Biofuels in Portugal and the new challenges for the rural world

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Abstract: *Portugal has specific environmental and farming characteristics, such as an arid climate, risk of soil erosion, high climatic variability over the year as well as a high share of extensive farmland with a high nature value. These areas need to be protected either from intensification and abandonment.*

Traditionally cultures areas, unused lands, and set-aside areas are being considered to suppress the demand of biofuels. However available areas to produce energy crops are in great extent extensive farmland.

Land allocation should be made in order to minimize land-use conflicts, considering the use of degraded land whenever it is possible. Irrigated land should be considered for new energy crops as an alternative to intensive food production.

Although virtually all CO_2 emitted during vehicle combustion of biofuels does not contribute to new emissions of CO_2 other emissions must be considered. Thus net GHG emissions depend of the boundaries of the fuel cycle analysis.

Keywords: *biofuels, cycle boundaries, carbon storage, biodiversity, emissions*

Introduction

There are a variety of biofuels potentially available, but the main biofuels being considered globally are biodiesel, bioethanol and biogas. Biodiesel is a fuel that can be produced from straight vegetable oils, edible and non-edible, recycled waste vegetable oils, and animal fat (Agarwal, 2007). Biodiesel consists of fatty acid methyl esters (FAME) and it could be used in pure form in conventional diesel vehicles with only minor engine alterations (Bomb et al. 2007) or as an additive for diesel fuel (Renews, 2005).

Bioethanol can be produced from a number of crops including sugarcane, corn (maze), wheat and sugar beet. Wheat and sugar beet are currently and for the foreseeable future the main sources of ethanol in Europe (Edwards et al., 2007). For bioethanol, it is generally accepted that all recently produced conventional petrol vehicles are compatible with blends up to 10% bioethanol and 90% petrol or E10 (Bomb et al. 2007).

Biogas, after upgrading to biomethane by removal of CO2 and compression, can be used in natural gas engines (Renews, 2005).

Land use conflicts and carbon storage

One of the major issues that came from bioenergy crops demand is land use conflicts. They depend on crop species, cultivation methods and soil and climatic condition. Because species differ in biomass production, carbon storage is primarily controlled by two fundamental processes: net primary productivity (NPP) and decomposition. An increase in NPP results in an increased of carbon storage, whereas increased decomposition has an opposite effect (Yang and Hsieh, 2002).

Management of degraded areas with more perennial crops (grasses) can enhance soil quality and improve soil organic carbon sink capacity by improving plant productivity (Lemus and Lal, 2005). Maintaining plant species with good vegetation cover and deep root systems such as perennial grasses are important to increase soil organic carbon pool in deeper soil layers (Lal, 2004).

However, the land-use effects of bioenergy-cropping systems must be considered with reference to current land-use (if any). Thus if bioenergy production replaces intensive agriculture, the effects can range from neutral to positive. If it replaces natural ecosystems the effects will be mostly negative.

Loss of biodiversity

The potential conflict between biodiversity and bioenergy crop cultivation depends on aspects like crop type, rotation schemes, pest management, fertilizer use, irrigation, field size and harvest procedures. More extensive forms of cultivation, combining crop types and rotation schemes and small scale structuring cultivation, can minimize those conflicts. Although the extensive regimes are more land demanding, the conversion from extensive “high nature value” farming to more intensive monoculture cropping could lead to a severe loss of biodiversity. Migration corridors must be excluded from bioenergy cropping areas. Adequate buffer zones must be maintained for habitats of rare, threatened or endangered species.

Production management plans should be created to assure that farming operations protect “high nature value” farming systems. In order to preserve genetic diversity, a minimum number of crop species and varieties, as well as structural diversity within the bioenergy cropping area must be demonstrated in management plans. Appropriate fire protection measures must be adopted both for combat the fires and for situations where fire is used to clear the lands.

Greenhouse gas (GHG) reduction impacts and potential

Estimating the net impacts of using biofuels on land use and GHG emissions is a complex issue. Virtually all CO_2 emitted during vehicle combustion of biofuels does not contribute to new emissions of carbon dioxide, because the emissions are already part of the fixed carbon cycle (absorbed by plants during growth and released during combustion). However to assure that all impacts are internalized, boundaries of a live cycle assessment should include:

- GHG emissions are released along the process;
- GHG emissions required for crops to grow;
- GHG emissions of transporting biofuels to distilleries;
- GHG emissions in biofuels production;
- GHG emissions of delivering biofuels to refuelling stations.

Depending of the boundaries considered emissions may be as high or higher than the net GHG emissions from gasoline vehicles over the gasoline fuel cycle (IEA, 2004).

Conclusions

Land allocation should be driven in order to minimize land-use conflicts, considering the use of degraded land whenever it is possible. Irrigated land should be considered for new energy crops as an alternative to intensive food production, instead of converting high nature value farmland to intensively used arable land for bioenergy production. Crops chosen must have low environmental impacts. Additionally, biomass extraction should increase to help preventing fires.

Net GHG emissions depend of the boundaries of the fuel cycle analysis. All relevant emission processes should be included within the scope of the fuel cycle assessment to assure that GHG emissions are comparable between fuels type.

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