their precarious economic condition 19

households express their inability to pay in terms of money but wish to offer their physical help for other activities such as plantation, patrolling with the forest frontline staff and awareness generation among the fringe dwellers for the conservation of the sanctuaries.

It is evident from Table 5.6 that there are 18 households, including nine protest bidders, express their unwillingness to pay for conservation of the forest ecosystem of the Laokhowa and Burhachapori WLSs. The protest bidders oppose the whole idea of the respondents' contribution for the conservation and restoration of the sanctuaries stating it is the responsibility of the forest department. The protest bidders retort with resentment, "It is the duty of the government or forest department to make necessary arrangement for restoration of eco systems of Laokhowa and Burhachapori WLSs for which we are paying in terms of tax. The crave for money, laxity and nepotism of the local forest managers are the prime causes of degradation of the sanctuaries". Bursting into angers they reply, "Why should one pay in such a situation? To make rooms for more such inactive money hankering staff?". People criticize saying that there is a nexus between a few malevolent locals and the local forest managers and guards. The forests managers are managed for handsome amount while the forest guards are remunerated (in terms of small sum or sometimes in petty stuffs like vegetables and chickens) for each and every product collected in the broad day light. The remunerated forest managers and guards are happy to not to take cognisance of what is happening around. The protest bids are extremely low, i.e., 2.9 per cent. The mean age of the household heads, family size, land holding, mean household income of the protest bidders are higher than other respondents. But, in spite of the higher mean household income these respondents are dependent on the sanctuaries and also call for protest bids. The table also shows that 25 respondents are undecided about making any payment.

It is evident from above discussions that while a small proportion of the respondents are unwilling to make any contribution, the majority express their willingness to make contribution and even their physical labour if needed for restoration of the sanctuaries.

5.3.3 Household characteristics and WTP:

Table 5.7 features the frequency distribution of the sample households and their WTP in relation to their household characteristics.

Table 5.7
Frequency distribution and Willingness to pay in respect to household characteristics

Household Characteristics	Particulars	Frequency (in numbers)	Average WTP (Rs.)	Not Willing to pay (in numbers)
WTP	More than average (Rs. 352.75) WTP	57	1039.64	62
	Less than average WTP	183	138.79	
Age	Median (45 yrs)	23	254.34	2
	More than median	117	505.64	16
	Less than median	100	196.5	44
Gender	Male	221	333.66	58
	Female	19	574	4
Education	Median (3 yrs)	20	270	3
	More than median	92	488.26	18
	Less than median	128	268.28	41
Occupation	Farmer	87	423.67	11
	Business	22	616.36	5
	Others	62	414	18
	Fishermen	23	136.95	10
	Wage earners	46	117.82	18
Land holding	Less than 1 hectare	253	298.51	57
	1 ha–less than 2 ha	37	519.11	3
	More than 2 ha	12	800	1
Below poverty line	Up to Rs 11680	108	226.38	4
Above poverty line	More than Rs 11680	132	456.13	58
Household having high dependency	More than 40% dependency	84	153	27
Household having low dependency	Less than 40% dependency	218	342	35
Forest product collectors		162	286	45
Non collectors		78	490	17

Source: Primary survey, 2016.

It is indicative from the table that the mean willingness to pay for the sample households has been estimated to be Rs. 352.75. There are 57 respondents whose WTP is more than average with a maximum of Rs. 5000. Similarly, there are 183 respondents having less than the average WTP. The median age of the household heads is 45 years and there are 23 household heads in this age group with a mean WTP of Rs. 254 highest being Rs. 1000. Perhaps peoples' understanding and outlook on environment changes with increased age and this is probably one of the causes that the WTP of the elderly respondents are higher than the relatively younger respondents. Education plays a pivotal role in environment conservation and it can be seen from the table above that the WTP is relatively more for the respondents having more years of schooling. On the other hand, if the WTP is regarded as a function of occupation then the business class has the highest WTP with a mean of Rs. 616 and the wage earners has the lowest with a mean of Rs. 117. Though the land-man ratios of the respondent households are small but it appears important in deciding their contribution. The table shows that with the increase of the land holding the WTP also increases. WTP is always described as an important function of income. The WTP is found to be very low for the households living below poverty line (spending less than Rs. 11680 person/annum in rural areas as per Rangarajan Committee) and vice versa. Following Jain and Sajjad (2015) the households have been categorised between 'high forest dependent' (households whose forest income accounts for more than or equal to 40% of their total household income) and 'low forest dependent' (households whose forest income accounts for less than 40% of their total household income). It is noteworthy that the mean WTP of the NTFP collector expressing their willingness to contribute for forest conservation is Rs 286 while for the non-collectors it is Rs 490. It is, thus, evident from the table that the WTP is low for the households relying more on the forest and vice-versa.

5.3.4 Determinants of Willingness to pay:

It has been explained in great detail in the previous chapter about the fringe peoples' understanding about the importance of the forest ecosystem services of Laokhowa and Burhachapori WLSs. Such understanding and realisation about the importance of the services of the sanctuaries make them express their concern over its degradation and voiced strongly for its conservation.

5.3.4.1 Factors influencing the Willingness to pay of the respondents:

There is limited prior understanding on the nature of impact of socio economic determinants on fringe communities' willingness to pay for forest conservation. Therefore, based on personal observations, discussion with the key informants as well as the knowledge gathered from the contingent valuation studies of the past (Adams et al. 2008; Han et al, 2011; Wilson et al. 2012; Jain and Sajjad, 2015) the variables influencing the WTP decision of the respondents have been selected. The available theoretical and empirical literature reflects on a number of factors determining the WTP decision of the fringe dwellers. However, subject to the availability of data and their relevance in the context of the present study age, education of the household heads, distance to the forest, size of the family, total household income, forest dependency and size of livestock measured as cattle unit have been selected as the explanatory variables. The theoretical justification for the inclusion of these explanatory variables along with their definition and expected sign has been discussed below.

Age of the household heads:

Given the description of the variable (***AGE***) in section 4.8.1 in the previous chapter the valuation literatures point out that as the age of the household heads increases their understanding of the importance of the ecological values of the forest is also expected to rise. WTP is related with higher environmental consciousness which increases with the increase in age and education (Lo and Jim, 2010). It is evident from the household survey that the mean age of the household heads is 46.2 years. The coefficient of the variable ***AGE*** is expected to have a positive sign with their willingness to pay. The positive coefficient suggests that the older the household head the more likely is his willingness to pay for forest conservation and vice-versa.

Education of the household head:

Educational achievement of the respondents would have an obvious impact on willingness to pay. The variable has been defined in section 4.8.1 of the previous chapter which is measured in years of schooling. Lo and Jim (2010) also reveal that with the increase in the educational attainment the environment awareness of the respondents rises. One can expect that with higher level of environmental awareness the respondents will have better understanding and a positive attitude towards the conservation of the environment. Thus, the willingness to pay of the respondents can be said to be positively associated with education which is denoted here

as ***EDU***. The positive sign of education means that an increase in numbers of years of education would increase their WTP (Kamri, 2013).

Distance from the forest:

Distance to forest has been measured in kilometres. The sample households are selected from within two kilometres from the forest boundary. The regression analysis conducted in the previous chapter (section 4.8.4) elucidates that the people living close to the forest depend more on the forest. Since most of the poor live in the forest fringes therefore, the WTP of these poor fringe dwellers would be low and thus the distance to the forest is hypothesised to have a negative relation with the forest dependency. The variable is signifies as ***DTF***.

Size of family:

Large family size is hypothesised to have more working members and thus the total household income of such families is expected to be high. Higher household income corresponds with the higher WTP of the households. Thus, the variable family size, which is expressed as ***FS*** here can be expected to have a positive sign signifying large family sizes would be having high WTP.

Total household income:

Household income which includes both the forest and non-forest income has a positive effect on the WTP reflecting a heightened concern about financial constraints in making a purchase decision (Lo and Jim, 2010). Studies of WTP usually analyse the relationship between income and WTP within a survey sample and shows a positive relation. Since forest products collection is illegal the forest foraging activity is not at all a preferred vocation of the fringe dwellers in the study area. Therefore, in our study area we expect a positive association of household income with the WTP of the respondents for forest conservation. The positive sign indicates that the higher the income higher would be the willingness to pay for forest conservation. The household income is expressed as ***Y*** here.

Forest dependency:

The result of the regression carried out in the previous chapter (section 4.8.4) reveals that the poorer fringe dwellers are more dependent on the forest for variety of goods and services. Forest products collection act as one of the important livelihood activities and thus reduces the number of people living below the poverty line. Thus, it can be concluded that the forest

dependent people are generally poor and in the absence of any gainful employment opportunities they rely on the forest to supplement their meagre income. Therefore, the forest dependency, denoted as ***FD***, as a variable is expected to have a negative sign.

Livestock population:

Livestock population of the respondents would have an obvious impact on the willingness to pay. The variable has been defined in section 4.8.1 of the previous chapter which is measured as standardised cattle unit denoted as ***CU***. It becomes pretty clear during the household survey that the people keeping large stock want to pay more for the conservation of the sanctuaries which act as alternative to pasture land for the livestock of the respondents. Therefore, the variable is expected to have a positive association with the willingness to pay of the respondents.

The definition and measurement of the explanatory variables and expected sign of the coefficients of the variables are summarised in Table 5.8. The dependent variable here is the willingness to pay of the respondents for forest conservation.

Table 5.8
Definitions and measurement of the explanatory variables influencing the Willingness to Pay of the respondents

Variables	Type	Definition and measurement	Expected sign
Dependent variable			
Willingness to Pay	Continuous	Income of the respondents that he/she wants to contribute for forest conservation. Amount in Indian Rs.	
Independent variables			
Age (AGE)	Continuous	Age of the household head. Number of years	+
Education (EDU)	Continuous	Education in years of schooling. Number of years	+
Distance to the forest (DTF)	Continuous	Distance to the source of produces in forest. In km.	–
Family size (FS)	Continuous	Household members. Members in numbers.	+
Total household income (Y)	Continuous	Annual household income including forest income. Amount in Rs.	+
Forest dependency (FD)	Continuous	Degree (%) of dependency on the forest.	–
Cattle unit (CU)	Continuous	Number expressed in standard cattle unit.	+

Table 5.8 presents the variables, both dependent and independent, together with their description and measurement. Age represents the experience and practical knowledge of the respondents and the education of the household heads implies the knowledge gained by them regarding the importance of the forests and its conservation. It is hypothesised to have a positive association of age and education with the willingness to pay of the respondents. Similarly, the size of family, household income and the cattle unit of the respondents have assumed to have a positive association with the willingness to pay for forest conservation. On the other hand the variable 'distance to the forest' and 'forest dependency' has been anticipated to have a negative relation with the willingness to pay.

5.3.4.2 Descriptive statistics:

Prior to starting the analysis of stated WTP the descriptive statistics with the key variables of the 293 samples (protest bidders omitted) are presented in Table 5.9. As observed in the table the mean WTP is Rs. 288.94 with a maximum of Rs. 5000. The mean age and year of schooling of the household heads are 46 and 3.43 years respectively.

Table 5.9
Descriptive statistics of the explanatory variables influencing the households' decision of willingness to pay for forest conservation

Variables	Mean	Std Deviation	Minimum	Maximum
WTP	288.942	633.159	0	5000
AGE	46.0170	13.7739	22	105
EDU	3.4368	4.2676	0	17
DTF	.4877	.5160	0	2
FS	5.4027	2.4400	2	18
Y	114693.7	107738.7	15000	783480
FD	27.1521	21.2877	0	74.4114
CU	5.8258	16.1612	0	176.2

Source: Author's calculation based on primary survey, 2016.

The respondent households are located in the close proximity to the forest mean distance of which is .4877 kms. The average cattle population of the respondent household is 5.82 units with a maximum of 176.2 units. The mean annual household income has been calculated to be Rs. 114693 with a maximum of Rs. 783480 and minimum of Rs. 15000.

5.3.4.3 Model Specification:

The WTP data from an open-ended format question has traditionally been analysed using ordinary least squares (OLS). Such econometric models were estimated in this study to explore the possible determinants of WTP (age, education, distance to the forest, family size, total household income, forest dependency and cattle unit) and analyze the relation between WTP and predictor variables. But, a problem with this statistical method is that data have a peculiar distribution, with a large mass of data centered on zero, comprising those who refuse to pay anything at all, and a continuous positive distribution of WTP amounts of those who agree to pay something (Lopez et al. 2007). Looking into the existence of zero WTP it is felt that these zero values should receive due attention in the analysis. The zero responses represent a significant portion of the sample having a range of explanations for it from true zero to protest responses. The large proportion of zero WTP responses called into question the continuity of the dependent variable and consequently the use of the classical multiple regression model (Haddak et al. 2016). It is said that the OLS estimation yields biased and inconsistent results since it fails to account for the limit (zero) and non-limit (continuous) observations. Therefore, the Tobit model is the alternative method frequently proposed for such censored data in the literature on contingent valuation (Haddak, et al. 2016).

Thus, anticipating a number of zero values in the dependent variable the current study uses of a Censored Regression Model (Tobit model). The following regression equation has been fitted to identify the factors that significantly explain the 'willingness to pay' of the respondents for restoration of the landscape of Laokhowa and Burhachapori WLSs.

$$Y_i = \propto_i + \beta_i X_i + \mu_i$$

where, Y_i denotes the willingness to pay (WTP) of the people (in Indian rupee), X_i is a vector of independent variables such asage, education of the household heads, distance to the forest, size of the family, total household income, forest dependency and size of livestock. β_i is a vector of coefficients to be estimated.

Incorporating the explanatory variables discussed in section 5.3.4.1, the functional form of the model specified above can be formulated for estimating the parameters influencing the decision of the respondents to pay for forest conservation in the following manner:

$$\boldsymbol{Y_i = \beta_0 + \beta_1(AGE) + \beta_2(EDU) + \beta_3(DTF) + \beta_4(FS) + \beta_5(Y) + \beta_6(FD) + \beta_7(CU) + \mu_i}$$

μ_i is the error term.

The maximum likelihood estimates of the model specified in the equation have been obtained using STATA 14.0.

5.3.4.4 Results and Discussion:

Results of the Tobit estimation of factors influencing the willingness to pay of the respondents have been presented in Table 5.10.

Table 5.10
Tobit estimate of the respondents willingness to pay

WTP	Coefficient	Std Error	t-value	Marginal effect
AGE	.6116	3.3258	0.18	.2696
EDU	10.0604	9.7127	1.04	4.4356
DTF	-12.5825	82.5544	-0.15	-5.5476
FS	39.3829***	18.0707	2.18	17.3639
Y	.0015***	.0005	2.83	.0007
FD	-6.1016***	2.1955	-2.78	-2.6902
CU	8.6572***	3.3171	2.61	3.8169
Constant	-204.5326	185.3764	-1.10	
Number of observation		293		
LR Chi^2 (10)		96.07***		
Pseudo R^2		0.0245		
Log Likelihood		-1914.4492		
Left – censored observations at P<=0		53		
Uncensored observations		240		

Source: Author's own estimation based on primary data

*** represents significant at 0.001 level.

It is apparent from the Table 5.10 that the model is a good fit with Likelihood Ratio Test (LR Chi^2) is found to be highly significant (LR Chi^2 96.07 pseudo R^2 of 0.0245). The Variance Inflation Factor (VIF) values are used to check the problem of multi-collinearity (shown in Table 5A.1 in Appendix 5.1). The value for the variance inflator factor and tolerance of the independent variables demonstrate absence of multi-collinearity, mean VIF being 1.73.

Table 5.10 shows that family size, total household income and cattle unit is positively and significantly associated with the willingness to pay of the respondents while forest dependency is negatively but significantly associated with the willingness. On the other hand, age and education of the household heads and the distance to the forest is insignificant but positively associated with the willingness to pay for forest conservation.

The table shows that size of family is an important variable ($p<0.001$) determining positively the WTP of the respondents in the study area. It indicates that as the number of household members increases the probability of WTP increases. The possible explanation may be that the member of the large family may have engaged in diverse income generating and off-farm activities and hence may want to contribute more for forest conservation. The marginal effect points out that other things remaining the same increase in one member in the family results in 17.36 percent increase in the willingness to pay of the respondents for forest conservation. Though this finding is in line with the finding of Gunatilake et al. (2012) but it is in contrast with the finding by Lalika et al. (2017).

The empirical study confirms that income of the household is one of the most important factors influences the willingness to pay for forest conservation. Other things being equal, a household's willingness to pay would be higher if the annual household income of the household is higher (Bowman et al. 2009; Haddak et al. 2016). The partial probability as shown by the marginal effect indicates that an increase in the income will increase the willingness to pay by .007 percent point. However, if the income of the households is low the household would find it difficult to contribute for forest conservation and thus may more unlikely to pay (Taale and Kyeremeh, 2016). Lalika et al. (2017) and Getzner and Svajda (2015) also confirm that rise of income signifies the increased ability for an individual to pay for conservation. The result of the present study contradicts the finding of the study by Lopez et al. (2007) which finds the income to be negatively associated with the willingness to pay for biodiversity conservation.

The cattle unit is also representative of wealth and capabilities of the households. It is found that the cattle unit is positively and significantly associated with the willingness to pay of the households. This indicates that higher the amount of cattle population higher will be the household's income and thereby the willingness to pay for forest conservation. The possible reason for higher willingness to pay may be that in the absence of any professional grazing ground in the vicinity the forests act as the only common grazing ground for the cattle

population reared by the fringe dwellers. In the possible event of disappearance or annihilation of the forests the cattle rearers will be the hardest hit and their income will decline. Therefore, higher number of cattle unit will result into higher payment for forest conservation. The marginal effect points out that, *ceteris peribus*, an increase in the number of one unit of the cattle unit will result into 3.81 percent increase in their willingness to pay.

It is indicative from the table that the variable 'forest dependency' is negatively and significantly associated with the willingness to pay of the respondents for forest conservation. The negative association implies that more the dependency of the people on forest less will be their willingness to pay for forest conservation. The partial probability shows that an increase in one degree of dependency on the forest will reduce their willingness to pay by 2.69 percent. The possible explanation may be that since the forest dependent people are poor they don't have surplus to contribute towards forest conservation. It is discussed in section 4.8 the previous chapter that the household living below poverty line are the most dependent on the forest to supplement their livelihood.

Coefficients for the age and education of respondents are positive implying that the older and educated people are willing to pay more for forest conservation (Hadker et al. 1997; Chen et al. 2017). However, the result of the present study contradicts to the findings of the previous such studies which find the age to be negatively associated with the willingness to pay of the respondents (Lopez, et al., 2007; Lo and Jim, 2010). While distance to forest is negatively associated with the willingness to pay which indicates that the respondents living close to the forest boundary are less likely to pay for forest conservation. The possible explanation could be that the people living close to the forest have more dependency since they are poor and thus can spare less to contribute to forest conservation.

One of the primary objectives of the current study is to assess the fringe dwellers willingness to pay for the conservation of Laokhowa and Burhachapori WLSs. The study reveals fringe dwellers' awareness about the continuous degradation of the sanctuaries as a result of exerting massive anthropogenic pressures which has been discussed in great detail in the previous chapter. This section reveals that most of the respondents in the study area have greater understanding of the benefits of the ecosystems services of Laokhowa and Burhachapori WLSs. Most of the elderly respondents have witnessed the painful transition and realise the importance of the sanctuaries in their day-to-day lives. The analysis reveal that almost all the respondents are for restoration and preservation and majority of them have

expressed their willingness to pay, the average WTP being Rs. 352, for the conservation of both the sanctuaries. Furthermore, the study reveals the potential of CVM as a policy tool for soliciting conservation funds. The WTP literatures show a mixed result regarding the independent variables influencing the WTP of the respondents. While some studies find a variable positively associated with the WTP others find the same variable to be negatively associated with the WTP. For example, while some literature finds age to be positively associated with WTP (Chen et al, 2017) the other reveal a negative association (Bowman et al. 2009; Lo and Jim. 2010). The regression analysis carried out for the current study has found family size, total household income, degree of forest dependency and cattle unit to be the important independent variables having significant association with the willingness to pay for forest conservation. The following section presents the comparative willingness to pay scenario between the respondents living in the close proximity to the forest and that of living in a distance.

5.4 Willingness to pay of the respondents in Control Group:

Control group is a method which compares a population that had benefited from a particular programme than the others which have not. When the purpose of a scientific study is to experiment the question of a control group comes in. The control group consists of almost the same characteristics of the experimental group (Pithon, 2013). The present study attempts to compare two groups of populations, i.e., direct beneficiaries of forest (or Treatment Group) and indirect beneficiaries of forest (or Control Group), for assessing their willingness to pay for forest conservation.

Looking into the immense importance of the forest ecosystem of Laokhowa and Burhachapori WLSs the current study aims at assessing the willingness to pay of the people living far from the sanctuaries for its conservation. The idea basically is that many of the ecosystem services benefit not only the local people living around the concerned ecosystems but also the benefits spills and accrue to a larger audiences beyond a particular locality or region and sometimes these go global (Kathuria, 2011). Though the resources are available locally and need to be managed locally however the benefits accrue to a much larger scale. Against this backdrop it is anticipated that since the regulating services or the non-use values of Laokhowa and Burhachapori WLSs may spill beyond the fringe area therefore people living far from the boundary of the sanctuaries may also be interested to contribute to its conservation. Therefore, the concept of a control group is introduced in the current study.

The study, thus, aims to evaluate whether the direct beneficiaries or the dependent households (termed hereafter as **treatment group**) only wish to pay for its conservation. If not, what would be the willingness to pay of the non-beneficiaries or indirect beneficiaries (termed hereafter as **control group**) for the conservation of the forests and what are the underlying factors influencing their willingness. Since, it is difficult to identify the non-beneficiaries (or indirect beneficiaries) living close to the forest boundary, a group of respondents were hypothetically chosen from beyond two kilometres from the forest boundary, anticipating to have no direct interaction with the forests.

5.4.1 Selection of sample for Control Group:

In order to analyse and obtain a general overview of the socio-economic characteristics of the people of these two groups (treatment group and control group) a survey is conducted among the people living beyond two kilometres from the forest boundary. The prime aim of such a survey is to investigate the relative impact of the household and other socio-economic parameters on their willingness to pay for conservation of forests. For the purpose 100 households beyond two kilometres from the forest boundary of Laokhowa and Burhachapori WLSs have been selected for detailed survey. Care has been taken to include various communities such as Bodo, Tiwa and Bengali Hindu and Muslim apart from general Assamese people in order to obtain diverse attitude towards forest conservation. The households are anticipated to have no reliance whatsoever on Laokhowa and Burhachapori WLSs. The objective of such a survey is to assess if people are really willing to pay for forest conservation despite obtaining no (direct) benefits from the forests and forest ecosystem. In other words, it tries to investigate whether the forest dependency has any impact on the willingness to pay for forest conservation. Thus, it can be said that the value these households are placing on the forest is basically non-use value. Given below is a short description of the villages studied.

5.4.2 Overview of the field study area for the respondents of control group and household survey:

Bheloguri is a village under Rupohi development block of Nagaon district located towards South of Laokhowa WLS and inhabited by the Bodo tribe. The forest department hired people of Bheloguri long back for plantation work later to be settled finally in Sunsahar and Nalkata taungya village. The people needed to work for 15 days in a year for free for the forest department under a system locally termed as '*begary*'. The elderly people of Bheloguri

lament during the household survey that there is no sign of the trees they once planted. The trees have been cut down indiscriminately by the fringe dwellers of the sanctuaries. People keep on visiting the taungya village since they have their kith and kin there and thus are informed about the sorry state of the forest. They have, thus, express grave concern for the forest and thus want to contribute for the restoration of the ecosystems of the sanctuaries.

Hatipukhuri is another village under Rupohi development block where the survey is administered. The respondents of Hatipukhuri express their apprehension on the forest managers and the fringe dwellers by saying "*Berai khet khai*" (meaning 'the products are eaten up by the fence itself'). They express serious concern on the forest land being encroached by the people living beside the forest. According to these respondents eviction of the encroachers is the most crucial task ahead of the forest department here. They also urge to tighten the vigilance by the forest frontline staff in cooperation with the local public once the eviction is completed. While most of the respondents are very much for conservation of the sanctuaries and wish to pay for forest conservation a few of them express their inability due to their precarious economic condition.

Thiatangoni is another village under Dagaon Development Block located at a distance of 4 kms from the boundary of Laokhowa WLS resided by Assamese Hindu people. The respondents express serious concern in continuous degradation of both the Wildlife sanctuaries. The poor villagers used to collect construction materials such as thatch and *imperata* grass but had ceased to do so long back. People are of the opinion that increasing population along with increased anthropogenic pressures on the forests driven by their ever increasing demand is the major factor of loss of forest and its diversity in Laokhowa and Burhachapori WLSs. The respondents here express their discontentment over the continuous degradation of Laokhowa and Burhachapori WLSs since they believe that forests help cooling the temperature of the globe by ensuring proper precipitation. People also feel that maintaining good health of the forests ensures abundant provisioning services for the fringe dwellers.

Mahguri is a tribal village located about 7 kms from the boundary of Laokhowa WLS. Falling under the jurisdiction of Dagaon Development Block, Mahguri is resided by Tiwa tribal people having good acquaintances about the state of Laokhowa and Burhachapori forests. The respondents spoke about various negative externalities of forest degradation such as loss of agricultural production and productivity, increase in CO^2 culminating into global warming,

etc. The respondents strongly feel the necessity of conserving both the sanctuaries and want to pay for its conservation. The respondents of the village blame the ignorance of the fringe dwellers and thus want invariably to become part of awareness drive besides their financial contribution.

Godaimari and Kashorigaon are two other villages under the Dagaon Development Block where the household survey have been carried out. Both the villages are resided by Bengali speaking Muslim people and belong to farming community. The low lying lands of the villages are suitable for fish-cum-paddy culture, a common practice here, and most of the poor farmers lease out their land in order to earn a good price. Since the village is located at about three kms from the forest they quite often witness the elephant and wild boars raiding croplands of the fringe villagers. Therefore, the respondents, here, view Laokhowa WLS as a good habitat of different wild animals. "Had the forest not existed", people apprehended, "the wild animals would come out of the forest and there would be severe man-animal conflict". The respondents reiterated the necessity to conserve the sanctuaries and prescribed plantation, protection, recruitment of young and energetic youths in the forest department (looking into the shortage of forest guards) and equipped them with modern weapons as the important task. The respondents express their willingness to pay a part of their income towards forest conservation. Some respondents, apart from contributing financially, wish to be part of an environmental awareness campaign for the fringe dwellers.

Kodomoni Pathar is a village resided by Bengali speaking Muslim and located about three kms from the forest boundary. Some of the respondents here hold the local forest managers responsible for encouraging encroachment and all sorts of illegal doings inside the forests. People opine that loss of habitat due to rampant felling of trees, loss of food and corridor, unregulated grazing, illegal fishing, etc. are some of the definite causes for the dilapidated condition of the sanctuaries. The respondents unanimously voiced that Laokhowa WLS is the pride of the fringe people and needs to be conserved at any cost. Proper coordination with the locals and the NGOs, working for the greater environmental benefits, should be maintained by the forest managers while making strategy for sustainable management of Laokhowa and Burhachapori WLSs.

5.4.3 Result of the face-to-face interview with the respondents of the control group:

The result of the last part of the questionnaire (environment valuation) survey of the control group has been presented in Table 5.11. It reveals that all the respondents are very much

aware about the plight of forested areas of Laokhowa and Burhachapori WLSs and realise its importance. It is evident from the table that all the respondents also have good knowledge about the intangible benefits they are obtaining from the forests nearby. While only 62.5 percent of the respondents of the treatment group realise that they are also obtaining the intangible services from their nearby forests the entire respondents of the control group know about the intangible services of the forests.

Table 5.11
Result of the face-to-face interview with the respondents of the control group regarding environment valuation

Questions	Frequency
Is Laokhowa and Burhachapori WLSs important?	
Very important	100
Cannot say	0
What benefits are you receiving from Laokhowa and Burhachapori WLSs?	
Tangible benefits (Fuel wood, fruits, vegetables, grazing, fish, etc.)	0
Intangible benefits (fresh air and water, biodiversity, habitat, reduction of pollution and thereby diseases, etc.)	100
Both tangible and intangible benefits	0
Would you like to conserve it?	
Yes	100
No	0
Would you like to pay for conservation?	
Yes	91
No	7
Cannot say	2
What else would you like to do for forest conservation?	
Plantation and protection	1
Physical help	22
Awareness	17
Physical help & awareness	6
Don't know	54

Source: Authors estimation based on primary survey, 2016.

The respondents are very much aware about the intangible services of the sanctuaries. According to them Laokhowa and Burhachapori WLSs are the habitat of diverse wildlife species and an important storehouse of biodiversity which may attract huge tourists into the area boosting up the local economy. It also provides them with a pollution free environment and supplies the lifesaving oxygen. Apart from that the respondents also opine that the sanctuaries prevent soil erosion and ensure good precipitation and thus strike environment balance. Most of the respondents expressed their concern for the continuous degradation of the forests and thus loss of the habitat leading to severe man-animal conflict. "Had there been no forests (habitat) the wild animals would come out and there would be severe conflict between man and wild animals" the respondents' express their concern. Each respondent feels that the degradation should be minimised and forests be restored and preserved. But despite this a few of them have expressed their inability to pay for its conservation due to their precarious financial conditions. About half of the respondents expressed their willingness to come forward with their physical and other sorts of help for the preservation of the forests.

A few of the respondents call for protest bid. 6 out of 100 respondents are not ready to contribute financially for the conservation of Laokhowa and Burhachapori WLSs. "This is not my responsibility to pay" – the respondents contested. They think that the onus is on the government that has enough money allocated for the purpose. The pressing need, according to them, therefore, is to ensure the proper utilisation of the funds for which it is envisaged for.

But, in contrast to the zero WTP or protest zeros there are also respondents who are enthusiastic enough to pay their bid money instantly.

5.4.4 Comparison of the descriptive statistics of treatment and the control group:

Table 5.12 represents the descriptive statistics of various household characteristics of the control and treatment group along with their willingness to pay. Protests zeros, whatsoever for both the groups, have been omitted for the analysis.

Table 5.12
Descriptive statistics of the explanatory variable influencing the WTP decisions of the respondents of control and treatment group

Variables	Control group (N=94)	Treatment group (N=293)
Mean Willingness to pay (Rs.)	1110	288.94
Mean distance to forest (Km)	4.81	0.48
Mean income (Rs.)	198936	114693
Average family size (No)	5.05	5.40
Education of the HH head (Years of schooling)	8.02	3.43
Age of the HH head (Years)	54.87	46.01
Cattle unit (No)	1.13	5.82
Land holding (Ha)	0.55	0.51

Source: Author's own estimation based on primary data.

Table 5.12 indicates distinct differences in willingness to pay of both the groups. The control group wants to pay much more for forest conservation than the treatment group. It is perhaps because of the higher family income of the respondents of the control group. The table also reveals that the mean distance to the forest is 4.81 for the control group while it is only 0.48 kilometre for the treatment group. The cattle unit for the control group is much smaller than the treatment group perhaps because of the absence of the grazing ground.

5.4.5 Determinants of willingness to pay of the respondents of the control group:

The selection of the samples for the control group has been discussed in section 5.4.2 of this chapter. The respondents are found to be well aware about the degradation of the Laokhowa and Burhachapori WLSs though they live far from it. Expressing their concern on the continuous degradation the respondents' express their willingness to pay for the conservation of the sanctuaries.

5.4.5.1 Factors influencing the WTP of the respondents:

It is to be noted that there are limited prior understanding on the nature and impact of the socio economic features on the control group respondents' WTP. Based on personal observation and household survey age, education, family size and total household income have been considered to be the independent variables influencing the WTP decision of the

control group respondents. The theoretical justification for taking these explanatory variables along with their definition and expected sign has been similar as is discussed in the section 5.3.4.1. Land holding of the respondents has been hypothesised to be one of the variables influencing the WTP of the respondents. Having large land holding may give larger income and thus expect to influence the WTP positively.

5.4.5.2 Descriptive statistics:

The descriptive statistics of the explanatory variables considered in the model are presented in Table 5.13.

Table 5.13
Descriptive statistics of explanatory variables that influence the WTP decision of the respondents of the control group

Variables	Mean	Std Deviation	Minimum	Maximum
Willingness to pay (WTP)	1110.63	2071.1	0	10000
Age (AGE)	54.8723	12.3307	22	85
Education (EDU)	8.0212	4.8681	0	17
Distance to forest (DTF)	4.8191	1.5517	3	7
Family size (FS)	5.0531	2.1370	2	17
Land holding (LH)	.5512	.6961	0	5.3333
Total household income (THI)	198936.2	192930	15000	1000000
Cattle unit (CU)	1.1382	1.7876	0	7

It is indicative from the table that the mean willingness to pay of the respondents of the control group is Rs. 1110.63 with a maximum of Rs. 10000. The mean age and years of schooling is 54.8 and 8.02 with a maximum of 85 and 17 respectively. The sample respondents are located in a distance mean of which is 4.8 km. The average family size is 5.05 maximum being 17. The land holding and cattle unit is .55 hectare and 1.13 units respectively. The mean household income is Rs. 1,98,936.2 the highest being Rs. 10,00,000.

5.4.5.3 Model specification:

For determining the variables influencing the WTP of the respondents of the control group a Censored Regression Model has been utilised. The justification has been described in detail in section 5.3.4.3 of this chapter. Incorporating the explanatory variables as discussed in section 5.3.4.1 the functional model would take the following form:

$$Y_i = \beta_0 + \beta_1(AGE) + \beta_2(EDU) + \beta_3(DTF) + \beta_4(FS) + \beta_5(LH) + \beta_6(THI) + \beta_7(CU) + \mu_i$$

μ_i is the error term.

The maximum likelihood estimates of the model specified in the equation have been obtained using STATA 14.0.

5.4.5.4 Tobit estimates of willingness to pay of the respondents of the control group:

The maximum likelihood estimates of the coefficients of Tobit regression model and marginal effects are presented in Table 5.14.

Table 5.14
Tobit estimates of willingness to pay of the respondents of control group

WTP	Coefficient	Std Error	t-value	Marginal effect
AGE	-11.5808	14.9960	-0.77	-6.1340
EDU	54.3229	40.4289	1.34	28.7733
DTF	98.1340	115.7505	0.85	51.9787
FS	-97.6704	83.5722	-1.17	-51.7332
LH	284.7109	276.8719	1.03	150.8031
THI	.0056	.0010	5.17***	.0029
CU	60.8893	96.1272	0.63	32.2513
CONSTANT	-50.952	1165.498	-0.04	
Number of observation			94	
LR Chi^2 (10)			46.97***	
Pseudo R^2			0.0284	
Log Likelihood			-804.6755	
Left – censored observations at P<=0			3	
Uncensored observations			91	

Source: Author's own estimation based on primary data

*** represents significant at 0.001 level.

It is clear from the Table 5.14 that the model gives a good fit indicated by the significant Likelihood Ratio Test (L-R Chi^2). The Variance Inflation Factor (VIF) values used to check multi-collinearity (shown in Table 5A.2 in Appendix -5.1) have shown the absence of multi-collinearity.

It is clear from Table 5.14 that while all other variables are found to be non-significant the variable 'total household income' (THI) is positively and significantly associated with the willingness to pay of the samples of the control group. It indicates that the willingness to pay of the respondents of the control group increases with the corresponding increase in their level of income. Since these groups of respondents don't have any forest interaction as they are away from the forest area, perhaps, therefore, other variables are found to be insignificant in deciding their WTP decision.

5.4.5.5 Description of Explanatory Factors of both the control and treatment group with mean difference test:

The *t*-test has been administered to compare or examine for possible differences of various parameters between two groups at baseline. It reveals that there are significant baseline differences in all the parameters between the experimental and control group. Table 5.15 presents the descriptive statistics of the continuous explanatory variables with mean difference test. It is evident that among the continuous explanatory variables the age and education of the household heads, distance to the forest and household income are found to be statistically different between the groups and significant at 1% probability level.

Table 5.15
Descriptive statistics of both the control and treatment group

Variable	Control group	Treatment group	Combined	Difference	t-value
WTP	1110.638 (213.6177)	288.942 (36.9895)	488.5271 (61.4472)	821.6963***	5.9878
Age (AGE)	54.8723 (1.2718)	46.0170 (.8046)	48.1679 (.7091)	8.8552***	5.5585
Education (EDU)	8.0212 (.5021)	3.4368 (.2493)	4.55038 (.2456)	4.5503***	8.7496
Distance to forest (DTF)	4.8191 (.1600)	.4877 (.0301)	1.5398 (.1046)	4.3314***	41.2783
Family size (FS)	5.0531 (.2204)	5.4027 (.1425)	5.3178 (.1205)	-.3495	-1.2440
Land holding (LH)	.5512 (.0718)	.5167 (.0410)	.5251 (.0355)	.0344	0.4144
Household income (Y)	198936.2 (19899.21)	114693.7 (6294.16)	135155.7 (7017.39)	84242.44***	5.3275

Note: Figures in parentheses represent standard error

***P = 0.001

Source: Author's own calculation based on primary survey, 2016.

The test aims at comparing the impacts of various household characteristics on the willingness to pay for forest conservation. The result shows that the variables age and education of the household head, distance to the forest and the household income are very important ($p<0.001$) in determining the WTP of the respondents. The size of family and the land holding are non-significant and have minimal differences.

The result shows that there are significant differences between the WTP of the respondents of the control group and that of their counterpart in the treatment group. It is seen from the table that the mean WTP of the respondents of the control group is Rs. 1110 while it is only Rs. 288 for the respondents of the treatment group the difference being Rs. 821. If combined, the willingness to pay for forest conservation becomes Rs. 488.52. There are studies which

shows that non-residents' WTP is higher than the residents' (Duffield et al. 1992). Loomis and Santiago (2011) also found international tourists' WTP is significantly higher than the locals. Other studies also have found local respondents willing to pay to be less than non-residents (Lockwood et al., 1993).

The mean age of the household heads of the control group respondents is relatively higher compared to the treatment group. The difference is significant which indicates that change in the age of the household heads is important factor influencing the willingness to pay decision for forest conservation. Similarly, mean years of schooling is more than 8 years for the control group against 3.4 years for the treatment group. The result shows that the difference in the average year of schooling is significant. The probable explanation may be that as the level of education increases people gain more knowledge about environment as well and hence are very concern for its conservation and thereby their willingness to pay for conservation. The average distance to the forest is more in case of the control group since these groups were purposefully selected from far from the forest boundary. The mean distance to the forest of the control group is 4.33 km higher than the distance of the treatment group. The people living close to the forest are found to be relatively poor. Therefore, perhaps the WTP of this segment of the population is less than that of their counterpart in control group. Household income is significantly different between the groups, i.e., by Rs. 84,242 per annum. The respondents of the control group has better education and it comes out during household survey that they are placed in better livelihood opportunities and hence have relatively large income. It is also to be noted here that household income of the respondents of the control group is the only variable positively and significantly associated with willingness to pay for conservation of Laokhowa and Burhachapori WLSs.

5.5 Summing up:

The objective of this chapter of the study was to carry out the economic valuation of Laokhowa and Burhachapori WLSs by means of both Market Price and Contingent Valuation method. The questionnaire captures the use values (both direct and indirect use) of Laokhowa and Burhachapori WLSs through the application of Market Price method. It is found that Laokhowa and Burhachapori Wildlife Sanctuaries supply significant amount of provisioning services to the fringe dwellers which is close to Rs. 9 million. Consequently, the lives and livelihoods of large number of fringe dwellers are very critically linked with the forest ecosystem of Laokhowa and Burhachapori WLSs. The fringe dwellers keep large stock of

low milking cattle population which are let loose in the sanctuaries to graze and in the process appropriate an amount of Rs. 3.6 million. The sanctuaries are very important in the day-to-day lives of the fringe dwellers. Apart from the provisioning services, the people are also enjoying diverse regulating services from the sanctuaries which are very crucial for the lives and livelihoods of the fringe dwellers. It is noteworthy that the people have realised the benefits of all these services and thus most of the people around the park want to restore the degraded sanctuaries and wish to be a part by contributing as per their financial and physical capabilities. The mean willingness to pay of the sample households is Rs. 352. The people living beyond two kilometres from the forest boundary also express their willingness to pay for the restoration and preservation of both the sanctuaries. It is found that mean WTP of these respondents is Rs. 1110.

The chapter also examines to a great detail the household characteristics and relative willingness to pay of two different samples (treatment and control group) separated by distance. It appears that the type of good being valued has an effect on WTP. While the respondents of the treatment group give more importance to the tangible benefits (direct use value) the respondents of the control group give more emphasis to the intangible services (regulating services or indirect use values) of the sanctuaries. The differences in the WTP of both the control and the treatment group can probably be attributed to the household income and education attainment (and thereby environmental awareness) which are significantly different between the groups. Age of the household head also is one of the factors in determining the WTP of the respondents as the experience and understanding of implications of environment degradation increases with the increase in the age of the respondents.

This chapter addresses two of the important research questions posed at the beginning regarding valuation of the tangible goods of the sanctuaries. The questions enquiring the awareness of the fringe people about the intangible services of forests and their attitude towards conservation have been addressed in this chapter in great detail.

Appendix – 5.1

Table 5A.1:
Variance Inflation Factor (VIF) of the explanatory variables of WTP of the treatment group

Variables	Collinearity Statistics	
	VIF	Tolerance
Education	1.26	0.79
Distance to forest	1.31	0.76
Forest dependency	1.48	0.67
Family size	1.49	0.67
Age	1.55	0.64
Cattle unit	2.22	0.44
Total household income	2.83	0.35

Mean VIF 1.73.

Table 5A.2:
Variance Inflation Factor (VIF) of the explanatory variables of WTP of the control group respondents

Variables	Collinearity Statistics	
	VIF	Tolerance
Cattle unit (CU)	1.03	0.97
Family size (FS)	1.11	0.90
Distance to the forest (DTF)	1.11	0.89
Age (AGE)	1.17	0.85
Land holding (LH)	1.29	0.77
Education (EDU)	1.33	0.75
Household income (Y)	1.52	0.65

Mean VIF 1.22

CHAPTER SIX

SUMMARY OF FINDINGS, CONCLUSION AND POLICY SUGGESTIONS

The present study is an attempt to understand the issue of forest dependency and the associated value of the forests from the perspective of the communities living in the periphery of Laokhowa and Burhachapori WLSs. The study further attempts to evaluate in monetary terms the benefits derived by the fringe community from the sanctuaries in order to demonstrate the true value of it. Moreover, it also tries to assess and elicit the fringe dwellers attitude and willingness to pay for conservation of the forest ecosystem of both the sanctuaries. Before drawing final conclusion and construct policy suggestions it would be worthwhile to have a recap of the principal findings of the study. A brief summary of the study has been presented below:

6.1 Principal findings:

6.1.1 Degree of fringe peoples' dependency on forests:

- Like most forest communities, the peripheral people of Laokhowa and Burhachapori WLSs are also linked to the forests in a variety of diverse ways. People do fulfil both their food and non-food necessities from the sanctuaries.
- 87 percent of the sample households depend primarily on the sanctuaries for different kinds of provisioning services including fodder for their livestock. Majority of the collectors realise that the forest products are declining over the years.
- Most of the forest products collected though basically are for domestic consumption but a portion of these goods are also sold in the market for deriving subsistence household income out of it.
- Respondents of eight out of nine sample villages are found dependent on Laokhowa and Burhachapori WLSs for different kind of provisioning services such as fuel wood, fish, various construction materials, etc. Although the respondents of the village don't collect any forest products but they are also depend on the sanctuaries for grazing their domestic stock.

- Fuel wood is the most important forest products collected by the fringe dwellers. 66 percent of the sample households depend on LBWLSs for their fuel woo need and a massive 78 percent of the total requirement of fuel wood is removed from Laokhowa and Burhachapori WLSs. The rest is supplied from ToFs (trees out of forests) and agricultural residues.
- 76 percent of the sample household keep stock of domestic cattle. The Nepali community of Dhania village, who are professional cattle graziers, keep the largest stock of cattle.
- The average cattle population per household is 7.62 cattle unit. Though the cattle population is composed of cow and bullocks, goat, sheep and buffalo but the share of cows and bullocks are the highest, i.e., 79 percent of the total cattle unit.
- The sanctuaries serve as the only source of fodder for all kinds of animals reared by the fringe villagers. All of them freely graze their cattle inside the sanctuaries in the absence of any professional grazing ground. During monsoon, when the grasslands of the sanctuaries are inundated by rain or flood water, the villagers resort to collection of palatable leaf for fodder.
- Most of the wild edibles and leafs can be identified by the tribal people living in the *taungya* villages and hence collected by them. These items are not transacted in the markets despite having good market price and thus collected absolutely for domestic consumption.
- Forty varieties of edible plant species and nine varieties of animal species are found to be collected from the sanctuaries especially by the tribal households.
- Construction materials consisting of *Imperata Cylindrica* and *Vetiveria Zizanoides* are available in good quantity. These are the products needed most for annual maintenance of the kutcha houses and has a good market.
- Fish is the second most important forest product in the study area and is collected mostly from the wetlands located inside the sanctuaries. In the face of a readymade and huge market the prices of the fishes caught from the forests fetch very high price in the markets.
- Fish is the only forest product which can be harvested almost round the year. Most of the fishermen use banned and destructive fishing gears and also use to fish during the banned season (April to July). On the contrary, the traditional fishing gears used by the tribal households are not destructive at al.

- Overall dependency of the fringe people on the forests is 28.25 percent. In other words the sample households appropriate 28.25 percent of their total household income from the sanctuaries. Grazing, fuel wood and fish contributes 11.71, 8.9 and 4.96 percent respectively towards total household income of the respondents.
- The average value derived by a sample household from Laokhowa and Burhachapori WLSs is found to be worth Rs. 33,314.
- Grazing and fuel wood contributes 41 and 32 percent respectively while fish contributes 18 percent towards the total forest income in the study area.
- The forest products are naturally available and collected mostly during dry season. Dry season is also suitable for easy accessibility and better mobility to the forest areas.

6.1.2 Determinants of dependency:

To identify the factors influencing the forest dependency of the fringe dwellers a Censored Regression has been administered. Education of the household heads, house structure of the dwelling houses, distance from the forest, cattle unit, household income, people living in below poverty line and occupation are found to be the influencing factors of forest dependency.

- Education is an important variable determining the extent of dependency of the fringe dwellers on Laokhowa and Burhachapori WLSs. It indicates that more the level of the education of the household heads less will be their dependency on forests. It is, probably, due to the fact that education opens up various opportunities outside the locality and people come out accordingly. Moreover, more educated households can be expected to have higher level of awareness and thus higher concern for the forest resources.
- People living in *kutcha, semi kutcha* and *semi pucca* houses are expected to extract more materials for house construction and thus their dependency on the forest is high. Thus, the house structure is also one of the important determinants of forest dependency.
- Distance to the forest is another important determinant of forest dependency. An increase in the distance will discourage the people to take up forest activities. An increase in distance increases the possibility of getting caught by the forest frontline staff and hence increase in the distance restricts the forest collection.

- Cattle population is another important variable determining the forest dependency. It implies that the greater the cattle population the greater will be the predicted forest dependency.
- Total household income from non-forestry sources is another important variable determining forest dependency. The household income is negatively associated indicating that the forest collection cannot be a preferred vocation for the fringe dwellers. They take up such activities in the absence of any regular sources of income.
- Employment in the non-farm sector reduces the probability of dependency on the forest. It is because that the people have more secure job and don't want, therefore, to engage in forest collection.
- The age of the household heads also determines forest dependency. The negative association implies that the young people are more likely to collect forest products, perhaps because, such activities are illegal, risky and more strenuous. The elderly people cannot take up such strenuous and risky activities.
- The households having large amount of land do depend less on the forests. Perhaps large amount of land can provide more fodder and other household necessities and thereby need to depend less on forests.

6.1.3 Value of Laokhowa and Burhachapori Wildlife Sanctuaries.

A. Value of provisioning services or direct use values of LBWLSs:

- Two methods of valuation have been adopted for valuing direct and indirect values of Laokhowa and Burhachapori WLSs, namely the Market Price (MP) Method and Contingent Valuation Method (CVM). The Market Price Method has been applied to value the provisioning services of the sanctuaries whereas the CVM has been administered to value the indirect use values of the sanctuaries.
- Nine different provisioning services are harvested by the sample households from Laokhowa and Burhachapori WLSs value of which is estimated to be more than Rs. 8 million. This is actually the flow benefit of the forests. 5 millions of these values are derived from the collection of forest products and the rest is derived from open grazing by the domestic stock reared by the fringe dwellers.
- Dhania is the village inhabited by the Nepali community, who are traditional graziers, appropriate the highest benefits accrued from open grazing.

- Per hectare value has been calculated by assuming the catchment area of the NTFP collectors to be 10, 25 and 50 percent of the total land area of the sanctuaries. The per hectare value of Laokhowa and Burhachapori WLSs, thus, estimated to be Rs. 7685, Rs. 3074 and Rs. 1537 respectively.
- Application of the opportunity cost method gives a lesser value per hectare of the sanctuaries. It comes down to Rs. 5775, Rs. 2310 and Rs. 1155 when this method is applied for estimating per hectare value of the LBWLSs.
- If this benchmark value is extrapolated to the entire fringe population the per hectare value becomes Rs. 1,00,567, Rs. 40,226 and Rs. 20,113 respectively for 10, 25 and 50 percent area of the sanctuaries.

B. Willingness to pay for conservation of Laokhowa and Burhachapori WLSs:

- Since Laokhowa and Burhachapori WLSs provide many provisioning services to its fringe dwellers and also people enjoy enormous amount of regulating services (indirect use values) a Contingent Valuation Method (CVM) is administered to assess peoples' Willingness to Pay (WTP) for conservation and preservation of the forest ecosystem services of both the sanctuaries.
- 99 percent of the respondents opine Laokhowa and Burhachapori WLSs as very important for their day-to-day life.
- 62 percent of the respondents have a clear understanding about intangible services, such as clean air and water, checking of flood and erosion, maintenance of local precipitation, etc. provided by the sanctuaries.
- Though all the respondents want the sanctuaries to be preserved and conserved only 79 percent of the respondents express their willingness to pay for its conservation. Rest conveyed their inability to pay for the same including very few protest bids. On the other hand, 62 percent of the respondents also articulate their willingness to get involved in other ways possible for the conservation of the sanctuaries.
- Plantation, protection, generation of environmental awareness among the poor and illiterate and semi-literate fringe dwellers besides strict vigilance to be paid by the forest frontline staffs are some of the suggestions put forward by the respondents for the conservation of the sanctuaries. They further express their willingness to get involved in such activities.

- The mean willingness to pay of the respondents is Rs. 351. However, some of the respondents convey their willingness to pay for more in future provided the amount so collected is utilised to its fuller extent.
- There are very few respondents who protested against the idea of contributing a part of their annual income for conservation though their annual household income is the highest among all categories. However, the protest bidders also depend on the sanctuaries for different items.
- There are 57 respondents willing to pay more than the mean WTP of the entire respondents the average being Rs. 1039. On the other hand, willingness to pay of 183 respondents are less than the mean WTP the average being Rs. 139 only.
- Considering the professional category of the household head the businessmen's WTP is the highest (mean Rs. 616).
- The mean WTP of the APL and BPL is Rs. 369 and Rs. 171 respectively.
- The family size is one of the important determinants of the WTP of the respondents. It is positively associated with the WTP implying that as the number of the household members increases the probability of WTP also increases. It is perhaps due to the fact that the members of a large family may get engaged into different livelihood activities and hence the probability of earning more than others culminating into more WTP.
- Income of the household head is another most important determinant of WTP. Other things being equal, a household's willingness to pay would be higher if the annual household income of the household is higher.
- The cattle unit is also representative of wealth and capabilities of the households and is positively associated with the WTP. The possible reason for higher willingness to pay may be that in the absence of any professional grazing ground in the vicinity the forests act as the only common grazing ground for the cattle population reared by the fringe dwellers. In the possible event of disappearance or annihilation of the forests the cattle rearers will be the hardest hit.
- The variable 'forest dependency' is another important variable determining the WTP of the respondents. The 'forest dependency' is negatively associated implying that more dependent are the people on the sanctuaries less is their willing to pay for forest conservation. The possible explanation may be that since the forest dependent people are poor they don't have surplus to contribute towards forest conservation.

- The age and education of respondents are positively associated with the WTP implying that the older and educated people are willing to pay more for forest conservation.

C. Willingness to pay of the respondents of Treatment group and control group:

- In the context of the present study the concept of a control group has been incorporated to compare the willingness to pay for conservation of forests between population living in close proximity to the forest and population living relatively away from the forest boundary both the samples representing almost similar socio-economic condition.
- All the samples of the control group are found to be familiar with the status of the sanctuaries and also aware about its degradation.
- All the samples opine that the Laokhowa and Burhachapori WLSs are very important to their lives since it provides various important intangible services. Fresh air and water, biodiversity, habitat of the wild lives, reduction of pollution and thereby various diseases are some of the important intangible services people have spoken about.
- Looking into the environmental services the sanctuaries are delivering to the people the respondents are quite eager to conserve the sanctuaries.
- Unlike the treatment group, 91 percent of the respondents of the control group have expressed vociferously to offer financial contribution for the conservation of the sanctuaries.
- While 62 percent of the respondents of the treatment group wanted to offer other kinds of help for the conservation of the sanctuaries only 46 percent of the respondents of the control group want to get involved in other way for the conservation of the sanctuaries.
- There are significant differences between the WTP of the respondents of the treatment and that of their counterpart in the control group. Mean WTP of the control group is Rs. 1110 in comparison to Rs. 288 for the treatment group.
- Average family size and land holding are almost similar for the respondents of both the groups.
- Mean income of the respondents of both the groups shows significant differences being Rs. 198936 for control and Rs. 114693 for the treatment group.

- Mean distance from the forest boundary is 4.81 kilometres for the control group and only 0.48 km for the treatment group.
- The mean year of schooling also shows significant difference between both the groups. It is 8 years in case of the control group while only 3.43 for the treatment group.
- The respondents protest on similar grounds against contributing to the forest conservation. "This is not my responsibility to pay" – the protest bidders of both the control and treatment groups echoed similar sentiment. Interestingly there are also people who are enthusiastic enough to pay instantly, i.e., during the time of household survey, for the cause of conservation.

6.2 Conclusion: The objectives of the current study are to examine the degree of dependency of the fringe dwellers on the forest and to estimate the value of the provisioning services and the willingness to pay of the fringe dwellers for forest conservation. Based on both the secondary and primary survey the study answers all the research questions posed at the beginning of the study. The result shows that Laokhowa and Burhachapori WLSs provide immense economic benefits to its fringe dwellers. In other words, the people living here are highly dependent on the forested ecosystem of Laokhowa and Burhachapori WLSs for their wellbeing and subsistence. The result of the quantitative estimation of the provisioning services supplied by the forest ecosystem of Laokhowa and Burhachapori WLSs shows that 28 percent of the total household income of the sample households in the study villages comes from various forest products they harvest from the sanctuaries. Fuel wood and fish are the two most important forest goods harvested by the fringe dwellers here. The results reveal that the NTFPs gathering is much more lucrative than the works the unskilled people of the study area could engage. The forest product collection here is need based, relatively less time consuming and is harvester flexible. There are various independent factors determining the forest use decision of the fringe dwellers in Laokhowa and Burhachapori WLSs. The Tobit estimation results found education of the household head, house structure, distance of the household to the forest, cattle unit and household income to be significantly associated with the forest dependency.

One of the research questions of the present study is about the varieties of tangible benefits the fringe dwellers derive from the sanctuaries. The study addresses and estimates the value of the provisioning services or tangible benefits extracted from the sanctuaries to be a

whopping Rs. 8.7 million per annum. The study, thus, indicate that the Laokhowa and Burhachapori WLSs has enormous value which can be gauged from the fact that per hectare value of the sanctuaries has been estimated by the study to be Rs. 7,685.

The study finds the fringe dwellers to have realised immense benefit arising out of not only the provisioning services but also from the regulating services of the sanctuaries. It is this realisation that has made them vociferously opine for conservation and preservation of the forest ecosystem of Laokhowa and Burhachapori WLSs. It is reflected from the fact that ~~79~~ (should be 86%) ~~percent of the respondents express their willingness to pay for conservation of the degraded sanctuaries. 62 percent~~ of the respondents also express their willingness to help in other ways besides contributing a part of their income for the conservation. Moreover, people living beyond fringe area of the sanctuaries also opt for their monetary contribution for the conservation of the sanctuaries. The study shows that 91 percent of the respondents living beyond fringe area (2 kms from the forest boundary) want to contribute for the conservation of the sanctuaries.

However, it is to be mentioned that there are a few respondents who call for protest bids. These protest bidders are of the view that the preservation of forests is the responsibility of the government and for the purpose the tax from across sections of the citizens are being collected. They further believe that crave of the local forest managers for money, laxity and nepotism are primarily responsible for the degradation of the sanctuaries.

6.3 Policy suggestions:

Looking into the important role played by the Laokhowa and Burhachapori Wildlife Sanctuaries it can be inferred that deterioration of these services or the sanctuaries would adversely affect the lives and livelihood of large section of the fringe communities. Therefore, the local forest managers should take into account the immense values while designing strategies for resource generation and allocation and take adequate measures for conservation of the sanctuaries to ensure a sustained flow of benefits to the fringe dwellers. The participatory approach should be encouraged and the local peoples' opinion should be respected and incorporated into the decision making processes so as to improve the supply of benefits through better management. Garnering support of the locals for conservation becomes easier once the incentives or benefits are ensured to the fringe people. Since the conservation benefits such as biodiversity, protection of endangered species, carbon

sequestration also go to the society at large the global community should come forward with technical and financial support for the conservation of the forested ecosystems.

The important policy suggestions based on the findings of the study have been summarised as follows:

1. More widespread provision and access to basic education and environmental awareness along with livelihood support is one of the important measures to be taken up for the fringe dwellers looking into the poor educational attainment. Education, by widening up the opportunities for outmigration and off-farm, high skilled and high-returning employment avenues shall lessen their forest reliance.
2. *Kutcha* house structure is one of the important driving factors of forest dependency. The people can be motivated to switch to *pucca* houses and they can be given access to cash fund to buy GI sheet and other materials through various governmental schemes. Eco development programme of the forest department can be of great help in this regard.
3. The study area has huge cattle population the average being 7.62 cattle unit per household. However, these un-inoculated cattle are low milking and graze freely inside the sanctuaries increasing the probability of contagion of diseases to the wild animals. Moreover, such unregulated overgrazing also reduces the food availability for the wild herbivores resulting into the population of the herbivores. Consequently, in the absence of ample prey population the number of carnivore population will also suffer in the long run. Therefore, villagers need to be motivated to do away with the low milking cattle with high milking variety. The government can make provision of the initial capital through eco development programme for the purpose. The provision of high milking cattle variety, i.e., dairy farming, thus, could serve twin objectives of generating income on the one hand and saving the forests from the unregulated grazing by the domestic stock.
4. Provision of more income generating activities need to be implemented for the fringe dwellers especially for the resource poor dependent households since increase in household income reduces the forest reliance to a great extent. Looking into the low employability of the people in the study area diverse capacity building programme to suit the interest and capability of the people would help to a large extent. Thus, taking up of capacity building programme on carpentry, electrical repairing, driving, computer training, mobile repairing, masonry, tailoring and cutting knitting, etc. could be some of the important livelihood activities. A shift from the farm to non-farm activities, thus, will help reducing the forest reliance to a large extent.

6.4 Limitations of the study and scope for further research:

Some of the limitations confronted by the researcher during the entire period of the study have been noted below:

- The study takes into account only the value of the provisioning services of Laokhowa and Burhachapori WLSs. It did not take into account the other ecosystem services of the sanctuaries while estimating the value of the flow of provisioning services. The estimated values here should be considered indicative, providing a first-hand estimate of the value of the provisioning services of the sanctuaries. Further studies are needed to estimate the value of other ecosystem services and thus to come up with total value of the sanctuaries.
- The current study relies primarily and heavily upon the account of the extractors which may not be accurate for various reasons and therefore is not recommended (Godoy et al., 1993). Though the most accurate and appropriate method recommended for valuing forest products is to identify, count, weigh and measure them as they enter the village each day. However, the study could not adopt such a method for valuing the forest goods of Laokhowa and Burhachapori WLSs. Therefore, future studies may be undertaken based on administration of such methodology.
- The respondents were hesitant to speak to the interviewer during the household survey as notifications for eviction were served by Nagaon Wild Life Division in many parts of the Laokhowa and Burhachapori WLSs. People suspected each and every new face entering their villages and also suspected such survey to be part of a ploy to steal their land and other properties and thus evict them from their land. It needed much effort to persuade and start a conversation with the respondents in some cases.

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Appendix - Questionnaire Administered in the Field to Collect Primary Data

'Dependency and conservation practices: A study of forest fringe villages in Assam'

"*A study undertaken for Ph. D. in the Department of Humanities and Social Sciences, Indian Institute of Technology Guwahati, Guwahati 39, Assam, India, Phone: 91-(361)-2582600, Fax: +91-(361)-2582599***"**

General Information: -

1. Name of the Respondent: Name of the Head:
2. Respondent's Relation with the Household Head:
3. Village: Post Office: Pin:
4. Phone number: Police Station:
5. Panchayat: Development Block:
6. District:

Household Information: -

1. Family structure: JOINT / NUCLEAR
2. Religion: HINDU / MUSLIM / OTHER
3. Caste: SC / ST / OBC / MOBC / Others
4. For how long you have been residing here?:
5. Structure of the house: KUTCHA / SEMI KUTCHA/ SEMI PUCCA / PUCCA
6. Do you have lavatory? Yes/ No. If yes: katcha/ pucca.
7. Distance to the forest from your home?
8. Main source of drinking water: Tube Well/ Well/ Stream/ River/ Other (Specify)
9. Do you have a tube well?: Yes/ No
10. What is the source of energy in the house: Fuel wood/ LPG/ Bio gas/ others (specify)
11. What is the daily need of fuel wood: ……..kg
12. Market price for fuel wood: Rs……../per kg.
13. Source of fuel wood: Forest/ home garden/ market/ any other
14. Do you have electricity connection: Yes/ No

15. Household member information:

Sl no. and name of the family members	Relation to the head	Age/ sex	Education	Occupation	Married/ unmarried

16. How much land do you own (having patta and no patta): …… bigha

Irrigated land	Unirrigated land	Source of irrigation	Land leased in	Land leased out

17. Pattern of cropping: single / multi cropping.
18. Name the principal crops you grow:
19. Any change in your cultivation pattern during last five years:
    i. More of a few crops has been grown
    ii. More varieties are grown

20. Name of various chemical inputs used in agriculture:
21. From when did you start using chemical fertilizers and pesticides:
22. Have you noticed any impact of the chemicals used on biodiversity (on fish, and others)?
23. Livestock:

Sl no.	Name of the animal	Total number	Stall feeding (yes/no)
1	Cow		
2	Horse		
3	Pig		
4	Chicken		

5	Goat		
6	Sheep		
7	Buffalo		
8	Duck		

24. Daily fodder requirement:……kg

25. Source and price:

26. Information on collection of NTFPs:

Items of NTFPs	**Use of it**	**Who collects (Male, female)**	**How many days and months it is collected in a year**	**How much of it is collected at one go@. Time taken per trip**	**How much of it is sold & where it is sold**	**Market Price (in Rs.)**
Dry stems of trees	Fire wood/ selling					
Leafs of trees	Fodder					
Roots, barks of trees	Medicine, edible					
Wild fruits	Consumption, selling					
Leafy vegetables	-do-					
Simul cotton pods	-do-					
Fish	-do-					
Thatch	Construction material					
Nol, Khagari/ Birina/ Jhao	Construction material					
Any other						

@ i) kg, ii) bundle, iii) other

27. How is the collection compared to five years back:

i. Collection has been increased: yes / no.
ii. Collection has been decreased: yes / no.
iii. Collection has been remaining stagnant: yes / no.
iv. If yes, can you specify reasons:

28. Do you purchase such items? Yes/ no.
29. If yes, how much and what price?
30. If there are substitute for the products? Yes/ No.
31. If yes, what is the price of the substitute? Rs.
32. Employment opportunities in the forest (both casual and permanent):
33. Fishing practices: Do you have a fishery? Yes/ No.
34. What is the status of availability of different (indigenous) fish species:
    i. Fish species are increasing yes / no
    ii. Fish species are decreasing: yes / no
    iii. Fish species are remaining the same: yes / no
    iv. Specify reasons:
35. What are the fish species that has gone down drastically:
36. Any fish species that is extinct:
37. Loss of other such species (animal, birds, trees, etc.) from the area:
38. Causes for such loss:
39. Impact of such loss:
    i) Increased diseases
    ii) Natural hazards increased
    iii) Loss of biodiversity
    iv) Human health
    v) Lack of clean and safe water
    vi) Reduction of tourism activities
40. What needs to be done to mitigate these affects:
41. Total family income (yearly):
42. Do you belong to BPL category:
43. What schemes have you availed as a BPL family:
44. Family assets:

Declaration: (The following questions are absolutely for the purpose of research and you will not be held accountable for the amount you have said you are willing to pay).

45. Whether the Laokhowa and Burhachapori forest is important for your day-to-day life?:
    i. Very important
    ii. Not important
    iii. Cannot say.
46. Whether the Laokhowa and Burhachapori forest has undergone a change over the years?: yes/ no / cannot say.
47. If yes, what kind of change it has undergone?:
48. Have you been benefited from the Laokhowa and Burhachapori Wildlife Sanctuaries?:
    i. Highly benefited:
    ii. Not benefited:
    iii. Cannot say:
49. If yes, what benefits are you receiving from the Laokhowa and Burhachapori Wildlife Sanctuaries? Name them.
50. If you are being benefited from Laokhowa and Burhachapori, would you like to see it conserved?: Yes/ No.
51. If yes, would you like to pay for its conservation provided all the fringe dwellers pay for it: Yes/ No/ cannot say.
52. Would you like to pay the amount for conservation even if you don't get anything from it?: Definitely yes/ definitely not/ cannot say.
53. If yes, what would be the mode of payment:
    i. Onetime payment:
    ii. Monthly payment:
    iii. Yearly payment:
54. If yes, how much would you like to pay: Rs.
55. Whom would you like to pay?:
    i. Government: yes / no
    ii. Local Forest Department (Nagaon Wildlife Division) : yes / no
    iii. NGO: yes / no

iv. Any other (specify): yes / no

56. What else would you like to do for its conservation?:

57. Are you a member of any environment organisation working for environment conservation?

i. Yes

ii. No.

iii. If yes, name the organisation:

58. Your comment, if any: