MULTIFUNCTIONAL AGRICULTURE AND THE PRESERVATION OF ENVIRONMENTAL BENEFITS

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ABSTRACT

In this article, we investigate welfare economic aspects of multifunctional agriculture, putting emphasis on the provision of rural environmental benefits. The formal analysis shows that the efficiency prices of agricultural and forest land include important amenity and non-use values that exhibit the character of undepletable externalities. Thus, to achieve a socially optimal land allocation these externalities must be internalised. We propose the compensation to agricultural and forest managers according to the marginal external benefit of their land, and a charge-subsidy scheme to improve rural water quality. Altogether, this is consistent with the requirement of optimal land allocation and would not cause additional market distortions. Moreover, it would leave the property right on the land and landscape benefits with the farmers, and assign the right on clean air and water to the consumers.

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INTRODUCTION

Agriculture is an economic activity which provides multiple benefits to society, ranging from the satisfaction of basic needs to the appreciation of rural amenities. Moreover, agricultural activities can have direct impacts on environmental functions, such as nutrient cycling, soil protection, flood control, and habitats for birds, insects and soil organisms. Some of these functions are crucial for sustainable agriculture, as they influence future soil productivity. Some provide non-use benefits to society (indirect use, functional, option, existence and bequest values) in form of biodiversity and habitat protection as well as ecosystem and watershed functions. In addition, non-environmental benefits associated with agriculture comprise food safety and food security, rural employment and the socio-economic development of rural areas, and cultural heritage. Altogether, this constitutes *the multifunctional character of agriculture*. It embraces a set of non-market costs and benefits, and thus constitutes a potential source of market failure. Correspondingly, multifunctionality could provide an efficiency-based argument for government support to agriculture. Indeed, based on such considerations, the concept of multifunctionality emerged as an argument for including "non-trade concerns" in the negotiations of the World Trade Organization (WTO) on agriculture.

Yet, the concept is prone to different interpretations. The recent debate about the multifunctionality of agriculture shows, on the one hand, agreement about the existence of multiple benefits arising from agriculture to society. On the other hand, there is disagreement as regards the justification of government intervention and the choice of adequate policy instruments.[1] Nonetheless, the *concept of multifunctionality* has been adopted as a policy principle by OECD Agriculture Ministers in 1998. It "recognises that beyond its primary function of supplying food and fibre, agricultural activity can also shape the landscape, provide environmental benefits such as land conservation, the sustainable management of renewable natural resources and the preservation of biodiversity, and contribute to the socio-economic viability of many rural areas" (OECD, 2001: 5).

[1] Recent publications on "multifunctional agriculture" in the economics literature include: Anderson (2000); Blandford (2001); Bohman et al. (1999); Bromley (2000); Brunstad et al. (1995, 1999); Cahill (2001); Latacz-Lohmann and Hodge (2001); Mahé (2001); Niedu (2002); OECD (2001); Randall (2002); Vatn (2002).

The entirety of these benefits can be referred to as the *total economic value* of agriculture, a concept which is well established in environmental economics (cf. Pearce and Turner, 1990; Perman et al., 1999).

Yet, even a large total economic value of agriculture cannot justify government intervention. Rather, it provides the framework of a *positive* approach which allows to analyse the multiple benefits of agriculture in relation to its production processes and outputs in a descriptive way. It constitutes the basis for addressing various stakeholder concerns. In contrast, a *normative* approach would allow for policy judgements that are based on welfare economic theory. In this case, the analysis would shift towards the societal objectives associated with agriculture and the environment, and involve conditions for optimal allocation of land and other scarce resources among competing uses (cf. Gardner, 1977; McConnell, 1989; Just and Antle, 1990; Lopez et al., 1994; Brunstad et al., 1999; Wossink et al., 1999) and the assignment of environmental property rights (cf. Bromley and Hodge, 1990; Bromley, 2000).

The aim of this article is to investigate these welfare economic aspects of multifunctional agriculture, and to address the question to what extent they can justify government intervention and support to farmers. We provide an analytical framework for the evaluation of alternative policy measures to support farmers for providing environmental benefits. In Section 2, we present an economic allocation model which includes the allocation of land among forest, agriculture and urban uses, as well as positive and negative externalities. These issues are subject to our analysis in Section 3. Based on this background, Section 4 is devoted to the question about how to arrange the provision of rural amenities. Section 5 concludes.

FORMALISING THE DEBATE — A MODEL OF OPTIMAL LAND ALLOCATION

The multifunctional character of agriculture is largely determined by the allocation of land and the joint production of land-related benefits. It involves the relationship between agricultural production and the preservation of agricultural land. The latter often yields significant amenity and ecological benefits that may not be reflected in the prevailing allocation of land between agricultural and non-agricultural uses. From an economic perspective, further government intervention may thus be justified because of the failure of the land market to fully consider these benefits from agriculture in allocating land (Gardner, 1977; Lopez et al., 1994; Bromley, 2000). On the other hand, the question is about what the public gets from preserving farmland, and whether other land uses would yield greater social returns than agriculture (McConnell, 1989). This is a key issue in the current debate on multifunctionality (cf. Anderson, 2000; Bohman et al., 1999; OECD, 2001; Vatn, 2002), which inevitably involves differences in perception and values associated to the rural landscape (Hodge, 1991; Mahé, 2001). On the consumers' side, this is clearly an empirical question of environmental valuation (cf. Randall, 2002), while the principle issue on the production side of multifunctionality concerns the nature and degree of jointness in production, which requires that the multiple outputs be considered simultaneously (OECD, 2001; Vatn, 2002). These issues are the most usefully integrated in the formal framework of an optimal allocation model.

Our analysis is based on the framework of a static allocation model of a small open economy which is endowed with two primary factors, land B and labour A, and which produces two commodities, an agricultural good Y_1 and a non-agricultural good Y_2. In addition, natural products Y_0 are harvested form sustainably managed forest land. Land is homogenous, and that the total amount of land B is allocated to three uses: forest B_0 (wilderness or nature), agriculture B_1, and manufacturing B_2 (urban or industrial areas):

$$B_0 + B_1 + B_2 = B \qquad (1)$$

The optimal allocation of the land requires that the social value marginal products of the different uses are equalised among all uses. Yet, this cannot be restricted to the production values of the land in the different uses. Indirect use and non-use values must also be taken into account. To this end, we introduce the concept of environmental quality as a formal construction at the interface of the interdependent systems of economy and the environment. It conceptually integrates the different components of an ecosystem and allows us to address the economic valuation problem in the context of multifunctional agriculture. According to Randall (2002), this is complicated because, "in general, a valid total valuation cannot be obtained by independent piecewise valuation; that is, adding up the component values, each estimated independently". To solve this problem Randall proposes a valuation strategy which begins with a valuation of the multi-component green output of agriculture on a large (e.g., continental) scale, as an upper bound value to the sum of all the local and particular component values. Formally, this corresponds to our concept of environmental quality which shall integrate those environmental components that are relevant regarding the multifunctional character of agriculture on an aggregate level: rural landscape and water quality.[2]

Correspondingly, we define environmental quality Q as a monotonically increasing and strictly concave function in both agricultural and forest land, B_1 and B_0, and rural water quality $W = W(E)$ which is impaired by pollution E from agricultural sources ($\partial W/\partial E < 0$) due to the application of manure, chemical fertilisers, and pesticides:

$$Q = Q(B_0, B_1, W(E)) \tag{2}$$

with

$$Y_1 = Y_1(A_1, B_1, Z_1) \qquad \text{and} \qquad E = E(Z_1, Y_1) \tag{3}$$

representing the agricultural production and emission function, respectively. The former is concave and increasing with the use of labour A_1, land B_1, and purchased inputs Z_1 (fertilisers and pesticides). Given the concave production function and the first law of thermodynamics (the conservation of matter and energy), the emission function E is convex and increasing in input and output. The above formulation allows for taking into account that agricultural water pollution is a consequence of the use of both chemical fertilisers, purchased from other industries, and manure (animal waste), which is an intermediate product within the agricultural system and directly related to the aggregate net output from agriculture.

We assume that our economy imports additional agricultural products M_1 in exchange for manufactured goods X_2 at world market prices p_1 and p_2:

$$p_1 M_1 = p_2 X_2 \tag{4}$$

Hence, the final consumption of agricultural and manufactured goods, respectively, is

$$C_1 = Y_1(A_1, B_1, Z_1) + M_1 \qquad \text{and} \qquad C_2 = Y_2(A_2, B_2) - Z_1 - X_2 \tag{5}$$

with A_2 and B_2 denoting the inputs of labour and land in manufacturing, and Z_1 the intermediate output which is used as production factor in agriculture.

Furthermore, sustainable management of forest resources on the area B_0 requires labour input A_0 and allows our economy to harvest Y_0 for domestic consumption (non-traded good). This is represented by the increasing and concave production function:

$$Y_0 = F_0(A_0, B_0) \tag{6}$$

In addition, we include leisure in our analysis. Thus, the total labour capacity A is allocated to forest management A_0, agricultural production A_1, the production of manufactured goods and services A_2, and leisure A_3:

$$A_0 + A_1 + A_2 + A_3 = A \tag{7}$$

Finally, the multifunctional character of agriculture depends on the valuation of the different outcomes by the individuals of a society. This is usefully expressed in terms of individual preferences, and represented by the utility function of a representative consumer: $u = u(y_0, c_1, c_2, a_3, Q)$ with $y_0 = Y_0/N$, $c_1 = C_1/N$, $c_2 = C_2/N$ and $a_3 = A_3/N$ denoting per-capita consumption of forest products, agricultural products, manufactured goods and individual leisure time, respectively. This function is assumed to be monotonically increasing in each variable and strictly concave for any positive value of y_0, c_1, c_2, a_3 and Q. Assuming uniform preferences and equal endowment in our society, the social welfare function can be written in a simple utilitarian form which is proportional to the size of population N:

$$U = N\,u(y_0, c_1, c_2, a_3, Q) \tag{8}$$

[2] At a second stage, one may look more detailed at the various components—like trees, hedges, field patterns and buffer strips—that influence the rural landscape and water quality.

To determine the socially optimal allocation of land and other resources, we maximise this function subject to the production system and the economy-environment relationships given in equations (1) through (7). This is represented by the subsequent Lagrange function which is maximised with respect to all decision variables:

$$L = N\,u(y_0, c_1, c_2, a_3, Q) - \lambda_0[N\,y_0 - Y_0(A_0, B_0)] - \lambda_1[Y_1 - Y_1(A_1, B_1, Z_1)]$$

$$- \lambda_2[Y_2 - Y_2(A_2, B_2)] - \lambda_A[A_0 + A_1 + A_2 + N\,a_3 - A] - \lambda_B[B_0 + B_1 + B_2 - B] \tag{9}$$

$$- \lambda_Q[Q - Q(B_0, B_1, W(E))] + \lambda_E[E - E(Z_1, Y_1)] - \xi[p_1(Nc_1 - Y_1) + p_2(Nc_2 - Y_2 + Z_1)]$$

From the first-order optimality conditions for an interior solution, we get the subsequent equations for the shadow prices (Lagrange multipliers λ_0, λ_1, λ_2, λ_A, λ_B, λ_Q, $\lambda_E > 0$ and $\xi = 1$):

$$\lambda_0 = \frac{\partial u}{\partial y_0} \quad , \quad \lambda_1 = p_1 - \lambda_E \frac{\partial E}{\partial Y_1} \quad , \quad p_1 = \frac{\partial u}{\partial c_1} \quad , \quad \lambda_2 = p_2 = \frac{\partial u}{\partial c_2} \tag{10a}$$

$$p_2 = \lambda_1 \frac{\partial Y_1}{\partial Z_1} - \lambda_E \frac{\partial E}{\partial Z_1} \quad , \quad \lambda_A = \lambda_0 \frac{\partial Y_0}{\partial A_0} = \lambda_1 \frac{\partial Y_1}{\partial A_1} = \lambda_2 \frac{\partial Y_2}{\partial A_2} = \frac{\partial u}{\partial a_3} \tag{10b}$$

$$\lambda_B = \lambda_0 \frac{\partial Y_0}{\partial B_0} + \lambda_Q \frac{\partial Q}{\partial B_0} = \lambda_1 \frac{\partial Y_1}{\partial B_1} + \lambda_Q \frac{\partial Q}{\partial B_1} = \lambda_2 \frac{\partial Y_2}{\partial B_2} \tag{10c}$$

$$\lambda_E = -\lambda_Q \frac{\partial Q}{\partial W} \frac{\partial W}{\partial E} \quad , \quad \lambda_Q = N \frac{\partial u}{\partial Q} \tag{10d}$$

These equations build the formal basis for the subsequent analysis of optimal land allocation and provision of environmental amenities from agriculture and forest land.

OPTIMAL LAND ALLOCATION IN THE PRESENCE OF ENVIRONMENTAL EXTERNALITIES

Rural amenities are external benefits

The condition for a socially optimal allocation of land among forest, agricultural and urban uses is given in equation (10c). It requires that the shadow price of the land, λ_B, equalises the social value marginal product of the land among all uses. Moreover, it illustrates the relevance of the concept of total economic value. For both agricultural and forest land, the shadow price (rental value of the land) includes two components: the value of land use in production, $\lambda_i \cdot \partial Y_i/\partial B_i$, and the indirect use and non-use values of the land, $\lambda_Q \cdot \partial u/\partial B_i$ (with $i = 0,1$). Under consideration of equation (10d), the second term reveals the public good characteristics of the environment: non-excludability and undepletability. This signifies that the appreciation of rural amenity benefits does not foreclose others from doing the same, and that enjoying the rural landscape does not impair the quality of the environment.

Despite these public good characteristics, environmental quality may not usefully be regarded as a public good which is produced by agriculture or forestry. Rather, these primary industries use land as a production factor and cultivate the natural environment for the purpose of enhancing the flow of food and fibre from their land. The rural landscape is then the consequence of land use patterns. It gains its value from its scale and the relationship between the different components of the landscape (Hodge, 1991). In general, this value is not reflected in market prices. Rather, the societal value of agricultural and forest land includes real interdependencies between production and individual utility functions that are not reflected in the land market. These production-related impacts on the environment and individual utilities exhibit the character of an "undepletable" positive externality in the sense of Baumol and Oates (1988). This is formally represented in the subsequent equation, which results from substituting the relevant optimality conditions in equation (10c):

$$\lambda_B = \frac{\partial u}{\partial y_0}\frac{\partial Y_0}{\partial B_0} + N\frac{\partial u}{\partial Q}\frac{\partial Q}{\partial B_0} = \left(p_1 + N\frac{\partial u}{\partial Q}\frac{\partial Q}{\partial W}\frac{\partial W}{\partial E}\frac{\partial E}{\partial Y_1}\right)\frac{\partial Y_1}{\partial B_1} + N\frac{\partial u}{\partial Q}\frac{\partial Q}{\partial B_1} = p_2\frac{\partial Y_2}{\partial B_2} \tag{11}$$

It shows that, apart of the production value, both forest and agricultural land include an additional value which can be enjoyed by all members of society without being depleted. For an optimal resource allocation the external benefits of agricultural and forest land use must be internalised. To this end, managers of agricultural and forest land may receive a compensation payment per land unit according to the social marginal external benefit of the land.

According to equation (11), these payments must be equal to $N\frac{\partial u}{\partial Q}\frac{\partial Q}{\partial B_1}$ and $N\frac{\partial u}{\partial Q}\frac{\partial Q}{\partial B_0}$ per unit of agricultural and forest land, respectively. Without such payments, to much land would be allocated to urban uses, and the provision of rural environment benefits would be below the socially optimal level. In contrast, with adequate payments, the production-related rental value of farmland could be below the rental price of urban land, and it would still be profitable to the farmers to cultivate the land. From a social point of view this is justified as long as the difference between the private rental prices is less than the marginal external benefit of the land.

Negative agricultural externalities

Yet, agriculture does not only generate positive side effects. Negative externalities due to water pollution, caused by the application of manure, chemical fertilisers and pesticides, have become major policy issues in many countries (cf. Shortle and Abler, 2001). This is formally included in our model with the emission function $E = E(Y_1, Z_1)$, and reflected in the optimality conditions regarding the social net marginal benefit of agricultural production, Y_1, and the social value marginal product of artificial inputs, Z_1, respectively:

$$\lambda_1 = p_1 - \lambda_E\frac{\partial E}{\partial Y_1} = p_1 + N\frac{\partial u}{\partial Q}\frac{\partial Q}{\partial W}\frac{\partial W}{\partial E}\frac{\partial E}{\partial Y_1} < p_1 \tag{12a}$$

$$\lambda_2 = \lambda_1\frac{\partial Y_1}{\partial Z_1} - \lambda_E\frac{\partial E}{\partial Z_1} = p_1\frac{\partial Y_1}{\partial Z_1} + N\frac{\partial u}{\partial Q}\frac{\partial Q}{\partial W}\frac{\partial W}{\partial E}\left(\frac{\partial E}{\partial Z_1} + \frac{\partial E}{\partial Y_1}\frac{\partial Y_1}{\partial Z_1}\right) < p_1\frac{\partial Y_1}{\partial Z_1} \tag{12b}$$

Given the fact that pollution is an “undepletable” negative externality which can affect the utility of each individual without reducing the effect on the utility of any other person (Baumol and Oates, 1988), the optimal price of the agricultural commodity must be above the private marginal cost of production. Likewise, the optimal price of artificial inputs in agricultural production must be above the private value marginal product of these factors. This requires a correction of market prices—the internalisation of external costs—, which can be realised in two different ways: Either consumers have to pay an extra price equal to the marginal external cost of the final product, or farmers are given an incentive (e.g., charged a fee) to internalise the external cost of agricultural production and input use.

Both measures are consistent with the “polluters pay principle”. They have the effect of reducing the level of agricultural production and pollution to the socially optimal levels. Both measures have the effect of reducing the direct use value of agricultural land, $\lambda_1 \cdot \partial Y_1/\partial B_1$, and the optimal amount of land in agriculture. Moreover, the internalisation of external costs has consequences on the farmers’ net revenues, and thus on income distribution in society. Altogether, the internalisation of external costs involves a trade-off between efficiency and equity considerations. In principle, this could be resolved by providing subsidies to farmers for reducing negative externalities and improving the rural water quality. This would allow farmers to remain on income levels comparable to the situation without internalising external costs. Yet, this would correspond to the “victims pay principle”, and imply a different assignment of environmental property rights than the solution discussed before. In addition, subsidies to farmers for improving water quality would have an effect on the allocation of land. This can formally be proven as follows.

Charging farmers a pollution fee τ equal to the marginal external cost of agricultural production ($\tau = \lambda_E \partial E/\partial Y_1 > 0$), or giving them a subsidy σ equal to their marginal abatement cost ($\sigma > 0$) does not have the same effect on the net marginal value of agricultural production

$$\lambda_1(\tau) = p_1 - \tau < p_1 + \sigma = \lambda_1(\sigma) \tag{13a}$$

and thus on the rental price of agricultural land:

$$\lambda_B(\tau) = \lambda_1(\tau)\frac{\partial Y_1}{\partial B_1} + N\frac{\partial u}{\partial Q}\frac{\partial Q}{\partial B_1} < \lambda_1(\sigma)\frac{\partial Y_1}{\partial B_1} + N\frac{\partial u}{\partial Q}\frac{\partial Q}{\partial B_1} = \lambda_B(\sigma) \tag{13b}$$

In an open economy with given world market prices, the rental value of the agricultural land with subsidy for pollution abatement, $\lambda_B(\sigma)$, would be larger than the value of agricultural land in case of a pollution fee, $\lambda_B(\tau)$, while the latter is equal to the efficiency price of the land given in equation (11): $\lambda_B(\tau) = \lambda_B$. As a consequence, the provision of subsidies for pollution abatement would tend to increase the demand for agricultural land above the socially optimal amount. The related loss of social welfare could be justified at a national level by equity considerations. However, as any form of subsidies for variable input factors and outputs of production, payments for pollution abatement are a potential source of market distortion. This reveals the fundamental trade-off between concerns of efficiency and equity.

A *charge subsidy-scheme* constitutes an alternative solution which jointly addresses these concerns. It would charge polluters an environmental tax according to the marginal external cost of pollution, and reimburse the tax revenue to the farmers. In contrast, to a pure pollution abatement subsidy, the charge-subsidy scheme is compatible with the conditions for an optimal land allocation and with payments to land managers according to the external benefits of agricultural and forest land. It implies the assignment of environmental property rights to both farmers and consumers. Farmers keep the property right on the land and landscape benefits.

The consumers have the implicit right on clean air and water.

Altogether, if the goal of multifunctional agriculture is to attain a social optimum, it requires internalisation of the external costs. This implies a deviation from the private optimum. The adequate form of intervention cannot be decided without taking into consideration the other aspects of multifunctionality, namely the amenity values associated with agricultural land use and the assignment of environmental property rights. In addition, the optimal allocation of scarce resources involves another fundamental issue in the debate about the multifunctionality of agriculture this is the question about the most adequate provision of rural amenities by agricultural or non-agricultural agents.

THE PROVISION OF RURAL AMENITIES: HOW SHOULD IT BE ARRANGED?

The reduction of agricultural price and production support as well as the internalisation of external costs and benefits may not only result in a decrease of the net marginal value of agricultural products and the farmers' net revenues, but also in a decline of the agricultural land area and a change in the mix of farm products. On the one hand, this gives rise to concerns about the farmers' income and national food security, as well as changes of the rural landscape. On the other hand, it brings about social welfare gains through the reduction of trade distortions and the elimination of related welfare losses. These welfare gains could, in principle, be used to partly compensate farmers for the non-desired distribution and food security effects. However, this must be decided on a political platform.

Furthermore, the elimination of market distortions may generate positive side-effects to society. The change in the product mix may also result in an improvement of the rural landscape and water quality, and thus lead to an increase of marginal external benefits and a decline of marginal external costs. In particular, the elimination of trade distortions and internalisation of externalities may induce a correction of the negative impacts of intensive agriculture (chemical use, waste disposal, and the removal of wildlife habitat and landscape features) that have "led to a perceived reduction in the quality of the rural environment and have reduced the values of other uses of the countryside" (Hodge, 1991).

From a perspective of cost effectiveness, the reduction of agricultural water pollution will, among other measures, require a partial retirement of cropland and conversion into extensive grassland and forest land and the installation of buffer strips, at least on marginal land and in areas particularly valuable water resources (Ribaudo et al., 1994). In addition, the internalisation of external benefits can be expected to give an incentive to farmers to change land use patterns and provide a more diverse rural landscape with valuable elements such as trees, hedges, natural pastures and water courses. Altogether, we can reasonably expect that the internalisation of external costs and benefits will have a positive effect on the rural environment and agricultural income.

Finally, we come to an additional issue in the international discussions on the multifunctionality of agriculture (cf. Anderson, 2000): the question about the provision of rural amenities by farmers or non-farmers. Our evaluation in this point is straightforward. As a by-product of agriculture and forest management, the rural landscape must not be produced like a "non-joint public good" which would require additional resources for production. Rather, market failures—including those associated with externalities—should first be corrected. In addition, potential *economies of scope* should be realised. The latter refers to "savings from production of several items by a single firm, as compared with their production by several specialized firms, each producing a subset of the items in question" (Baumol, 1997), a concept originally presented by Panzar and Willig (1981). In the agricultural sector and on the farm level, economies of scope can result from jointly addressing various aspects of multifunctionality. In particular, the joint benefits of pollution abatement and landscape improvement—including amenities, habitats and ecological functions.

In short, the question is less one about "other forms of provision of landscape amenities" by non-agricultural producers, such as frequently requested in the debate on multifunctionality. From a welfare economic point of view, the key issue for multifunctional agriculture is the elimination of trade distortions and internalisation of external costs and benefits. On the production side, this must involve a better realisation of economies of scope through improved environmental management and innovation.

CONCLUSION

Agriculture inevitably interacts in major ways with the natural environment. Negative consequences are the loss of habitats, impairment of ecosystem functions, and agricultural water pollution due. Positive aspects involve the effects on the rural landscape, which in many places is valued for its amenity benefits and cultural heritage. As a consequence of past human activity, it has largely been determined by the objectives of agricultural and environmental policies and developments on the world markets. Now, some OECD member countries are concerned about the consequences of trade liberalisation upon the multiple benefits from their agricultural systems. They are particularly concerned about the effects on the rural landscape from further reducing domestic agricultural support and border protection.

In the present article, we investigate the last issue from a welfare economic perspective. We use a formal approach in order to additional provide insights and recommendations for agri-environmental policy and multifunctional agriculture that are theoretically sound and consistent. Apart of providing the conditions for an optimal resource allocation, our analysis reveals that the environmental aspects associated with the multifunctionality of agriculture exhibit the character of undepletable externalities, as defined by Baumol and Oates (1988). This is fundamental for the analysis. First, it emphasises the need for internalising environmental externalities of agriculture. Second, it indicates that rural environmental benefits must not be separately produced as non-joint public goods (cf. Vatn, 2002), which would require additional resources for their production. Rather, policy should provide incentives to eliminate these sources of market failure:

On the one hand, farmers and forest managers should receive payments according to the marginal external benefits from the land. On the other hand, they should be charged for the marginal external costs of water pollution which is caused by the application of animal waste and chemical inputs. Apparently, this is complicated by the nonpoint-source characteristic of agricultural water pollution,[3] and the effects on income distribution of such policy.

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[3] A detailed analysis of this issue is beyond the scope of this article, and has extensively been addressed in the literature. Shortle and Abler (2001) provide an actual review on this topic.

To alleviate the negative income effects, we propose a charge-subsidy scheme with the reimbursement of effluent charge revenues to the farmers. This leaves the property right on the land and landscape benefits with the farmers, and assigns the right on clean air and water to the consumers. In contrast to a subsidy for pollution abatement, the charge-subsidy scheme is consistent with the requirements of an optimal land allocation and would not cause new distortions on commodity and factor markets.

Finally, economies of scope may result from jointly addressing the challenge of agricultural water pollution and landscape improvement. In particular, changes in the product mix and agricultural land allocation may, at the same time, contribute to improve water quality and provide a more diverse rural landscape. From a welfare economic perspective, the key issues of multifunctional agriculture are the realisation of social welfare gains due to the elimination of trade distortions and the internalisation of external costs and benefits, and the joint consideration of efficiency and equity concerns.

REFERENCES

Anderson, K. 2000. Agriculture's 'Multifunctionality' and the WTO. Austral. J. Agr. Res. Econ. 44, 475-494.

Baumol, W.J. 1997. Musing on vertical integration. Internat. J. Social Econ. 24, 16-27.

Baumol, W.J., Oates, W.E. 1988. The theory of environmental policy. Second edition. Cambridge University Press, Cambridge, New York, Melbourne.

Blandford, D. 2001. Oceans Apart? European and U.S. Agricultural Policy Concerns are Converging. EuroChoices Spring 2001, 17-21.

Bohman, M., Cooper, J., Mullarkey, D., Normile, M.A., Skully, D., Vogel, S., Young, E. 1999. The Use and Abuse of Multifunctionality. Economic Research Service, USDA.

Bromley, D.W. 2000. Can Agriculture Become an Environmental Asset? World Econ. 1, 127-139.

Bromley, D.W., Hodge, I. 1990. Private property rights and presumptive policy entitlements: reconsidering the premise of rural policy. Europ. Rev. Agr. Econ. 17, 197-214.

Brunstad, R.J., Gaasland, I., Vårdal, E. 1995. Agriculture as a Provider of Public Goods: A case study for Norway. Agr. Econ. 13: 39-49.

Brunstad, R.J., Gaasland, I., Vårdal, E. 1999. Agricultural Production and the Optimal Level of Landscape Preservation. Land Econ. 75, 538-546.

Cahill, C. 2001. The Multifunctionality of Agriculture: What Does It Mean? EuroChoices Spring 2001, 36-41.

Gardner, B.D. 1977. The Economics of Agricultural Land Preservation. Amer. J. Agr. Econ. 59, 1027-1036.

Hodge, I. 1991. The Provision of Public Goods in the Countryside: How Should It Be Arranged? In: Hanley, N. (Ed.), Farming and the Countryside: An Economic Analysis of External Costs and Benefits. CAB International, Wallingford, U.K., pp. 179-196.

Just, R., Antle, J. 1990. Interactions between Agricultural and Environmental Policies: A Conceptual Framework. Amer. Econ. Rev. 80, 197-202.

Latacz-Lohmann, U., Hodge, I. 2001. 'Multifunctionality' and 'Free Trade': Conflict of Harmony? EuroChoices Spring 2001, 42-47.

Lopez, R.A., Shah, F.A., Altobello, M.A. 1994. Amenity Benefits and the Optimal Allocation of Land. Land Econ 70, 53-62.

Mahé, L.-P. 2001. Can the European Model be Negotiable in the WTO? EuroChoices Spring 2001, 10-16.

McConnell, K.E. 1989. Optimal Quantity of Land in Agriculture. Northeastern J. Agr. Res. Econ. 18,: 63-72.

Niedu, M. 2002. La multifunctionnalité agricole entre marché et externalité. Econ. Appliquée 55, 105-132.

OECD 2001. Multifunctionality: Towards an analytical framework. Organisation for Economic Co-operation and Development, Paris.

Panzar, J.C., Willig, R.D. 1981. Economies of Scope. Amer. Econ. Rev. 71, 268-272.

Pearce, D.W., Turner, R.K. 1990. Economics of Natural Resources and the Environment. Harvester Wheatsheaf, Hemel Hempstead, UK.

Perman, R., Yue, M., McGilvray, J., Common, M. 1999. Natural Resource and Environmental Economics. Second Edition. Addison Wesley Longman, London and New York.

Randall, A. 2002. Valuing the outputs of multifunctional agriculture. Europ. Rev. Agr. Econ. 29, 289-307.

Ribaudo, M.O., Osborn, C.T., Konyar, K. 1994. Land Retirement for Reducing Agricultural Nonpoint Source Pollution, Land Econ. 70, 77-87.

Shortle, J.S., Abler, D.G. (Eds.) 2001. Environmental Policies for Agricultural Pollution Control. CABI Publishing, Wallingford, UK, and New York, USA.

Vatn, A. 2002. Multifunctional agriculture: some consequences for international trade regimes. Europ. Rev. Agr. Econ. 29, 309-327.

Wossink, A., van Wenum, J., Jurgens, C., de Snoo, G. 1999. Co-ordinating economic, behavioral and spatial aspects of wildlife preservation in agriculture. Europ. Rev. Agr. Econ. 26, 443-460.