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Biofuel production and its impact on food security in low and middle income countries: Implications for the post-2015 sustainable development goals

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ABSTRACT

The post-2015 sustainable development goals (SDGs) aim to strengthen the achievements of the Millennium Development Goals (MDGs). There are 17 SDGs, the first two tackle ending poverty and hunger as well as food insecurity, under nutrition and sustainable agriculture. To address these goals requires eradicating chronic hunger. This paper examines challenges associated with biofuel production and how they relate to SDGs and their targets. We mainly focus on challenges associated with biofuel production not adequately addressed in the SDGs. It draws from a range of peer reviewed and grey literature to advance the understanding of how biofuel production will impact the post-2015 development agenda. The findings suggest that increasing use of food crops to produce biofuels in the United States, European Union, Japan and Brazil has been one important element in explaining the steady rise in staple food prices since 2000. While this is a potential threat to food and nutrition security in low and middle-income countries, biofuel production also offers significant opportunities in low income countries. There are several challenges to the development and harnessing of biofuels, these include 1) the interaction between biofuel production and climate change; 2) biofuel production and foreignisation of land; 3) food wastage; 4) poor governance and limited production capacity; 5) biofuel production within a weak and fragmented policy framework; 6) biofuel production, land tenure, and socio-economic impacts; 7) biofuel production and conflicts; and 8) biofuel production and deforestation. For the post-2015 sustainable development agenda to have an impact, strong actions are required to protect rural communities as well as nurture the biofuels industry. This should be matched by commensurate investments in food and nutrition security, and transparent public–private partnerships. This calls for strong and pro-poor policies on feedstock farming, processing and trading. Such policies must address the rhetoric of stakeholder participation in land use management.

1. Introduction

The "transforming our world: the 2030 Agenda for Sustainable Development" is a resolution adopted by the General Assembly on 25 September 2015 (A/70/L.1). [1]. The resolution outlines 17 sustainable development goals (SDGs), and the potential of biofuel production to contribute towards meeting the SGDs is strong, especially its contribution to energy security; climate change mitigation; and poverty alleviation through increased economic activity, income generation and diversification, and investments in agricultural production systems [2,3]. However, there are also unintended negative impacts of biofuel production on land (land quality, land tenure, and land rights), water and biodiversity, food security, and market opportunities (Table 1). Despite the institutional, social, economic, and environmental impacts of biofuel production, studies examining the potential contribution to the SDGs are lacking. Most available studies and reviews have focused on the machinery and application of biofuel production [4–11]; the overall main environmental, and socio-economic impacts of biofuel production [12–14]; and policy implications at local, national and international levels [15–21]. Therefore, in this paper we examine challenges associated with biofuel production and how they relate to SDGs and their targets. We mainly focus on challenges associated with biofuel production not adequately addressed in the SDGs.

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Table 1
Potential institutional, social, environmental, economic and technological implications of biofuel options at local to global scale.

Type of impact	*Scale*	
Institutional impact		
May contribute to energy independence (+), especially at the local level (reduce dependency on fossil fuels)	+	LN
Can improve (+) or decrease (–) land tenure and use rights for local stakeholders	+/–	L
Cross-sectoral coordination (+) or conflicts (–) between forestry, agriculture, energy, and/or mining	+/–	LN
Impacts on labour rights among the value chain	+/–	LN
Promoting of participative mechanisms for small-scale producers	+	LN
Social impact		
Competition with food security: availability (reduced food production), access (price volatility), usage (food crops diversion)	–	LG
Integrated systems (including agroforestry) can improve food production bring investment in agricultural production systems	+	L
Increasing (+) or decreasing (–) existing conflicts or social tension	+/–	LN
Impacts on traditional practices: using or discouraging local knowledge in production and treatment of biofuel crops	+/–	L
Displacement of small-scale farmers. Biofuel alternatives can also empower local farmers by creating local income opportunities	+/–	L
Promote capacity building and new skills	+	L
Gender impacts	+/–	LN
Efficient biomass techniques for cooking (e. g., biomass cookstoves) can have positive impacts on health	+	LN
Environmental impact		
Biofuel plantations can promote deforestation and/or forest degradation, under weak or no regulation	–	LG
Used on degraded lands, perennial crops improve soil carbon and structure, abate erosion and salinity problems.	+	LG
Large-scale bio-energy crops and extensive use of fertilizers can lead to poor soil quality, water pollution, and biodiversity loss.	–/+	LT
Can displace activities or other land uses	–	LG
Smart modernization and intensification can lead to lower environmental impacts and more efficient land use	+	LT
Creating bio-energy plantations on degraded land can have positive impacts on soil and biodiversity	+	LT
There can be trade-offs between different land uses, reducing land availability for local stakeholders.	–/+	LN
Ethanol utilisation leads to the phaseout of lead addititives and methyl tertiary-butyl ether & reduces sulfur, particulate matter, and carbon monoxide emissions	+	LG
Economic impact		
Increase in economic activity, income generation, and income diversification	+	L
Increase (+) or decrease (–) market opportunities	+/–	LN
Contribute to the changes in prices of feedstock	+/–	LG
May promote concentration of income and/or increase poverty if sustainability criteria and strong governance is not in place	–	LR
Using waste and residues may create socio-economic benefits with little environmental risks	+	LR
Uncertainty about mid- and long-term revenues	–	N
Employment creation	+	LR
Technological impact		
Can promote technology development and/or facilitate technology transfer	+	LG
Increasing infrastructure coverage. Restricting infrastructure and/or technology to few social groups can increase marginalization	+/–	L
Biofuel options for generating local power or to use residues may increase labour demand, creating new job opportunities.	+	L
Technology might reduce labour demand. High dependent of technology transfer and/or acceptance	–	L

Adopted from [3] L=Local; LN= local to national; LG=local to global; LT=local to transboundary; +: positive impact; –: Negative impact.

2. Historical and contextual background

While the food vs. fuel argument will continue to divide the international community, its policy relevance and negative impact on food security has been taken for granted at high-level political for a on sustainable development. Yet, hunger and undernutrition in low and middle income countries (LMICs) have continued to be a subject for concern for the international community since the 1960s [22]. Perhaps the most important and concrete high-level political forum to address hunger was the 1996 World Food Summit (WFS) in Rome, the result of which was the Rome Declaration on World Food Security in which 182 governments committed to "*… eradicate hunger in all countries, with an immediate view to reducing the number of undernourished people to half their present level no later than 2015*" [23]. As a follow-up, the United Nations Millennium Development Goals (MDGs) were proposed in 2000 and outlined eight goals which were endorsed by all 189 United Nations member states at the time. The first MDG focused on eradicating extreme poverty and hunger and among its targets was to "*halve, between 1990 and 2015, the proportion of people who suffer from hunger*" as measured by the prevalence of underweight among children under five years of age and the proportion of population with hunger (chronic undernourishment) or below minimum level of dietary energy consumption [24].

Progress of the above initiatives has been monitored through the "State of Food Insecurity in the World" annual reports by the FAO and the annual MDGs Report by the United Nations. The year 2015 marked the end of the monitoring period for the internationally agreed targets for hunger reduction [25]. The number of people who are undernourished worldwide decreased from 1011 million in 1990 and 930 million in 2000 to about 795 million people in 2015 [24]. The prevalence of undernourishment declined from 18.6% in 1990 and 14.9% in 2000 to 10.9% in 2015 worldwide; and from 23.3% in 1990 and 18.2% in 2000 to 12.9% in 2015 for the developing regions. The prevalence of underweight among children under five years of age followed a similar pattern, decreasing from 27.4% in 1990 to 16.6% in 2013 in the developing regions of the world [25]. Stunting, which represents cumulative hunger and inadequate nutrition over a long period and/or an exposure to repeated infections, remains a significant public health challenge. The overall prevalence of stunting remains significantly high and has recorded a steady decline over the MDG monitoring period, from 40% in 1990 to 25% in 2013 [26], and from 60% to 38% in least developed countries and from 48% to 38% and in sub-Saharan Africa [27].

Although these data are encouraging, there have been some regional variations, with great success observed in Latin America, the east and south-eastern regions of Asia, the Caucasus and Central Asia, and the northern region of Africa. However, southern Asia, sub-Saharan Africa, and Oceania recorded modest progress, and the progress was too slow to reach the MDG target of halving the proportion of the chronically undernourished [25,28]. It is interesting