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ECONOMIC VIABILITY OF SUGAR BEET AND CORN AS ENERGY CROPS VERSUS FOOD AND FEED MARKETS: A CASE STUDY IN SPAIN

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Abstract

In the last years many different events, as reforms of the CAP (Common Agricultural Policy), promotion of biofuels due to the international engagements, new energy objectives, etc., have led to a change in the agricultural sector in the EU and particularly in the Mediterranean countries, affecting to a greater extent those regions where agriculture has a higher economic importance, as it's the case of Castile and Leon (Spain). Thus, farmers have been forced to readapt their productive system to the new exigencies of the markets and the policy frame, focusing on new outputs, as energy crops, which compete in both food/feed and energy markets. While technical viability of growing such crops (*e.g.* corn and sugar beet) has been largely proved by different studies and experiences, nevertheless the economic viability of these market orientations versus food/feed markets is not still sufficiently contrasted. This study is an attempt to determine the economic results for these productions, comparing both possible market outputs, using the methodology set by the Economic Accounts for Agriculture (EAA). Results show that both outputs could be options to be taken into account, though an initial support could be needed depending on the evolution of the international context, due to the opportunity cost which implies the energy option versus food/feed markets.

Keywords: Energy crops, Sugar beet, Corn, EAA (Economic Accounts for Agriculture).

Introduction

Over the last few years, a number of events have produced a deep change in agriculture in the European Union, and particularly in the Mediterranean countries, as it's the case of Spain, affecting more deeply those regions where agriculture has a higher importance from an economic point of view, as it's the case of Castile and Leon region. Thus, the agreements ensuing from the negotiations within the WTO (World Trade Organization), the reform of the CAP and the different CMO (Common Markets Organizations) (in particular that of sugar), along with the region's vocation to produce (greatly influenced by geo-climatic factors) have led to a deep and long-lasting crisis of the agricultural sector in Spain, with a subsequent loss of activity and of the relative importance of the sector as regards its weight in the economy as a whole. Within this framework, farmers feel impotent before the situation of international markets and the region's climatic constraints, limiting the type of alternative crops to be introduced and often reducing competitiveness because of production costs higher than in the European regions of competitors[35]. In spite of it, the region can count on the highest crop yields and surface of sugar beet, as well as maintaining a central role in the production of cereals at the national level, especially regarding corn (Robles and Vannini, 2012).

Likewise, it is noteworthy how important role agriculture has as a supplier of raw material in fulfilling the commitment to reduce emissions of carbon dioxide by 20% (below 1990 level)

[35] The sparse rainfall, which is in addition very unequally distributed by location and by season, determines the need of irrigation to achieve yields which allow a reasonable profit.

at the latest by 2020, and, in particular, to ensure that biofuels reach a weighting of 10% within overall petrol and diesel consumption (Robles and Perkumiene, 2011). The part it is intended it should play in the requirement to slow down the decrease in biodiversity by 2010 is also crucial. The document "The CAP towards 2020" (European Commission, 2010) reinforces the above mentioned aspects and stress that the future CAP should contain a greener and more equitably distributed first pillar and a second pillar focusing more on climate change and the environment. Thus, further efforts in the field of biomass and renewable energy production will be required to meet the EU energy and climate agenda.
From this perspective, energy crops are an opportunity for the future development of agriculture in this region, enabling farmers to continue their activity in the future (Robles, 2012, Robles *et al*, 2013), but different factors of a legal, technical, economic, or socio-cultural nature have a direct or indirect effect on the value chain for biofuels. These can affect the production sector (area cultivated, costs and the price of raw material), manufacturing (costs and price of biofuel), distribution and consumers (quantities used and prices paid), as noted by Robles and Vannini (2008) and Robles *et al* (2012). In any case, the final decision to include or exclude energy crops when considering alternatives for production lies with the entrepreneur (the farmer) and if energy crops are to be grown farmers must perceive some advantage in the financial results of growing them (Robles, 2011; Robles and Vannini, 2012). In this new context, the present paper aims to analyse the economic accounts for the production of the main local crops which could be grown as raw material for biofuel production, more specifically, corn and sugar beet.

Materials and methods

The methodology implemented to undertake the work being reported upon here is based on the Rapid Rural Appraisal (RRA). For this purpose, first, we have collected information from different secondary sources, mainly legal and policy documents and reports, which has been contrasted with the primary information supplied by a panel of different stakeholders, which has been interviewed, being experts selected as a function of their prestige, experience and representativeness within each of the following areas: government and administration, farmers and their organizations, supporting institutions and firms, researchers and consultants.
The data obtained in this way were used to undertake an analysis of the circumstances and economic viability of corn and sugar beet as energy and food/feed crops, respectively, applying the EAA methodology (table 1).

Table 1. Economic Accounts.

Production account	**Generation of income account**	**Generation of current profit**
Crop Output (Producer Price*yield)	Net value added	Net operating surplus/net mixed income
- Intermediate Consumption	- Compensation of employees	- Non salaried labour
- Consumption of fixed capital	- Other Taxes on production	- Opportunity cost of the own capital
	+ subsidies on production	= Current Profit after distribution
= Net value added	= Net operating surplus/net mixed income	
- Other Taxes on production		
+ subsidies on production		
= Net Value added at factor cost/factor income		

In respect of this, the situation investigated corresponds to the parameters for prices for inputs and end products relating up to the 2011 harvest, using the price trends that emerge from market developments up to that point. For the case of sugar beet, three different situations have been considered, as follows: quota sugar beet (this crop has the institutional support of the CAP and the local administration), sugar beet without quota (it doesn't perceive any subsidy and could be devoted to the food or energy market). As well different levels of yields according to the productivity of the farmers interviewed have been taken into consideration. Moreover the possibility of growing new much more productive varieties specifically focused on energy markets has been considered. Moreover other indicators are calculated:
Employment Rate: It represents the labour required by the crop cultivation. It is measured in two different units: Agricultural working unit (AWU)/ha and ha/AWU.
Break-Event Point (BEP): It's the point at which cost or expenses and revenue are equal; there is no net loss or gain.
Ratio subsidies on product/Crop output: It represents the importance (in percentage) of the subsidy linked to the energy crop over the total crop output.

Results and discussion

Corn

The economic results, supported by the important rise of prices of the final product, have been, in general, positive for farmers addressing their products to the food/feed market. The main explanatory factor for this trend is the positive evolution of the output prices, set at the maximum levels of the analyzed series (2001-2011), yet the parallel increase of the input prices has hold the benefits rise back. With prices around €0.23 per kilogram for corn, even though an increased cost for inputs has to be taken in consideration, both net income as current profit reach positive values (see table 2). This implies adequate remuneration for the factors land, family labour and capital, together with profits for the entrepreneur that range from about €275.24 for energy market and €1001.24 for food/feed markets. Its inclusion among alternative choices, whether seen from a technical and environmental viewpoint or from an entrepreneurial angle, then becomes feasible. BEP for food/feed market drop relative to the energy market, reaching figures of about 7.74 t/ha versus 10.48 t/ha for energy markets, nevertheless, both values are perfectly achievable in irrigation production systems in the region, with yields over 12 t/ha in normal climatic conditions. As also evidenced by some other studies (*e.g*., Ericsson *et al*, 2009), the adoption of an energy crop means an opportunity cost which reaches the maximum level for the case of corn (with a profit difference of about 726 €/ha). This amount being for guidance when setting a possible support for energy crops versus food/feed. It must be considered anyway, that there are some other factors apart from the profitability, which could also influence the farmer decision, as diversification of market outputs and minimization of risk. This way, being prices for energy crops subject to a lower prices fluctuation versus food/feed crops, farmers could perceive a comparative advantage when addressing part of the production to the energy markets, which could drive them to grow a certain percentage of the total agricultural area for this productive orientation (Gómez-Ramos, 2009).

Sugar-beet

This crop shows good economic results in any studied scenario, remunerating appropriately every productive factor and providing entrepreneurial profit, too, being this last one considerably higher for the case of sugar-beet with quota (due to the CAP support), reaching values of 1244-2372 €/ha (depending on the considered yields) with respect to 38-776 €/ha for sugar-beet without quota (which could be the one addressed to the energy market). Nevertheless, economic results could improve as a consequence of the prices rise in the international markets, as it's foreseen by the EU (European Commission, 2012), as well as a

result of implementing the farming of new sugar-beet varieties with higher yields (as fuel sugar-beet), currently under experimentation (Merino, 2008) and the reduction of costs due to a possible lesser use of inputs (Salazar-Ordoñez *et al*, 2013). In such situation, current profit could reach values of 1700 €/ha. This crop has a better economic result (compared to corn), with BEP for energy markets being about 86 t/ha (see table 2). Moreover it should be considered that more efficient farms could reach yields over 150 t/ha, and that the current experimental fuel varieties with higher yields could become a reality in a near future.

Table 2. Economic accounts results.

	Sugar beet without quota		Sugar beet with quota		Fuel variety Sugar-beet	Corn (food/feed)	Corn (energy)
Output							
Yield (t/ha)	115.20	87.10	115.20	87.10	150.00	12.1	12.1
Producer Price (€/t)	26.29	26.29	26.29	26.29	26.29	230	170
Subsidies							
(€/t)			13.85	13.85			
Production Account (€/ha)							
Crop Output (Producer Price*yield)	3028.61	2289.86	3028.61	2289.86	3943.50	2783.00	2057
Intermediate Consumptions	1441.28	1441.28	1441.28	1441.28	1441.28	975.26	975
Fixed Capital Consumption	163.42	163.42	163.42	163.42	163.42	42.75	42.75
Net Value Added	1423.91	685.17	1423.91	685.17	2338.81	1764.99	1038.99
Taxes	103.95	103.95	103.95	103.95	103.95	103.95	103.95
Subsidies on products	0.00	0.00	1595.52	1206.34	0.00	0.00	0
Net Value added at factor cost/factor income	1319.96	581.22	2915.48	1787.55	2234.86	1661.04	935.04
Generation of Income Account (€/ha)							
Net Value Added	1423.91	685.17	1423.91	685.17	2338.81	1764.99	1038.99
Compensations of Employees	30.00	30.00	30.00	30.00	30.00	30.00	30
Taxes	103.95	103.95	103.95	103.95	103.95	103.95	103.95
Subsidies on products	0.00	0.00	1595.52	1206.34	0.00	0.00	0
Net operating surplus/net mixed income	1289.96	551.22	2885.48	1757.55	2204.86	1631.04	905.04
Generation of Current Profit (€/ha)							
Net operating surplus	1289.96	551.22	2885.48	1757.55	2204.86	1631.04	905.04
Non-salaried Labor	92.46	92.46	92.46	92.46	92.46	220.10	220.10
Opportunity cost of the own capital (land and investments)	420.69	420.69	420.69	420.69	420.69	409.70	409.70
Current Profit after distribution	776.81	38.06	2372.33	1244.40	1691.70	1001.24	275.24
Current Profit after deducing just non-salaried labor	1197.50	458.76	2793.02	1665.09	2112.40	1410.94	684.94
Current Profit after deducing just the opportunity cost of the own capital	869.27	130.52	2464.79	1336.86	1784.16	1221.34	495.34
Employment Rate (AWU/ha)	0.008	0.008	0.008	0.008	0.008	0.020	0.020
Employment Rate (ha/AWU)	118	118	118	118	118	50	50
BEP (€/t)	19.55	25.85	19.43	25.69	15.01	0.15	0.15
BEP (t/ha)	86	86	56	56	86	7.74	10.48
Ratio subsidies on product/Crop Output (%)	0.00	0.00	34.50	34.50	0.00	0.00	0.00

Otherwise, sugar-beet for energy use could be an output for the 50% of the surface which is actually being object of deregulation as a consequence of the last reform of the sugar CMO, and for which, it is difficult finding any other suitable crop, due to the climatic and market conditions. The difference between the profit obtained in the two studied scenarios (sugar-beet without and with quota) varies from 1206 €/t to 1596 €/t for yields from 87-115 t/ha, respectively. This will also be the opportunity cost for energy crop (assuming that just sugar-beet without quota would be devoted to the energy market). Otherwise, more productive fuel varieties have a lower opportunity cost of about 681 €/ha vs. quota sugar-beet grown in more efficient farms, and becoming null for those farms with yields under 98t/ha. This cost would disappear as soon as the present quota system does it (foreseen in 2017), later on there will be no opportunity cost for this crop.

Conclusions

Except in the case of sugar beet, once the current quota system will be deregulated, the choice of corn or sugar beet as energy crop means an opportunity cost for the farmer due to the lower profit when comparing with the corresponding food/feed market. Nevertheless, both options could be profitable for the crops subject of this research (though an initial support is advisable in a former stage when introducing these new market orientations).

This factor together with the expected evolution of the demand of these crops up to 2020 according the EC prospects, pointing to a stabilization of the demand in the food/feed markets and an increase in these crops demand for energy use, lead to an expected expansion in the surface devoted to these crops in the region.

The above mentioned facts, together with the expected rising in prices (driven by the increasing demand for energy crops) and the more stable price of irrigation crops (as it’s the case of corn and sugar beet), make it advisable to consider the energy option as a part of the productive alternative.

There is an opportunity for these new market orientations, even when growing new surfaces requires the need of investment (as the opportunity cost of the capital has been considered when assessing the costs in this study), yet, in this case, it should be first checked the need of surface in order to get the BEP.

Finally, the current economic situation in the EU, and in Spain in particular, questions the achievement of the foreseen energy crops expansion, due to different factors, as the reduction in institutional funds for research, supporting policies, the cut in energetic expense, or consumer willingness to pay for commodities (outweighing price over environmental or ethic factors).

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