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The Contribution of Forest Sector in Building of Green Economy

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Abstract: Protection of environment has been the cornerstone of Indian ethos and culture. Forests play an important role in environmental stability and provide a variety of benefits to the economy. The current environmental crisis presents unique opportunities for moving towards greener future by giving a major thrust to the forest sector that will generate employment, create real and durable assets and help rebuild rural India**.** The objective of this paper is to assessing the contribution of forest sector in building green economy**.** The paper is divided into two sections, first section reflects the role of forest sector in building green economy and in second section explains suggestions and policy implications. Use of bio energy will contribute to reduce greenhouse gas emissions and will be helpful in conserving bio diversity as well as will reduce India's dependence on importing oil. Producing biodiesel from tree-borne oilseeds is seen by many as a win-win opportunity to solve India's most pressing problems. Biomass is a versatile renewable resource and wood fuels contribute 56 percent of total biomass energy in India. The time seems to be right to give forestry a prime place in India's pursuit of more equitable, inclusive and sustainable development. Green economy can be built by joint effort of government and people of country. The transition to a green economy will entail moving away from the system that allowed, and at times generated, these crises to a system that proactively addresses and prevents them.

Keywords: Ecosystem services, Forests, Green Economy, Wood fuel, Biodiesel and Bamboo

1. INTRODUCTION

The United Nations Environment Programme defines a green economy as one that is low-carbon, resource efficient and socially inclusive, which would result in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities [1]. In a green economy, growth and employment are driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency and minimize the loss of biodiversity and ecosystem services. The strategic objective in the transition to a green economy is therefore, to facilitate economic growth and investment while at the same time taking measures to enhance environmental quality and social inclusiveness leading to sustainable development[2]. Green economy has the potential to be a major driver of far-reaching and innovative policy reforms and changes in business-as-usual economic interests. It provides

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new economic incentives for investments thus creating a new generation of greener employment opportunities thus helping to reduce poverty in a range of important sectors, *viz*. agriculture, forestry, fisheries, fresh water and energy.

The forest sector displays many of the characteristics of a green economy. These characteristics are

i) Low carbon, in that the forest is a major carbon store, and sequesters carbon while wood from renewable sources replaces high carbon non-renewable fuels and materials.

ii) Resource efficient, in that almost all industry residues are used and much paper and, increasingly, wood products are recovered for re-use. Any wood not used as material can often be used for energy.

iii) Socially inclusive provide millions of jobs in the forest sector.

The Millennium Ecosystem Assessment (MA) report presented to the United Nations in 2005 assessed the consequences of ecosystem change on human well-being. This report also examined the scientific basis for action needed to enhance the conservation and sustainable use of those ecosystems and their contribution to human wellbeing can be seen in figure 1.

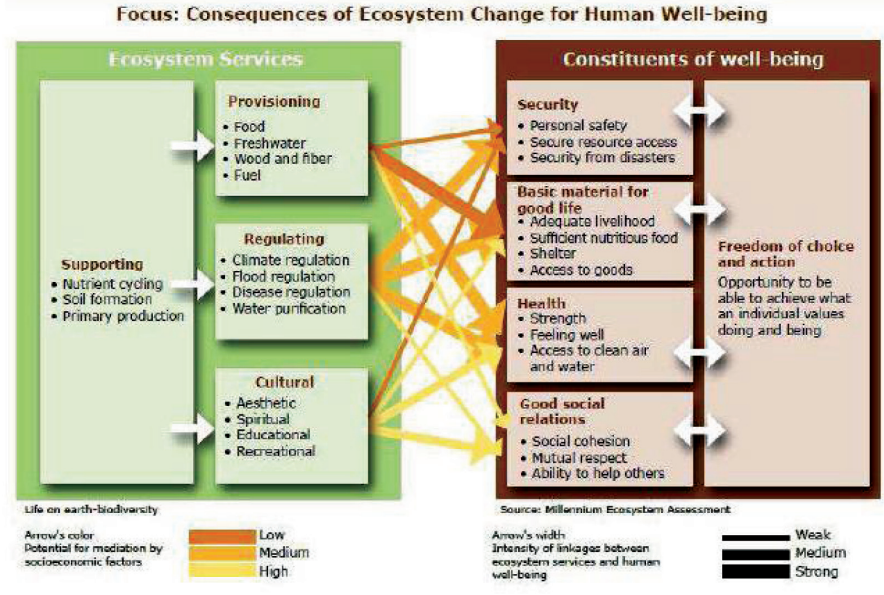

Figure 1: Ecosystem serivces and their linkages with human well-being (MA, 2005).

One of the major findings of the MA is that human actions are depleting Earth's natural capital, putting such strain on the environment that the ability of the planet's ecosystems to sustain future generations can no longer be taken for granted. The Rio +20 Outcome Document also recognises that forest ecosystems make important contributions to sustainable development through the provision of goods and services which are environmentally sound, enhance food security and the livelihoods of the poor, and invigorate production and sustained economic growth. The Outcome Document also reaffirms the necessity to promote, enhance and support more sustainable forestry that eradicates hunger and is economically viable, while conserving biodiversity and water resources and enhancing resilience to climate change and natural disasters [3]. Furthermore, the Outcome Document acknowledges that:

> "…the wide range of products and services that forests provide creates opportunities to address many of the most pressing sustainable development challenges. We call for enhanced efforts to achieve the sustainable management of forests, reforestation, restoration and afforestation, and we support all efforts that effectively slow, halt and reverse deforestation and forest degradation, including promoting trade in legally harvested forest products. We note the importance of such on-going initiatives as reducing emissions from deforestation and forest degradation in developing countries, and the role of conservation, sustainable management of forests and enhancement of forest carbon Stocks in developing countries" [4].

Objectives of the study

The study will focus on following main objectives:

1. To examine the contribution of forest sector in building green economy
2. To analyse how forest can contribute to solve problem of energy.

2. METHOD OLOGY

Study is based on secondary data collected primarily from reports of planning commission, United Nations Environment Programs etc. The paper is divided into two sections, first section reflects the role of forest sector in building green economy and section II explains suggestions and policy implications.

The rapid increase in greenhouse gases in the atmosphere, large-scale deforestation, loss of biodiversity, severe land-degradation, increasing floods and droughts and environmental pollution have become subjects of serious global concerns. There is ample evidence that given the right environment,

farmers could easily green the country and meet the raw material needs of forest-based industries. Today, forestry has a wide spectrum of interfaces and multi-dimensional array of impacts. The situation calls for new and in-depth knowledge about forest resources, their use and non-use values, externalities, their management and conservation, and inter linkages of forestry with other sectors. Physical developments that are poorly conceived, planned and implemented are the causes of many of today's severe environmental problems affecting soil, water, flora and fauna, and integrity of Ecosystems vital for human welfare and security.

The phrase "building a green economy" means different things to different people, but in general it refers to encouraging economic development that prioritizes sustainability that is, working with nature and not against it in the quest to meet peoples' needs and wants instead of disregarding environmental concerns in the process of growing the economy**.** Forests produce a range of both tangible and intangible ecosystem services and have an enormous potential to contribute to green economy.

The acceptance of the plantation growth as raw material by the wood base industries and their potential to produce standard products by adopting improved technology has shown rays of hopes to build green economy. The processing of wood products can be seen in figure 2.

Efficient use of wood

Bio Diesel

Bio fuels are environment friendly fuels and their utilization would address global concerns about the control of carbon emissions. Dependence on imported

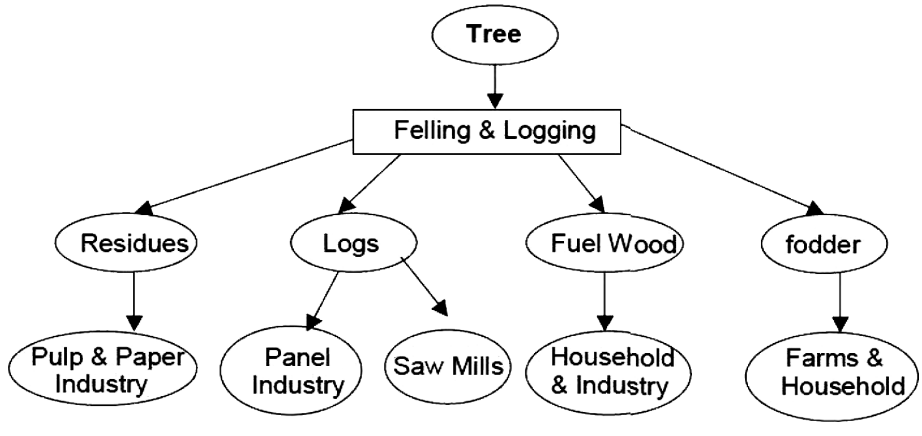

Figure 2: A generalized flow chart for processing of tree into wood products

crude oil, environmental issues and employment in rural areas are reasons for replacement of fossil fuels by biofuels [5]·Shifting to biodiesel would also reduce greenhouse gas emissions and urban air pollution. Producing biodiesel from tree-borne oilseeds is seen by many as a win-win opportunity to solve two of India's most pressing problems. First, India needs to stimulate rural development and secondly, India needs energy. The Indian biodiesel sector is different from biofuel activities elsewhere in the world. Biodiesel production in India involves much fewer risks for the environment and food security. This is mainly due to the type of feedstock, while most other countries use annual crops for fuel production, in India biodiesel is produced from the seeds of trees with a life time of 30 to 200 years. In comparison to most annual crops, oil-bearing trees need little fertiliser and thereby avoid negative impacts on the net carbon balance. In contrast to countries like Malaysia, Indonesia and Brazil, there is no threat that natural forests will be destroyed for biofuel plantations. Since biodiesel cultivation is to take place on land mostly with marginal biomass cover, planting of oil-bearing trees is likely to increase the carbon sequestration of the respective lands. In fact, biodiesel production can be integrated into forestry programmes and therefore contribute to afforestation. Several tree species can be selected for biodiesel production. More than 300 different species of oil-bearing trees exist in India. All of them are naturally grown wild species, which have not yet been cultivated and harvested systematically for oil production. Some of the seeds have been collected by poor people for lightning for decades. Only in small quantities, tree-borne oilseeds (TBOs) are used for commercial purposes in the paint, lubricant and soap industry. According to the National Oilseeds and Vegetable Oils Development Board of the Indian Ministry of Agriculture there are about ten species with economic potential for biodiesel production including Jatropha, Pongamiapinnata, Simaroubaglauca, Azadirachtaindica (Neem) and Madhucaindica (Mahua).Five tree species with economic potential for biodiesel production shown in table 1 and table shows that all oil bearing trees can grow in areas with less rainfall and even grow in less fertility. Due to this quality there is a potential to rehabilitate degraded lands which are abundantly available in India. Table further explain that height of Jatropha plant is very less with comparison of other trees and gestation period is also two very less. Since the time span between investments and returns is shorter, more people might adopt the cultivation of this crop. The seed collection period of Jatropha, Pongamia and Simarouba does not coincide with the time of rainfalls in July when most of the agricultural activities take place.Economic life span of Jatropha is 35 years, Mahua is 60 years where as Neem has 150 to 200 years. Capacity of oil content per seed in percentage term is the highest in Mahua followed by Pongamia, simarouba, Neem and

Table 1: Oil-bearing tree species in India[6]

	Jatropha	Pongamia	Mahua	Simarouba	Neem
Climate	Arid, semi arid and tropical area with rainfall 1000-1500 mm; mixed hot and humid climate	Grows almost throughout India up to altitude of 1,200 m ; with rainfall 500- 2500 mm		Grows almost throughout India up to altitude of 1000m with rainfall 700-400 mm	Grow under sub-arid to subhumid conditions with 400-1200 mm annual rainfall
Soil	Hardy plant growing also on stony, gravely or shallow and calcareous soils with low fertility, well drained soils required	Tolerate to salinity, alkaline and water logging soils		Wide variety of drained soils with pH from 5.5-8.0. Loamy and red laterites are preferred	Wide variety of soils including clayey, saline alkaline soil, with pH upto 8.5.
Height	3-4	15-25	2123	15	15-20
Gestation Period	2-3	4-7	815	6-8 (3-4 when graftied)	5-6
Economic Lifespan	35		60		150-200
Oil content per seed (in%)	28-35	2739	3540	50-60	45
Yield per tree (kg)	1-2.5	20-25	20-40	15	15
Oil/ ha (t)	0.7-1.8	1.5-3	2.7	1-2	2.5
Collection Period	Oct-Nov	May-June	June-July	April-May	
Density of Plant/ha	1500	500	200	500	400
other characteristics and uses	Used as lubricant, soap and candle manufacturing	Fixing nitrogen into the soil, Used as lubricant, leaves used to protect grain from insects, good for firewood	Source for soap and bathing oils manufacturing, medical purpose and animal feed, used for vegetable and alcohal production	Most suitable for waste lands reclamation Watershed Development Can produce ethanol	Famous as Ecological friendly, changing acid soil into neutral

Sources: Biodiesel policies for rural development in India, 2008

jatropha. Density of Jatropha Plant is the highest with 1500 ha followed by Pongamia(500 ha), simarouba (500 ha) , Neem (400 ha) and Mahua(200 ha). All oil bearing trees except oil can also be used for other purposes.

Proponents of biodiesel in India almost exclusively focus on Jatropha and to some extent on Pongamia. Other species have not received much attention. Among various alternatives to diesel, Planning Commission of India has identified *Jatropha curcas*L. (Jatropha), a non-edible oilseed tree whose oil can be easily converted into biodiesel with properties very similar to diesel [7] . Jatropha is a drought-resistant, perennial plant living up to 50 years and has the capability to grow on marginal soils. It requires little irrigation and grows in all types of soils, thus making Jatropha a more sustainable choice than other vegetable oils [8]. Jatropha biodiesel can be used for decentralized micro-grid electricity generation at village or taluka (suburb) level and as a replacement fordiesel fuel in irrigation pump sets, diesel generators and also as an alternative to kerosene. The Indian Government regards bio fuels as a feasible option for

Table 2: Some economic benefits of bio-diesel production from Jatropha seeds grown on wastelands in India [9]

	Year		
	2010	**2020**	**2030**
Wasteland to be cultivated in (million ha)	0.4	2	10
Production of bio-diesel (million tons/ years)	0.2	1.01	5.07
Foreign exchange savings by fuel substitution (million US/ years)	67	334	1672
Employment Generation (man-days)	20000	10,00,000	50,00,000
Saving to CO_2; consumption by use of of produced bio-diesel as automobile fuel (million tons/	0.5	2.7	13.4
CO_2 Sequestration in biomass (mllion tons/year)	0.9	4.6	22.9
Possible Income from CO_2; reduction from emission trading (MUS$)	14.5	72.5	362.5

Source: A concept for simultaneous wasteland reclamation, fuel production, and socio-economic development in degraded areas in India: Need, potential and perspectives of Jatropha plantations, 2005

augmenting future fuel supply. The document, India Vision 2020 presented by the Planning Commission as a framework for policy planning in the coming decades, mentions the potential of bio fuels in general and specifically refers to plantations of *Jatropha curcas*to produce large quantities of bio-diesel. Cultivation of 10 million ha of this crop could generate 7.5 million metric tons of fuel annually, while generating year-round employment for 5 million people. Economic benefits of Jatropha plant production can be seen in table 2 and table shows projections in terms of use of wasteland, production of bio-diesel, foreign exchange savings, employment and CO_2 Sequestration capacity. Table reveals that with theproduction of Jatropha seeds, cultivation of waste land will be increased from 0.4 million ha in 2010 to 10 million ha in 2030. Positive impact on the production of bio- diesel can be seen that it can increaseupto 5.07 million tons, whereas increase in foreign exchange savings will be more than 24 times in 2030 from 2010. 250 times employment generation can be increased in 2030 than 2010, moreover it can also solve environment problem by increase in CO_2 sequestration in biomass from 0.9 mllion tons in 2010 to 22.9 mllion tons in 2030.

The focus on Jatropha is justified mainly by two arguments. First of all, Jatropha does not grow into a tree but remains a shrub. Therefore, it is easier to harvest than large trees and has a much shorter gestation period. Since the time span between investments and returns is shorter, more people might adopt the cultivation of this crop. Second, the seed collection period of Jatropha does not coincide with the time of rainfalls in June-July where most agricultural activities take place. Therefore, people can generate an additional income in the slack agricultural season. Pongamia has become the second feedstock of the Indian biodiesel sector for the reason that this tree is traditionally planted in several states and therefore well known to the people. Being a multipurpose plant that is not only a source for oil but also for animal feed, manure, fire wood and medical uses, farmers already integrate Pongamia into their farming systems. Also on public land such as from forests or along road sides, it already is common practice for people to collect and sell the seeds – provided they find a market. Since availability of land with low opportunity costs is a prerequisite for the economic viability of the biodiesel sector, much attention has been given to so-called wastelands that could be utilised for cultivating oil-bearing trees. There is large amount of degraded and unfertile land in India. The Government of India identified 72,000 km² of the 553,000 km² wastelands as suitable for biofuel crop cultivation. The Forest Department in Chhattisgarh created employment for 3.2 to 3.7 labourers per ha for 25 days for the *establishment* of a Jatropha plantation. Corporate-centred cultivation can have a significant impact on the green cover of a region. In Chhattisgarh,

for example, S.K. Shukla, head of CREDA, stated that 30,000 to 50,000 ha of Jatropha plantation on revenue land is envisaged per district. Converted to the whole State of Chhattisgarh that means an area of 3.5 percent to 5.9 percent will be brought under Jatropha plantation [10]. If this land is currently only covered with minor shrubs and grasses, the cultivation of Jatropha bushes do make a difference in the green cover of the state.

Some species major thrust in agroforestry and JFM programmes are: Bamboo species, Casurinaequisetifolia, Acacia nilotica, Eucalyptus species, and Populusdeltoids and Prosopis cineraria.

Bamboo is a fast growing woody grass which constitutes 12.8 per cent of the total forest area. The total annual production of bamboo is estimated to be 4.5 million tons, second only to China. Bamboo craft is one of the oldest cottage industries primarily due to versatility, strength, lightness and easy workability of bamboo with simple hand tools. Bamboo has been put to use for various applications ranging from construction to household utilities and have more than 1000 documented uses including an important industrial use in paper and pulp manufacture. Due to plethora of essential uses, it has been aptly described as “poor man’s timber” “green gold”, “friend of people” “the cradle to coffin timber”, “Green Gasoline”. The major industrial use was in paper manufacturing.

Casuarinas equisitifolia

Casuarina was introduced in the coastal regions of India to meet the supply of firewood to steam locomotives during the last century. Since then it has gained its importance as an important fuel wood species in the peninsular India. Casuarina has been identified as a species for environmental control such as sand dune stabilization, shelter-belts, erosion control and reclamation of poor soils. Casuaria has become most popular among the farmers due to its multiple use and ready marketability. Casurina can grow well in poor soil and can improve the soil. The most common use of casuarina is as fuel wood. The wood is dense and burns slowly with great heat and no smoke, its calorific value is about 500 kcalories and Casuarina stumps form excellent charcoal, some of its species can also be used for fodder under distress conditions.

Eucalyptus

Eucalyptus has been used for timber, poles, veneer, pulp, fuel and for chemical products like essential oils and oxalic acid. There was a time when eucalyptus was untouchable as a furniture timber. But at present it is a common species in house and furniture making. It is also being increasingly used as poles. Hybrid wood is also being used for manufacturing paper and rayon grade

pulp. As pulpwood, the younger, low-density eucalyptus is preferred to older and denser wood. Eucalyptus leaves are an important source of essential oil. Eucalyptus plantations were raised by Forest Departments in several states for meeting the demands of firewood and pulpwood for many years.

Poplar

Poplar has come to occupy a unique and important position in the rural economy in several parts of India. Poplar, which was being used mainly for match splints, has suddenly found more profitable use in plywood and prices have increased significantly. Now, Poplar is the most promising timber for industrial and other applications in the north western states, where it is largely grown in agroforestry sector. It is widely used as wood poles, packaging, making veneer and plywood, fibre board, cement bonded board, in the manufacture of artificial limbs, matches and sports good. Owing to very little risks and high profits in poplar cultivation, large farmers and absentee land-lords prefer to put their lands under poplar-based agroforestry rather than other agriculture/ agroforestry options.

Prosopis cineraria

Prosopis cineraria also known as Khejri holds an important place in the economy of Indian desert. This is the only leguminous tree that grows well in deserts against all odds of climatic conditions. Because of its economic value the tree is left standing in the arable land, its population being regulated by the farmers. The wood is suitable for interior construction work, such as columns, roofs, doors and windows and for wheels and hubs of carts, agricultural implements, tool handles, small turnery articles and well-curbs.

Woodfuel

Rapid urbanization, industrialization, rising incomes and the growing use of energy intensive products are driving India's demand for energy. Lack of access to modern energy services and its implications for human well-being mean that energy supplies need to grow to reach the unserved population. Addressing growth and energy poverty could have significant implications for energy supplies. Though there are significant coal reserves they are mostly located in environmentally sensitive areas and are inferior in quality. India's reliance on coal for more than half of its power needs is an issue of great concern for energy security. Keeping this in view, India is seeking to increase the use of renewable energy sources to meet the projected economic growth rate since these would be non exhaustible. Initiatives are also directed towards energy efficiency and demand side management, with a view to control the

growth in energy demand. Biomass is a versatile renewable resource used since millennia as a fuel as well as material for meeting myriad human needs. Biomass energy constitutes wood fuels (including charcoal, wood waste wood), crop residues (such as Bagasse, rice husk and crop stalks) and animal dung (including biogas). The use of wood fuel has several benefits. Wood fuel can benefit financially because it is currently the cheapest heating option. Primary Energy use in India shown in table 3 and it shows that total commercial per capita energy use is more than per capita energy use of total Biomass energy. Table further reveals that in quantity term use of fuelwood is highest followed by coal, electricity and then oil while in terms of use of per capita energy of fuelwood is second largest after the use of coal. Per capita use of fuelwood also keeps the highest position in total use of biomass energy thus it can be seen that fuelwood is a good substitute for fossil fuels like coal and oil etc. which have limited supply.

The percentage of households using different forms of energy needs in rural and urban areas is given in table 4 and table shows that 60 percent energy is used in form of fuelwood and chips followed by LPG (23 percent)and Kerosene (2.9 percent).While more use of LPG in urban area (57.1 percent), on the other hand, rural areasuse only 8.6 percent they have to depend on fuelwood and chipsi.e. 75 per cent. There is no use of dung cake in urban areas and kerosene is not used in rural areas.The fuelwood will be completely replaced, as poorer sections of

Table 3: Energy use in India[11]

Fuels	**Quantity**	**Per capita energy (GJ/yr)**
Coal	217 million tones	7.49
Oil	53.7 million tones	2.71
Natural gas	17.9 billion m^3	0.79
Electricity	77.8×10^9 units	0.33
Total commercial		**11.32**
Fuelwood	227–298 million tones	4.03–5.29
Crop residues	97–156 million tones	1.77–2.68
Cattle dung	37–114 million tones	0.60–1.85
Total biomass energy		**6.40–9.82**
Total energy		17.72–21.14

Source: The Woodfuel Scenario and Policy Issues In India 1997

the community may lack the cashresources to purchase the minimum amount of kerosene or LPG, or appliances which usethese fuels.

The average per capita consumption of only fuelwood per month at the national level in rural areas is about 17.7 kg and in urban areas 6.3 kg. The total fuelwood consumption estimated is 248 million m^3 in household sector [12]. Forest Sector Report of India (FSI) 2009[13] has also estimated that about 13 million m^3 additional fuelwood is consumed in hotels and restaurants, cottage industries and cremation of dead human bodies. This makes the total annual consumption of fuelwood to be 261 million m^3 which comes from different sources. The modern technology and markets are set to transform biomass from an inefficient and unclean traditional fuel to an efficient and clean fuel that is produced and consumed through modern technologies and competes in a market. Policy makers, especially in developing countries, are increasingly perceiving the additional benefits of commercial biomass such as - I) accessibility in rural areas where commercial fuels and centralized electric grid are not available, ii) employment generation in energy plantations and rural industries, iii) saving of foreign exchange spent on oil imports and, iv) restoration of deforested and degraded lands by energy plantations [14]. Another argument in favour of biomass energy is that it may help to tackle the problem of surplus agriculture production in industrialized countries. These advantages, together with more efficient and versatile biomass electricity generation technologies, have led to the transition of re-emergence of biomass as a competitive and sustainable energy option for the future. Biomass energy offers positive environmental and social benefits. Biomass plantation is often a best way to reclaim degraded lands and to generate sizable employment.

Table 4: Percentage of household using different forms of energy in India in 2005

Form of Energy	**Rural**	**Urban**	**Combined**
Fuelwood & chips	75	21.7	60.0
Dung Cake	9.1	0	6
Kerosene	0	10.2	2.9
LPG	8.6	57.1	23.0
Agriculture residue, coal, coke & others	6.0	6.1	6.0
No Cooking	1.3	4.9	2.0
Total	**100**	**100**	**100**

Source: Forest Sector Report of India 2010

Agriculture and forestry often still account for the bulk of employment and livelihoods. Because it is more labour-intensive than industrialized agriculture, it can be a source of growing green employment. Planting trees creates large numbers of jobs, although these are often seasonal and low paid. Agroforestry, which combines tree planting with traditional farming, offers significant environmental benefits in degraded areas including carbon sequestration. There is additional job potential in efforts to adapt to, and cope with, climate change. Building flood barriers, terracing land, and rehabilitating wetlands is labour-intensive work. Efforts to protect croplands from environmental degradation and to adapt farming to climate change by raising water efficiency, preventing erosion, planting trees, using conservation tillage, and rehabilitating degraded crop and pastureland can also support rural livelihoods. Forestry's potential for employment generation stems from several factors as low capital requirements, multiplier effect and flexibility and adaptability in diverse situations. The variety of the tasks required and the levels of technology available offer various employment options. For example, planting could be undertaken as an extremely labour-intensive operation if there are no labour constraints, or it could be partially mechanized depending on the relative costs of labour and other inputs.

There should be increase in investment in forest sector. Government should identify strategies and practices to improve the involvement of small holders and communities in the forest industry. Research on all aspects of forestry (scientific, technological, economic, social, environmental and institutional) is essential to maintain the dynamism of the sector. The Government should support relevant research, extension, technological packages, input delivery, market information, credit and insurance facilities.The future of bioenergy and wood energy development is largely dependent on the effectiveness of policies and the consistency with which they are implemented. Depending on the effectiveness of policy and institutional frameworks, there is also an opportunity for countries to promote sustainable national and rural development through bioenergy expansion. Larger bamboo resource, has very high potential for development of bamboo products and there is need to harness this potential through result oriented and coordinated strategy for development of bamboo.Lack of market intelligence and timely delivery of information to farmers is one the bottlenecks which needs to be removed.

3. CONCLUSION

The potential benefits of investing in forestry and progressing towards a green economy are manifold. It can solve the problem of economy and environment by replacing fossil fuel energy with renewable energy sources. Producing biodiesel from tree-borne oilseeds is seen as opportunity to solve two of

India's most pressing problems that of stimulating rural development and needs of energy. As oil-bearing trees can be grown in semiarid regions, there is a potential to rehabilitate degraded lands which are abundantly available in India. Biodiesel production in India involves much fewer risks for the environment and food security. The use of wood fuel has several benefits it can benefit financially because it is currently the cheapest heating option moreover it also help in reducing carbon dioxide emissions and subsequently help to combat the climate change. The financial and environmental benefits are probably good enough reasons to switch to wood fuel. The future of bio energy and wood energy development is largely dependent on the effectiveness of policies and the consistency with which they are implemented.

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