Assessment of bioenergy potential and associated costs in Japan for the 21st century

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1 Introduction

Background

- Bioenergy with carbon capture and storage technology is important for climate mitigation, as well as energy supply.
- In its long-term strategy, Japan aims for an 80% reduction in GHG emission by 2050 and decarbonization in the second half of this century.
- Japan has set a goal to increase electricity generation from renewable energy to between 22% and 24% of the total by 2030, with bioenergy rising from 1.5% in 2014 to between 3.7% and 4.6%.
- However, most of the growth in renewables until 2017 was contributed by solar energy. The development of bioenergy is limited.
- A thorough analysis is needed to improve our understanding of Japan's domestic bioenergy production potential and the economic feasibility of using bioenergy to secure energy supply, and to strengthen the role of bioenergy in the national economy.

Estimation methods for each feedstock

- **Black liquor**: estimated from Paper, Paper Products, and Pulp sector (by AIM/Hub).
- **Livestock residues**: proportional to livestock production (by AIM/Hub).
- **Municipal wastes**: proportional to the population size.
- **Surplus wood**: wood growth minus roundwood demand (by AIM/Hub).
- **Forest residue**: derived from wood growth.
- **Dedicated bio-crops**: *miscanthus* and *switchgrass* on the abandoned cropland.
- **Agricultural residues**: *residue to product ratio* from six crops.

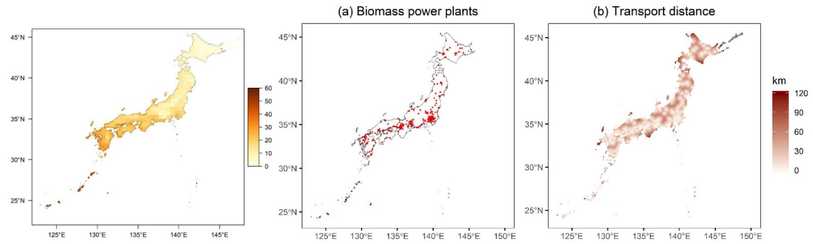

Figure 2. Biocrop yields (tonne/ha/year)

Figure 3. Biomass power plant locations (a) and transport distances to the nearest plants (b)

2 Material and method

AIM/PLUM-Japan: a country scale agriculture land-use allocation model with 0.05-degree resolution, developed from the global version of AIM/PLUM (Hasegawa et al., 2017).

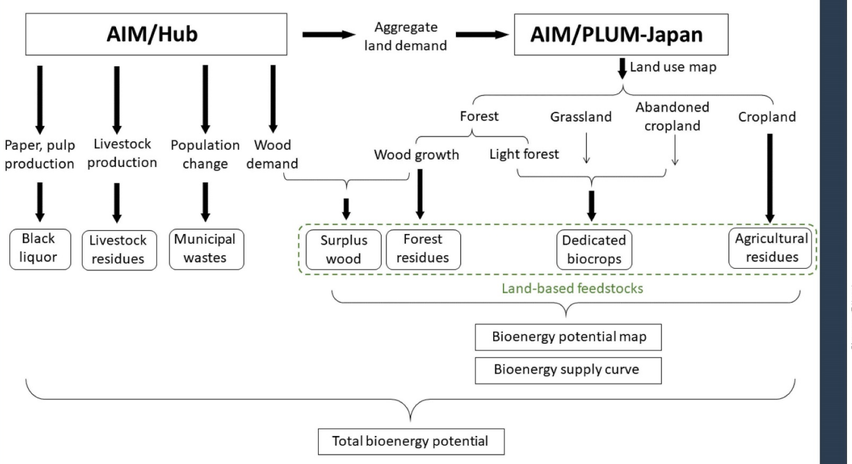

Figure 1. Research framework

3 Results and conclusions

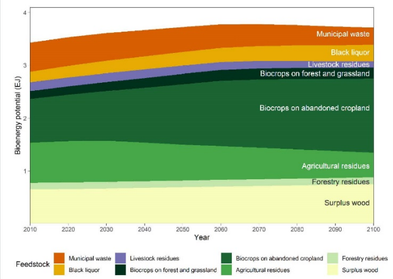

Figure 4. Japan's bioenergy potential

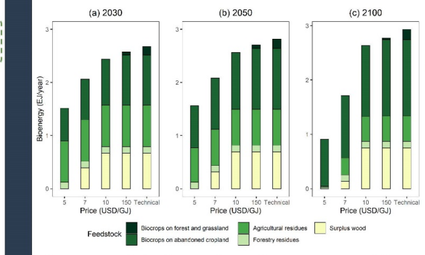

Figure 5. Technical and economical bioenergy potential of land-based feedstocks

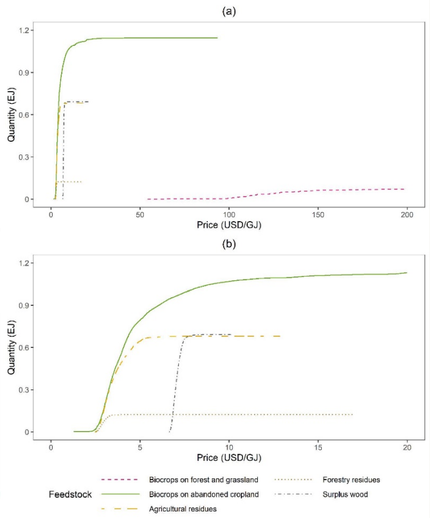

Figure 6. Supply curves for land-based feedstocks in 2050

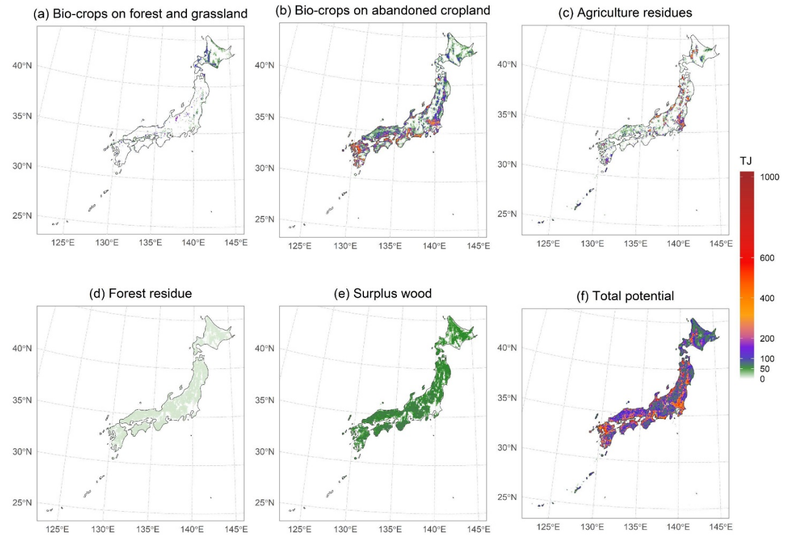

Figure 7. Bioenergy potential maps for the land-based feedstocks

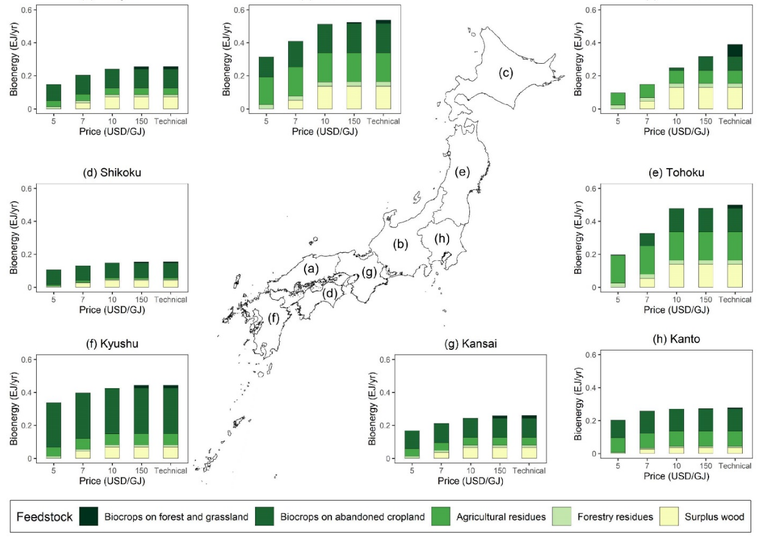

Figure 8. Technical and economic bioenergy potential by region in 2050

Conclusions:

- Total bioenergy potential for Japan is 3.43–3.78 EJ/year in the 21st century.
- About half of the land-based potential could be produced for under 5 USD/GJ.
- The bioenergy contribution to Japan's energy supply and GHG emission reduction could be larger than previously expected.

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