Chapter 5

Social Aspects of Biomass Utilisation

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CHAPTER 5
SOCIAL ASPECTS OF BIOMASS UTILISATION

5.1. Introduction

This chapter focuses on various social issues related to accelerated production and consumption of bioenergy in East Asia. The findings on social aspects are based on a case study of India, giving details on demand and supply of bioenergy, its merits in terms of rural employment generation and rise in income, and possible negative impacts of food insecurity and increased pressure on natural resources.

The demand for transport fuels is continuously rising and increased use of fossil fuels is constrained due to international commitments, environmental concerns and financial considerations. These factors have attracted the global attention towards development of non-conventional or renewable energy forms including bioenergy. Figure 5.1 depicts the energy mix for some major regions of the world and indicates that the share of thermal energy dominates in total energy production. Further, the share of renewable energy and bioenergy in total energy production is quite low. For instance, in USA the share of bioenergy is 1.1% and in Japan it is 1.07 %, in comparison to India's about 3%. Thus, there is enough scope for development of bioenergy, particularly in East Asian countries, which have suitable conditions for biomass production (Sharma, 2000; Planning Commission, 2003; WEO, 2006; PFI, 2007).

Consumption of bioenergy varies in both forms and proportions in various countries. For example, Brazil uses ethanol as 100% fuel in about 20% of vehicles and

25% blend with gasoline in the rest of the vehicles. USA uses 10% ethanol-gasoline blend whereas it is 5% in Sweden and 10% in Australia. India has mandated 5% ethanol blend, which will increase to 10% by October, 2008 with long-term targets set at 20% blending for both biodiesel and bioethanol. In most of the East Asian countries biofuel policies have emerged almost at the same time, in last 2-5 years, and are dedicated to promotion of biofuels (Raju, 2006; PFI, 2007).

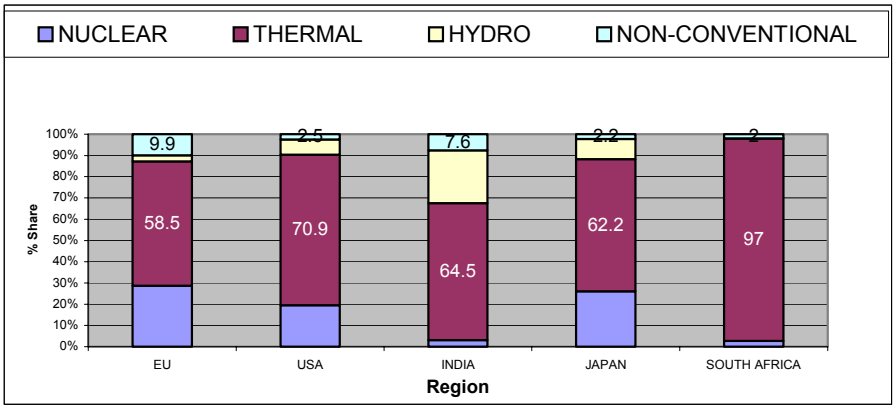


Figure 5.1: Percentage fuel-mix in power production in some regions (2004)

Source: Sharma (2000); Planning Commission (2003); WEO (2006); PFI (2007)

5.2. Promotion of Bioenergy

Most East Asian countries have extensive programmes on biomass energy with emphasis on production of biodiesel and bioethanol production. In some countries, like India, thermal gasification and anaerobic decomposition of biomass are also being promoted. Development and use of biofuels by East Asian economies has been initiated with the launch of national biofuel policies. Various types of biomass

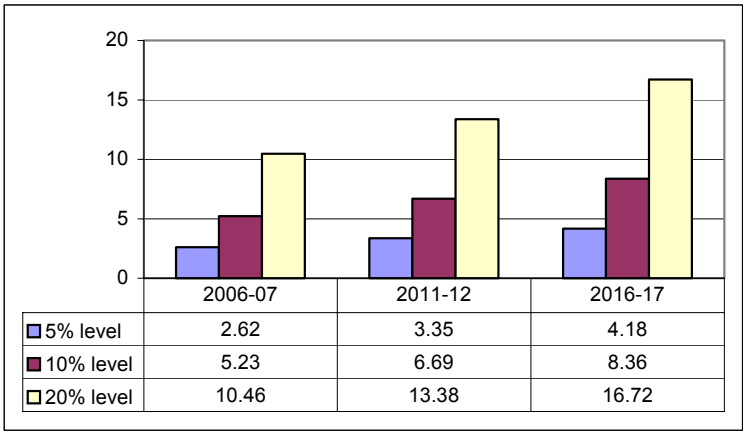
are used for the production of biofuels and blending targets range from 5% to 20%, in most countries.

5.2.1. Future demand projections

The future of bioenergy in East Asian countries seems to be bright due to gap in demand and supply of biofuels, which is to be met either by import or by producing bio-fuel within the country. For example, in India, renewable energy scenario indicates that the share of bioenergy in total renewable energy will be as high as 50% by 2032. Figure 5.2 show the demand for biodiesel and area requirement for energy plantation for various levels of blending in India. The National Biodiesel Mission of the GoI aims at introducing a mandatory 5% blend of biodiesel in 2006-07 and gradually increasing it to 20% by 2011-12. To achieve this, through domestic production, the government hopes to bring about 2.19 million hectares land under Jatropha plantation in 2006-07 and raise it to 11.2 million hectares by 2011-12. Tax incentives and guaranteed minimum purchase prices by the state oil companies for all biodiesel products are being considered. The Ministry of Petroleum and Natural Gas has launched a bio diesel procurement policy with effect from January 01, 2006 at the rate Rs.25 per litre, which has been increased to Rs.26.5 per litre recently, through state owned petroleum companies in 12 states (IBFC, 2008; MNRE, 2007).

In case of ethanol, a 5%t blend in petrol has been made mandatory, which will increase to 10% by October, 2008. Figure 5.3 projects the future ethanol demand and indicates that, under normal conditions, available supply of ethanol would be sufficient upto 10% blending requirement even upto 2016-17. However, due to an expected large increase in vehicle population and for blending of 10% and above, the

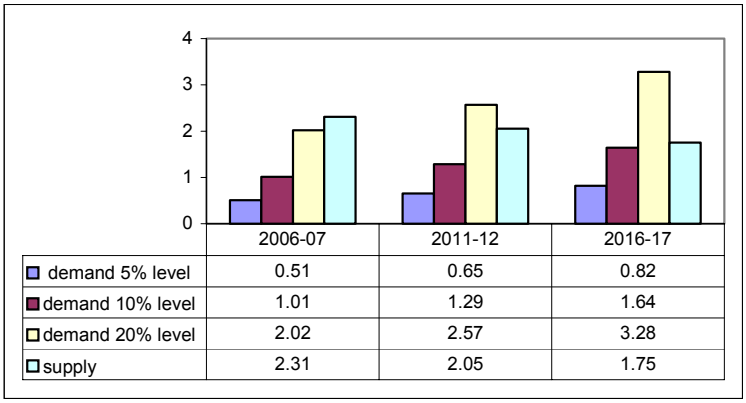
demand for ethanol will increase, which can be met either by increasing area under sugarcane or by application of other production techniques using cellulosic crops.



	2006-07	2011-12	2016-17
5% level	2.62	3.35	4.18
10% level	5.23	6.69	8.36
20% level	10.46	13.38	16.72

Data Source: Committee on Biofuels, GOI; Note: Area calculated on the basis of plantation density of 2500 per hectare, seed production of 1.5 kg per tree or of 3.75 T of seed per hectare corresponding to 1.2 T of oil per hectare of plantation.

Figure 5.2: Present and future biodiesel demand (MT)



	2006-07	2011-12	2016-17
demand 5% level	0.51	0.65	0.82
demand 10% level	1.01	1.29	1.64
demand 20% level	2.02	2.57	3.28
supply	2.31	2.05	1.75

Date Source: Planning Commission (2003)

Figure 5.3: Present and future ethanol demand (MT)

5.3. STATE OF SOCIAL DEVELOPMENT

Despite rapid economic growth, domestic income distribution is skewed in many East Asian countries and the poor are being bypassed by this growth. At an aggregate level, in Asia, the share of income of the poorest 25 percent of the population fell from 7.3 percent in 1990 to 4.5 percent in 2004 (ADB, 2007). In case of India, although the economy has grown steadily over the last two decades, its growth has been uneven when comparing different social groups, economic groups, geographic regions, and rural and urban areas. After economic reforms in earlier 1990s, it has been observed that even though the country is growing richer, a large part of population is only growing hungrier as the much needed calories have vanished from the plates of those who need them the most (HT, 2008).

5.3.1. Low human development

Human development Index (HDI), is a composite measure of three dimensions of human development, namely, living a long healthy life (measured by life expectancy), being educated (measured by adult education and enrolment at primary, secondary and tertiary levels) and having a decent standard of living (measured by purchasing power parity). The HDI values and ranking based on it for the countries participating in this study, (out of a total of 177 countries reported in HDR-2007-08), are – Japan- 0.953 (8), Singapore- 0.922 (25), Malaysia- 0.811 (63), Thailand- 0.781 (78), Philippines-0.771 (90) and India- 0.619 (128).

Thus, the current situation of social development in some East Asian countries, like India, is quite disturbing. While India is being seen as one of the fastest growing economies of the world, shining with 8-9% annual economic growth, the ground

reality on social development front is quite different. An incredibly low HDI of 0.619 in 2005, ranks India at 128th place in the list of 177 countries, which is two places lower than the country's ranking in 2006. This rank was 127/177 in 2003 and 126/177 in 2004, and thus, India has slipped two places between 2004 and 2005. Further, India ranked 128th even in 2000, which is certainly a matter of great concern (HDR, 2007-08). The ranks in others social parameters are- life expectancy at birth 125 (63.7 years); Adult literacy ratio 114 (61.0%); combined entry in primary, secondary and tertiary level 122 (61.0%); and GDP per capita income is US$3452, which all indicate a low level of human development in India. In comparison, its two main neighbours China and Sri Lanka have quite impressive HDI rankings of 0.777 (81) and 0.743 (99), respectively. Despite a fast rate of growth of the GDP, on the basis of the HDI, India is ranked in the lowest bracket of 50 countries along with African countries. Thus, GDP growth can be a determinant of social development only if it is shared equitably by all sections of the people (HDR, 2007-08).

5.3.2. Large income disparity

Wealth distribution in East Asia's developing economies is quite uneven. For example, in India, the top 10% of people earn more than 33% of the income. While India has produced more millionaires and billionaires, in terms of dollar, compared with most other developing countries, a quarter of the nation's population earns less than the government-specified poverty threshold of US$0.40 per day. A survey of 250 MNCs in 47 countries indicates that the salary hikes in India has been among the top 10 countries, globally, and highest in Asia, which is benefiting middle and upper middle class people only. But India cannot derive much satisfaction from the GDP growth when more than a quarter of the population in the country still lives in abject

poverty. Several studies, indicate that a variety of social and economic inequalities have a strong impact on population's social development indicators such as health, nutrition, female literacy and gender equality (HDR, 2007; Asianage, 2007; HT, January 18, 2008).

5.3.3. Declining calorie intake

The latest World Development Report stresses that in the 21st century, agriculture continues to be a fundamental instrument for sustainable development and poverty reduction. Three of every four poor people in developing countries live in rural areas (2.1 billion living on less than US$2 a day and 880 million on less than US$1 a day) and most of them depend on agriculture for their livelihoods. Given, their location and skills, promoting agriculture is imperative for meeting the Millennium Development Goal of halving poverty and hunger by 2015 and reducing the same thereafter. As per Global Hunger Index published by the International Food Policy Research Institute, the proportion of calorie-deficient people in India at present is more than what is was in late 1980s. In a recent survey, conducted by the National Nutrition Monitoring Board, it is revealed that compared with 1990, Indians today are consuming almost 16% less calories per day. On an average, Indians in 2005 consumed 370 kcal less per day than they did in 1988. Similarly, in last seven years, a period of economic boom, number of children under 5 years of age who are malnourished has dropped by just 1% (47% to 46%), as reported by the National Family Health Survey (WDR, 2008; HT, 2008).

5.3.4 Gender inequality

Gender inequality exists in every country, but it varies in degree. As per the Human Development Report of 2008, the three top ranking countries in the gender-related development index (GDI) are Iceland, Norway, and Australia and Iceland tops with the GDI value of 0.962 in the list of 177 countries. A GDI value of 1.00 indicates a maximum achievement in basic capabilities without any gender bias. The GDI values for East Asian countries covered in this study are- Japan (0.942); Singapore (Not Available); Malaysia (0.802), Thailand (0.779); Philippines (0.768) and India (0.600). Thus, some countries in East Asia show low level of gender equality. For example, India ranks 126 in the list of 177 countries with a GDI value of 0.600, showing that women in the country suffer the double deprivation of gender disparity and low achievement (HDR, 2008). Gender inequality often results in the inequality in child care, nutrition and education, which leads to higher morbidity and mortality among female children.

5.4. Social impacts of bioenergy

From the present plans of governments in East Asian countries, it is foreseeable that large amount of land, water and man-power resources will be devoted to bioenergy programs, which may have irreversible socio-economic and environmental impacts. If selected judiciously and managed properly, accelerated development and use of bioenergy may accrue several benefits to the society. Some positive and negative social impacts of bioenergy development are outlined as follows.

5.4.1. Positive impacts

Some East Asian countries like India, have a large land area classified as wastelands and degraded forests, which could be utilised for growing biomass. This would offer an opportunity to develop a vast extent of wastelands, leading to more vegetative cover and protect such lands from further degradation. Increased used of biofuels will reduce import of petroleum products improving the economy and reduce dependency on imported oil resulting in energy security for these country. Use of biodiesel and bioethanol blending, even at current levels of 5-10%, will substantially reduce auto emissions and will create a positive impact on air quality, particularly in urban areas. Reduction in emissions of CO_2 and SO_2 will be an added advantage from global perspectives and CDM opportunities.

Increased employment in farm-activities of bioenergy development such as raising of biofuel crops, seed collection, briquetting and transportation of biomass, etc. would employ many people and help in raising the economic status of people in rural areas. Increased income may reduce income disparity between the rich and poor in rural area and also between rural and urban areas. Higher income levels are positively correlated with rise in literacy rates, medical care and nutrition. Traditional use of biomass as domestic fuel for cooking, heating and other purposes causes several health hazards among women and children in rural areas and urban poor areas. Introduction of biopower, biogas and other clean fuels will drastically reduce such health problems resulting in increased life expectancy and decreased infant mortality in East Asia.

5.4.2. Negative Impacts

Ongoing global debate on "biofuels versus food security" could be more relevant for East Asian countries. At global level, vegetable oil production in 2006 has been 153 MT, which was short of the demand by about 10 MT. In 2007, while crude oil prices rose by 40%, oil palm prices rose by 67%, which translates into crude at US$593 per tone and palm oil US$735 per ton. Rising prices of cooking oil are forcing poor residents in India to ration every drop. In the US, bakeries are fretting over higher shortening cost and in Malaysia, brand new factories built to convert vegetable oil into diesel for trucks sit idle as their owners are unable to afford the raw material- i.e. edible oil. Thus, from India to Indiana, shortage and soaring prices for palm oil, soybean oil and other vegetable oils are examples of global costly food. (HT, January 19, 2008).

WDR (2008) indicates that potential conflict between food and fuels is bound to increase in future and cereal production has to rise by 50% by 2030 to meet the escalating worldwide demand. The competition between food and fuel can be estimated with the fact that "grain required to fill than tank of a sports utility vehicle once could feed one person for a year." In 2006-07, around 20% of maize harvest was used for ethanol but it could displace only 3% of gasoline consumption. GHG emission reduction due to biofuels is also vary substantially. For example, while Brazil's sugarcane based ethanol programs estimate a cut of about 90%, it is only 10-30% from USA's maize-derived ethanol (WDR, 2008).

As estimated by the International Water Management Institute (IWMI), present plans of India and China for biofuel production could face acute water scarcity

by 2030. Both India and China are two water-scarce countries as they use more than 75% of its available fresh water for human consumption against the global norms of below 60%. If both of these countries pursue their present biofuel plans, they will definitely be in the red zone in water terms.

The participation of small and marginal farmers in the biofuel projects is uncertain due to many reasons. In case of biodiesel, the initial instability in the market demand for raw material and return from investments may not be quick and attractive due to long gestation period. Involvement in ethanol requires accessibility to irrigated land, which small farmers may not be able to spare due to their needs of other crops. Further, initial investments in both biodiesel and ethanol programmes are large, which such farmers may not be able to afford.

Changes in crop pattern, such as shifting from food crops to commercial crops (sugarcane or oil-seed crops) may create employment problems for small farmers and landless labourers. Present cultivation practices offer them round the year farm-employment but commercial energy crops may keep them out of work for a part of the year. In general, biomass energy systems appear to be more labour intensive than their fossil fuel counter parts. But the distribution of these jobs among various stages of biofuel production process is very important. If the biomass handling and transport is a major factor then the rural job opportunities will be promoted. On the contrary, the distribution of waste, marginal and pasture lands to corporate and bigger farmers will have adverse effect on the rural poor community as it could lead to highly mechanized production process and less job opportunities.

5.5. Assessment of social benefits

As mentioned earlier, biomass energy, offers several socio-economic and environmental advantages. Assessment of social benefits of bioenergy development is explained with the help of some Indian case studies as follows.

5.5.1. Employment generation

(1) Thermal gasification power plant at Sunderbans, West Bengal

Chhottomollakhali Island in Sunderbans is situated in the district of South 24 Parganas, about 130 km away from Kolkata, having a population of about 28,000. It is difficult to extend grid electricity to this Island due to prohibitive cost involved in crossing of various rivers and creeks. In the absence of electricity, the economic activities of the Island were suffering and people had a very hard life. Installation of biomass based Gasifier Power Plant (4x125 kW) in June, 2001 has changed the life of the inhabitants of four villages on this remote Island. The plant is catering to electricity needs of domestic, commercial and industrial users such as drinking water, hospital, ice factory, etc. Employment generated due to energy plantation, used in the biopower plants, is about 100 person days per hectare.

(2) Earth stove by Nishant Bioenergy

This is a community cooking stove, named as Sanjha Chulha (means combined stove), also known as "Earth Stove," developed by Nishant Bioenergy and uses agro-waste briquettes as fuel. Many schools and other institutions in India, provide meals for a large number of people and, use Liquefied Petroleum Gas (LPG) for cooking, which is currently subsidised by the Government. However, this subsidy is due to be phased out over the next five years and the cost of cooking by LPG is set

to increase. Use of such type of community biomass stoves would save lot of funds for these institutions as waste briquettes are much heaper than LPG. It will allow use of a sustainable fuel (agro-waste), provide the briquetting industry with a more regular income, and generate income for the small farmers and labourers who will be involved in the supply chain. Estimated social benefits of an Earth Stove for 450 persons are as follows.

- Briquetting plants earn typically 40% more from selling briquettes to schools and similar community kitchens than to industrial users, and have a guaranteed market.
- Production of one tonne of briquettes needs about one day of labour, which is used by six stoves and thus generates one extra full-time job.
- Farmers are paid about Rs.500 per tonne for agriculture waste, and a typical small holding of 2 hectares produces about 5 tonnes of waste per year, which brings in the equivalent of an extra month's income (Rs.2500) to the farmer.
- The government has encouraged users by providing 100% depreciation on the capital cost of the stove.

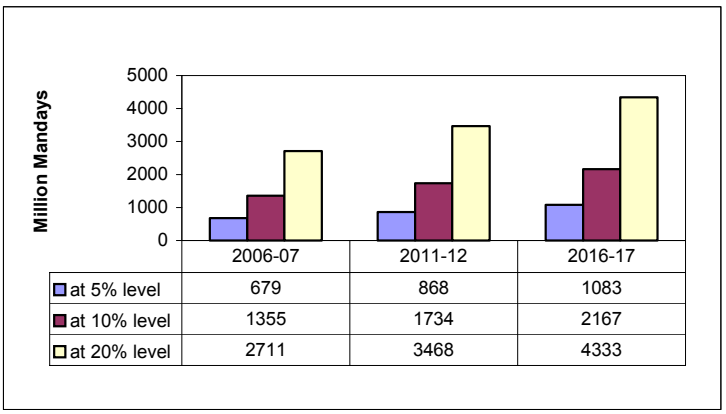
(3) Biodiesel production

Under the bio diesel programmes, employment will be generated in preparation of land and plantation, nurseries development, seed collection, oil extraction centres, transesterification plants, blending and marketing, etc. Of this, the plantation and seed collection are labour intensive and the most dominant item of the expenditure generating job opportunities in rural areas. Some of the estimates of

employment created by value added chain of biodiesel are as follows (Planning Commission, 2003).

- One hectare of plantation will generate employment of 311 person days.
- About 40 person days of labour per hectare is needed for seed collections.
- Additional employment in value added chain.

Based upon the above premises, Figure 5.4 indicates a large potential for rural employment in the farm sector. In addition, millions of jobs will be created in non-farm activities such as oil extraction plants, biodiesel production units and associated activities. The income derived from plantation and seed collection will be additional and may help in reducing poverty (Planning Commission, 2003; UNCTAD, 2006).



	2006-07	2011-12	2016-17
at 5% level	679	868	1083
at 10% level	1355	1734	2167
at 20% level	2711	3468	4333

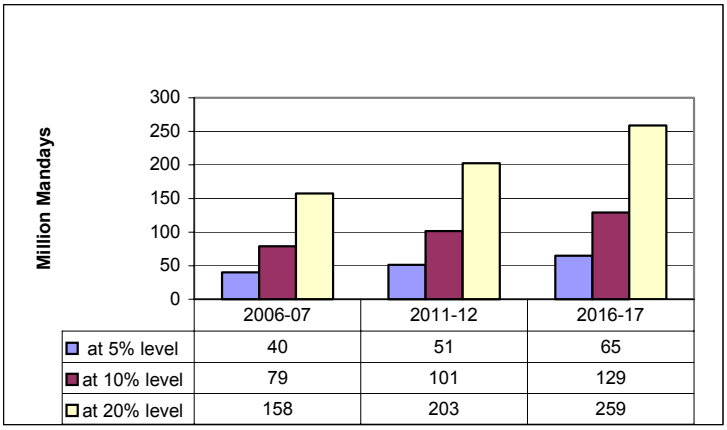
Source: Author's Estimates based on Data from Planning Commission and other GoI Sources.

Figure 5.4: Employment in biodiesel production at various blending levels

4) Bioethanol production

In India, more than 50 million farmers and their families and about 0.5 million workers are dependent on sugarcane production for their livelihood. The sugar industry caters to an estimated 12% of rural population in nine sugar producing states through direct and indirect employment. Effectively, each farmer contributes to the production of 2.9 tone of sugar every year. The current distillery capacity is 2,900 million litres of alcohol, of which 1,300 million litres are attached to the sugar industry. Given the adequate availability of molasses and viable economic returns, present distillery capacity could meet E5 and possibly E10 demands (Planning Commission, 2003; KPMG., 2007).

But due to increase in petrol demand for an expected large increase in vehicle population and other economic activities or for achieving above 10% blending, additional acreage under cane will be required. Assuming 183 person days per hectare, with expansion of sugarcane acreage only, some estimates of employment generation, for various ethanol blending percentages, at all India level, are shown in Figure 5.5. In addition, millions of jobs will be created in ethanol production units and associated activities.



Source: Author's Estimates based on Data from Planning Commission and other GoI Sources.

Figure 5.5: Employment in ethanol production at various blending levels

5.5.2. Health Benefits

In developing countries, the most important indoor air pollutants are the combustion products of unprocessed solid biomass fuels used by the poor urban and rural people for cooking and heating. A recent report of the World Health Organization (WHO) asserts the rule of 1000, which states that a pollutant released indoors is one thousand times more likely to reach people's lung than a pollutant released outdoors, indicating the danger of indoor air pollutants. In India, about 90% of rural households still rely on biomass fuels such as wood, dung and crop residue for cooking and heating. The country has among the largest burden of disease due to the use of such fuels and 28% of all deaths due to indoor air pollution in developing countries occur in India. Cataract and adverse pregnancy outcome are the other conditions associated with the use of biomass fuels. In most of the cases, women and

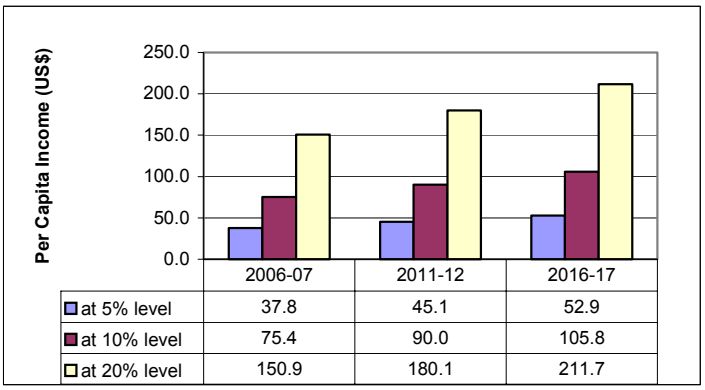
children are over-exposed to indoor air pollution as women spend 3-7 hours in the kitchen. Each day breathing in smoke is equivalent to consuming two packs of cigarettes and causes acute and chronic respiratory and cardiovascular diseases. Thus, the use of improved biomass techniques for cooking and home heating will improve quality of life for women and infants. Reduced incidences of diseases will also result in economic benefits due to less hospitalisation and work-days lost and less expenditure on medical care.

5.5.3. Women Empowerment

Development of bioenergy has the potential for engaging women in raising nurseries and collection of seeds, which could lead to their enhanced participation in the village economy. In India, bioenergy is included under the women development associate scheme initiated by the Indian Renewable Energy Development Agency (IREDA), which has undertaken extensive programme for the empowerment of women. The basic objectives of this scheme are to provide term loan by extending concession in its lending terms to women entrepreneurs and to generate entrepreneurial potential among women. In addition to term loan on soft terms, various concessions are provided to women entrepreneurs for setting up projects in bioenergy sector. Some of these concessions include waiver for registration and various other fees, rebate on interest rates and contribution of entrepreneurs, etc., which are in addition to the already existing concessions of central governments to all other entrepreneurs.

5.5.4. Possible Improvement in HDI

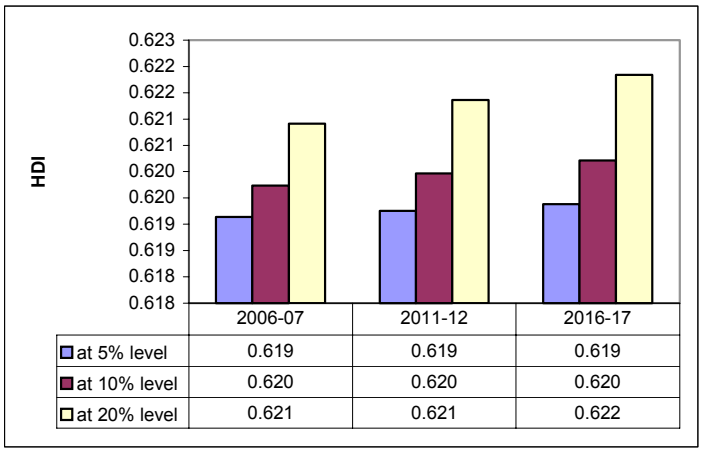
As indicated earlier, development of bioenergy programmes are expected to increase employment, which will improve income of individuals. People may use extra income to spend on their basic needs such as education, health care and nutritious food. Based upon the formulation of HDI, as per UNDP parameters on social development, estimations have been made to reflect possible changes in social well-being among people in India. Figure 5.6 shows the marginal income rise in per capita per annum due to bioenergy projects. Accordingly, if targets of biofuel programmes are met, marginal increase in per capita income is substantial to make visible changes in the life style of rural masses. Figure 5.7 shows the possible improvement in the HDI from bioenergy programmes. However, it should be for more exact calculations on social impacts, a large-scale study on primary data on social issues in affected rural areas is needed.



	2006-07	2011-12	2016-17
at 5% level	37.8	45.1	52.9
at 10% level	75.4	90.0	105.8
at 20% level	150.9	180.1	211.7

Source: Author's Estimates based on Data from UNDP and Various GoI Sources

Figure 5.6 Marginal income from biofuels (per capita per annum)



Source: Author's Estimates based on Data from UNDP and Various GoI Sources

Figure 5.7 Estimated HDI due to increased income

5.6. Summary and Conclusion

5.6.1. Overall conclusions

- In addition to economic gains in cost reduction of imported fossil fuels, development of bioenergy will result in energy security for the East Asian countries by diversifying the energy supply. Generating decentralized electricity, such as biopower through Biomass Gasifier Technology could be a boon to the people in remote areas. This would help transform the entire economic activities and life style of the people. A large part of rural population would be able to use the energy for various basic needs such as cooking, irrigation, education, etc.

- Growing more and more sugarcane may not be sustainable as it will reduce area under other food crops resulting in their price rise. While farmers with large

holding may get benefited in short term, in the long run, all farmers and landless labourers may be affected adversely. Thus, complex analysis is needed to ascertain a balance between sugarcane and other crops for the production of ethanol.

- Due to easy access and wide spreading of Jatropha cultivation, at initial stage, some agriculture land may be used. But comparing Jatropha cultivation with Sugarcane cultivation, farmers may not find the former remunerative enough. For instance, in India, sugarcane plantations yield 70 ton per hectare and fetch the farmer Rs.70,000 per hectare at a sugarcane price of Rs.1,000 per ton. In comparison, with Jatropha plantation farmer gets Rs.5,000 per ton of oilseeds and if the yield is 3.75 ton per hectare, his income is only Rs.18,750 per hectare (UNCTAD, 2006).

- It is observed that end users care the most about cost of the product they buy and very few users think in terms of environmental benefits and social benefits to farmers or to the nation. In India, the cost of in-house production of ethanol and biodiesel is about US$0.40 per litre, which is about the same as for production of fossil petrol and diesel but higher than the import cost of ethanol and biodiesel (about US$0.20 per litre). Thus, production of biofuels, in case of escalating cost of petroleum could be beneficial for India. But the cost of production, both for economic reasons for the nation and attracting end users has to be kept low.

- Promotion of bioenergy would generate a large-scale employment in rural areas. For example, in India, by 2007-08, the first phase of the National Biodiesel Mission is expected to generate about 127.6 million person days to plant, 36.8 million person days to collect seeds and 1.35 million person days for running the

seed collection and oil-extraction centres. Similarly, marginal increase in sugarcane area will also generate rural employment.

- Increase in employment would generate extra income for individuals. Increased income may improve living standard and life style of people as they will be able to spend more on their basic needs such as food, education and health. Higher income in rural areas may also have positive impact on female literacy, uplifting of women and reduction in income disparity in rural and urban areas.

- Food versus fuel debate is more crucial for the East Asian countries. If prices of edible oil and other food items rise sharply, it will neutralize the positive impacts of bioenergy development. Also, in some countries, a large number of livestock heads use some crops and agro-residue as fodder. In addition, a large quantity of biomass is used as fuel for domestic cooking and other applications. Thus, any imbalance in food, fodder and other requirements, due to extensive use of biomass for energy, without any substitute, could create problems in rural areas.

5.6.2. Policy recommendations

- As far as possible, the existing agriculture land should be spared from, and the wastelands should be used for, growing biofuel crops. Land availability for biofuel crops is a crucial issue globally and to meet 5% blending demand by 2015, almost additional 100 Mha land are is needed across the world. Although total land available may be above 100 Mha but all of it can not be developed for biofuel crops (ET October, 2007). For heat or biopower production, through plants such as biomass gasifiers, focus should be on the use of agriculture waste.

- Small-scale farmers will be interested in cultivating the biofuel crops only if they are assured of higher economic returns. This necessitates introduction of mass awareness programmes and capacity building programmes in rural areas. In addition, financial and technical supports such as interest free loans or soft loans, easy availability of quality seeds and other inputs, crop insurance, etc. may be introduced. There is an urgent need of a policy for purchase of raw material from the farmers and biofuel from the producers at a guaranteed price.

- Along with sugarcane, some other raw materials such as sugar beet, sweet sorghum, and non-food crops and emerging technologies including cellulosic ethanol, may be tried for the production of ethanol. Sugar beet has certain advantages over sugarcane as it provides higher yield (12.5 to 17.5 ton per hectare of sugar against 7.5 to 12 ton of sugar per hectare from sugarcane). In addition, it requires lesser water and power for crushing and shorter maturity time.

- East Asian Countries could also explore a model similar to that of Brazil, where the ethanol blending ratio could be varied between E5 and E10, on an annual basis, depending on the availability of molasses and the economic and environmental rationale for ethanol production. Presently, upto 20% blending of ethanol is considered safe for use in automobiles without any modifications. East Asian governments may bring policy to encourage auto industry to use technology, which uses higher levels of blending.

- In some countries like India, lack of coordination between central and state authorities causes undue delay in commissioning and expansion of bioenergy

projects. Speedy clearance, preferably through a single window clearance policy, may be introduced to expedite various consents and permissions.

- Presently, only govt. agencies have been assigned the task of plantation on wastelands in some East Asian countries. It is needed that these agencies work in tandem with local people, NGOs and voluntary groups and create a sense of ownership among them. Involvement of women, landless labourers, marginal and small-scale farmers and other weaker sections of the society must be encouraged to reap the real social benefits of bioenergy programmes.

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