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Sustainable Agriculture: A Technical or Economic Issue? Reducing Nitrate Water Pollution with Market Incentives

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Abstract

The introduction of the economic dimension into the design of sustainable agro-ecological systems is essential to the different stages involved in identifying the problem and finding viable solutions within a sustainable development perspective. Taken as an example, the problem of nitrate water pollution caused by agriculture is faced by analysing the possible employment of economic instruments as market incentives for the implementation of less polluting agricultural practices. EC's actions are also briefly assessed.

Problem and objectives

The public-type nature of most environmental goods and services, missing markets, market and government failures, have all contributed and still contribute to modelling agricultural realities which are blamed for causing welfare decreasing externalities to society. It cannot be denied that the choice of the production process, the adoption of new technologies, the amount and timing of external/internal input used are driven by economic appraisals mainly following a private point of view. At issue is not the private decision process but the lack of those element of cost (external costs) that should be included in the decision process in order to internalise environmental and social costs at the farm level. If the farmer paid the full cost of his activity he would efficiently allocate not only the priced production factors but also all those unpriced natural and environmental goods and services which participate to the production process either as input or as receiving media for the waste products. This would be translated into shifting towards agricultural systems designed to take account of a wider spatial and temporal dimension of their impacts, thus becoming more "sustainable", even though some concern arises from defining "sustainability" in absolute terms, since it is important to clarify what is being sustained, for how long, for whose benefit and at whose cost, over what area and measured by what criteria. It is somehow surprising that although rational agricultural techniques and shrewdness are known and suggested by agriculturists and scientists to mitigate the impact of agriculture on the environment, some obstacles still persist thus impeding a wide implementation. Promoting "voluntarism", through moral suasion, education and assistance, is a possible option but it is likely to produce some results mainly when farmers' profits can be increased or there is the belief that failure of the approach will eventually lead to mandatory action. It is then important to create forms of economic incentives through market instruments such as taxes, marketable permits, subsidies etc. in

order to make farmers apply those techniques that, although highly sustainable, would not be implemented otherwise.

Material and methods

The vast literature on the issue of nitrate water pollution has been essential to follow an environmental economics theoretical path in order to highlight the feasibility of adopting market incentives to the analysis and design of feasible agri-environmental policies. Although aware of the need of a wider approach to assess alternative policy options on the ground of economic efficiency, this paper mainly focuses on the environmental effectiveness of different economic instruments.

As Shortle and Dunn (1991) point out that along with assessing the benefit of water quality protection, the cost of adjustment in agricultural production, the cost of administration and enforcement, economic criteria for evaluating alternative policy options also include "The incentive created for the development and adoption of less polluting production methods, shifts to products less intensive in polluting inputs, and reallocation of production from higher risk to areas with lesser risk of water quality problems."

Results

The design of appropriate environmental policies to tackle the problem of nitrate water pollution from agricultural sources is a quite difficult task because of the nature of the pollution process and the aspects to be considered. The fact that agriculture is a non-point source of water pollution creates great difficulties in relating nitrate emissions to the polluters. Moreover what is defined as emission is the real quantity of nitrate reaching surface and ground water and not the nitrogen applied. Unfortunately, this feature rules out the use of taxes on nitrate emissions, which would appear to be very cost-effective. In terms of environmental effectiveness a tax on emissions would give to farmers the right incentives to modify the agricultural management in order to reduce the level of nitrate emissions, farmers would change the choice of crops, the mix and timing of fertiliser applications, and agricultural practices.

Monitoring problems associated with the inability to observe directly individual emissions are one of the causes that have driven environmental economists to focus on the control on inputs.

Taxes on nitrogen fertilisers, although attractive for their potential for raising revenue and ease of administration, have many drawbacks. Only a high tax rate (England, 1986; Burrel 1989) leads to a significant reduction of inorganic fertilisers, which would severely affect farm profitability. "The agricultural sector is now faced with surpluses, but also income problems, so the farm lobby is likely to argue against the operation of the "polluter pays' principle" (Bonnieux and Rainelli, 1988). Moreover, a tax on fertilisers is not cause oriented which means that is not environmentally effective. It should not be forgotten that inorganic nitrogen fertilisers are only a partial cause of the problem; organic fertilisers, leguminous crops and soil humus all contribute to the amount of nitrogen present in the soil. The incentive given by the tax might cause farmers to reduce inorganic fertilisers but at the same time changes in cultural practices and management are likely to occur and perhaps to exacerbate the problem.

An important limit of the tax scheme is that it cannot be spatially differentiated penalising farmers irrespective of the damage done. "The non-trivial real economic costs of reducing chemical use even under a least-cost approach underline the importance of environmental targeting in the management of non-point source pollution. Targeting of environmental policies to areas with the most severe pollution problems reduces total costs of pollution control and improves the linkage between environmental protection" (Rendleman, Kenneth, Reinert and Tobey, 1995).

Land use permits suggested by Pan and Hodge (1994) along with their cost-effectiveness of an emission control policy and straightforward implementation and monitoring, also offer the advantage that they can be targeted spatially. Land use permits would essentially be leaching permits in terms of Kg of nitrate per hectare. Farmers would be required to hold a prescribed number of permits per hectare according to specific land uses. "The number of permits required for each type of land use would depend upon the extent of nitrate leached from it. This would be established according to local data relating to the land use and soil conditions rather than being measured for each site individually. The data could take account both of the general type of land use and of its intensity, subject to the feasibility of policy compliance with the land use" (Pan and Hodge, 1994) The attractiveness of this approach is that subject to an overall leaching constraint farmers would be free to maximise their return to land use. For instance, they might crop some of their land intensively and allocate the rest for land uses with little or no leaching, such as forestry or even land retirement. Needless to say that the total number of permits issued would be calculated on a catchment basis and they would be tradable only within the same catchment.

The importance of targeting is particularly felt by the European Community. The design of "vulnerable zones" and "homogeneous areas" required by the EC Nitrate Directive (91/676) and the Agri-Environment Programme (Reg 92/2078) respectively, is clearly an attempt to differentiate and concentrate action on particular environmental realities.As for the EC Directive 91/676, the Code of Good Agricultural Practice, although to be implemented by farmers on a voluntary basis is in nature a command and control regulatory standard approach. In fact it makes use of "Design standards" requiring farmers in the vulnerable zones to follow rules on the amount and timing of applications of fertilisers and manure, and to meet specific requirements for manure storage.

Despite the high cost of implementation (farmers would receive a payment for adhering to the scheme) and difficulty of enforcement, this approach is environmentally effective since it suggests the right farming practices that farmers should follow. It should not be forgotten that often farmers do not know what are the right agricultural practices to reduce nitrate pollution.

The Agri-Environment Programme (Reg.92/2078) also provides an aid scheme to induce farmers to reduce fertilisers by a "substantial amount". In this case the focus is mainly on the amount, of fertilisers applied thus diminishing the environmental effectiveness of the scheme whose success will depend on the level of fertilisers that farmers will be required to reduce.

A common feature of both the Directive and the Regulation is that farmers can adhere to such schemes on a voluntary basis and be compensated thus neglecting the operation of the "polluter pays" principle. The evidence provided by the EC's legislation on the agricultural sector it makes appear that political viability is an important factor to be considered when designing agri-environmental policies.

Conclusions

The use of market instruments to incentive the adoption of more sustainable agricultural activities is assessed in light of the need to take account of the economic dimension when defining sustainable agricultural systems. The specific case of nitrate water pollution is taken as a good example to highlight how farmers may modify their behaviour according to the different market incentives. Being agriculture a non point source of water pollution, this creates some problems regarding the application of taxes on fertilisers and taxes on nitrate emissions. Land use permits (Pan and Hodge, 1994) are described for the advantages they may present. Their employment could be broaden to take account of others polluting factors such as soil erosion, pesticides and so on.

Along with political feasibility, the main constrain to the introduction of economic instruments in agriculture seems to be the scarce knowledge about the links between agricultural activities and polluting emissions. It is then suggested that, when defining agricultural systems, a particular attention should be paid in the calibration of mathematical models which elaborate information on farm management activities, weather, soil characteristics and other relevant factors to estimate farm pollutant flows, if economic instruments are to be efficiently adopted. The EC' action, highly influenced by political feasibility, is in nature a command and control regulatory approach, which is aimed at differentiating and concentrating actions (targeting) in particular environmental realities, where design standards are meant to make farmers implement those agricultural practices with high environmental effectiveness.

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