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Impact of policies and subsidies in agribusiness: The case of oil palm and biofuels in Colombia

Carmenza Castiblanco [a,b,*], Alvaro Moreno [c], Andrés Etter [a]

[a] Departamento de Ecología y Territorio, Facultad de Estudios Ambientales y Rurales, Pontificia Universidad Javeriana, Bogotá DC, Colombia
[b] Instituto de Estudios Ambientales, Universidad Nacional de Colombia, Bogotá DC, Colombia
[c] Facultad de Ciencias Económicas, Universidad Nacional de Colombia, Bogotá DC, Colombia

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ABSTRACT

We analyze the economic impacts of policies supporting biodiesel production in Colombia, such as subsidies and mandates for compulsory fuel mixtures. In the major biodiesel source being palm oil, we seek to establish the impact of these policies on oil palm producer incomes, prices and production levels of crude palm oil (CPO) and biodiesel, as well as the impacts on demand for land for oil palm plantation expansion.

We also calculate the so-called “deadweight costs”, to account for the social costs derived from the inefficiencies of government interventions in the biodiesel markets. The analysis is done using a partial equilibrium models for the two interrelated sectors, the production of palm oil and biodiesel, and the demand for new land needed to cope with the additional palm oil needed. The model was calibrated for 2009 to simulate for the 2010–2020 period.

The results of the simulations reveal that the subsidies alone are themselves not effective tools to achieve the government objectives defined in the Biofuels Program in Colombia.

Subsidies need to be complemented by increased blending mandates to ensure that palm cultivation and production of biodiesel investments are profitable enough that producers would bet on such business. Additionally, we find that producers of palm oil benefit most from subsidies in the short term; however, in the long-term it is the biodiesel entrepreneurs who will appropriate the larger share of growth revenue of the entire production chain. The social costs of the Biofuels Program are small in the short term, and represent only between 0.2% and 0.7% of the tax expenditure. However, in the long term they would become significant, and would account for around 4.1% to 6.1% of the tax payers' expense.

1. Introduction

An analysis of the economic impacts of biodiesel promotion policies is a topic that has been addressed in various countries and for different raw materials (Arndt et al., 2009; Gardner, 2007; De Gorter and Just, 2007). Generally these studies seek to make the relationships between business decisions of feedstock cultivation and industrial production of biofuels and fuel consumption explicit, with the aim of determining the effects of the various direct support instruments on the links in the production chain, as well as in other markets for agricultural inputs, food, land or fuels (Latruffe and Mouel, 2009). For example, the way in which the establishment of mandatory blending not only increases the demand for biodiesel, but also reflects in the agricultural markets, food, land and fuel. Similarly, direct subsidies or tax exemption for biodiesel can generate the conditions for biofuel production to be profitable, but may create inefficiencies and welfare costs for society, more commonly known as “deadweight losses” (Tirole, 1988). All these policy decisions have impacts on the use and conversion of land, CO_2 emissions and on the income of the different players in the sector. Such aspects need to be estimated in order to assess the benefits and costs of public policies.

In recent years, significant progress has been made in refining the tools to analyze the impacts of policies promoting biofuels. Kretschmer and Peterson (2008) conducted a detailed review of the various options for economic modeling of biofuels. Among these tools, the computable general equilibrium models have been used intensively, because these models can examine the impacts of policies and exogenous shocks globally, taking into consideration all the interactions between the various markets and agents (Hosoe et al., 2010).

In the general equilibrium model of the GTAP-E version, Woltjer et al. (2007) explicitly represents the use of cereals, vegetable oils and sugar cane as raw materials for the production of biofuels in a multilevel structure of the oil industry. This allows analyzing the policies of tax exemption and obligatory blending mandates as exogenous increases of the share of biofuels (Woltjer et al., 2007). Reilly and Paltsev (2008) used a computable general equilibrium model to estimate the global land area needed to produce the biofuels required to

* Corresponding author at: Instituto de Estudios Ambientales (IDEA), Universidad Nacional de Colombia, Bogotá DC, Colombia. Tel.: +57 1 3165000x10572.
E-mail address: ccastiblancor@unal.edu.co (C. Castiblanco).

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attain the stabilization policies and mitigation of atmospheric gases proposed by the US Congress for the period 2010–2100. The simulated scenarios indicate that by 2100 an additional area of between 700 million and 1 billion ha would be required globally.

Hertel et al. (2008) studied the effects of mandates of ethanol and biodiesel blends with fossil fuels in the US, EU and Brazil on land use and land cover changes in the 2005–2015 period. Results show that the effects are substantial: grain production would increase by 6.2% and vegetable oil by 7.7% in the US; cultivation of vegetable oils would grow by 48% in Europe; while in Brazil, sugarcane and soya should increase by 23% and 6.4% respectively. Hertel and Beckman (2010) argue that promoting biofuels increases price volatility of agricultural products, which creates problems for macroeconomic management and significant challenges in food security issues of poor countries.

In a study carried out for the World Bank, Timilsina et al. (2010) examined the long-term impact of large-scale expansion of biofuels on land use change, food supplies and prices globally. The study found that the impact on agricultural prices was moderate with the exception of sugar prices that grew between 7% and 10%. However, there were significant impacts in terms of changes in land use, with a reduction of pasture and forest areas alongside the increase in biofuel crops. They estimated that the expansion of biofuels in the world can lead to the loss of about 26 million ha of forest by 2020. Another study using a general equilibrium model for Mozambique to evaluate the results of large-scale investments in the biofuel sector in economic growth, income distribution and poverty in the country, Arndt et al. (2009) found that the investment policies in the biofuel sector should have positive effects on growth and poverty reduction.

Although general equilibrium models are a powerful tool to simulate the impacts of biofuel promotion policies on changes in land use, changes in welfare and potential climate impacts, and the existence of information gaps and data quality problems, often limit the scope of calibration and simulation exercises (Feng and Babcock, 2008). Taheripour et al. (2008) show that many conventional general equilibrium models tend to overestimate the effects of biofuels on agricultural markets. One possible reason is that most of these exercises ignore the role of byproducts in the production of ethanol and biodiesel, which can mitigate the effects on raw material prices for animals and the food industry.

An important conceptual alternative that requires less information and less computational complexity are partial equilibrium models. These models have been used for the evaluation and restructuring of agricultural policies in the US and Europe (Dewbre et al., 2001; Floyd, 1965; Guyomard et al., 2004). In recent years, there has been theoretical and empirical research using partial equilibrium models applied to examine the impacts of biofuel promotion policies on different economic variables, climate change and the environment. Studies have mostly focused on ethanol in the US and biodiesel in Europe (Gardner, 2007; De Gorter and Just, 2007, 2009a,b; Hochman et al., 2008; Khanna et al., 2008).

In Colombia the promotion of a “new energy paradigm” began in 2001, when the national government issued Law 693 of 2001 which establishes deadlines and requirements for mixtures of oxygenated fuels consumed in cities of over 500,000 inhabitants. In 2004, the Law 939 defined the general guidelines for mixtures of diesel fuel with vegetable fuels, especially palm oil. Finally, Documento CONPES 3510 (2008) defined the ground rules and direction of national policy to promote “sustainable production” of fuels of vegetable origin in Colombia (Fajardo, 2009; FAO, 2010). The Ministry of Mines and Energy and the Ministry of Agriculture and Rural Development undertook the task of designing a specific support model (Bochno, 2011). It introduced various incentives and schemes of direct and indirect subsidies targeted at different stages of the business chain. To increase the production capacity of biofuels, tax free zones with benefits to investments in ethanol and biodiesel production plants were established and blending mandates were introduced for the period 2008–2020. Additionally, significant resources were allocated to finance the cultivation of sugarcane and oil palm for biofuel production, channeled through instruments such as the “rural capitalization incentive” (ICR), the Agricultural Income Insurance Program, the Price Stabilization Fund for Oil Palm Production (FEP) and the development of programs of partnerships and the “Social Financial Model” (MF-S) adapted from Malaysia (FAO, 2010).

However, in Colombia there have been many questionings as whether all these promotional and subsidy policies are really targeting all actors in the production chain (Fajardo, 2009). Apparently, the studies on the assistance and subsidies to rural capitalization tend to show that the main beneficiaries are mostly the landlords and not necessarily the direct producers, who initially sought help (Latruffe and Mouel, 2009).

The aim of this paper is to quantify the possible future economic impacts of biodiesel promotion policies in Colombia applying a partial equilibrium sector model based on the model by Gardner (2007). The Gardner model was adapted to the palm oil and the biofuel sector, to simulate quantitative scenarios of the costs and benefits of government programs aimed to support and promote the production and consumption of biodiesel. The exercise is also aimed at establishing the differential benefits and costs of the subsidies to the different actors in the production chain.

2. Materials and methods

2.1. Study area

Colombia is located in northwestern South America on the equator with a land area of 1.14 million Km^2. By location in the equatorial zone and large mountain ranges, the country has a large variety of climates, ecosystems and cultures differentiated into five geographic regions: Caribbean, Pacifica, Andina, Orinoco and Amazon regions (Etter et al., 2006). Current population is around 45 million inhabitants, located mainly in urban zones (76%). Large tracts of land especially in the Amazon and pacific are very sparsely populated. Indigenous territories span 31 million ha (one third of the country) but only with 1.4 million inhabitants (3%) living there. Collective territories owned by Afro-Colombian communities reach 5.5 million ha and around 3 million inhabitants are living there (GEF, 2010).

The most extended land use is cattle grazing which spans over more than 70% of the agricultural land, usually exhibiting low productivity levels (McAlpine et al., 2009). In 2012, the agricultural area was approximately 5.2 million ha, out of which 3.1 million have permanent crops, 1.6 million correspond to annual crops, and 0.5 million are forestry plantations (FEDEPALMA, 2013).

The added value of the agricultural sector accounts for 7% of GDP and employs 18% of the working population (World Bank, 2012). Colombia has one of the highest indices of land concentration in the world (Land Gini 0.86) (PNUD, 2011), and high rates of rural poverty, reaching 54.3% of the population (DANE, 2012).

With the implementation of the “free market” treaties and policies in the 1990s, the Colombian economy showed a progressive reduction in the share of modern sectors such as industry in GDP, strengthening its specializing in the export of primary goods, mining and agricultural goods. The pressures of exchange rate appreciation generated symptoms of “Dutch disease”, where non-tradable activities such as financial services and construction gain importance with respect to non-traditional and industrial exports (Sarmiento, 2011).

The commercial oil palm plantations have been developed in Colombia since more than fifty years, but in the last decade the area has increased at an annual rate of more than 8%, reaching an area of 452,435 ha in 2012, which represents 14.5% of the area of permanent crops and 8.75% of the national agricultural production (FEDEPALMA, 2013).

Currently oil palm is cultivated in 108 municipalities of 17 departments (Fig. 1), forming four productive zones: Northern, Center, Eastern and South-Western. Each one has varied characteristics relating climate,