Instruments to assess direct and indirect impacts of biomass producer decision making: concepts and preliminary application

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Introduction

Farmers and biomass producers are economic agents that are considering a range of alternatives in their decision making. Inputs to this process are derived from local as well as remote impacts of their activities. Producers of biomass for bioenergy usually do not consider remote signals thus ignoring transboundary problems like water quality deterioration, soil erosion and indirect land use change. We propose four multiplier types to quantify the impacts of biomass production or conversion at the local/farm, regional/sector and other/global levels.

Spheres of interaction and influence

Inputs to the decision making process of biomass producers are derived from direct and indirect as well as outer spheres. Direct sphere refers to the farm or biomass production area. Producers have considerable if not (almost) full control here. The indirect sphere is referring to the near environment of the producer (Figure 1). This can include the village or region and relates to the physical and economic as well as ecological, social and legal structures that are found here. Interactions between biomass producers and their environment are characterised and quantified by transfers (exchange of materials, labour or money).

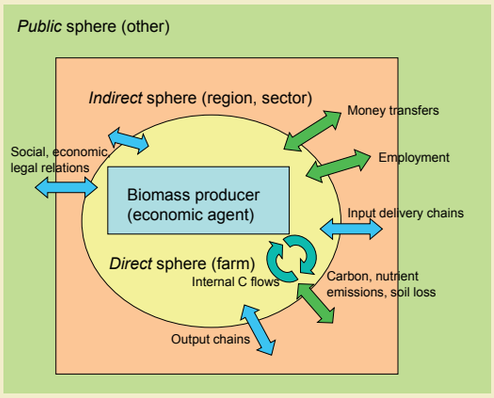

Figure 1. Interactions and transfers between biomass producers and their environment

Defining multipliers

A *multiplier* is an economic term for a factor of proportionality that measures how much an endogenous variable changes in response to a change in some exogenous variable. Multipliers can be used to define different types of economic benefits caused by an investment in renewable energy. It is proposed to apply the multiplier concept also to material flows and (input and output) transfers related to farming. The following dimensions can be identified: biomass (for bioenergy), nitrogen (contained in nitrogen, farming inputs or nutrient losses), carbon or organic matter, jobs and money transfers (Table 1).

Table 1. Biomass, material, labour and monetary flows and transfers related to stover for bioenergy production affecting direct, indirect and outer spheres

Sphere	Biomass	Nitrogen	Carbon	Labour	Money
Direct (farm)	Growth, collection, removal	Additional fertilizer needs, unvoluntary N losses	Reducing the replenishment of soil organic matter	Jobs (stover collection)	Higher farm income
Indirect (region)	Transport, conversion to biofuels and bio-products	Fertilizer transport, nutrient leaching or runoff losses	Additional erosion risks, CO_2 losses from land use change	Jobs (ethanol, transport)	Higher regional incomes and tax revenues
Outer (international)	Replacement of fossil fuels	Increasing demand for fertilizers	CO_2 emissions (replacing fossils, fertiliser production, indirect land use change)	Job shifts (fossil, biomass industries)	Reduced costs for and dependence on importing fossils, fertilizers

Discussion and conclusion

The multiplier concept is able to depict interactions between biomass producers and their direct and indirect environments. It is suited to quantify potential positive (employment, economic activity) and negative (nutrient removal and soil erosion) effects that can occur when additional biomass is utilized to supply emerging bioenergy production chains. The information provided by the multipliers can play a role in depicting and summarizing (indirect) effects, and could be used to inform producers about how to minimize negative effects while maintaining or increasing positive effects. Additionally, they reveal the distributional impacts of bioenergy development on key stakeholders across the three spheres. This model is generic and can be applied to all kinds of bioenergy chains across a range of environments.

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