

Global bioenergy potential under environmental protection policies and societal transformation measures

W. Wu¹, T. Hasegawa¹, H. Ohashi², N. Hanasaki², J. Liu¹, T. Matsui², S. Fujimori³, T. Masui¹, K. Takahashi¹

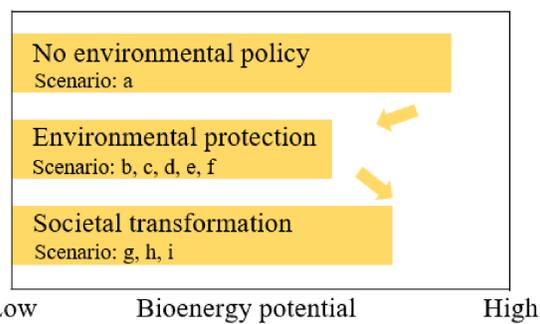
1. National Institute for Environmental Studies; 2. Forestry and Forest Products Research Institute; 3. Kyoto University

1 Introduction

Background

- Bioenergy is expected to play an important role in mitigation.
- A large deployment of dedicated bio-crops can pose risks to the environment, such as water stress, deforestation, land quality deterioration, and biodiversity loss.

Figure 1. Schematic illustration of environmental policy and societal transformation measures to bioenergy potential



Objectives

- Assessing global biomass energy potential and production costs under conditions that conserve land quality and biodiversity.
- Exploring societal transformation measures to increase potential and lower production costs.

2 Method

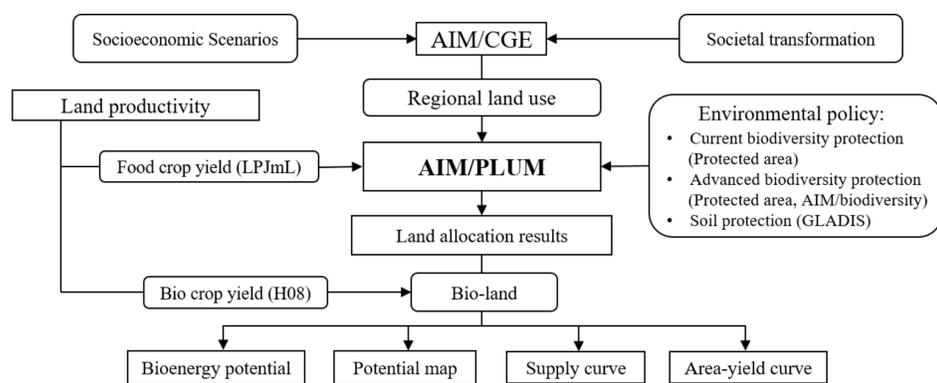


Figure 2. Research framework

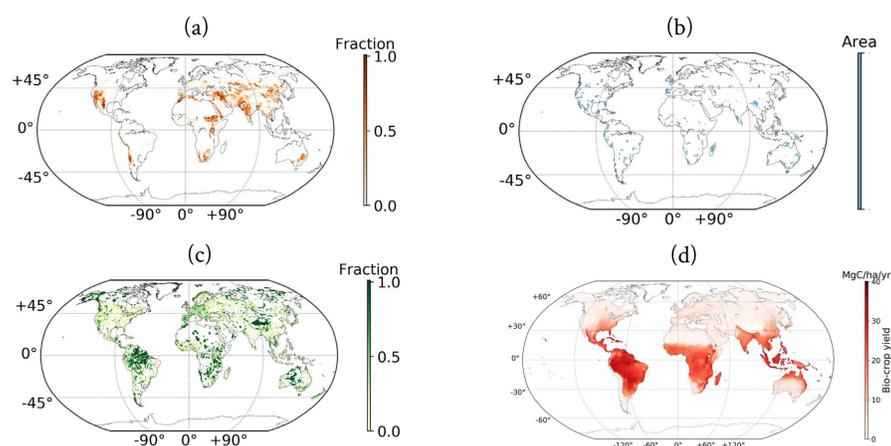


Figure 3. Data: (a) Degraded land; (b) Biodiversity sensitive area; (c) Protected area; (d) Bio-crop yield [switchgrass and miscanthus].

Table 1. Environmental protection policy and societal transformation measure

Environmental protection policy	Societal transformation measure
Biodiversity protection	Sustainable diet
Degraded land protection	Agricultural intensification
	Globalized international trade of food

3 Results

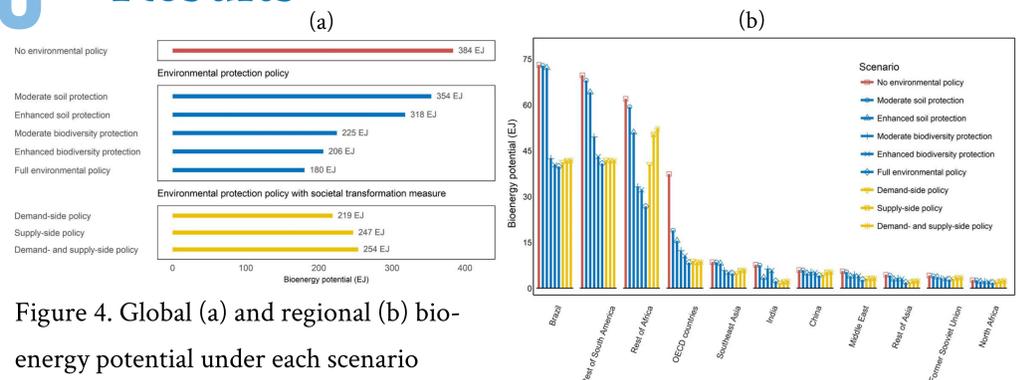


Figure 4. Global (a) and regional (b) bioenergy potential under each scenario

Remarks 1:

- The maximum global technical bioenergy potential is 281 EJ in 2050;
- Full Environmental protection policy reduces bioenergy potential to 136 EJ in 2050 (enhanced soil protection + enhanced biodiversity protection);
- Demand- and supply-side measures could promote it to 168 EJ in 2050;
- The potential is the highest in *Brazil, Rest of South America* and *Rest of Africa*.

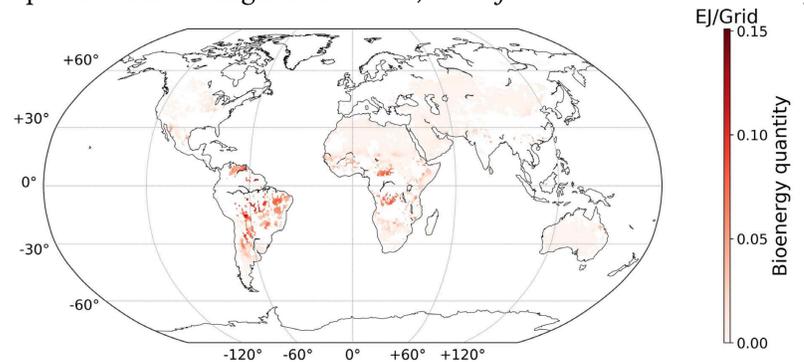


Figure 5. Bioenergy potential map

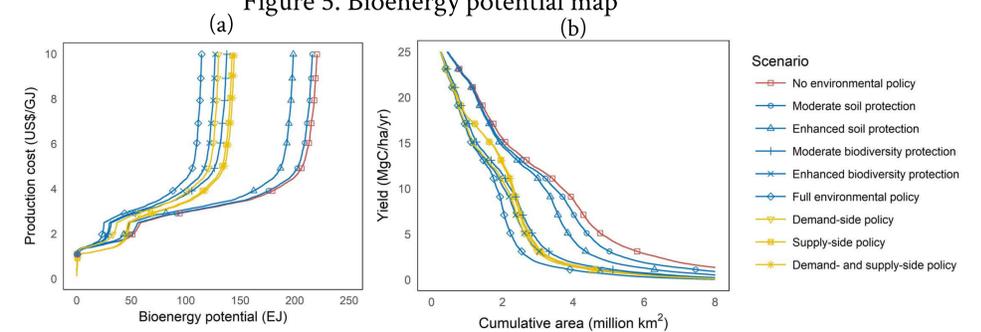


Figure 6. Bioenergy supply curve (a) and area-yield curve (b)

Remarks 2:

- Environmental protection policy pushes supply curve outward (increases cost); societal transformation measure could in part counteract such raise.
- Production cost is lower in *Rest of Africa, Rest of Asia, Rest of South America, Brazil, India, and Southeast Asia*.
- Potential reduction and cost increase are mainly caused by the unavailability of high-yield land.

4 Conclusion

- Bioenergy potential in 2050 was 168 EJ when full environmental policy is combined with societal transformation measures.
- About three-fourths of the estimated potential was produced in South America and parts of Africa.
- Large scale bioenergy deployment required for mitigation could be fulfilled without compromising terrestrial system protection if societal transformation measures are supplemented.