IUFRO

RESEARCH LETTER

On Forest Bioenergy

renewable material – forest biomass – traditional usage – climate change – sustainability – bio-based economy – bioenergy

OUR SOURCE FOR RENEWABLE MATERIALS

Natural, planted and plantation forests are our most important sources of renewable materials as well as providers of multiple ecosystem services. With a growing global population, natural and planted forests are increasingly under pressure.

In principle, it is possible to ensure continued flows of goods and services from the forests while maintaining the integrity of the forest ecosystem, since forests result from renewable processes; but if utilization entails fundamental changes in the conditions for these processes, the integrity of the forest ecosystem will be at risk.

WIDELY USED IN DEVELOPING COUNTRIES

For a majority of the global population, woody biomass constitutes the main fuel, needed for cooking and for keeping warm. Most forest energy users are found in developing countries where forest biomass is employed for traditional, small scale and domestic uses.

With increasing population, sources of woody biomass are in danger of being regionally exhausted with subsequent loss of soil productivity, important forest ecosystem services and biodiversity.

Traditional biomass usage is normally characterized by very low energy efficiency. By reducing waste, the pressure on forests may be alleviated, while meeting the basic needs of people.

GROWING IMPORTANCE IN DEVELOPED COUNTRIES

In developed economies forests are primarily used for feedstock supply and for their environmental functions. But in recent decades there has been a strong interest in increasing the use of forest biomass for energy, either directly through combustion for heat or both heat and power, or through industrial refining into higher value fuels. This development was initially driven by a foreseen oil shortage and increasing costs of petroleum.

More recently, the most important driver has been the concern for climate change through release of carbon dioxide from fossil fuels into the atmosphere.

In some countries, large scale use of woody biomass for energy now plays an increasingly important role in energy supply. It is important for the harvesting regime and the employed production systems to be economic, socially acceptable and ecologically sound.

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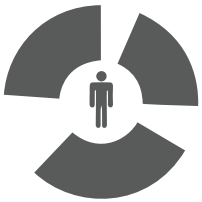
A MATTER OF SUSTAINABILITY

There has been a lot of concern that increased use of biomass and intensified harvesting of forest biomass could be adverse to sustainable forest management. The question of increased use of forest biomass in all forests - natural, planted and plantation - boils down to the question of sustainability.

The report by the Food and Agriculture Organization of the United Nations (FAO) "Global Forest Resources Assessment 2010" shows mixed progress towards sustainable forest management. The world's forest resources appear to be fairly stable. At a global level, the consumption of forest products is equal to production. The large changes are interpreted as positive rather than negative trends.

Unfortunately, this reassuring picture changes dramatically when the data is broken down by region. Deforestation and loss of forest continues at an alarming rate in several regions and countries, e.g. primary forests are decreasing by about 4 million ha/yr. Also, forests are increasingly affected by drought and by insect pests.



KNOWLEDGE GAPS

In the long-term, the intensity of forest management and harvesting is expected to increase as the change to a bio-based economy continues. If carried out incorrectly, such intensified use of woody biomass for energy, based on comprehensive and more complete harvesting of trees may lead to long term nutrient deficiency, resulting in lower vigour and growth of trees. Less dead and decaying wood may lead to loss of biodiversity in natural or planted forests.

The full effects of increased biomass harvesting from forest ecosystems is not yet entirely understood and there is evidence that the effects vary depending on silvicultural regime and history, the proportion harvested, soil type and climatic region/forest type. In plantation forests with a more rapid turnover (e.g. pine: 20-30 years; Eucalyptus: 7-10 years), impacts of harvest intensification and removal of biomass are much better understood.

TOWARDS A BIO-BASED ECONOMY

There are several reasons for the interest in bioenergy and a bio-based economy. The two major ones are the economic and societal benefits of using biomass as feedstock for both specialty high value products and bulk products, and the opportunities for creating a considerably more sustainable society since biomass may replace fossil sources for both energy (heat, electricity, transportation fuels etc.) and as feedstock for production of materials and chemicals. Biomass can replace fossil sources for both heat and electricity during production processes. For certain product types, there are better opportunities for recycling biomass-based energy sources than fossil-based ones. In such situations, energy aspects, e.g GHG mitigation through substitution of fossil fuels and possible energy savings may be considerable. The energy aspects, regardless of product, are therefore crucial in a bio-based society. Forests planted solely for biomass and biorefinery purposes are being increasingly considered where there will be little impact on intensification of food production.

IUFRO'S TASK FORCE "FOREST BIOENERGY"

This Research Letter summarizes the findings of IUFRO's Task Force "Forest Bioenergy" between 2011 and 2014. The Task Force focused on supporting forest management, wood harvesting and utilization schemes that are adapted to regional conditions in order to optimize the multitude of benefits received from forests, while preserving or re-establishing the conditions that promote sustainability.

The group worked on synthesizing the best available knowledge on forest biomass procurement systems, on exemplifying how to avoid wasteful and inefficient use of forest biomass, and on illustrating how forest biomass can be efficiently promoted and supported during an introduction phase, under competition from established fossil carbon-based product chains with a developed infrastructure for marketing and use.

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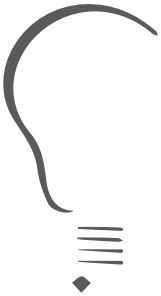

LESSONS LEARNED

The technological opportunities for a more efficient small-scale use of energy are promising. Studies conclude that, through a more efficient use of available resources, the availability of energy in developing countries may be improved beyond the satisfaction of basic needs, even if world population doubles and economic growth continues in both developing and developed countries. If sustainably used, forest biomass may substitute fossil energy sources, with no significant addition of greenhouse gases. This industrial use of forest biomass is characterized by high energy efficiency, but also by low profitability due to the complexity of operations and the need to be competitive with established energy sources. Hence the development of the parallel concept of biorefineries producing not only low profit/high volume bioenergy but also high value chemicals and other materials.

CONCLUSIONS

The functions of forest ecosystems vary between and even within regions and between forest types. Also, the per capita availability, tradition and know-how vary. Policy-makers should acknowledge and support the need to develop forest management, harvesting and utilization practices that are adapted to regional conditions, and that fulfil social, economic and ecological sustainability criteria.

Policy-makers need to ensure that forest utilization is developed in a direction that will preserve or re-establish the conditions that are needed for sustainability. However, improved management and utilization is better than not being able to perfect forest utilization.

It is important to support the movement towards a more efficient and less wasteful use of globally limited biomass resources. The value extracted from a given amount of forest biomass is maximized when fulfilling both material and energy needs from the same feedstock.

In order to ensure the availability of feedstock, policy-makers may need to introduce legislation aiming to preserve and improve the productiveness of forests and forest lands. There is also the need to support revegetation of degraded soils previously covered by forests and the introduction of sustainable management, or replanting of plantation forests.

Mechanisms for cascading the use of forest biomass may need to be introduced. Such mechanisms would prioritize the use for socially-preferable products, such as materials, followed by re-cycling and re-use, and finally uses for energy conversion. An example, which is already functioning in many countries, is the use of virgin fibre for high-grade paper, repeated re-cycling for lower grade paper and cardboard, and finally energy conversion. A cascading use enables the most efficient use of biomass. This calls for improved connections between different sectors, to allow for a transfer of biomass-based products, by-products, wastes and residues between sectors.

There are also implications for the (bio)energy sector which should be restructured to promote an increased use of waste products and advanced conversion technologies, while at the same time increasing the development of plantations to secure a consistent supply of biomass.

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