Introduction

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1 Introduction

Over the last decades, agricultural production has risen constantly. Unfortunately, the increase in agricultural production has often been accompanied by degradation of environmental conditions, such as soil erosion, the pollution of aquifers and surface water bodies, a loss in biodiversity, and negative effects on the health of consumers and agricultural workers. The increase in agricultural production has also often been coupled with the introduction of new technologies, which have increased output at the expense of environmental quality.

Over the last 10–20 years, there has been a shift from purely productive technologies to productive and environmentally friendly technologies. The main objective of this special issue of the *International Journal of Agricultural Resources, Governance and Ecology* is to explore the effects of the introduction of new technologies on output and environmental quality. In order to address the issue of environmental quality, an active resource management system is required. However, this management regime must be closely tied in with the management of agricultural production from an agronomic and economic point of view. Therefore, the aim of this special issue on Technology and Resource Management in Agriculture is to integrate both management regimes, and to analyse to what extent new technologies can make environmental and economic objectives compatible.

This special issue is a collection of papers that focus on some of the main questions related to agricultural innovation and environmental quality: pollution reduction and technology, nonpoint source pollution from agricultural land, valuation of the risks and benefits of technologies that employ genetically modified organisms, and technologies for the reclamation and reuse of wastewater in agriculture.

2 Pollution reduction and technology

The relevance of pollution-reducing and resource-saving technological progress is discussed in the paper by Nelissen and Requate, which is a survey of the main theoretical literature on these types of technological progress. The authors divide the literature into two categories. The first deals with microeconomic models that involve incentives to adopt and develop more environment-friendly technologies in different economic environments, such as market structure and timing and commitment patterns. Normally, price-based instruments, such as emission taxes and tradable permits, perform better than command and control policies and under competitive conditions, optimal ex-ante and ex-post policies are equivalent. Under imperfect market conditions, policy conclusions are more suitable.

The second category deals with pollution-reducing and resource-saving technological progress within endogenous growth models. Most of these models are characterised by three market imperfections: market power for new (intermediate) products, positive R&D spillovers, and pollution. These imperfections can be mitigated by subsidies for intermediate products, subsidies for R&D efforts, and a tax on emissions. Moreover, in most models, there is a trade-off between the speed of growth and environmental quality.

3 Nonpoint source pollution from agricultural land

The issue of agricultural nonpoint source pollution is taken up in the papers by Lacroix, Bel, Mollard and Sauboua; Martínez, Calvo and Albiac; and Wossink and Denaux.

In the paper by Lacroix, Bel, Mollard and Sauboua, spatially targeted environmental policies are considered optimal, since economic agents attune their efforts according to the sensitivity of the environment in which they operate. Some empirical findings suggest, however, that this advantage is undermined by the high cost of information. One of the main proposition of the paper is that it is possible to reduce the spatial scale and, simultaneously, to limit costs and retain environmental effectiveness. The paper analyses the example of nitrate pollution of water using a biophysical model coupled with an economic model. A cost-effectiveness analysis of various solutions for mitigating water pollution was conducted at two sites in France. The paper shows that a substantial part of the differences between abatement costs may be explained by nitrate pollution heterogeneity due to soil characteristics, climate variability and the agricultural context. Moreover, the paper puts forward decision-making guidelines for investigating the trade-off between the scale of the abatement effort and its effectiveness.

The paper by Martínez, Calvo and Albiac is an empirical assessment of nitrogen pollution abatement in the Ebro basin in northeastern Spain. Its aim is to contribute to the ongoing policy debate by ranking several emission-control measures. The results indicate that nitrogen-based instruments are more cost-efficient than water-based instruments. This finding questions the reliance of the Water Framework Directive on water pricing to improve water quality. The study also provides welfare, quasi-rent and pollution information for each crop and control measure. This information could be useful when abatement measures are differentiated by crop type, in cases of valuable ecosystems and heavy nitrogen damage costs.

The paper by Wossink and Denaux focuses on the implications of efficiency and innovation offsets for the management of nonpoint source pollution from agriculture. They develop a theoretical model of a farm in which pollution is a joint output of production. Moreover, inefficiency in production prevails and environmental innovations are available. The paper presents a discussion of whether education on farming practices that are more environment-friendly would be effective in this context. The empirical analysis carried out by the authors addresses pesticide use in conventional and genetically modified cotton production in North Carolina, USA. The conceptual model is implemented by means of the non-parametric directional distance function approach in Data Envelopment Analysis (DEA).

4 Valuation of the risks and benefits of technology

Issues surrounding techniques for the valuation of environmental risks and benefits of technology are currently a priority in all agrifood markets, because of the growing awareness and concern about environmental costs and benefits of agrifood production.

In the paper by Gracia, Pérez and Sanjuan, a hedonic approach is used to study farmland prices in Aragón (Spain). Data characterising over 450 transactions in 33 counties in 2001 and 2002 are analysed, and the marginal values for irrigated vs. non-irrigated land, the productive orientation and the differentiation of production

through the designation of an origin quality scheme are computed. The socio-economic variables of the counties are also included as additional explanatory variables in the hedonic function. A Box-Cox transformation is used to test for the most appropriate functional form, in order to reconcile the theoretical postulates with the statistical model that best fits the data. The analysis indicates that the availability of water, crop orientation, and eligibility within a designation of origin are the key factors affecting farmland prices, while the social environment and infrastructure of the rural community has only a minor impact.

The paper by Loureiro presents a contingent valuation modelling approach that allows a net 'willingness to pay' to be calculated for the case of proponents and detractors of genetically modified crops and foods. 'Willingness to pay' is contrasted with 'willingness to accept', and a net 'willingness to pay' estimate is computed. The results suggest that not properly accounting for the existence of negative preferences may seriously bias welfare estimates. These findings encourage policymakers to assess new technologies by employing a framework of heterogeneous consumer preferences, including both perceived benefits and perceived risks.

5 Technologies for the reclamation and reuse of wastewater in agriculture

The economic viability of a system for the reclamation and reuse of wastewater in the village of Colera in Girona, Spain, is the central issue of the paper by Seguí. The village of Colera is located in the northeastern corner of the Empordà region, in Catalonia (Spain). In the paper, policies for integral water management are described, and a methodology covering the identification, quantification and economic evaluation of different environmental impacts is applied to vineyard irrigation. According to the author, reusing the reclaimed water produced in Colera to irrigate vineyards would generate a maximum benefit of 6.3089 €/m^3. If all the costs involved in the reclamation and reuse of wastewater were recovered, the minimum sale price of the regenerated water would be 1.69 €/m^3. The results reflect the fact that recovering the investment and establishing finance rates in agreement with the user improves the viability of the water reclamation and reuse plans and programs over time.