Analysis

An economic analysis of the possibility of reducing pesticides in French field crops

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1. Introduction

The harm caused by pesticides to human health and the environment is a major subject of concern which involves some sensitive issues such as drinking water contamination, the health of users and the harmful effects on wildlife and biodiversity. In France, which ranks third in the world (and first in Europe) for the use of field crops, the strong social and political willingness was displayed in 2008, in a large social forum tracing objectives of the environmental policy of the country (known as the “Grenelle de l’environnement”). Ambitious targets were set and different measures and incentives are currently being implemented. The objective of reducing, if possible, the use of pesticides by half by 2018 has been announced.

The issue of reducing pesticide use has also emerged in the environmental policy debates in several other European countries, and therefore in 2009 the European Union (EU) adopted a common framework (directive 2009/128/EC) that requires each member state to submit a 2012 action plan to reduce pesticide use in agriculture. The EU directive gives the policy launched in France a broader perspective.

However the objectives set in 2008 are still under discussion: is the 50% reduction target realistic? What would be the consequences of such a level of reduction on French agricultural production and on farmers' income? What are the economic incentives needed to encourage such a reduction?

Our research was conducted to help answer these questions.1 The work we present here concerns the French production of field crops. Although the use of pesticides per hectare of crops is not as high as in other crops (fruit, vegetables, and vineyards), the territorial extent of field crop production is such that any global reduction of pesticides in France necessarily involves a reduction in the field crops sector. In 2006, field crops represented 80% of the total cultivated land and accounted for 68% of the pesticides used in agriculture. During the last ten years, pesticide use in French agriculture has been quite stable, showing no decrease despite a fall in prices for agricultural products relative to input prices. Most of the French production of field crops is grown using intensive conventional techniques. Although some farmers use less intensive techniques, it is difficult to know exactly what proportion of the total field crop area is concerned. The fraction of organic farming of the total field crop area is around 1% (Butault et al., 2010).

In this context, the evaluation of the effect of a reduction in pesticide use on agricultural production raises the question of how to take account of the possible changes in the production techniques used by farmers. Most of the recent work on analysing the effects on European agriculture of a reduction in pesticide use based on economic simulation models does not consider this aspect. Because of this they lead to the conclusion that reinforcement of the regulation of pesticides would have dramatic consequences on the supply of agricultural products and farmers' income (Nomisma, 2008;...

1 It is part of a large interdisciplinary study “Ecophyto R&D” carried out by the French “Institut National de la Recherche Agronomique” (INRA) in order to answer specifically the three mentioned questions, this study has been done at the request of the French ministries in charge of agriculture and the environment. All the results can be found on the INRA website.
Adenauer and Witzke, 2008). However, in Europe, particularly Denmark, there have been successes with policies for reducing pesticides allowing significant reduction without harm to the production or to farmers’ income (Neumeyer, 2007; Nielsen, 2005).

Taking account of farmers’ changes of practices in the analysis of the effects of medium- and long-term policies is the main difficulty of approaches based on econometric estimations (Carpentier, 2010). From this point of view, mathematical programming has the advantage of allowing an analysis of modifications in the production decisions of farmers, independently of what has already been observed in the past. A detailed representation of the production technologies can be embodied in the economic models. It thus makes it possible to study the environmental impacts of agricultural production considering the joint production of agricultural outputs and environmental externalities. This explains why this approach has been adopted by many economists analysing the impacts of changes in agriculture practices on the environment (Buyssse et al., 2007; Falconer and Hodge, 2001; Havlík et al., 2005; Mosnier et al., 2009; Peerlings and Polman, 2008; Van Calker et al., 2008).

However it is difficult to obtain the data needed for such analysis at an aggregated level. Consequently, the economic studies addressing the issue of pesticide use reduction are generally based on data from observations on a few farms, or data from agronomic experiments (Falconer and Hodge, 2000; Falconer and Hodge, 2001, Kerseelaers et al., 2007, Van Calker et al., 2008). Thus, most of them are conducted at the farm level.

The novelty of our paper is to conduct an economic analysis of the possibility of reducing pesticide use at the national level (i.e. for France) using a mathematical programming model and taking into account alternative technologies. The construction of different production technologies by experts is the solution that we have chosen to provide indicators for techniques ranging from low-input to organic production, for which we lacked data in the farm-based surveys. Those experts used their knowledge combined with data from different sources from statistical surveys, experimental data and farm networks.

We present the method in Section 2; firstly the design of current and alternative production techniques, then the model and the scenarios. In Section 3 we present the results. Section 4 is devoted to a discussion of the results and Section 5 to conclusions.

2. Method

Our methodology relies on a combination of two approaches. Firstly, a group of agronomists studied the feasibility of pesticide reduction in the main French field crops and elaborated for each crop (and several climatic zones) alternative crop management plans to reduce the use of pesticides. Next an economic evaluation of the alternative crop management plans and of economic incentives that would allow the possibilities of reducing pesticide use. This indicator is defined as the number of treatments applied, multiplied by the ratio of the applied dose per hectare to the recommended dose (OECD, 2001; Pingault et al., 2009). It thus took into account the intensity of treatment, which can be applied in reduced doses or on only one part of the area (e.g. chemical weed control in the row only). Using the EPC survey TFI was calculated from records of each treatment applied to plots compared to recommendations, per class of product: herbicides, fungicides, insecticides and “other pesticides”.

Other indicators were also used, particularly the number of times pesticides were applied (in order to estimate working time), the energy cost and the nitrogen balance. The nitrogen balance (in kg of nitrogen per hectare per year) was defined as the total quantity of nitrogen applied to the field, minus nitrogen exports calculated from the crop yield and nitrogen export coefficients per crop. The energy cost (in gigajoules per hectare per year) took into account the energy directly consumed by agricultural equipment and the indirect energy consumption used to produce fertilisers.

The estimates of costs per hectare of crops from the FADN data provide results in terms of costs per hectare that are not exactly the same but are consistent with input quantities obtained from the

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2 This latter class covers products used against pests like mollusks, and substances that are not, strictly speaking, pesticides, but which have a controlling effect on crop development (cereal growth regulators).
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