Chapter 1

Introduction

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CHAPTER 1
INTRODUCTION

1.1. Background

Biomass is defined as the organic matter formed due to natural or anthropogenic process and it includes trees, plants and all kinds of vegetation, several types of waste such as agro-waste, forest residues, industrial wastes, animal waste and municipal solid waste (MSW). Natural biomass is in fact formed due to storage of solar energy in various types of vegetation in the presence of atmospheric moisture and carbon-dioxide. Chemically, biomass is a mixture of carbon, hydrogen, oxygen and nitrogen and the ratio of these chemical species vary in different types of biomass. The biomass can always be grown in the form of vegetation and, due to human activities; various types of waste are always generated. Energy derived from biomass is defined as a renewable energy and it may offer several merits over conventional energy.

Biofuels offer several socio-economic and environmental benefits, particularly in countries importing a large quantity of fossil fuels. A major economic advantage is found in savings from foreign exchange used to import fossil fuels. Another merit of biofuels is the reduction of greenhouse gases (GHGs), as biomass is regarded as a carbon neutral material. Its value as a carbon neutral material is based on its ability to accumulate carbon dioxide from the atmosphere during its growth and release the same when burnt or decomposed, and thus, does not add to the net carbon balance in the atmosphere. The reality of the entire process is however, more complex. Any change in land use or large clearance of tropical forest to grow more biomass resources may end up in emitting more GHGs than the expected reduction. The

appropriate conditions to avoid a biofuel system that emits more carbon than it can possibly sequester are discussed in Chapter 4.

Due to rising environmental concerns of conventional energy forms, the global energy scenario has to be changed and bioenergy could offer a sustainable alternative. When burned or decomposed, the chemical energy in biomass is released in the form of either heat or gas. Use of biofuels reduces the emissions of pollutants such as carbon monoxide, unburnt hydrocarbons, particulate matter, polycyclic aromatic hydrocarbons (PAH) and nitrated PAH. Another environmental benefit of biofuels is that it contains virtually no sulphur. Presently, only select countries are promoting use of biofuels but in couple of decades it is expected that almost 25% of global energy demand will be met by the biofuels (UN-Energy, 2007).

1.1.1. Biomass Production

East Asian countries are endowed with rich biomass resources. Figures 1.1, 1.2, 1.3., 1.4 and 1.5 show share of some Asian countries in the production of major crops used for biofuels. Globally, more than 95% of coconut oil and 90% of rice and palm oil are produced in East Asian countries. As far as production of sugarcane and cassava is concerned, East Asian region has the second largest share in the world. Despite this, the farmers in many countries within this region are struggling for their livelihood due to low income. This is responsible for income disparity among various countries in the region and also between rural and urban areas within a country.

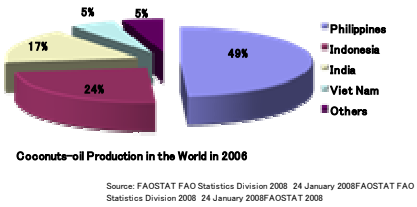


Fig. 1.1 Coconut oil production

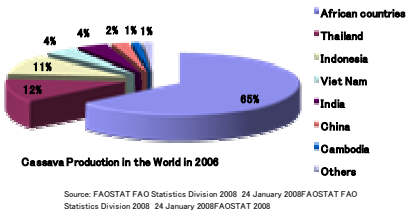


Fig. 1.2 Cassava production

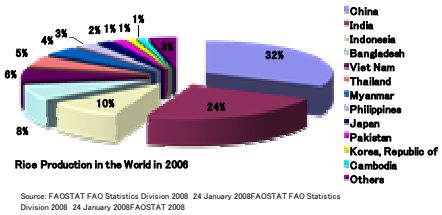


Fig. 1.3 Rice production

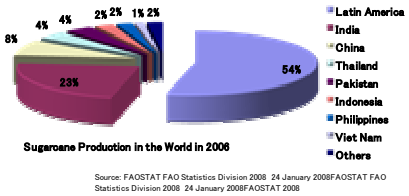


Fig.1.4 Sugarcane production

1.1.2. Biofuel Usage in East Asia

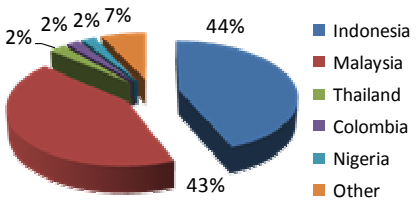


Fig. 1.5 Palm Oil Production

Many East Asian countries have extensive programmes on biomass energy and biodiesel and bioethanol are being developed as major transport biofuels in the region. In some countries, a few other forms of bioenergy such as “heat or electricity” by thermal gasification and “biogas” by anaerobic decomposition of biomass are also being promoted. Most biodiesels are fatty acid ethyl or methyl esters produced by trans-esterification of vegetable oils, both edible and non-edible, and can be used in vehicles up to 20% blend without any engine modifications. In most of the developed and even developing countries, edible oils have been used as raw material for producing biodiesel. But, in some East Asian countries like India, due to high cost

and demand of edible oils, use of only non-edible oils have been proposed for biodiesel production so as to avoid competition with food.

Bioethanol is an oxygenate containing about 35% oxygen and produced by fermentation of three major types of biomass as raw material, namely, starch (such as grain, corn), sugar plants (such as sugar beet or sugarcane), tubers like cassava, and cellulose plants (such as trees, plants and agro-waste). Ethanol can be used upto 20% blending with petrol without any modification in vehicle engines. In the US and some European countries, cellulosic material has been used but in most East Asian countries, only molasses, a by-product of sugar industries, is used for the production of ethanol.

Table 1.1 shows the state of biofuel blending policy in some East Asian countries as compared with other major biofuel producing countries in the world. Each country employs different types of biomass for production of biofuels. In most of the East Asian countries, national policy on bio-fuels has been introduced in the last five years and present blending rates are in the range of 1% and 5%. Some countries have more challenging long-term targets of higher than 10%. To meet these targets, the demand for the biomass resources will increase in the region, substantially.

1.2. Impacts of bioenergy

Accelerated development of bioenergy in East Asian countries, would have several socio-economic and environmental impacts in the region. Biofuels have several positive impacts such as economic gains due to reduced import of fossil fuels, energy security due to diversification of energy types and employment generation due to cultivation of energy crops in rural areas. Higher employment rate will increase income in rural areas, which could result in better health prospects for all, and for

women and children, in particular; better life style, etc. On the other hand, negative impacts of bioenergy could arise in price of food crops due to their increased demand for biofuels. Bioenergy crops may compete with other food and fodder crops and reduce their supplies resulting in higher food prices. Also, biomass cultivation on a large-scale may increase pressure on natural resources such as water, land and forests.

Some of these impacts are mentioned as follows.

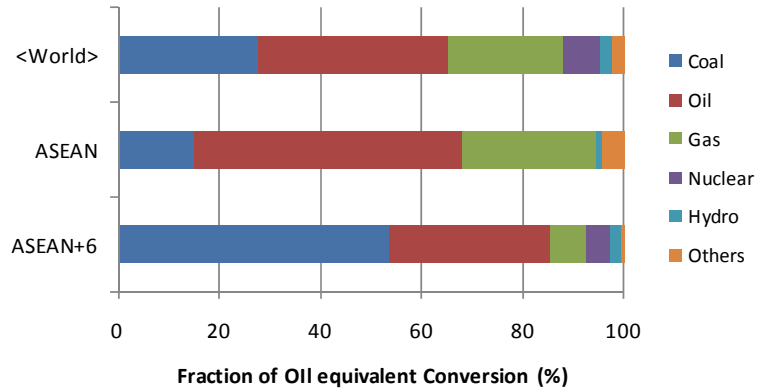
Table 1.1: Status of biofuel blending targets in some countries

Country	**Major Biofuel (Raw Material)**	**Blending Rates in 2007 (Future Targets) in %**	**Year of Biofuel Policy/ Act**
Australia	Ethanol (Sugarcane and Grains)	10	NA
Brazil	Ethanol (Sugarcane)	24	NA
China	Ethanol (Sugarcane) Biodiesel (used food oil and Jatropha)	5-20	2005
India	Ethanol (Molasses) Biodiesel (Jatropha and Pongemia oil)	5 10 (2008)	2003
Japan	Ethanol (Corn)	3	2003
Malaysia	Biodiesel (Palm Oil)	2-5	2005-06
Sweden	Ethanol (Corn)	20	NA
Thailand	Ethanol (Molasses) Biodiesel (Palm Oil)	Ethanol- 10 Biodiesel- 2 (2008) 5 (2010)	2005
The Philippines	Biodiesel (Coconut Oil)	1 2 (two years)	2006
USA	Ethanol (Corn)	10	NA

Source: TOI (2007); ERIA-WG Meeting (2008); NA- Not Available

1.2.1. Energy Security

Many East Asian countries are heavily dependent on fossil fuels such as coal, oil and natural gas and are net importers of these fuels. Figure 1.6 shows share of primary energy in East Asian countries in 2004, and indicates that more than 70% of the primary energy in these countries is produced using fossil fuels. Thus, promotion of bioenergy in East Asian region would diversify energy supply and could help in achieving energy security in the region.



Source : EDMC Energy- Economic Data Book 2007

Figure 1.6 Primary energy sources in some East Asian countries

1.2.2. GHG Emission Reduction

Since some Asian countries are showing a rapid economic growth, and therefore, their energy demand is increasing. A large growth in the consumption of fossil fuels is leading to a rapid increase of GHG emissions in this region. As shown in Figure 1.7, GHG emissions in Asia are higher than other regions. Though impact of post Kyoto Protocol measures are yet to be seen, GHG emission reduction targets are necessary and required to be met by most of the countries. If sustainable agricultural practices and proper land management are employed, biomass derived energy can be one of the major components for the reduction of GHG emissions.

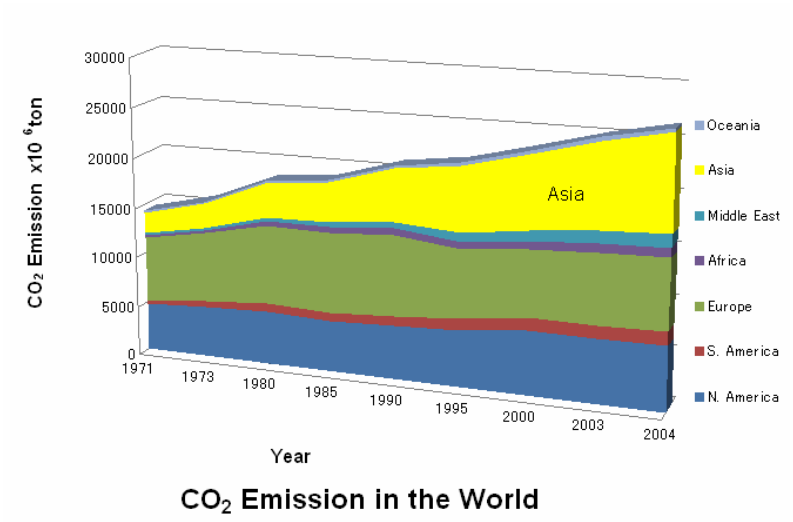


Fig. 1.7 GHG emission in the World

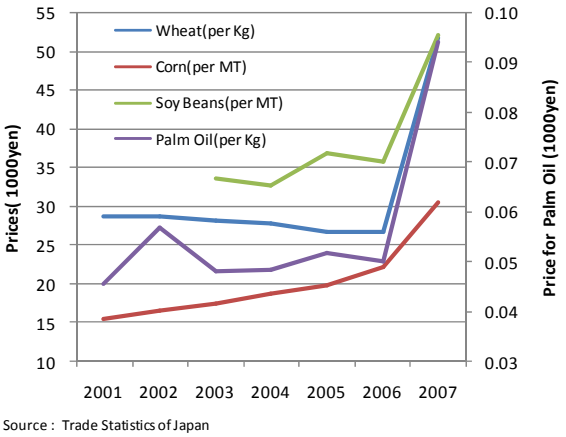


Figure 1.8 Recent annual prices of bioenergy related agriculture products

1.2.3. Rise in Food Price

Since the year 2006, the price of some food crops such as corn and wheat, which are used as feedstock for biofuels, have gone up as shown in Figure 1.8. One of the reasons of such sudden rise in price is high demand of these crops. Since these are basic food crops and are indispensable for human life, the higher price may inflict heavy damage on poor people relying, for meeting their nutrition needs, on these crops. Increasing demand of these crops for energy and food may result in continuous rise in their price, aggravating the situation further.

1.3. Objectives

As mentioned earlier, gap in energy demand and supply and high energy cost may adversely impact the development of the East Asian region. Global environmental concerns are recognized worldwide and we must contribute to resource conservation and environmental protection. Bioenergy is considered as carbon neutral and expected to contribute to GHG emission reduction, could be an alternate primary energy source. Since the production of biomass is mostly done by local farmers, increased demand for biomass must contribute to improvement in their employment and income levels, which, in turn, may enhance their quality of life. Development of bioenergy may also have positive impacts on local industries. On the other hand, some biomass resources are utilised as food and an increase in their demand for energy generation may result in reduced or expensive food supply. It might eventually affect household expenses, especially for poor people. With this background, biomass utilisation should be optimised keeping in view the conditions of people in East Asia.

The objective of this project is to study the “Sustainable Biomass Utilisation in East Asia.” Through an elaborate discussion among experts on environmental and socio-economic aspects, necessary measures are suggested to achieve the sustainable development of bioenergy in the region.

1.4. Method

The methodology used in this study is based upon the UN World Commission on Environment and Development (WCED) report titled as “Our Common Future”, which defines the sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." The Triple bottom lines, or "People, Planet, Profit", captures an expanded spectrum of values and criteria, for measuring organisational (and societal) success, are based upon economic, environmental and social aspects. Hence, for the sustainable utilisation of biomass resources, these aspects are necessary and must be considered to overcome the problems cited above.

The WG discussed the “Sustainable Biomass Utilisation Vision in East Asian Region” based upon the above criteria.

1.4.1. Economic aspects

Sustainable use of biomass for energy production is expected to generate economic gains for biomass growers (farmers) and, through value addition in the production chain, for local manufacturers. It must also contribute to decrease in imports of fossil fuels and provide energy security in the region. To maximise the beneficial effects, production potential of each biomass resource should be evaluated

and then appropriate conversion technology should be applied. To ascertain this, some case studies to evaluate economic benefits of bioenergy are conducted in the region.

1.4.2. Environmental aspects

As the consumption of biofuels continues to increase, its environmental implications arising from increased demand for biomass, its cultivation and harvesting could be serious in the long-term. The environmental benefits of establishing small and large-scale biofuel industries in East Asia require thorough inspection. Unlike other renewable energies (solar, wind, sea waves, etc.), the supply of biomass resources is constrained by the availability of land, water and the climate conditions (e.g. temperature, precipitation). Energy and fertiliser inputs are also required in their growth and cultivation. The crops or biomass feedstock for biofuels are harvested using machinery that burns fossil diesel. In some cases, the total energy inputs required in the production of biomass and its conversion into energy may be more than the energy output of the final biofuel product. Hence, a life cycle approach should be applied to take into account the energy use and carbon footprint of the entire supply chain of the biofuel industry.

There would be ecological risks in the large scale development of agricultural systems for biomass production. Biofuels cannot be considered advantageous if their production results in environmental destruction, pollution and damage to society. Different biofuels vary enormously in how "green" they are, and promoting the right feedstock is crucial to ensure environmental sustainability. The environmental issues associated with biomass production and utilisation include deforestation, water

scarcity and contamination, use of fertilisers and pesticides, carbon dioxide emissions and climate change, and finally, resource or energy consumption.

As long as biofuels are produced in a sustainable manner, they can bring many positive benefits to both the society and the environment. On the other hand, if not managed properly, ecosystem degradation may result in environmental and social damages. For example, deforestation due to land clearance (for biomass production) contributes to both climate change and loss of biodiversity, while the overuse of artificial fertilizers and pesticides leads to water contamination and emissions of nitrous oxide (another GHG).

1.4.3. Social aspects

Bioenergy production and utilisation are expected to improve quality of life of people in East Asia, especially of those living in rural areas and are lagging behind in the development process. Increased employment and income opportunities could make a difference in reduction in disparity of income in the region and also between rural and urban areas within a country. The WG experts discussed this issue and other social aspects of bioenergy and tried to find out the measurable social parameters based upon indices developed by international organisations. It was felt that further detailed work in this direction is needed to establish quantitative methods for calculating measurable social impact in the region.