



Zentrum für Entwicklungsforschung
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Bioenergy, food security and poverty reduction: trade-offs and synergies along the Water, Energy, Food Security Nexus

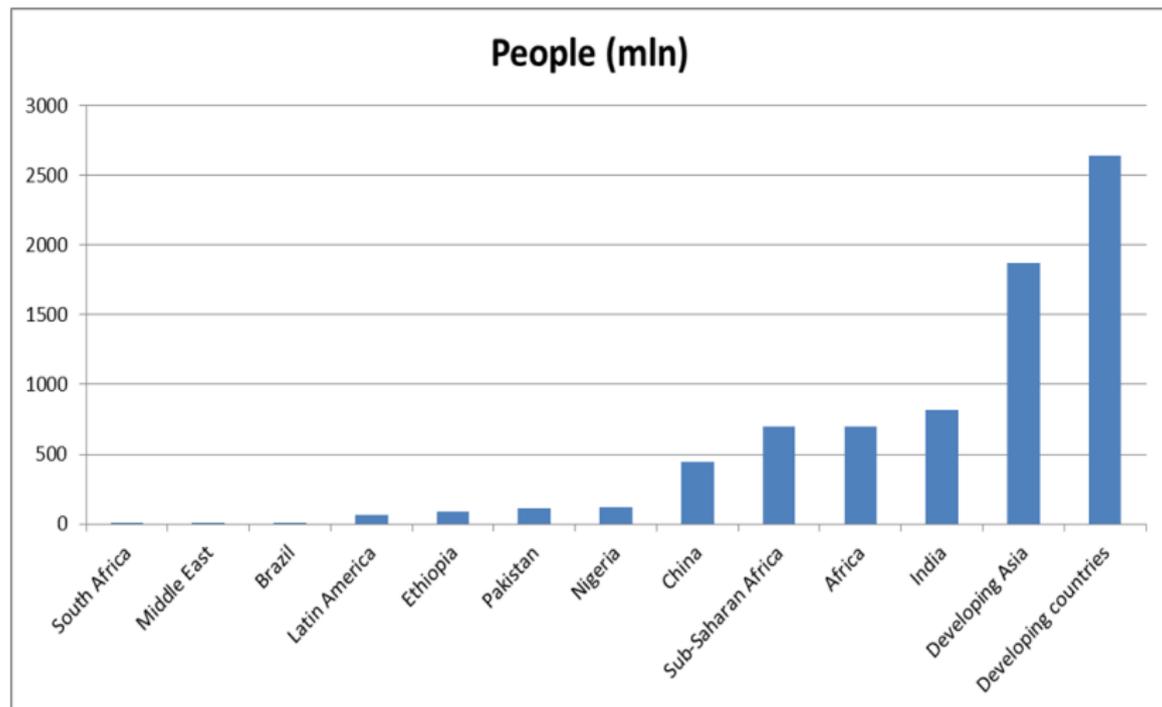
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What is bioenergy ?

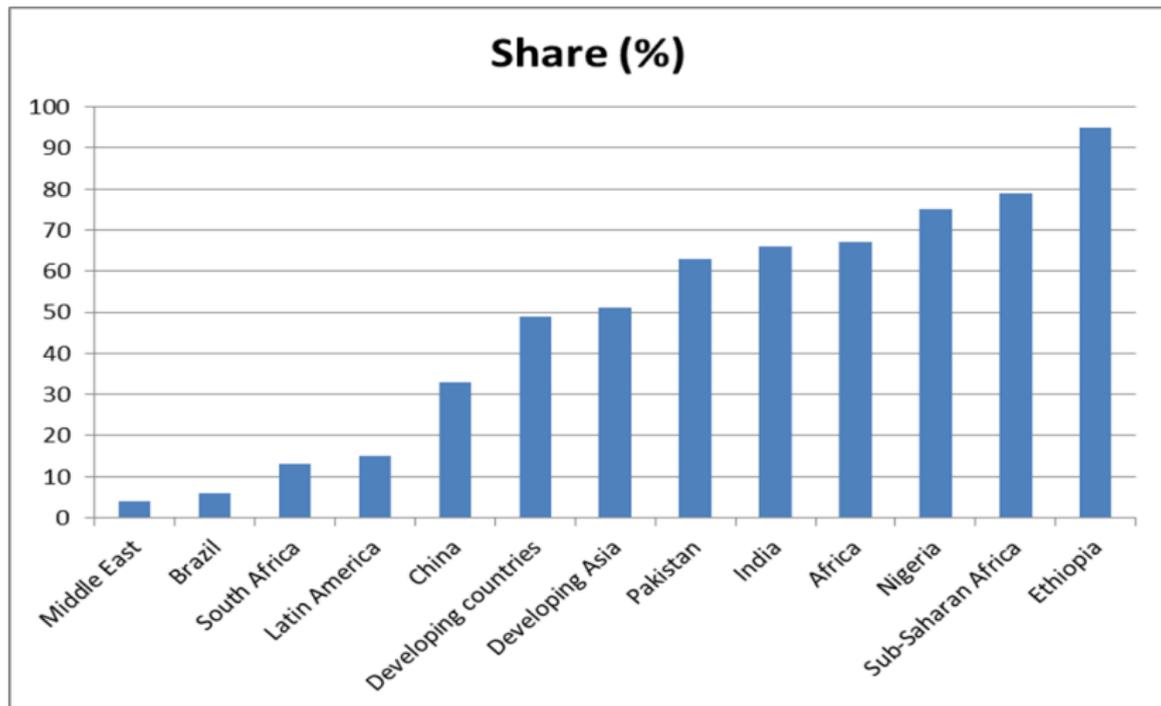
- ▶ **Bioenergy**: energy derived from woody biomass, agro-residues, energy and food crops, agro-industrial and municipal solid wastes and other biological resources (Edmonds et al. 2012).
- ▶ **Bioeconomy**: the aggregate of all industrial and economic sectors and their associated services which produce, process or in any way use biological resources (BioeconomieRat 2009).
- ▶ **Biomass**: comprises all types of biological resources used for or processed into energy, food, feed, or any other bio-based products (Denich and Virchow 2014)

Reliance on traditional biomass for energy



► Source: US EIA (2013)

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Problem Definition

- ▶ Lack of access to clean, reliable and affordable energy is one of the key barriers to sustainable development.
- ▶ Especially, in developing countries, which have much higher reliance on traditional bioenergy, with considerable number of rural communities living in so-called “energy islands”.
- ▶ Other global, national and local drivers.
- ▶ So, the fundamental **research problem** is how to frame already substantial and increasing reliance on bioenergy to achieve multiple-win *Nexus* outcomes: food security, environmental sustainability, poverty reduction, improved health, etc.

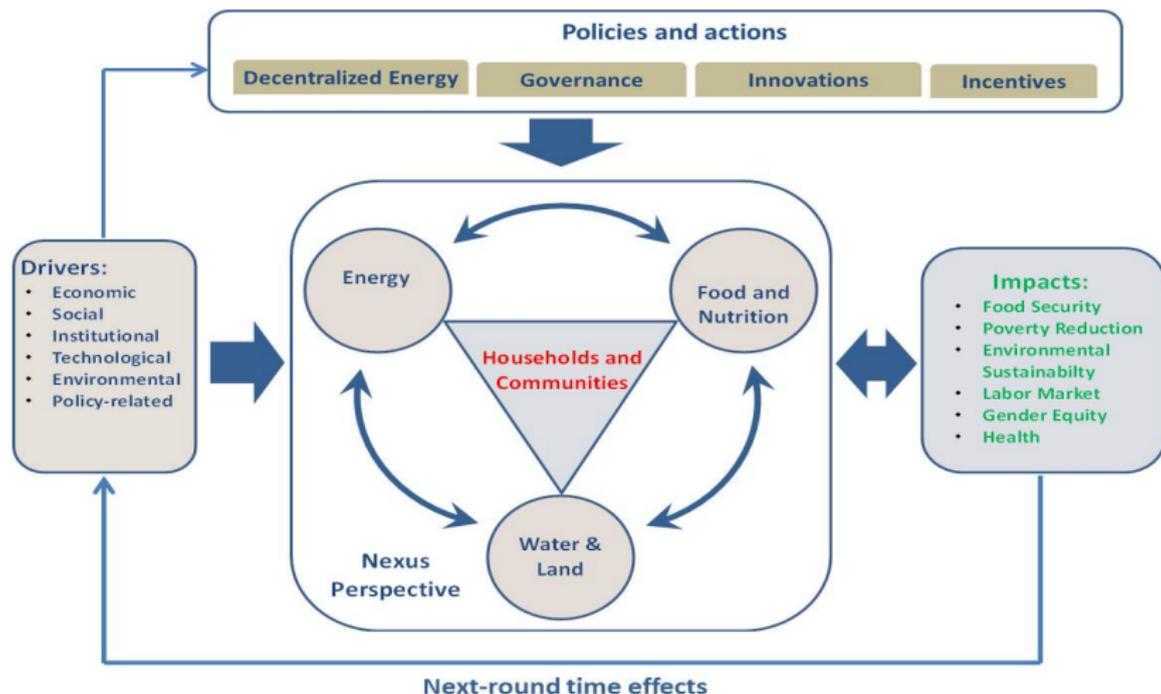
Research Areas

1. Economic, social, health-related and environmental impacts, tradeoffs and synergies of bioenergy production and utilization within water-food-energy nexus at the household and community levels.
2. Constraints and opportunities for the development of decentralized energy production and use.
3. Catalyzing multiple-win outcomes from bioenergy use in terms of economic development, energy security and food security for the poor.

Bioenergy in the Water-Energy-Food Nexus

- ▶ The Nexus is a conceptual framework that recognizes the interconnectedness of these three broad sectors and seeks to develop joint solutions that mitigate the tradeoffs and promote synergies among them (Hoff 2011).
- ▶ Examples of tradeoffs and synergies:
 - ▶ bioenergy vs food production: competition for water land and other resources (Rathman et al. 2010, Bogardi et al. 2012)
 - ▶ bioenergy-deforestation-soil erosion (Bazilian et al. 2011, Nkonya et al. 2014)
 - ▶ water supply - micro hydropower - modern bioenergy adoptions (Kitio 2013, Heltberg 2004)

The Conceptual Framework



- **Source:** Adapted from Hoff (2011), von Braun (2014), including inputs by N.Gerber.

Bioenergy and Food Security

- ▶ Biofuels may have contributed from 3% to 75% to the recent global food price spikes (Mitchell 2008), with negative implications on the poor (von Braun 2008).
- ▶ Drastic increases in biofuel production could increase the number of malnourished pre-school age children by 9.6 mln (Rosegrant et al. 2008)
- ▶ On the other hand, higher food prices could mean higher incomes for net-food selling farmers, bioenergy sector could also generate new jobs (Rathman et al. 2008, Koh and Ghazoul 2008).
- ▶ **What is the way forward:** energy crops on “marginal” lands? 3rd and 4th generation biofuels?

Bioenergy and Poverty Reduction

- ▶ Modern bioenergy development has a considerable potential to reduce poverty ([World Bank 2000](#))
- ▶ For example, [Arndt et al. \(2008\)](#) find that large-scale investments into biofuels may reduce poverty by 6% over 12 years in Tanzania.
- ▶ Several mechanisms:
 - ▶ by creating new rural employment and business opportunities
 - ▶ by raising food prices (!..), land rental values, higher investments into the agricultural sector
- ▶ Net effects need to be evaluated in case by case basis. For example, [Sawyer \(2008\)](#) cannot find any impact from large-scale bioenergy development on poverty reduction in Brazil.

Bioenergy and Environmental Sustainability

- ▶ Modern bioenergy is expected to help in decarbonizing the energy production and in mitigating climate change (Pacala and Socolow 2004).
- ▶ However, the life cycle assessments do not always point at net positive carbon balances, especially when indirect land use changes (LUC) are taken into account (Fargione et al. 2008)
- ▶ Biofuels expansion can also be detrimental for biodiversity, especially in areas with endemic species richness (Koh 2007).
- ▶ **What is the way forward:** energy crops on “marginal” lands? 3rd and 4th generation biofuels?

Bioenergy, Health and Gender

- ▶ From 2.5 to 4 million premature deaths and 39 million disability-adjusted life years (DALYs) annually worldwide due to indoor air pollution (Lim et al. 2012, WHO 2006, Smith et al. 2004)
- ▶ About 40% of 1.3 mln deaths among women due to pulmonary diseases; the same share for men is only 12% (Smith et al 2004)
- ▶ Traditional fuel wood collection lowers school attendance and performance by girls (Nankhuni and Findeis 2004, Malawi).
- ▶ Modern bioenergy development could mean lower disease burden for women, lower health care costs, more productive use of female labor, better school attendance and performance by children, especially girls (Duflo et al. 2008, Wilkinson et al 2009).

Energy research within WEF Nexus

- ▶ Quantitative evaluation of Nexus tradeoffs and synergies of bioenergy
- ▶ Evaluation of feasibility and spillover effects of household- and community-based decentralized energy production and use
- ▶ Health, gender and labor productivity effects of modern bioenergy options