Chapter 2.

Reconciling food and industrial needs for biomass

This chapter is mainly about non-OECD countries and their developing bioeconomies. They are central to the development of a globalised bioeconomy and to the sustainable future of OECD countries' bioeconomies. Future projections see the need for significantly increased agricultural output to feed a growing population. And yet there seems to be limited capacity for increased land use (extensification). This dilemma could bring OECD countries and partner economies into competing use for biomass. Many OECD countries will be net biomass importers, while many developing and poorer nations can be expected to be exporters of biomass. Nations could easily collide with each other through biomass disputes. A top priority for policy makers is to reconcile the food and industrial demands of biomass to prevent negative effects in some nations being created through positive effects in others. A sustainable bioeconomy cannot be produced through such poorly distributed benefits.

Introduction

In the post-fossil world, major sources of carbon will still be required. The internal combustion engine is ultimately replaceable, but society will forever need chemicals to maintain the lifestyle of developed countries, and to bring this more comfortable lifestyle to other countries. The foreseeable sources of carbon are renewable biomass carbon and waste industrial gases. As the latter is the target of climate change mitigation and waste reduction policies, it also will dwindle with time. Therefore, renewable biomass carbon is envisaged to become a major source of carbon for chemicals, plastics, textiles, materials and aviation fuels of the future.

This immediately creates a dilemma as the food and industrial uses of biomass clearly come into competition. While there are fewer people hungry than ever before, food security is still elusive in many countries (FAO, 2017). Moreover, this conflicting use of biomass has geographical and geopolitical implications. On the one hand, many OECD countries can be expected to be importers of biomass (some already are) due to a shortage of land and high population densities. On the other, many partner economies are rich in biomass, including Brazil, India, Indonesia, Malaysia, the People's Republic of China (hereafter "China") and the Russian Federation. The latter may be tempted simply to export natural resources, as was sometimes the case in the past.

Two problems with an export-focused strategy for developing nations would be:

- Simply exporting natural resources may inhibit technological development. There is far greater value added for a nation to develop the technologies of a bioeconomy (e.g. industrial biotechnology, green chemistry and modern agricultural practices).
- In the absence of strong governance, biomass could be over-exploited as a resource, resulting in market and societal failures such as deforestation and soil destruction. Many potential social risks can be imagined (e.g. warlordism, displacement of landowners, threats to traditional lifestyles, and job losses and gains within the same society) (Obidzinski et al., 2012).

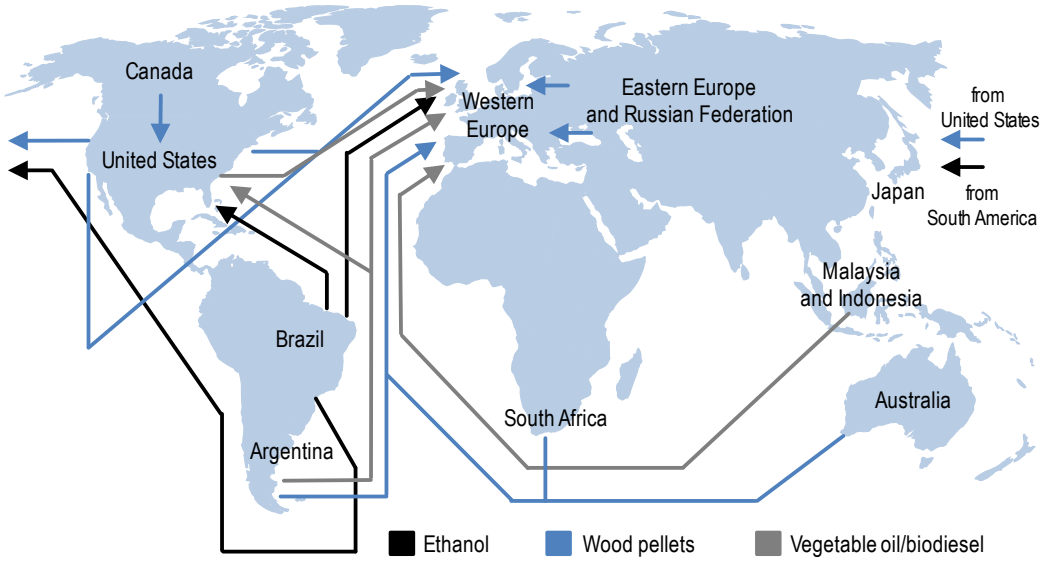
Biomass flows

Global biomass flows point to a trade issue for OECD countries, many of which are advanced economies that lack access to large amounts of biomass within their boundaries. Therefore, bioeconomies in these nations rely on biomass imports. This may encourage exporting countries to grow and harvest biomass unsustainably. If this involved food crops destined for industrial use, it could be a potential threat to food security. There is a massive quandary at the beating heart of the bio-production concept – how to reconcile the food and feed use of biomass with the needs of industrial production.

Figure 2.1 clearly shows that biomass flows should concern the OECD: every single arrow-head points to an OECD country or region. Further, there is a significant convergence on Western Europe.

The flow of world biomass shipping routes towards the OECD presents risks for both parties. OECD countries that lack biomass resources may switch their dependence on oil exporters to biomass exporters. Consequently, bio-production may fail to achieve policy goals like energy security. Biomass exporting countries that rely simply on exporting raw materials would miss the opportunity to create the greater value-added bio-production industries. This, in turn, could lead to unsustainable practices, particularly over-exploitation.

Figure 2.1. **Major world biomass shipping routes in 2011**



Source: Redrawn from BP-EBI (2014), *Biomass in the Energy Industry, An Introduction*.

The bioeconomy can deliver great benefits for society as a whole in terms of both energy and food security. For example, it could distribute energy resources more evenly rather than concentrate them in small, politically unstable regions of the world. Further, agricultural productivity (the value added per agricultural worker) of many Asian countries is much lower than in developed countries (World Bank, 2017). Farming is characterised by small farms, subsistence farming and high levels of poverty. Changing both agricultural practices and the application of modern biotechnology could thus greatly enhance food supply.

Box 2.1. **Controlling deforestation in Liberia**

Forest covers more than 40% of Liberia, a country considered one of West Africa's most important carbon sinks and biodiversity hotspots. The United Nations estimates that 30 000 hectares of primary Liberian forest is cleared each year. The country's administration, backed by more than USD 150 million of international aid, is driving policy aimed at enabling the country and communities to make money from reduced carbon emissions. First, carbon levels are measured in a forest. Then, if the land is not cleared, the carbon that is retained in the forest – or not emitted through clearing – can be sold as offsets.

Norway is providing USD 70 million to help Liberia develop the policy framework and create capacity to implement the changes. It is providing a further USD 80 million to pay for the first carbon offsets. Other governments and private investors are welcome to buy the offsets. It will take time to see whether such a system could succeed, but this could be a test-bed for deforestation prevention. A bioeconomy is likely to stimulate markets for wood further; this policy is consistent with reducing emissions, one of the major policy goals of a bioeconomy.

Source: Aglionby (8 April 2016), "Green revolution aims to stem deforestation in Liberia", www.ft.com/intl/cms/s/0/9e596f2e-dbbb-11e5-a72f-1e7744c66818.html#axzz45DdIxzJY.

A large reliance on forestry for industrial biomass could lead to environmental degradation as a result of the direct consequences of deforestation. Logging in the past has created conflict, including violence. Illegal logging is already costing nations tens of billions of dollars each year, and tropical deforestation contributes 12% of total anthropogenic carbon dioxide emissions globally (Lynch et al., 2013). Therefore, illegal logging works against two founding policy goals of a bioeconomy – economic growth and climate change mitigation. Paying to prevent deforestation is likely to be contentious, but contributions from OECD countries may be less expensive than letting it continue unabated (Box 2.1).

The twin dilemmas of food and energy security are intimately linked

The case of India shows how easily the bioeconomy could develop unevenly. Like most countries, India imports crude oil at great expense. During the next 25 years, demand for electricity in India is expected to increase five-fold. Many believe the biotechnology sector could help solve India's growing energy problem and its need for energy security. India faces the ultimate dilemma of the bioeconomy: can it produce sufficient biomass to contribute to energy security and economic growth through bio-based production, while still feeding the nation? Many nations with bioeconomy aspirations face the same dilemma. Korea imports 97% of its energy, which still comes from fossil fuel reserves. Many countries in Africa are in the same position, if not worse, as their economies are developing more slowly than some in Southeast Asia. The Japanese government projects that the population of Japan will seriously decline by 2050. Moreover, Japan has a dwindling number of farmers, who are ageing; the average age of Japanese farmers was 65.9 years in 2011. They are also farming very small plots. This poses problems for agricultural vitality (Karan, 2005). Farmers' children do not want to stay in farming. This is by no means unique to Japan. In China, for example, the rural population is also declining, the average age of farmers is rising and fewer young people are choosing to farm as a vocation (Yang, 2013).

Land potential: Tension between food and industrial use of biomass

Table 2.1 contains data that highlight the tensions between food and industrial use of biomass. It demonstrates that if OECD countries become active in world food security, there will soon be no farmland left for industrial use.

Table 2.1. **Land potentials (farmland) for non-food use, "business as usual" scenario**

	2010	2015	2020	2050	2010	2015	2020	2050
Europe	102 717	115 134	127 096	171 446	44 531	20 315	0	0
North America	65 621	59 090	53 709	33 144	27 759	10 135	0	0
Central America	-3 545	-11 765	18 639	-42 219	1 171	446	0	0
South America	35 786	29 132	24 170	18 066	21 182	9 364	0	0
Oceania	33 157	28 185	23 362	-6 416	14 026	4 834	0	0
Asia	-62 219	-113 430	-153 786	-292 920	18 540	6 734	0	0
Africa	-56 818	-91 310	-121 677	-322 022	6 385	3 717	0	0

Note: Figures are x 1 000 hectares.

Source: Adapted from DBFZ (2011), *Global and Regional Spatial Distribution of Biomass Potentials*.

This table shows the farmland potentials (i.e. farmland for non-food use) in the "business as usual" (BAU) scenario developed by the authors. The left side of the table

represents farmland potential if the countries in these continents (134 countries in total) do not take part in food security for nations in food deficit. The right side represents the remaining non-food land potential when the same group of countries participates on a *pro-rata* basis in exports to cover the deficit food supply of the import countries. In the following quote, bold text is the author's emphasis.

> The data for the "BAU" scenario indicates that no more farmland potentials for non-food use will be globally available from the year 2020. However, there is still grassland for non-food use. Since no more farmland is available for non-food purposes, the big surplus states for agricultural primary products, such as Europe, North America and South America would have to export as of 2020 all agricultural primary products, which are no longer needed for their own food supply, into countries in deficit (mainly Asia and Africa). (DBFZ, 2011.)

If this analysis is correct, and accepted worldwide, then using waste sources for biorefining is not a luxury, but an absolute necessity. What is more, this is a near-term situation. However, the figures may vary according to assumptions and this table relates to only one resource (farmland). The overall discussion considers more resources, including forests, residual biomass, the marine environment and waste gases. It is this variability in assumptions that leads to such great variety in studies.

Conclusions

Far greater attention must be paid to the conundrum of food-industrial use of biomass. The OECD could host a future event, but should include more stakeholders such as the Food and Agriculture Organization of the United Nations (FAO), the European Commission and the German Bioeconomy Council. Other key players are sustainability certification organisations such as International Sustainability and Carbon Certification, and the Global Bioenergy Partnership. Such an event could also engage government ministries with direct interest such as the departments of energy and agriculture in the United States.

There are countries that are biomass-poor and those that are biomass-rich. A sustainable bioeconomy would have a better balance of power among nations, but this requires serious consideration of another critical balance – between food and industrial use of biomass. An international trade of biomass that achieves industry security in consumer nations (many OECD countries), but food insecurity in exporting nations would defeat the purpose of a bioeconomy. While it might achieve climate change mitigation, it may also threaten food and energy security.

The policy regime governing this transition is enormously complex. Clearly, international and domestic policy will be equally essential. There is much to be gained in a bioeconomy. However, if it does not achieve sustainability, then it will miss a great opportunity for inclusive economic growth.

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