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ECONOMIC IMPACT EVALUATION OF BIOENERGY IN THE PROVINCE OF SANTA FE

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Overview

The main objective of this study is to estimate the economic characteristics of the bioenergy sector of the Province of Santa Fe and analyze the impact of the policies at the level of provincial production and employment. Increase in production given the current capacity, investments in new plants and substitution of conventional energy for energy based on biomass, as well as contribution to CO_2eq emission reduction of the energy matrix, will be analyzed.

Bioenergy is obtained from biofuels (fuels derived from biomass), solids (mainly firewood and vegetable), gaseous (methane gas) or liquid (biodiesel and bioethanol). Biomass is all material of biological origin (excluding that of fossil formations), such as energy crops, agricultural and forest residues, manure or microbial biomass. In particular, Santa Fe has facilities dedicated to the production of biodiesel, bioethanol, biogas and thermal generation. Therefore, is one of the provinces that leads the production of bioenergies in the country.

The development of green energy based on biofuel and biomass has received considerable attention recently, Ardent et al. (2009), Baer et al. (2015), Harsdorff and Phillips (2013), Kolokontes (2008), Garret-Peltier (2017), Lehr et al. (2008). However, the measurement of the impact on the economy continues to be a challenge, due to the lack of supply and demand information on bioenergy. In this article, we estimate the impact of bioenergy projects based on information collected from existing bioenergy firms, and we develop an input-output model. The model allows to estimate the indirect and induced production and employment that is generated in other branches of the economy. In order to face problems related to the quality and availability of data at the regional level, this study also presents an estimation of a input-output matrix of Santa Fe that includes bioenergy sectors.

Methods

To achieve the objectives, detailed information is required on: i) the supply and demand of the bioenergy sector, ii) the input-output relations of the provincial economy and iii) detailed information on household employment and expenditure by activity. First, to estimate the size and structures of costs and sales of the bioenergy sector, information has been gathered from specific surveys of production companies. Second, the input-output matrix representative of the province's inter-industry relations is estimated. To do this, the mentioned surveys are used and statistical methods are applied. Third, employment information is based on surveys and information collected from provincial agencies and the expenditure structure is estimated from the national household expenditure survey.

The use of an Input-Output model allows us to achieve a broader and more detailed analysis of the effects of a given policy on not only the sectors it directly affects, but also on those that could indirectly benefit or be harmed. To include the effects of upstream industries and consider the use of intermediate inputs, the evaluation requires the use of input techniques resulting from the analysis of the productive chain, Miller and Blair (2009).

The first regional input-output studies used as a starting point the national technical coefficients, which were adjusted to suit the characteristics of the region. The objective of the adjustment is to obtain an input output regional matrix with regional technical coefficients associated with inputs acquired in the region itself, which does not arise directly from the national input output matrix.

Conducive to achieving the input output regional matrix of Santa Fe, Location Quotients (LQ) are used. The location coefficient proposed by Flegg and Webber (1997), the FLQ (Flegg Location Quotient) formula, which takes into account the regional size explicitly, is incorporated. Optimal parameters from Flegg et al. (2016).

About the hybrid methods, the field survey of the biomass production branches serves to estimate the totals of intermediate consumption, the totals of the intermediate sales and several of the components in intersectoral structures of intermediate purchases.

Once the input-output tables have been obtained, alternative scenarios related to public decisions that influence the bioenergy sector are simulated. To estimate the direct, indirect and induced effects of the policies, open and closed Leontief models are used with household consumption.

Results

The simulations evaluate the impact of the potential use of the biomass supply of the province. We consider several scenarios: 1) increase in production of existing plants, 2) entry of new plants, 3) fuel substitution and 4) total bioenergy potential.

The results of the production increase scenarios imply a considerable increase in employment, both in new direct and indirect jobs as well as in induced ones. Concerning production, the multiplier effect duplicates the direct effect.

The increase in investment scenario includes two extreme alternatives: that the machinery is produced and acquired entirely in the province and, on the other hand, that all the expenditure in the Machinery and Equipment sector is imported from the est of Argentina or the Rest of the World. The multipliers of employment are substantially greater than those of production. Assuming that all Machinery and Equipment sector is imported, direct employment decreases significatively.

A third scenario simulates the case where the greatest demand for biofuel is offset by lower demand for conventional fuel and where bioenergy replaces conventional electric power. In terms of production value, in the aggregate the net effect is positive, led by the Biofuel because in Biomass it results in a negative net impact. With respect to employment, high levels of biomass productivity Translate into a negative net effect.

The fourth scenario of comparison estimates the production and investment costs necessary to expand production to the levels calculated with the WISDOM methodology that estimates the total biomass potential of the Province. The strongest impact on employment, both direct and indirect and induced, is derived from the installation of plants.

Conclusions

This study is a first approximation to the regional impact of renewable energy based on biomass on production and employment. Scenarios of increased production with existing capacity, investments in new plants and the substitution of conventional energy for energy based on biomass, were analyzed.

The effect on employment, indirect and induced, is high in the production cases, which is explained by the low level of direct employment coefficient of the production of biodiesel, which is the main bioenergy branch of Santa Fe. Therefore, substitution scenarios generate a net effect of negative employment. The increase in biofuel production capacity leads to the creation of employment. In particular, this is due to the increase in the production of biomass based on agricultural production.

Concerning employment, the main driver is the production of biodiesel in terms of production and of biofuels in general when investment is considered as an engine. With regard to the type of total employment generated by the boost of the bioenergy branches, results similar to the gender, age and education structure of the province are observed. The results suggest a strong impact in terms of employment, mainly derived from the jobs necessary for the construction of the plants.

References

Ardent, F., M. Beccali and M. Cellura, 2009. “Application of the IO Methodology to the Energy and Environmental Analysis of a Regional Context,” in S. Suh (ed.): Handbook of Input-Output Economics.

Baer, P., M. Brown and G. Kim, 2015. “The Job generation impacts of expanding industrial cogeneration.” Ecological Economics 110, 141-153.

FAO, 2018. “Análisis espacial de la oferta and la demanda de biomasa para uso energético, Metodología WISDOM Provincia de Santa Fe.” Buenos Aires, draft.

Flegg, A., L. Mastronardi and C. Romero, 2016. “Evaluating the FLQ and AFLQ formulae for estimating regional input coefficients: empirical evidence for the province of Córdoba, Argentina.” Economic Systems Research.

Flegg, A. and C. Webber, 1997. “On the Appropriate Use of Location Quotients in Generating Regional Input-Output Tables: Reply.” Regional Studies 31, 795-805.

Harsdorff, M. and D. Phillips, 2013. “Methodology for Assesing Green Jobs,” International Labour Organization.

Kolokontes, A., C. Karafillis and F. Chatzitheodoridis, 2008. “Peculiarities and usefulness of multipliers, elasticities and location quotients for the regional development planning: another view,” Department of Agricultural Products Marketing and Quality Control, Grecia.

Garrett-Peltier, H., 2017. “Green versus brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model.” Economic Modelling 61, 439–447

Lehr, U., J. Nitsch, M. Kratzat, C. Lutz and D. Edler, 2008. "Renewable energy and employment in Germany." Energy Policy 36:1, 108-117.

Miller, R. and P. Blair, 2009. Input-Output Analysis. Foundations and Extensions. Cambridge University Press, United States.