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Efficiency of Farm Conservation and Output Reduction Policies

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ABSTRACT

This paper examines recent European policy initiatives from the point of view of technical and economic efficiency. It is shown that policies which focus primarily on agricultural output reduction are technically inefficient since they do not take advantage of the potential complementarity between reducing agricultural output and increasing the output of rural environmental goods and services. It is also shown that the use of a budgetary break-even rule is not consistent with economic efficiency and that the first best social optimum might be achieved, without dismantling existing supports, using a type of cross-compliance policy.

1. This paper has benefited greatly from comments by David Colman, Trevor Young and Michael Burton. Any remaining inaccuracies or inconsistencies are the author's responsibility.

1.0 Introduction

In an era of chronic food surpluses and continuing degradation of the rural environment the notion of encouraging more extensive forms of agricultural production has many attractions; it leads to a reduction in budgetary support costs as output is reduced, while offering the possibility of increasing the stock of rural environmental resources. Many recent European policy initiatives have tended to focus on one or other of these problems. Among those policy instruments which have been implemented are stabilizer mechanisms (e.g. co-responsibility levies), output reduction policies (e.g. set-aside) and environmental management subsidies (e.g. the environmentally sensitive areas scheme).

This approach to policy management, which seeks to implement independent policy instruments for different policy objectives, provides the framework within which any desired level of each objective can be achieved in the long-run. However it may lead to inefficiency, especially in the short to intermediate term, if the complementarities between the achievement of different objectives are not properly exploited.

This efficiency problem can occur in many different sets of circumstances of which one important set is represented by the potential complementarity between output reduction and environmental improvement. The potential efficiencies which might be achieved by integrating output reduction and environmental improvement policies are the focus of this paper.

2.0 The Analytical Framework

It is assumed in this paper that farming and food production activities are inextricably associated with changes in the rural environment. An annual flow of environmental goods and services is posited. This is treated as a homogenous aggregate here to simplify the analysis. In reality there are many different goods and services, each contributing in various ways both to the rural landscape and to the rural ecology. Landscape and ecology are represented here as a single aggregate environmental stock. Agricultural output is also treated as a single aggregate annual flow.

2.1 Technical Relationships

The technical relationships underlying the analysis are described in Figures 1 and 2, which show how the annual flow of environmental goods and services, and the equilibrium environmental stock, respectively, change in response to changes in the annual level of agricultural output for a given endowment of land and other inputs.[1]

In Figure 1, the vertical axis (A) measures annual agricultural output while the horizontal axis (F) measures the flow of environmental goods and services. Negative environmental flows are allowed, reflecting the notion that environmental deterioration can occur depending on the technology and the specific set of production techniques.

The curve aa', represents an intensive technology and is drawn to reflect the popular view that intensive agriculture, while maximizing agricultural output, leads to environmental deterioration. The technique of production used will depend on relative input and output prices and will determine where on aa' production takes place. The technology bb', on the other hand, produces a lower level of agricultural output but represents a set of techniques which are more environmentally friendly. Similarly, cc' represents the extensive technology with point c' representing the extensive margin of production.

The curve enveloping these technologies may be regarded as an agro-environmental frontier relationship since it represents the maximum attainable flow of environmental goods and services for any level of agricultural output and vice-versa. Such a relationship will be continuous, even where only a limited number of discrete technologies exist, as long as each technology is scale-divisible over land.[2]

Point d represents the idea that total abandonment of the land leads to environmental deterioration. This assumes that the relevant environmental stock is of "semi-natural" rather than "natural" origins. Many European rural environments would fall into this category including the heather moorlands of the British Isles, mountain meadowlands in the Alps and Pyrenees and wet grasslands in many parts of the continent. Partial abandonment of the land area can, in some circumstances, be represented by points on dc'.

In Figure 2, the horizontal axis, A, represents annual agricultural output as above, while E on the vertical axis represents the equilibrium environmental stock which would be attained, if the given area of land were continuously farmed using techniques on the agro-environmental frontier. An asymptotic monotonic relationship is assumed between E and F such that points, d, c' and a in figure 2 correspond to points d, c', and a in figure 1.

2.2 Economic Relationships

The profit curves corresponding to technologies aa', bb' and cc' (figure 1) are labelled a, b and c respectively in Figure 3. These curves are drawn to represent differences between the technologies which include direct investments in environmental regeneration (such as dam construction to maintain wetland habitats or the rebuilding of field boundaries to facilitate traditional livestock management and contribute to traditional landscape patterns), as well as reductions in variable inputs which reduce both variable costs and land productivity.

The curve DD' represents the agro-environmental profits frontier and shows the maximum profits which can be achieved using techniques on the technical frontier illustrated in figure 1. The continuity assumption in figure 1 also holds here.

Reversing DD' and transforming the resulting relationship into E-space gives the relationship S'S in figure 4. This shows the cost in terms of foregone profits of efficiently achieving alternative levels of E (i.e. by moving along the agro-environmental frontier). The segment S"S corresponds to c'd in figures 1 and 2. For rational profit-maximizing producers this relationship may be interpreted as a subsidy requirements curve.

Since increases in the achievable level of E are associated with increases in F in figure 1 and hence with reductions in the level of agricultural output, there will also be a reduction in the costs of agricultural market support as indicated by the relationship B'B in figure 4.

The marginal economic relationships in E-space, the focus for subsequent policy analyses, are shown in figure 5. The relevant part of the marginal subsidy requirements curve is S'S", while B'Eo is marginal budgetary costs. Both of these relationships are defined for points on the agro-environmental frontier.

The marginal value of the environment, which allows us to define the socially optimal environmental stock, is represented by V'V. This reflects the public's demand for the rural environmental good and is taken as given for the purposes of this paper.

The remaining relationship in figure 5, EoSw is an alternative marginal subsidy requirements curve defined for movements along the agro-environmental frontier when agricultural prices are at free-market "world" levels.

3.0 Policy Alternatives

A limited number of policy alternatives are examined in this paper and these are summarised in Table 1. The primary distinction is between those policies which are geared towards reduction of surpluses and budgetary expenditure and those which include environmentally positive components. Set-aside, extensification and price reduction policies belong to the former category. Within the latter category we can make a further distinction between those policies which provide incentives by subsidizing environmentally positive action and those which provide similar incentives through altering the structure of property rights. This distinguishes between the Farm Conservation Grants Scheme, the Environmentally Sensitive Areas Scheme, Management Agreements and Environmental Purchase/Leaseback schemes (Colman, 1989) on the one hand, and Cross Compliance schemes (Batie and Sappington, 1986) and Direct Planning Controls on the other.[3]

The efficiency and cost-effectiveness of some policies from each of these categories is examined in subsequent sections of this paper.

Table 1 : Alternative Policies Considered in this Study

A. Support Expenditure and Surplus Reduction Policies

- Set-Aside
- Extensification
- Price Reduction

B. Environmental Incentive Policies

(1) Environmental Management Subsidy Schemes
Conservation Investment Grant Schemes
Enviornmental Purchase/Leaseback Schemes

(2) Cross-Compliance

4.0 The Efficiency of Output Reduction Policies

Policies which focus primarily on reducing output, while targeting a single policy objective, are technically inefficient (Farrell, 1957) because they ignore potential complementarities between agricultural output and the rural environment. This is easily demonstrated in figure 1.[4]

Taking X to represent the current farming technique selected from technology "a" so as to maximize farmer profits, a set-aside policy, involving partial abandonment of the land area, is illustrated by some point on Xd. This type of policy is clearly inefficient because any point between X and d represents the provision of a lower level of the environmental good, for any given level of agricultural output, than could be obtained by using a technique on the agro-environmental frontier.

Extensification policies, on the other hand, which involve a reduction in variable inputs, are represented by movements from X towards a'. Again these policies are clearly inefficient since they constrain farmers to using techniques which are not on the frontier. Since the effect of a reduction in output prices, leading to a reduction in the output/input price ratio, is similar to that of extensification policies, these too are agro-environmentally inefficient.

5.0 The Efficiency of Environmental Incentive Policies

Policies which provide incentives to farmers to adopt environmentally sensitive production practices could lead to technically efficient production to the extent that techniques on the agro-environmental frontier can be identified and effectively monitored for a given area of land. These techniques can be represented by some point on YC' of figure 1.

The subsidy required for the adoption of these techniques by profit maximizing farmers is represented by points on YS" of figure 4. Alternatively this represents the cost to farmers of meeting the requirements of a cross-compliance policy or of following environmental planning controls.[5]

Further analysis of these policies relies on the marginal relationships presented in figure 5. The intersection of VV' and S'S" identifies the socially efficient level of the equilibrium environmental stock (E") under current policies. This might be regarded as a "second-best" optimum since it is derived on the assumption that present levels of agricultural support will continue. On the other hand, E* represents a first best optimum. The underlying assumptions here are that all existing market supports are removed (at least at the margin) and that technically efficient agro-environmental techniques are being used. In addition a subsidy equivalent to the marginal value of the environmental good is assumed available.

Another point of interest in this figure, E', corresponds to the level of environmental stock which is optimal from a budgetary costs point of view since marginal subsidy payments and marginal budgetary savings are equal at this point. It is not surprising that this point is clearly non-optimal from a social point of view even if a budgetary break-even rule might have been used in guiding some recent policy decisions.

Point Eo corresponds to the level of environmental stock which could be achieved using efficient production techniques when all market supports are removed and no further subsidy is provided (cf point e in figures 1 and 2 where ao is the free market level of agricultural output).

Since figure 5 represents only technically efficient production techniques, output reduction policies need not be discussed here. It is clear, however, that any given level of environmental stock can be achieved using a suitably designed incentives policy.

If environmental subsidies are used to provide the necessary incentives then areas under S'S" indicate the total subsidy required to achieve any given level of environmental stock (assuming current market support policies are not charged). Thus E' can be achieved at zero cost while for E" or for E*, the first best optimum, the cost of subsidies could be substantial.

A cross-compliance policy could have distinct advantages in this situation. By requiring production of the environmental good in order to qualify for receiving support payments, the adoption of this type of policy removes the need to consider providing one kind of subsidy to compensate for loss of another. If the compliance guidelines required use of technique "e" in figure 1, then level Eo in figure 5 could be achieved at no additional budgetary cost (i.e. using a "red-ticket" policy). By contrast, the first best optimum, E*, could only be achieved on payment of additional subsidies at a level equivalent to the marginal value of the environmental good, (i.e. using a "green-ticket" policy).

6.0 Summary and Conclusions

The analysis presented here focuses on recent agricultural policy initiatives aimed at the problems of production surpluses and rural environmental deterioration. A distinction is made between those policies which are geared primarily towards surplus reduction and those which incorporate environmental guidelines. Among the latter policies a further distinction is drawn between those which provide subsidy payments and those based on the notion of cross compliance.

The analysis clearly shows that only the policies which exploit the complementarity between agricultural production and the production of the environmental good, can be technically efficient. They can achieve environmental efficiency if guidelines and monitoring procedures are carefully implemented. These policies could also be socially optimal, in a "second-best" world, if the usual marginal conditions are met. However the use of marginal rules based on budgetary break-even criteria, is inappropriate in this context.

A cross compliance policy might allow the possibility of achieving an improvement over the second-best optimum, leading to higher levels of environmental goods and services, with no additional budgetary costs over and above those required for market support. With this type of policy, however, the first-best social optimum could only be achieved by paying additional subsidies.

Notes

1. Viewing the given endowment of resources as being equivalent to the "European farm" simplifies part of the analysis.

2. With a limited number of technologies and in the absence of scale-divisibility, the frontier will be upper semi-continuous.

3. Cross-compliance schemes, which make the receipt of market support (and other agricultural subsidies) conditional on implementing specified environmentally friendly production techniques, have been operated for many years in the U.S. (See Batie and Sappington). An important distinction is between "red-ticket" policies, where compliance attracts only existing subsidies, and "green-ticket" policies, where additional subsidy is payable.

4. The agro-environmental frontier in figure 1 represents points which are technically efficient in the sense defined by Farrell. At least one point on this frontier (where the ratio of the marginal values of agricultural and environmental outputs is less than or equal to the slope of the frontier) will also be economically (and socially) efficient.

5. An important distinction between cross-compliance policies and planning controls is that while the former allows the farmer the option of not complying (albeit with loss of revenue) the

latter involves using legal powers to force compliance. Since voluntary participation is generally regarded as a fundamental requirement for a viable agricultural policy, planning control policies are not discussed further in this paper.

References

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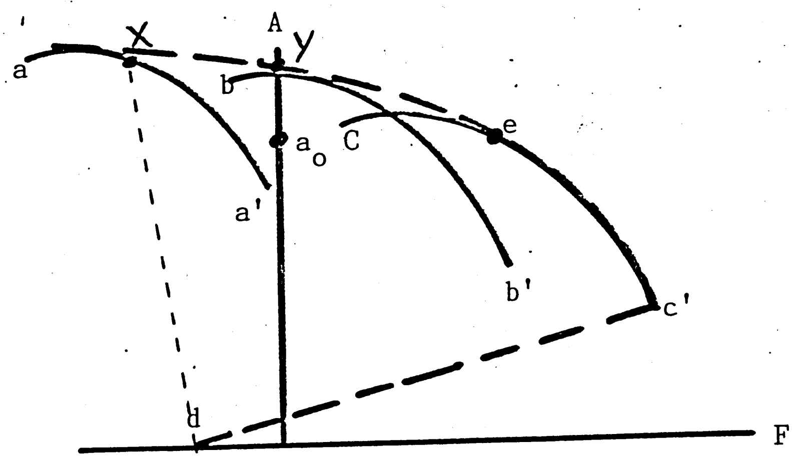

Figure 1

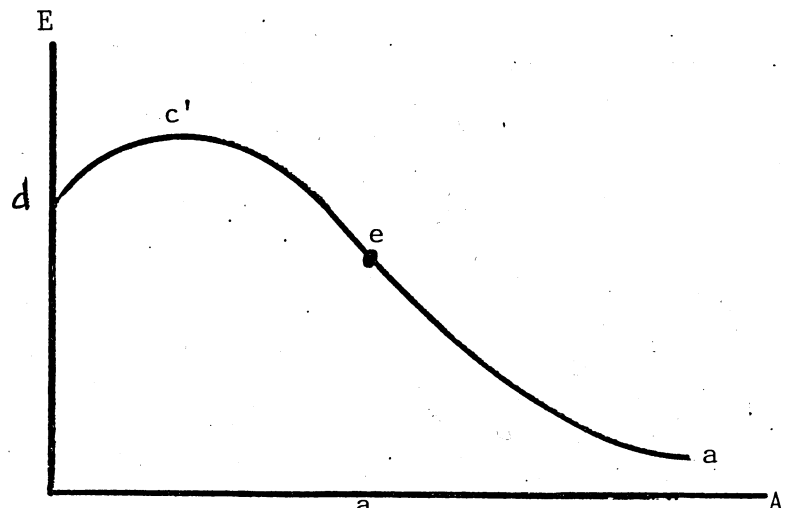

Figure 2

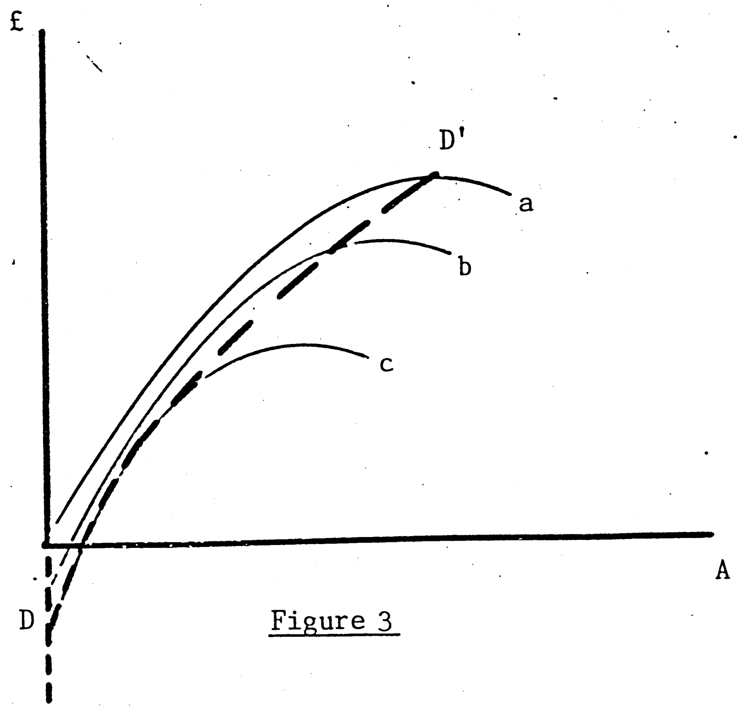

Figure 3

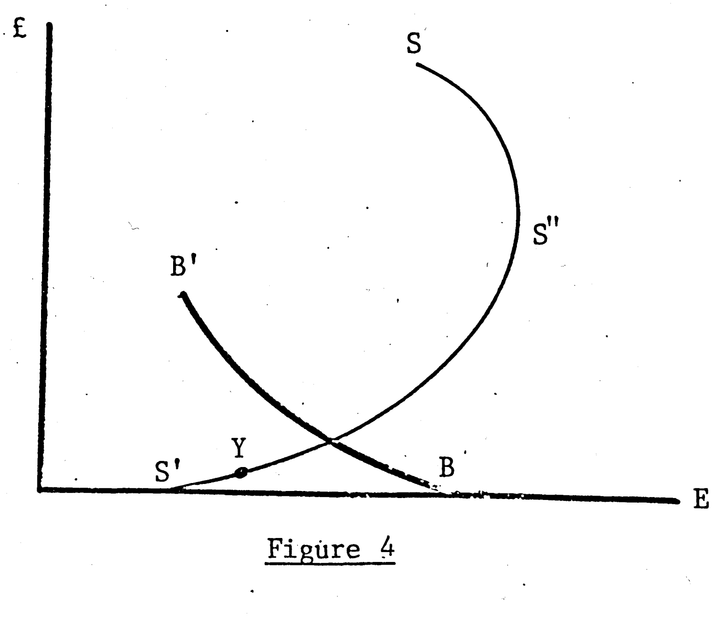

Figure 4

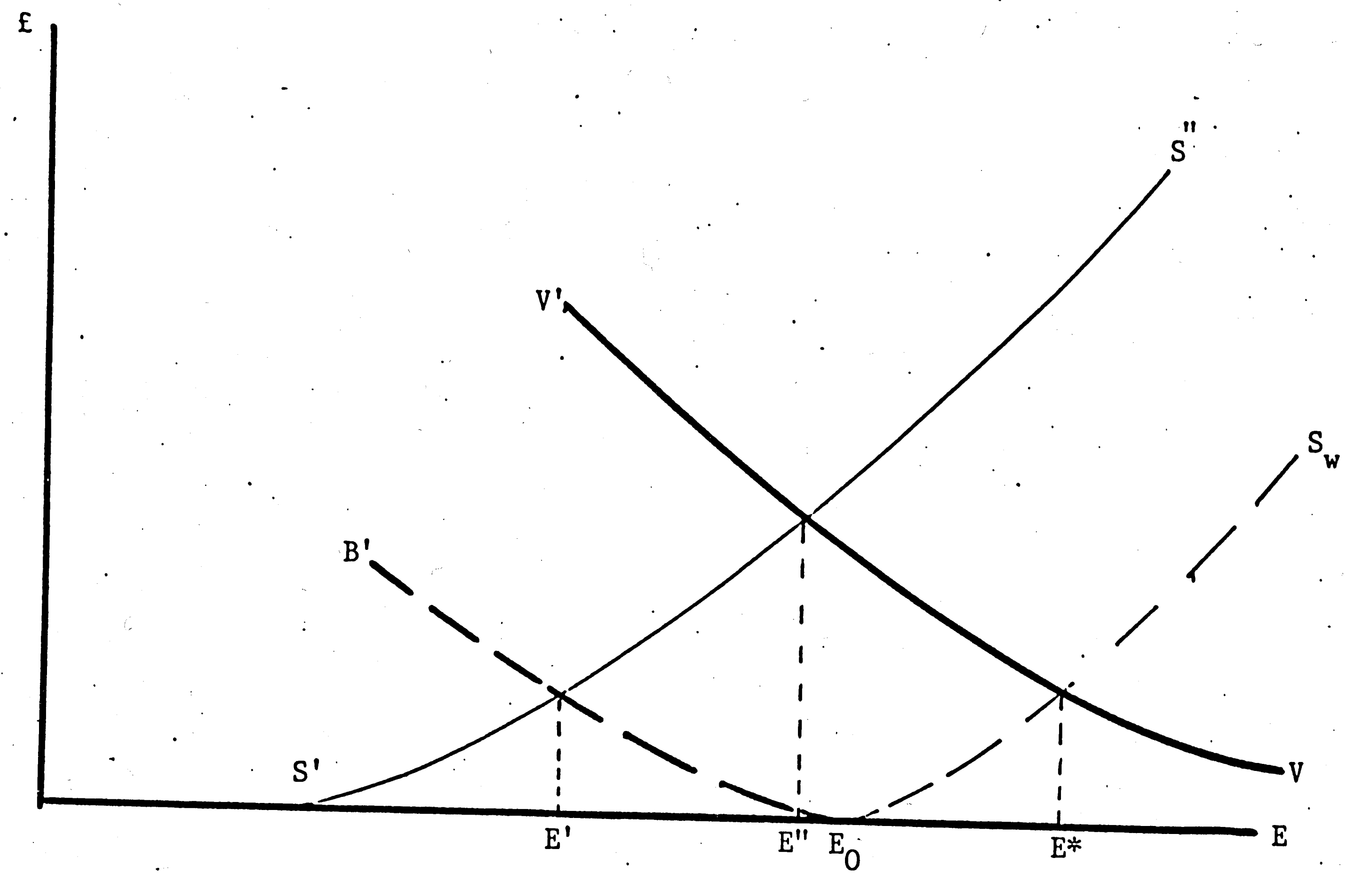

Figure 5