FAO's views on Bioenergy

Bioenergy offers many new opportunities, but if not managed carefully, it may also carry significant risks. Bioenergy can contribute to achieving several policy objectives such as agricultural and rural development, climate change mitigation and energy security. But it is the manner in which bioenergy development is supported and regulated that determines whether or not bioenergy will be sustainable and how impacts are distributed. Traditional biomass provides important sources of energy; in most developing countries wood fuels still constitute the largest single source of energy, mainly for cooking and heating. Biofuels are extracted through conversion technologies from wood, crops and waste material. There are many different kinds of biofuels and their usage and performance in economic, environmental and social terms varies significantly depending upon technology, location and farming practices.

Rapid bioenergy growth over the last few years, in particular in liquid biofuels for transport, has not been a purely market driven phenomenon. Rising oil prices have had an important effect of making alternative energy sources more viable. However, the key factor driving rapid growth have been policy measures in OECD countries, such as blending and market share mandates and subsidies. A sector which is driven so significantly by policy measures must meet the goals that these policies aim to achieve.

Key Terms

Biomass: non-fossil material of biological origin, such as energy crops, agricultural and forestry wastes and by-products, manure or microbial biomass

Biofuel: fuel produced directly or indirectly from biomass such as fuelwood, charcoal, bioethanol, biodiesel, biogas (methane) or biohydrogen

Bioenergy: energy derived from biofuels

Bioenergy and Food Security

The rising demand for liquid biofuels is one of several factors driving up commodity and food prices. Food and bioenergy crops are now competing for land, water and other resources in many parts of the world. However, soaring food prices observed in 2007 and 2008 were caused by a confluence of different factors including poor harvests in major producing countries linked to extreme weather events, food stocks decline, high oil and energy prices raising the cost of inputs like fertilizers and irrigation as well as the cost of transport of inputs and food, subsidized production of bio-fuels, speculative transactions and the imposition of export restrictions leading to hoarding and panic buying.

Higher food prices particularly affect the poorest segments of the population that spend a large share of their income on food. Both urban and rural poor suffer from higher food prices as most of the poorest rural households buy more food than they produce. But bioenergy also offers opportunities to increase incomes and employment in rural areas, provided that appropriate policies and investments are put in place to enable smallholders to take advantage of growing biofuels markets.

Bioenergy and Rural Development

Bioenergy brings new investment into the agricultural sector which over the last decades has had to sustain productivity improvements in the face of declining real prices for food and agricultural commodities. New investment can provide market and employment opportunities for the 2.5 billion people dependent upon agriculture, which include most of the 900 million rural poor. Bioenergy growth, if managed appropriately, can also contribute to improving infrastructure and market access in rural areas. Modern bioenergy can also be a clean source of energy in rural areas that can provide new opportunities for modernisation of agriculture and the rural economy and improve access to modern energy services for households. Reducing indoor pollution by switching to cleaner biofuels can improve health and livelihoods. Continued investment is also required to improve the efficiency, effectiveness and safety of the traditional biofuel use and technology; especially in the domestic and small scale industry sectors.

Bioenergy and Climate Change

Bioenergy has the potential to reduce greenhouse gas emissions, relative to fossil fuels, since the carbon released during fuel combustion can be recaptured during plant growth. But actual reductions depend on how much land and energy are used to produce bioenergy, the use of agrochemicals, and on whether process energy is generated from renewable resources. Greenhouse gas balances also depend on the impacts of land conversion. Converting carbon-rich land (such as natural forests or peat land) to produce bioenergy feedstocks —or to produce other crops displaced by feedstock production —can release more greenhouse gases than the annual emission reductions provided by many years of bioenergy feedstock production on that land. FAO supports monitoring of indirect land use change caused through land conversion for bioenergy feedstock production.

Bioenergy and the Environment

Unless appropriate safeguards are put in place bioenergy feedstock production can threaten biodiversity, and lead to the degradation of natural resources such as land and water. The threat to wild biodiversity from bioenergy growth is associated primarily with land-use change. When areas such as natural forests are converted for feedstock production, the loss of biodiversity may be significant. A further concern is the introduction of invasive species for biofuel production. Agricultural biodiversity could be affected by large-scale monocropping practices and the introduction of genetically modified materials.

Many feedstocks – including sugar, palm oil and maize – are highly water intensive, meaning that depending upon location, production and processing methods their expansion may create even greater competition for this already scarce resource,. Feedstock production can also affect downstream water quality through run off of fertilizers and agrochemicals, and soil erosion.

The impact of feedstock production on soil erosion depends critically on the farming techniques that are employed, in particular on the use of tillage practices, the level of soil cover and crop rotations. Where perennial bioenergy feedstocks replace annual crops, the permanent cover and root formation will help improve soil management and reduce soil erosion.

FAO is developing and applying tools to assess and avoid or mitigate potential negative impacts in bioenergy planning and implementation.

Technological progress and 2nd Generation Biofuels

2nd generation liquid biofuels can be produced from lignocellulosic biomass as opposed to sugars starches and oils used for 1st generation biofuels. 2nd generation biofuels are not commercially viable. As cellulosic biomass is the most abundant biological material on earth, the successful development of commercially viable 2nd generation biofuels could significantly expand the volume and variety of feedstocks for production, including waste products from agriculture, forestry and processing. This may reduce competition for land and other resources and also limit competition with food. However, decomposing biomass also plays a crucial role in maintaining soil fertility and texture and excessive withdrawals for bioenergy could have negative effects. Several species under consideration for 2nd generation feedstocks are invasive or potentially invasive and expanded use must be managed carefully. 2nd generation biofuels perform well in terms of GHG balance, probably exceeding reductions achievable by any 1st generation technology. As cellulosic biomass is bulky, a well-developed transportation infrastructure is necessary which may be a particular challenge for developing countries.

Good farming and harvesting practices for feedstock production

The adoption of good agricultural practices, such as no tillage and direct seeding, retention of soil cover, multiple cropping, appropriate crop choice and crop rotations, can mitigate negative impacts, in particular on carbon, soil and water resources. The application of these practices also can reduce the threat to biodiversity, particularly soil biodiversity, through the retention of crop residues and diversified crop rotations. Wildlife habitats can be enhanced by introducing landscape approaches in agricultural areas and retaining ecological corridors, as well as by careful and sustainable use of high-biodiversity biomass sources, such as grasslands, as feedstocks. Furthermore, non-food cropping systems could enrich agrobiodiversity. Promoting integrated local food-energy production systems, by combining feedstock production with crop production and feeding livestock on biomass not used for energy production or soil cover can avoid waste and increase the overall system productivity for food and energy. Sustainable harvesting techniques for wood suitable for fuel and charcoal should also be promoted to reduce forest degradation.

Bioenergy and Energy Security

Bioenergy can diversify a country's energy mix, broaden sources of supply and reduce energy import bills where nationally produced bioenergy substitutes for imported fossil fuel. Precise potentials depend upon the country's potential for bioenergy feedstock production. Under current scenarios the contribution to energy security at a global scale is likely to be modest. While bioenergy accounts for approximately 10% of world energy consumption, the vast majority of this energy is derived from the burning of biomass by poorer communities, often coupled with significant costs in terms of health risks and time expended in the collection of biomass fuel. Looking at the case of liquid biofuels, ethanol and biodiesel accounted for less than 2% of global transport fuels in 2007 and projections suggest that this share may rise to between 3 and 10% by 2030.

Integrated Food –Energy Systems

Integrated Food Energy Systems (IFES) are designed to integrate, intensify, and thus increase the simultaneous production of food and energy in two ways:

- by combining the production of food and fuel feedstock on the same land, through mixed cropping and/or agro-silvo-pastoral systems. or
- by transforming the by-products of one system into the feedstocks for the other, through the adoption of farming systems and agro-industrial technology that allow maximum utilization of by-products, diversification of raw materials, waste production on a smaller scale, and encouraging recycling and economic utilization of residues, for harmonization of energy and food production.

Besides savings on energy consumption, the use of by-products as bioenergy feedstock can also lead to reduced land use needs and concurrent reduced GHG emissions from land conversion – hence reducing the food-fuel competition. A more systematic use of by products, brought about by stricter

GHG reduction targets and use of second generation biofuels, could amount to a reduction of 10-25 percent in land needed to produce liquid biofuels.

Bioenergy and the International Policy Environment

Support policies in OECD countries — in particular mandates, subsidies and trade restrictions — have driven rapid growth in liquid biofuels when implications are still uncertain, and trade distortions have favored producers and production systems in OECD countries at the expense of producers in tropical countries where there is a natural comparative advantage. These policies should be revised to become more market-oriented, eliminating distortions that create artificially high growth rates and hamper international trade for developing countries. The global implications of biofuel policies for the environment, food security and economic opportunities highlight the importance of adopting in inter-governmental approach to bioenergy development that complements national measures.

The role of criteria, standards and certification in promoting sustainable bioenergy

The promotion of sustainable bioenergy development needs clear criteria and indicators to steer decision-making and aid programme design, both at the investment and at policy level. FAO collaborates in the Global Bioenergy Partnership (GBEP) "to provide relevant, practical, science-based, voluntary sustainability criteria and indicators". Additionally, FAO participates in the Roundtable on Sustainable Biofuels (RSB) to establish a standard based upon principles criteria and indicators for sustainable biofuels production (liquid biofuels only). Definitely, certification is one option to ensure compliance with standards and criteria, but should not be considered the only option. Therefore, capacity building in developing countries to facilitate and enforce compliance should be complementary strategies.