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'Sustainable de-growth' in agriculture and food: an agro-ecological perspective on Spain's agri-food system (year 2000)

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ABSTRACT

Traditionally, energy balances in agrarian production have been used to calculate the impact of food on the Spanish economy in physical terms. However, this tool is clearly insufficient. Human diet has undergone significant changes in recent decades. Between production and consumption, previously non-existent or insignificant processes such as transportation, packaging, processing, distribution, preservation, etc. have come to the fore. This article aims to evaluate the energy cost of the Spanish agri-food (AFS) system in the year 2000 with a view to ascertaining the relative importance of each link in the agri-food chain.

This information is essential when it comes to designing any strategy for sustainable de-growth. The results of this research show that feeding the Spanish population is an inefficient process: the Spanish AFS currently consumes 1408 PJ, while all of its residents combined consume only 190 PJ. Agrarian production is effectively the main source of this inefficiency (34% of the primary energy consumed), but not the only one: processes such as the preservation and preparation of food in the home (18%), transportation (17%) and packaging (10%) show that the way we feed ourselves is not sustainable. The paper makes a strong point that a fundamental transformation of the AFS is required. A move towards organic farming and corresponding new consumption patterns (i.e., local, seasonal food, less meat consumption) may considerably reduce resource use in the AFS and contribute to sustainable de-growth in Spain.

1. Introduction

Energy balances in agriculture are used as an important tool to assess the impact agrarian activity has on the environment. They provide information about the depletion of non-renewable resources as well as other environmental problems (Dutilh and Kramer, 2000). In the 1970s, the first research into energy balances in agriculture was published (Leach, 1976; Pimentel and Pimentel, 1979) revealing that new forms of agrarian production were more inefficient since they were increasingly dependent on inorganic inputs derived from the use of fossil fuels, electricity or agrochemicals. In Spain, studies were carried out soon afterwards, offering similar results (Naredo and Campos, 1980; Puntí, 1982; Simón, 1999). These findings indicated that energy efficiency in Spanish agriculture had reduced five-fold in just over two decades, from 6.1 J J^{-1} in 1950–51 to 1.2 J J^{-1} in 1977–78. Reuse levels fell significantly (from 94.3% to 59%) and the use of inorganic fertilisers increased, along with mechanical traction, electricity and phyto-sanitary treatments.[1]

Since industrialisation, the role of agrarian activities in the metabolism between society and nature[2] has changed. From being the main energy source for society (by harvesting chemical energy stored by plants through photosynthetic conversion), agrarian activity has become a resource intensive sector with high energy requirements. Between production and consumption, new economic processes have gradually developed: transportation, packaging, processing, preservation, distribution and consumption. Therefore, in the 1950s, the discipline of Agronomy proposed the idea of the 'agri-food economy', since the provision of food increasingly depended on activities that took place outside of farms (Davis and Goldberg, 1957). The gap between the concept of

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[1] A recent review summarises the different studies about energy balances in Spanish agriculture, in which these estimations can be found (Carpintero and Naredo, 2006).

[2] In relation to the concept of 'Social Metabolism' as it is used in this text, see Fischer-Kowalski and Haberl (1998).

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'agrarian product', understood as the output derived from the production of the agrarian sector (Rodríguez-Zúñiga and Soria, 1986) and the concept of 'food product', understood as the final production of goods resulting from the transformation of agrarian products and addition of diverse uses (Lancaster, 1966), has continued to grow in recent decades.

New dietary habits in western countries are the cause and at the same time consequence of these changes. In Spain, average food consumption measured in nutritional energy has increased by almost 30% since the 1960s, mainly due to the increase in the consumption of fats, which has risen from 72 g/cap/day to 154 g/cap/day in 2001-3 (Schmidhuber, 2006). The abandonment of Mediterranean dietary habits (Alexandratos, 2006), replaced by the mass consumption of products derived from livestock farming, is responsible for the fact that 41% of the population is overweight (Schmidhuber, 2006).

This diet has a high territorial cost for the current Spanish agriculture. According to Carpintero and Naredo (2006), producing a kg of vegetables requires an area of 1.7 m^2 whereas producing a kg of meat takes 7 m^2. Hence, since the mid 20th Century, the ecological footprint of Spanish food has gone from a positive balance of 80000 ha to a deficit of 2.4 million ha in agricultural surface in Span in the year 2000 (Carpintero and Naredo, 2006), a pattern that corroborates what has happened in the rest of Europe, where the amount of 'virtual agricultural land' has a negative balance of 35 M ha (Witzke and Noleppa, 2010), an area equivalent to the size of Germany. Feeding European countries, including Spain, requires the mass importation of agrarian products from elsewhere, mainly those that sustain livestock production (González de Molina and Infante, 2010). All of this increases the participation of non-agrarian activities in the agri-food system.

Consequently, the debate about food cannot focus solely on the ecological performance of agrarian production. The environmental pressures exerted on the rest of the agri-food chain can be much more severe (Dutilh and Kramer, 2000; Heller and Keoelian, 2002, 2003) and, as a consequence, a coherent policy for the promotion of sustainable agrarian systems must take the entire agri-food process into consideration.

The idea of 'sustainable development', promoted over two decades ago with the Brutland Report (WCED, 1987), has not been able to articulate responses to halt environmental problems. For some authors, the very idea of sustainable development seemed to be a contradiction in terms (Georgescu-Roegen, 1993). Practice has shown unequivocally that it is not possible to reconcile economic growth with environmental sustainability (a general overview is provided in Krausmann et al., 2009). However, scientific community, including UNEP (IPSRM-UNEP, 2010), thinks that the western lifestyle is damaging not only its own environment but also that of poorer countries and, in general, the planet as a whole. In this context, the proposal of 'sustainable de-growth' has emerged as a strategy that aims to generate new social values and new policies capable of satisfying human requirements whilst reducing the consumption of resources (a theoretical context in Martínez-Alier et al., 2010). 'Sustainable de-growth' is not yet a formalised theory (Latouche, 2006) but rather a meeting point for social movements, academia or politics. In any case, its future success will depend on the capacity it has to generate coherent political responses and empirical results that shore up its proposals.[3] De-growth-in contrast to the idea of dematerialisation, which aims at a reduction of resource use while the economy continues to grow-, in our opinion goes further and means that significant reductions of resource use require fundamental changes in the production and consumption system (Schneider et al., 2010; Spangenberg, 2010).

The aim of this article is to place the current environmental problems of agriculture and food at the centre of the debate surrounding 'sustainable de-growth'. To do this, a change in approach is essential, evaluating the physical cost of feeding the Spanish population as a whole, beyond the agrarian sector. For this purpose, the total energy use of the Spanish agri-food sector (AFS) was calculated, from agrarian production to domestic consumption. Breaking this total figure down into specific processes, we can identify which parts of the chain give rise to the majority of the energy consumed and, consequently, propose alternatives for sustainable de-growth. The first section outlines the methodology used and the limitations of this study. The second section describes the main research results. Thirdly, and finally, the debate is opened about the possibility of reducing the energy consumption of the agri-food sector by promoting organic farming with agro-ecological criteria and responsible consumption.

2. Methodology and system boundaries

LCA methodology is fully standardised (ISO, 1997) as an official tool used to evaluate the environmental burdens of producing certain products or certain activities, attempting to reflect them from the 'cradle to the grave'. It would be impossible to cite all the case studies to which it has been applied, even just within the agrarian sector.[4] The aim here is not to apply its precepts rigidly to the entire agricultural and food sector (AFS), since this would be unachievable. We merely take on board the philosophy of its proposals with a view to estimating the energy use of the sector at an aggregated level from the 'land to the table', offering data that can be used to evaluate the level of sustainability of the Spanish agri-food chain in the year 2000. For this purpose, we are following the methodology proposed by Heller and Keoelian (2002) in their study of the Life Cycle Analysis of the US Food System from the late 1990s. The different Spanish statistical sources mean that our estimations are somewhat different. At the end of this text there is a methodological annex included, detailing the calculations carried out and the sources used.

All AFS are inserted into international markets where they exchange materials and energy with many other sectors and territories. It is impossible to reconstruct the precise boundaries of their biophysical structure with the statistical data and case studies currently available. Spanish agriculture, for example, consumes energy to produce not only food but also other types of goods such as fibres, fuels, etc, which cannot be distinguished. Furthermore, the energy consumption of the AFS transcends national borders in complex networks that make it impossible to evaluate the energy consumed in other territories destined for the Spanish market.[5] Similarly, there is consumption in activities of other sectors, such as the services sector (for example, in advertising) which, with the available statistical data, has been impossible to estimate.

We took into consideration the energy consumption of six main activities included in the Spanish national agri-food chain: agrarian

[3] In the last five years, there has been a boom in the bibliography about 'sustainable growth'. An interesting summary can be found in the special issue published in this magazine: Journal of Cleaner Production (2010), issue 18. See Schneider et al. (2010), Griethuysen (2010) and Spangenberg (2010). Or, in Spanish, a monograph about sustainable growth included in the magazine "Ecología Política" (2008). For a more summarised version, see the recent review of this issue provided by Martínez-Alier et al. (2010).

[4] See the work of Audsley (1997). For Spain, a summary of different studies on LCA and agriculture can be found in: Rieradevall and Antón (2004).

[5] According to the data by González de Molina and Infante (2010) Spain's agrarian production does not suffice to feed its population. In the last decade, Spain has consumed 109 Mt of agri-food products and produced only 98 Mt. Consequently, although Spain exports 20 Mt. it is necessary to import more than 30 Mt. This implies that feeding the Spanish population requires more energy than estimated in this paper.