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# Assessing the production and welfare effects of agri-environmental policy: a conceptual analysis

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**Abstract**

**The paper develops a conceptual framework for the welfare analysis of agri-environmental policy targeting the use of agricultural inputs within an international trade context. Based on a two-factor production model, we analyze the marginal social costs of agricultural production with and without an efficient agri-environmental policy. We demonstrate that an assessment of social external costs based on factor intensities in the absence of environmental policy underestimates the potential welfare improvements that can be achieved by introducing an efficient agri-environmental policy. We demonstrate further that, even if the marginal environmental effect of farming is negative in the absence of agri-environmental policy, the existence of positive externalities may cause production levels to rise as a result of an optimal environmental policy.**

**Keywords: Agri-environmental policy, international trade, multifunctionality, welfare analysis**

## 1. Introduction

Environmental protection and trade liberalization have become predominant issues affecting world agriculture at the beginning of this century. While the main goal of freer trade is to enhance international specialization, some countries are concerned that trade liberalization may conflict with non-trade policy objectives. Such non-trade objectives include, *inter alia*, environmental protection, food security, rural development, animal welfare and landscape preservation (Cahill 2001; Latacz-Lohmann and Hodge 2001; Vatn 2002; Harte and O'Conell 2003; Brun-

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stad et al. 2005). Some European countries have argued that their agricultural sectors need to be supported in order to ensure the continuing delivery of such public-good type benefits (Swinbank 1999; Potter and Burney 2002; Latacz-Lohmann and Hodge 2001). Other countries have expressed concern that, as international trade agreements reduce the scope for tariff setting, domestic policies might be used as a substitute for conventional border protection (Vasavada and Warmerdam 1998; Freeman and Roberts 1999; Blandford et al. 2003).

Although the implementation of subsidies linked to production may no longer be acceptable in future trade rounds, a properly configured regime of environmental, health or safety rules can have very similar trade effects (Hungerford 1991; Sumner 2000). Agri-environmental payments have been classified as not, or least, trade-distorting and have therefore been included in the WTO's "Green Box". However, some countries have become increasingly skeptical of the non-trade distorting classification of various Green Box policies (WTO 2006; Glebe 2007). Some authors suggest that the appropriateness of domestic policies targeting non-trade objectives can be judged by their impact on domestic production and international trade flows (Hooker and Caswell 1999; Runge 1999; Latacz-Lohmann 2000). Environmental goods that are distinguishable from farming can be detached from agricultural production (Anderson 2000; Abler 2004). However, problems arise when domestic policies promote non-commodity outputs which are jointly produced with agricultural commodity outputs, such as the maintenance of the cultural landscapes (Hodge 2000; Harte and O'Connell 2003). Such policies cannot, by their very nature, be production-neutral.

In order to tell efficient policies apart from disguised protectionism, a conceptual framework is needed which allows for a simultaneous analysis of trade and environmental policy changes. A widespread approach to analyze the welfare and production implications of *trade policy* changes has been based on partial equilibrium diagrammatic trade models (Anderson 1992a; Snape 1992; Steininger 1994). In these models, environmental externalities are depicted as a divergence between marginal private and marginal social costs. Social costs associated with agricultural production exceed private costs when pollution problems are considered (Anderson 1992b; Runge 1995; Reed 2001), but social costs will be smaller than private costs when agriculture generates positive externalities (Ito 1996; Latacz-Lohmann 2000).

The notion of marginal social costs contrasting marginal private costs has also been applied to the analysis of *environmental policy* changes (Anderson 1992b; Runge 1995; Reed 2001). Environmental policy has been integrated into an international trade framework as a production tax/subsidy. However, since agriculture's pollution problems are primarily affected by the composition of inputs, production technologies and resultant land use intensities, a well targeted environmental instrument would need to address the use of inputs rather than the level of agricultural output (Peterson et al. 2002). Although an analysis based on output rather than input taxes/subsidies will not affect the directions of welfare changes (Glebe and Latacz-Lohmann 2007), we will demonstrate that a policy targeting output will result in welfare gains that are smaller than the gains from an efficient environmental policy which targets agricultural inputs as the key source of externalities.

The main contribution of the paper thus is to extend existing diagrammatic trade and environment models by distinguishing between social cost arising before and after the introduction of an efficient agri-environmental policy. Moreover, by accounting for the co-existence of agriculture's positive and negative externalities, we demonstrate that an efficient environmental policy can enhance production even if the net environmental effect of farming is negative prior to policy implementation. Production (and trade) effects associated with agri-environmental policy are therefore unsuitable for judging whether a policy is trade-distorting and whether it should be removed from the WTO's Green Box.

The paper is structured as follows: Section 2 conceptualizes the various agri-environmental effects within a two-factor production model. Based on this model, we analyze the marginal social costs of agricultural production with and without an efficient agri-environmental policy. Section 3 demonstrates that the social costs attributable to missing agri-environmental policy do not fully capture the welfare gain that can be achieved if agri-environmental externalities are internalized. Section 4 presents a conceptual framework that allows for a simultaneous analysis of agricultural trade and environmental policy changes. The paper concludes with a summary of the main findings.

# 2. Analysis of the *social shadow* supply function of agricultural output

We start by analyzing the marginal social costs of agricultural production in the absence of environmental policy. In this context, we introduce the notion of a social shadow supply curve ($S^{SS}$) contrasting a social supply curve ($S^{S}$). The *social shadow supply* curve reflects the marginal social costs of production in the absence of environmental policy. The *social supply* curve, by contrast, is defined by the marginal social costs in the presence of an efficient environmental policy. The latter induces a change in input use intensities or production technology.

We choose a simplified model of farming by dividing factors of production into two categories: agricultural land area (*A*) and variable inputs (*I*), with their respective prices $P_A$ and $P_I$. Private production costs can then be written as:

$$C^P = P_A A + P_I I \qquad (1)$$

For a given production technology, agricultural output can be expressed as a function of land area and other inputs ($\text{Output} = Q(A, I)$). We specify profit ($\pi$) as the difference between revenues and costs, where $P_Q$ denotes the price of agricultural output:

$$\pi = P_Q Q(A, I) - P_A A - P_I I \qquad (2)$$

The profit maximizing input levels, $\bar{I}$ and $\bar{A}$, are obtained by maximizing $\pi$ in (2) with respect to both factors:

$$\frac{P_A}{P_I} = \frac{\partial Q(\bar{A}, \bar{I})}{\partial A} \Big/ \frac{\partial Q(\bar{A}, \bar{I})}{\partial I} \qquad (3)$$

Considering the marginal revenue products for input levels $\bar{I}$ and $\bar{A}$, profit maximization requires equality of factor prices and marginal revenue products ($MRP$) for both factors simultaneously:[1]

$$MRP_A^{private} = P_Q \frac{\partial Q(\bar{I})}{\partial A} = P_A \tag{4}$$

$$MRP_I^{private} = P_Q \frac{\partial Q(\bar{A})}{\partial I} = P_I \tag{5}$$

In order to analyze the welfare effects of agricultural trade policies, we also need to consider the environmental impact of farming. The various environmental aspects of farming (relating to, for example, water quality, biodiversity, or landscape amenity) are determined by land cultivation and the intensity of agro-chemical and heavy machinery use. Let $E(A,I)$ denote the monetary value of the overall environmental effect of agricultural production. The total *social shadow costs* associated with farming can then be written as the sum of private and environmental costs:

$$C^{SS} = C^P - E(A,I) \tag{6}$$

The difference between private and social shadow costs can be derived from a simple diagrammatic production model (Figure 1). The production function $Q(A,I)$ defines the technical substitutability between land and variable inputs for any particular level of agricultural output and thereby determines the shape of the isoquants shown in quadrant 1 of Figure 1. Profit-maximizing producers choose their factor intensity such that the marginal rate of technical substitution between land and other inputs equals the reciprocal factor price ratio ($-\partial A/\partial I = P_I/P_A$). Hence, given a price ratio defined by $tan(\alpha)$, farmers cultivate area $\bar{A}_1$ and demand quantity $\bar{I}_1$ of agricultural inputs to produce $Q_1$. Similarly, optimal input combinations for any other output level are depicted by the expansion path shown in quadrant 1 of Figure 1. We assume the expansion

[1] Note that, in accordance with economic theory, the marginal revenue products in (4)-(5) have been evaluated at the point where the respective other factor is held constant at its optimal level. The MRP curves thus do not represent factor demand curves. The MRP curves do however coincide with factor demand in equilibrium, i.e. at the point where the other factor is used at its optimal level.

path to be 'well behaved' in the sense that an increase in agricultural output is generally linked to an increase in both land area and the use of variable inputs.

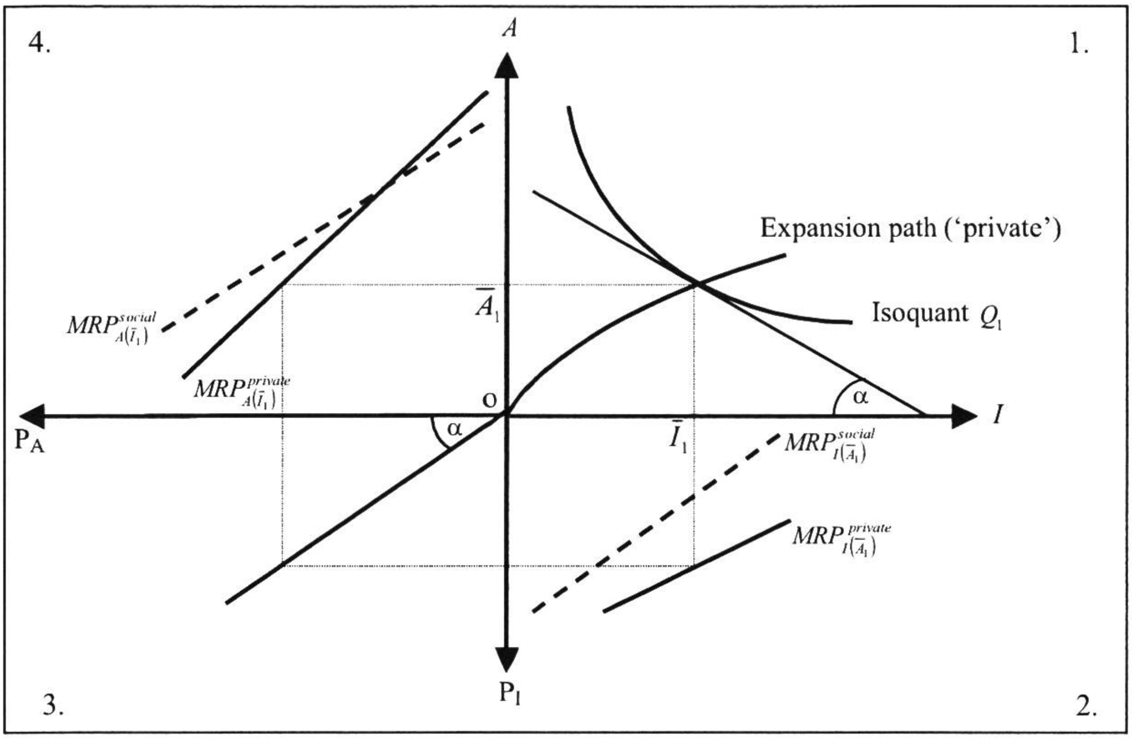


*Fig. 1: Environmental effects of factor use.*

Optimal input use and the corresponding output level are obtained by equating the marginal revenue products for land and inputs to their respective factor prices (Quadrant 2 and 4 of Figure 1). Recall that $MRP_A^{private}$ and $MRP_I^{private}$ are based on the profit-maximizing input levels $\bar{A}_1$ and $\bar{I}_1$, in accordance with equations (4) and (5). They thus only represent factor demand in equilibrium ($\bar{A}_1$, $\bar{I}_1$). Since marginal productivities are expected to increase as more of the other input is used ($\partial^2 Q / \partial I \partial A > 0$), MRP curves shift outwards as the level of output rises - a phenomenon that cannot be illustrated in a static diagram.

Taking into account the environmental effects of farming, the marginal revenue product functions need to be 'corrected' in order to derive the social shadow costs associated with farming. We therefore introduce the *social* marginal revenue products of land ($MRP_A^{social}$) and inputs

( $MRP_I^{social}$ ), which are obtained by adding the value of the marginal environmental effect to the *private* marginal revenue product:

$$MRP_A^{social} = MRP_A^{private} + \frac{\partial E(\bar{I})}{\partial A} = P_Q \frac{\partial Q(\bar{I})}{\partial A} + \frac{\partial E(\bar{I})}{\partial A} \quad (7)$$

$$MRP_I^{social} = MRP_I^{private} + \frac{\partial E(\bar{A})}{\partial I} = P_Q \frac{\partial Q(\bar{A})}{\partial I} + \frac{\partial E(\bar{A})}{\partial I} \quad (8)$$

As to the sign of the environmental impacts the following can be said. Various studies have shown that farming has a positive impact on landscape quality as long as agricultural production does not encroach upon environmentally sensitive or otherwise unsuitable land (Antrop 1997; Phillips 1998; Bruns et al. 2000). Landscape and open space amenities are particularly valued in urban areas, such as the Northeast region of the United States (Batie 2003; Abler 2004). However, as more land is cultivated, farming will increasingly contribute to soil erosion, reduce biodiversity and cause the aesthetic value of the rural landscape to deteriorate (Jones and Daugstad 1997; Glebe 2007).[2] We thus assume for the analysis to follow that the environmental value of agricultural land increases up to some critical level of land use, but will decrease beyond that level, an assumption also made by Brunstad et al. (1999) and Latacz-Lohmann (2000). $MRP_A^{social}$ therefore is assumed to be greater than $MRP_A^{private}$ when little land is used for farming, but smaller than $MRP_A^{private}$ when much land is cultivated, as depicted in quadrant 4 of Figure 1.

The marginal environmental damage related to agro-chemical inputs, on the other hand, is expected to increase steadily as more of these inputs are applied. This is because any increase in pesticides and fertilizer usage will cause biodiversity and water quality to deteriorate, among other things. Similarly, a higher degree of mechanization in agriculture

[2] Positive landscape values have been elicited by both hedonic price methods and contingent valuation studies (Garrod and Willis 1992; Drake 1992; Pruckner 1995). Other studies have attributed monetary values to changes in biodiversity (Brouwer and Slangen 1998; Macmillan et al. 2002).

may reflect a higher share of arable farming, which may adversely affect biodiversity and foster soil erosion. We thus postulate that the social marginal value product of variable inputs lies below the corresponding private marginal revenue product across the entire range of agricultural input use (Quadrant 2 of Figure 1). Since we assume marginal environmental damage to increase with the level of variable input use, the wedge between $MRP_I^{social}$ and $MRP_I^{private}$ widens, although the results of this analysis do not change if this assumption is relaxed.[3]

Based on the constellation of private and social marginal revenue curves, as depicted in Figure 1, we can now derive the marginal social shadow costs of agricultural production. [4]Since an increase in agricultural output is generally linked to an increase in both factor categories, the marginal social costs can be derived by taking the first derivative of equation (6) with respect to agricultural output *Q*:

$$\frac{dC^{ss}}{dQ} = \frac{dC^P}{dQ} - \left( \frac{\partial E}{\partial A}\frac{dA}{dQ} + \frac{\partial E}{\partial I}\frac{dI}{dQ} \right) \qquad (9)$$

Equation (9) demonstrates that marginal social shadow costs ($MC^{SS}$) outweigh marginal private costs ($dC^P/dQ$) if the marginal environmental impact of farming is negative ($dE/dQ < 0$), and vice versa. The latter (vice versa) case may arise when the level of production is low. In this case, the social marginal revenue product of land outweighs the private ($MRP_A^{social} - MRP_A^{private} > 0$), and the marginal environmental damage attributed to variable inputs ($\partial E/\partial I$) is relatively low. Based on these principles, we can infer that the social shadow supply curve of agricultural production ($S^{SS}$) lies below the private supply function ($S^P$) if agricultural output is low, and above $S^P$ if agricultural output is high. This is plausi-

[3] The rationale for this assumption is that, as the intensity of agro-chemical input use increases, there will be a more than proportional increase in the leaching of groundwater pollutants and health problems associated with it (Yiridoe et al. 1997; Kolpin 1997; Watson et al. 2000).

[4] Notice that the social marginal revenue product curves as depicted in Figure 1 are determined by the factor quantities $\bar{A}_1$ and $\bar{I}_1$. However, although the location of MRP curves would change if we considered a different combination of $A$ and $I$ on the expansion path, the relative constellation of social and private MRP curves would be maintained constant.

ble since, as agricultural output increases, the importance of negative externalities from agro-chemical and machinery use grows, while positive effects of land cultivation decline and eventually turn negative.

# 3. Analysis of the *social* supply function of agricultural output

The analysis of the social shadow supply curve is predicated on the assumption that no policy intervention occurs. In this section, we analyze how the social costs of agricultural production may be affected if agri-environmental policy causes input use intensities to change. We shall refer to the marginal social cost curve that arises when environmental policy affects the factor market as the *social supply* ($S^S$) function.

We simplify the welfare analysis of agri-environmental policies by modeling an optimal policy as a tax on agro-chemical inputs and a subsidy linked to land cultivation. [5]Such a policy regime could be seen to approximate agri-environmental contracting schemes which offer area-based payments to landholders who voluntarily restrict their input of chemicals or adopt certain conservation practices. Examples include the various extensification schemes offered across the European Union. We are aware that such a policy regime still does not represent the best possible policy instrument. Indeed, the first-best policy regime would be one that targets specific environmental problems as directly as possible. However, given the non-point source nature of agricultural pollution on the one hand and the diversity of environmental benefits from land cultivation on the other, the proposed tax/subsidy instrument appears reasonable. Notwithstanding these objections, we shall refer to this tax/subsidy scheme as “efficient agri-environmental policy” in the subsequent analysis. The impact of an efficient agri-environmental policy on factor intensity is demonstrated in Quadrant 1 of Figure 2. An efficient internalization of environmental externalities changes the factor price ratio and thereby causes farmers to choose less input-intensive farming practices, symbolized by the ‘social’ expansion path. Assuming a so-

[5] The latter may also be a tax if the marginal environmental effect of land cultivation is negative, for example if agriculture encroaches upon environmentally sensitive areas.

cially 'efficient' factor price ratio of *tan(β)*, farmers would cultivate area $\bar{A}_2$ and demand quantity $\bar{I}_2$ of variable inputs. If output level $Q_1$ is maintained, the input-based tax/subsidy scheme causes social costs of agricultural production to fall below social shadow costs.[6] The discrepancy between social costs with and without efficient internalization of environmental externalities can be derived with the use of iso-cost lines based on the 'efficient' factor price ratio. It is clear from Figure 2 (quadrant 1) that the iso-cost line for the initial input pair $(\bar{A}_1, \bar{I}_1)$ lies to the north-east of the iso-cost function passing through $(\bar{A}_2, \bar{I}_2)$, implying that *social costs* are smaller than *social shadow costs.*

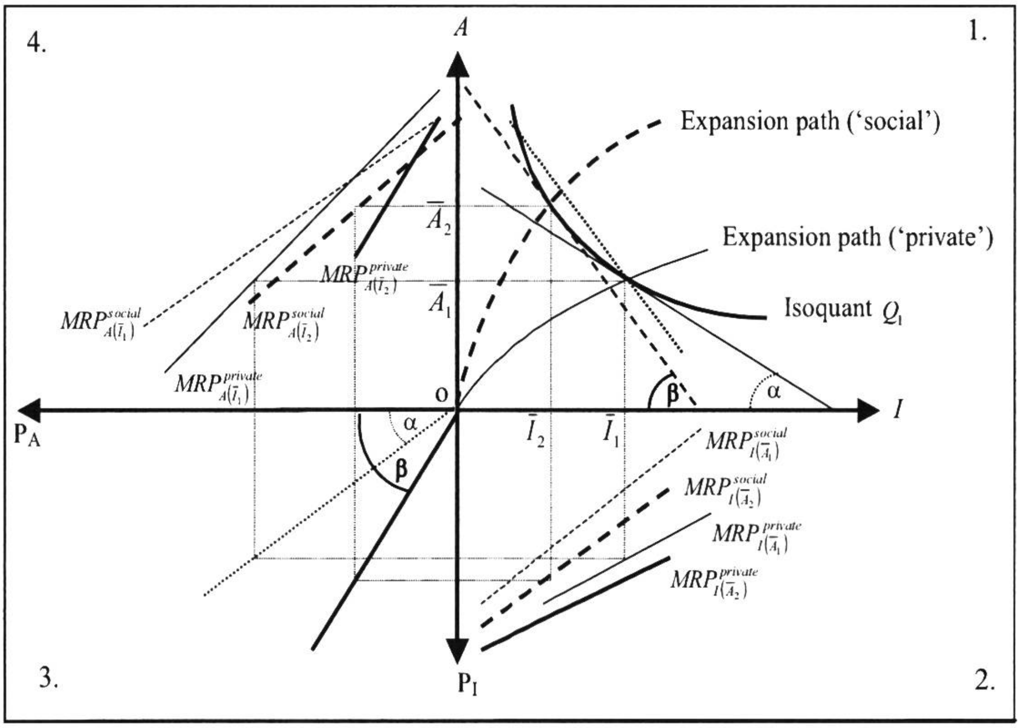


*Fig. 2: Influence of agri-environmental policy on factor intensity.*

This difference in costs can be interpreted as the welfare gain from introducing an efficient agri-environmental policy. From this analysis we can conclude, with reference to Figure 3, that the social supply curve ($S^S$) lies below the social shadow supply curve ($S^{SS}$) at low levels of

[6] If the partial derivative of the environmental quality function with respect to land area is positive, a policy subsidising the use of agricultural land will enhance the efficiency of resource allocation. The reverse, an agricultural land tax, will be optimal for the opposite scenario.

agricultural output, though this may reverse as production increases (above $Q_6$, Figure 3). The rationale for this reversal is the limited availability of land. Agri-environmental policy induces environmentally friendlier production methods as indicated by the dashed expansion path in Figure 2. However, once all land is under cultivation, an increase in production can be reached only by using more environmentally harmful inputs. This implies that the expansion paths with and without agri-environmental policy will eventually converge. From this we conclude that marginal social costs of production will exceed marginal social *shadow* costs at output levels which require all land to be under cultivation. Nevertheless, note that even at an output level where *marginal* social costs exceed *marginal* social shadow costs, *total* social costs will never exceed *total* social shadow costs.

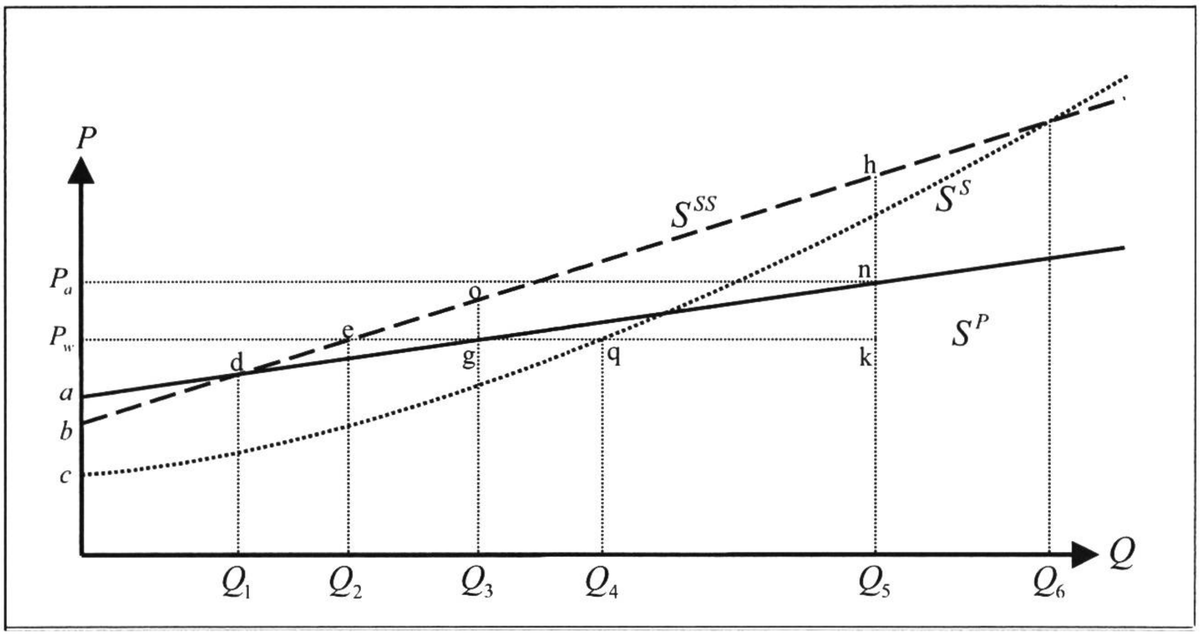


*Fig. 3: Social welfare prior to and after implementation of agri-environmental policy.*

# 4. Welfare effects of agri-environmental policy and trade policy changes

Building upon the notion of social supply and social shadow supply functions, we now proceed to analyze the welfare effects of agri-environmental and trade policy changes. Figure 3 represents a small country's farming sector, which faces a higher domestic producer price ($P_d$) than the world price ($P_w$). In the absence of agri-environmental policy, aggregate output is determined by the private supply curve ($S^P$). Consider therefore an initial output level ($Q_5$) at which both the overall environmental effect of farming (area *dhn* - *adb*) and the marginal environmental effect (distance *hn*) are negative.

If the country opened up to free trade and lowered domestic prices to world market levels, domestic production would decline to $Q_3$. This would boost social welfare by area *ohkg*. At output level $Q_3$ the marginal environmental effect of farming remains negative (distance *og*), justifying further government intervention in the form of environmental policy to enhance social welfare.

Previous studies have modeled environmental policy as a tax or subsidy linked to output (Anderson 1992b; Runge 1995; Reed 2001). An output tax would cause agricultural output to decline from $Q_3$ to $Q_2$ in Figure 3, enhancing social welfare by area *eog*. We argue that area *eog* does not represent the maximum possible welfare gain from environmental policy, because a tax or subsidy linked to output is too blunt an instrument to cater for the 'real' scarcity of land and chemical inputs as sources of both positive and negative externalities. A more targeted, efficient agri-environmental policy would target the inputs, land and chemicals, rather than agricultural output, inducing a change in land use intensity commensurate with the 'real' scarcity of these two types of input. Such a policy causes the supply curve to shift from $S^P$ to $S^S$. Compared to the output-related tax/subsidy scheme, production would rise from $Q_3$ to $Q_4$ in Figure 3. The welfare gain from an efficient agri-environmental policy, measured against the benchmark of no environmental policy intervention, is represented by area *bogqc*. This welfare gain is unambiguously greater than the welfare improvement from an output tax/subsidy (area *eog*). This result is plausible in as much as it confirms the general principle that a policy instrument is more efficient the closer it is to the source of the market imperfection (Corden 2002).

Next we will demonstrate that an approach based on output taxes/subsidies rather than input taxes/subsidies will not only affect the size of the welfare effect, but may also alter the sign of the production effect. Figure 3 represents an interesting scenario in this respect since the marginal social cost curve lies between the marginal private and the marginal social shadow cost curve at the production level in the absence of agri-environmental policy ($MC^{SS}(Q_3) \geq MC^{SS}(Q_3) \geq MC^{P}(Q_3)$). Therefore, an output tax would induce a reduction in production (from $Q_3$ to $Q_2$), whereas an efficient agri-environmental policy would cause production to rise from $Q_3$ to $Q_4$. The latter occurs when reduced land use intensities cause the positive environmental effects of farming to more than outweigh the negative effects. We conclude that, even if the marginal overall environmental impact of agriculture is negative in the absence of environmental policy, an efficient agri-environmental policy may still raise production relative to the level that would be forthcoming under free trade alone.

Note that if a country (or trade bloc) is large enough to have a lever in the world market, the world price would be increased by tariff reductions. However, if the implementation of an efficient agri-environmental policy stimulates agricultural production, agri-environmental policy would shift the world price in the opposite direction.

# 5. Summary

We demonstrated how the social supply curve differs from the social shadow supply function. The former represents the marginal social costs of agricultural production when environmental externalities are internalized, whereas the latter is based on a sub-optimal factor allocation. The social supply curve was used to derive the welfare effects of environmental policies which directly influence factor allocation. The social shadow supply curve, in comparison, was employed for the welfare analysis of policies which do not directly influence factor intensities.

We showed that an assessment of social external costs based on the factor intensity in the absence of environmental policy (social shadow costs) would underestimate the potential welfare improvements that can be achieved by introducing an efficient agri-environmental policy. This is because agricultural externalities are primarily input related. An efficient agri-environmental policy enhances the efficiency of factor allocation, thereby lowering the social costs associated with agricultural production. Hence, a welfare analysis based on a production tax or subsidy does merely capture the trade and welfare effects of an agri-environmental policy's *output effect*, but not the *allocation effect* of an efficient agri-environmental policy.

Two important policy implications follow from this analysis. First, potential welfare improvements based on the traditional analysis of a marginal social cost curve are an underestimate of the welfare gains that can be achieved by an optimal environmental policy. Second, an optimal agri-environmental policy may cause production levels to increase relative to the level under free trade alone. More importantly, production under an efficient agri-environmental policy may increase, while it would fall if a production tax were implemented. Agri-environmental policy thus cannot be trade-neutral. However, we confer with Edwards and Fraser (2001) that any change in production caused by an efficient agri-environmental policy should not be considered trade-distorting. Rather it should be considered trade-correcting in that it corrects trade flows that were previously distorted by lacking internalization of externalities from agricultural production.

## References

Abler D., 2004. Multifunctionality, Agricultural Policy, and Environmental Policy. *Agricultural and Resource Economics Review* 33(1): 8-17.

Anderson K., 1992a. The Standard Welfare Economics of Policies Affecting Trade and the Environment. In: K. Anderson and R. Blackhurst (eds.), *The Greening of World Trade Issues*, pp. 25-47. Exeter: Harvester Wheatsheaf.

Anderson K., 1992b. Effects on the environment and welfare of liberalizing world trade: the cases of coal and food. In: K. Anderson and R. Blackhurst (eds.), *The Greening of World Trade Issues*, pp. 145-172. Exeter: Harvester Wheatsheaf.

Anderson K., 2000. Agriculture's 'multifunctionality' and the WTO. *Australian Journal of Agricultural and Resource Economics* 44: 475-495.

Antrop M., 1997. The concept of traditional landscapes as a base for landscape evaluation and planning. The example of Flanders Region. *Landscape and Urban Planning* 38(1-2): 105-117.

Batie S., 2003. The Multifunctional Attribues of Northeastern Agriculture: A Research Agenda. *Agricultural and Resource Economics Review* 32(1): 1-8.

Blandford D., R.N. Boisvert and L. Fulponi, 2003. Nontrade concerns: reconciling domestic policy objectives with freer trade in agricultural products. *American Journal of Agricultural Economics* 85: 668-673.

Brouwer R. and L.H.G. Slangen, 1998. Contingent valuation of the public benefits of agricultural wildlife management: The case of Dutch peat meadow land. *European Review of Agricultural Economics* 25: 53-72.

Bruns D., D. Ipsen and I. Bohnet, 2000. Landscape dynamics in Germany. *Landscape and Urban Planning* 47(3-4): 143-158.

Brunstad R.J., I. Gaasland and E. Vårdal, 2005. Multifunctionality of agriculture: an inquiry into the complementarity between landscape preservation and food security. *European Review of Agricultural Economics* 32(4): 469-488.

Cahill C., 2001. The Multifunctionality of Agriculture: What does it mean? *EuroChoices* Premier Issue (Spring): 36-41.

Corden W.M., 2002. *Trade Policy and Economic Welfare*. Clarendon Press, Oxford.

Drake L., 1992. The non-market value of the Swedish agricultural landscape. *European Review of Agricultural Economics* 19: 351-364.

Edwards G. and Fraser I., 2001. Reconsidering agri-environmental policy permitted by the Uruguay round agreement. *Ecological Economics* 37: 313-326.

Freeman F. and O. Roberts, 1999. Multifunctionality – A Pretext for Protection? *ABARE Current Issues* 99.3, Canberra, Australia.

Garrod G.D. and K.G. Willis, 1992. Valuing goods' characteristics: An application of the hedonic price method to environmental attributes. *Journal of Environmental Management* 34(1): 59-76.

Glebe T., 2007. The Environmental Impact of European Farming: How Legitimate Are Agri-Environmental Payments? *Review of Agricultural Economics* 29(1): 87-102.

Glebe T. and U. Latacz-Lohmann, 2007. Agricultural multifunctionality and trade liberalisation. *Cahiers d'Economie et Sociologie Rurales* 82-83: 57-73

Harte L. and J. O´Connell, 2003. How well do Agri-Environmental Payments conform with Multifunctionality? *EuroChoices* 2: 36-41.

Hodge I., 2000. Agri-environmental Relationships and the Choice of Policy Mechanism, *World Economy* 23: 257-273.

Hooker N.H. and J.A. Caswell, 1999. A Framework for Evaluating Non-Tariff Barriers to Trade Related to Sanitary and Phytosanitary Regulation. *Journal of Agricultural Economics* 50: 234-246.

Hungerford T.L., 1991. GATT: A cooperative equilibrium in a non-cooperative trading regime. *Journal of International Economics* 31: 357-369.

Ito J., 1996. Trade Liberalization of Agricultural Products and Conservation of the Environment. Japan Ministry of Agriculture, Forestry and Fisheries, Research Paper No. 15, Tokyo.

Jones M., and K. Daugstad, 1997. Usage of the "Cultural landscape" Concept in Norwegian and Nordic Landscape Administration. *Landscape Research* 22(3): 267-282.

Kolpin D.W., 1997. Agricultural Chemicals in Groundwater of the Midwestern United States: Relations to Land Use. *Journal of Environmental Quality* 26(4): 1025-1037.

Latacz-Lohmann U., 2000. Beyond the Green Box: The Economics of Agri-Environmental Policy and Free Trade. *Agrarwirtschaft (German Journal of Agricultural Economics)* 49(9/10): 342-348.

Latacz-Lohmann U. and I. Hodge, 2001. Multifunctionality and free trade – conflict or harmony? *EuroChoices* Premier Issue (Spring): 42-47.

Macmillan DC, L. Philip, N. Hanley and B. Alvarez-Farizo, 2002. Valuing the non-market benefits of wild goose conservation: a comparison of interview and group-based approaches. *Ecological Economics* 43: 49-59.

Peterson J.M., R.N. Boisvert and H. de Gorter, 2002. Environmental Policies for a multifunctional agricultural sector in open economies. *European Review of Agricultural Economics* 29(4): 423-443.

Phillips A., 1998. The Nature of Cultural Landscapes-a nature conservation perspective. *Landscape Research* 23(1): 21-38.

Potter C. and J. Burney, 2002. Agricultural multifunctionality in the WTO – legitimate non-trade concern or disguised protectionism? *Journal of Rural Studies* 18: 35-47.

Pruckner G.J., 1995. Agricultural landscape cultivation in Austria: An application of the CVM. *European Review of Agricultural Economics* 22: 173-190.

Reed M.R., 2001. *International Trade in Agricultural Products*. New Jersey: Prentice Hall.

Runge C.F., 1995. Trade, Pollution, and Environmental Protection. In D. Bromley (ed.), *The Handbook of Environmental Economics*, pp. 353-375. Oxford: Blackwell.

Runge C.F., 1999. Beyond the Green Box: A Conceptual Framework for Agricultural Trade and the Environment. Working Paper WP99-1, Center for International Food and Agricultural Policy, University of Minnesota.

Snape H., 1992. The Environment, International Trade and Competitiveness. In K. Anderson and R. Blackhurst (eds.), *The Greening of World Trade Issues, pp.* 73-92. Exeter: Harvester Wheatsheaf.

Steininger K., 1994. Reconciling Trade and Environment: Towards a Comparative Advantage for Long-term Policy Goals. *Ecological Economics* 9: 23-42.

Sumner D.A., 1999. Domestic Support and the WTO negotiations. *Australian Journal of Agricultural and Resource Economics* 44(3): 457-474.

Swinbank A., 1999. CAP reform and the WTO: compatibility and developments. *European Review of Agricultural Economics* 26: 389-407.

Vasavada U. and S. Warmerdam, 1998. Environmental Policy & the WTO: Unresolved Questions. *Agricultural Outlook* 256: 12-14.

Vatn A., 2002. Multifunctional agriculture: some consequences for international trade regimes. *European Review of Agriculture Economics* 29(3): 309-327.

Watson C.J., C. Jordan, S.D. Lennox, R.V. Smith and R.W.J. Steen, 2000. Inorganic Nitrogen in Drainage Water from Grazed Grassland in Northern Ireland. *Journal of Environmental Quality* 29(1): 225-232.

Yiridoe E.K., R.P. Voroney and A. Weersink, 1997. Impact of Alternative Farm Management Practices on Nitrogen Pollution of Groundwater: Evaluation and Application of CENTURY Model. *Journal of Environmental Quality* 26(5): 1255-1263.

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