

## INCLUDING NON-POINT SOURCES IN A WATER QUALITY TRADING PERMIT PROGRAM

Dennis Collentine\*

*\*Department of Economics, Swedish University of Agricultural Sciences,  
Box 7013, S-750 07 UPPSALA. [dennis.collentine@ekon.slu.se](mailto:dennis.collentine@ekon.slu.se)*

### ABSTRACT

There has been overwhelming interest in addressing water quality issues through the use of economic instruments. Much of this attention has focused on the cost efficiencies offered by Transferable Discharge Permit (TDP) systems. Unfortunately, the attempts to start up permit markets which are able to exploit abatement cost differences between sources have not met with the success expected. Two of the reasons for the lack of success that have been taken up in analysis of these programs have been the problem of transaction costs and in the case of non-point sources (NPS), undefined property rights. The composite market design is a proposal for a TDP system which specifically includes agricultural non-point source (NPS) dischargers and addresses both property rights and transaction cost problems. The composite market consists of three interrelated markets each serving a particular function. When the composite market is mature, the total number of permits issued represents the cap on discharges allowed in the catchment. The structure of the composite market allows this system to be phased in over time with existing institutions and limited demands on financing.

**KEYWORDS :** *NPS, property rights, transaction costs, tradable permits.*

### INTRODUCTION

Achievement of mandated water quality standards has increasingly focused on the role of NPS discharges, in particular, runoff of nutrients from agricultural activities (EPA, 2000; Horan et al, 2002). However, the mitigation of non-point source (NPS) pollution from agricultural practices on surface and groundwater remains a conundrum for policymakers as well as economists. The contribution of nutrients, phosphorus and nitrogen, from farming practices has been the target of various types of agri-environmental policy for over a decade without notable success. Environmental policies which create a system of tradable discharge permits (TDPs) are economic instruments that offer a great deal of flexibility to polluters and thus are often construed to be cost effective.<sup>1</sup> This has led to a great deal of enthusiasm for TDP policies and led to rapid development and design of programs of this type (Woodward et al, 2002; Faeth, 2000). The United States Environmental Protection Agency in a recent report (EPA, 2003) “believes that market-based approaches such as water quality trading provide greater flexibility and have potential to achieve water quality and benefits greater than would otherwise be achieved under more traditional regulatory approaches” and that “market-based programs can achieve water quality goals at a substantial economic savings”. Unfortunately, as Stavins (1995) observed “In some cases, environmental policymaking has outrun our basic understanding of the new pollution control instruments” and “Consequently, the claims made for the cost effectiveness of marketable permit systems often have exceeded what can be reasonably anticipated.”

This paper proposes an innovative design for a transferable discharge permit system, a composite market system. The composite market consists of a set of three interrelated markets that represent three different types of market functions. The first of these is a market for discharge reduction credits, the primary sellers market, where a catchment level agency quantifies reductions through purchases of reduction activities. The function of this market is to identify marginal abatement costs, the supply curve for abatement measures. The second market is an offset market, the primary buyers market, where choice constrained dischargers may purchase permits from a catchment agency in lieu of investing in abatement measures. The function of this market is to equalize marginal abatement costs across discharge sources, by offering discharge permits priced at the marginal cost of abatement. The third market is an exchange for discharge permits, a secondary market, where discharge sources and other actors can engage directly in the market transfer of permits.

### PRIMARY SELLERS MARKET

There are two types of actors active in a primary sellers market. On the one hand, the supply side, there are dischargers, who through adoption of control (abatement) technology have the possibility of reducing their discharges.<sup>2</sup> On the other hand, the demand side, there is a local catchment authority with a budget for purchase of discharge reducing measures. Purchases of measures by governmental agencies already take place in many catchment areas in the form of programs to induce agricultural dischargers through economic incentives (cost sharing or direct subsidies) to adopt abatement measures. The potential for least cost abatement of nutrient discharges by agricultural producers is often ascribed to the

<sup>1</sup> See Collentine (2002b) for an analysis of why under a standard set of assumptions tradable permit systems will always appear to be the most cost effective policy alternative.

<sup>2</sup> Tietenberg (2000) distinguishes between TDP which are based on allowances and those based on credits. The feature which distinguishes these two is that credits are created when a discharger adopts a control measure while allowances are the distribution of permits allocated when a system of permits is established. No particular distinction is made in this paper between allowances and credits because while in the seller’s market these allocations (purchases) fit the description of credits, in the buyers market they are more similar to allowances.

adoption of these best management practices (BMPs) (Shortle et al, 1998; Horan and Ribaud, 1999; Horan et al, 2002). Examples of existing programs which support the adoption of BMPs on farms include direct payment for taking cultivated land out of production (wetlands or buffer strips), payments to compensate for reduced expected yields (catch crops, reduced fertilization, tillage techniques or timing), cost sharing (manure storage or adaptation of drainage systems), and the provision of information through existing channels (extension services or agricultural producer organizations). These types of programs may be national but implementation is often delegated to regional institutions and accompanied by a budget for supporting them.<sup>3</sup>

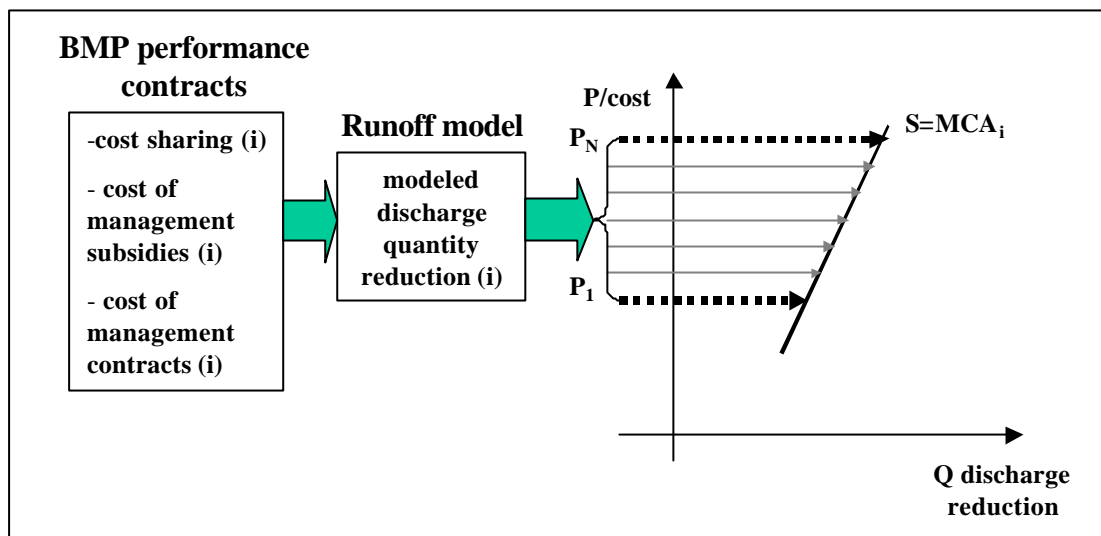


Figure 1. Primary sellers market

The necessary step for the transformation of BMP programs of this type, into credits in a TDP program lies in the quantification of the expected effect of the BMP on discharges by the adopting source. Modelling offers a possibility for site-specific quantification of the effect of BMPs when adopted by individual producers. In essence, the use of modelling transforms the NPS discharge into quasi-NPS discharge or what perhaps may be best described as a model generated PS. The transformation of a BMP through modelling, assigns a *fiat* value to the associated reduction in the discharge from this source. This value represents the marginal cost of abatement (MCA).

The sum of all these model transformed marginal abatement costs produces the supply curve in the primary sellers market in Figure 1. Each time a contract is entered into by the catchment agency more information becomes available with respect to marginal abatement costs. In an idealized market of this type a purchasing agency with full abatement cost information would always purchase the least cost measures first. In the model this gives rise to the upward sloping MCA/supply curve depicted in Figure 1. In practice, incomplete information or particular forms of transactions, such as uniform BMP support programs, may lead to model generated MCAs that vary in order (not always chronologically ascending from least cost to higher cost measures). However, this does not present a problem since the agency unilaterally determines which price to use as the 'last' price from this market to be transferred to the primary buyers market. The price of permits in the primary buyers market represents the marginal abatement cost determined in the primary sellers market, the main function of this market.

## PRIMARY BUYERS MARKET

The primary buyer's market described in Figure 2 is a unique allocation method for discharge permits in a TDP system. The two types of actors in this market are a regulatory authority on the supply side of the market and potential dischargers on the demand side. The good traded in the market is a limited set of property rights, quantified as a discharge volume that is transferable pursuant to approval by the issuer. In the program design discussed in this paper, this good is an annualized volume in kilograms, of nitrogen or phosphorus discharge into a particular catchment area for a specified number of years. Prices are therefore defined either explicitly or implicitly as a price per kilogram of discharge.

The buyers market phases in the quantity of discharge permits issued over time. This contrasts with other TDP systems which require the quantification of total discharges in the trading area as the first step in initiating a trading program (Hahn and Hester, 1989b; Horan et al, 2002). In a conventional program it is assumed that determination of total discharges is necessary both for allocating discharge rights and simultaneously constraining discharges to create a market. In the composite market approach, rights are assigned through the sale of permits as different sectors of dischargers are constrained into making a choice between purchasing a permit and investing in abatement. Allocation in the buyer's market takes place each time a discharger purchases a permit in this market. A willingness to sell a permit is an indication on the part of the regulatory agency, the seller, that the allocation is positive with respect to the environmental benefits for

<sup>3</sup> Under the EU Water Framework Directive the designated catchment management authority would be in a position to assume management of programs of this type.

the catchment under its jurisdiction. The agency does not need to know the total targeted discharges to arrive at this conclusion but only needs to have a way of evaluating the incremental effect of the permit sale. The primary seller's market is a source of this information.

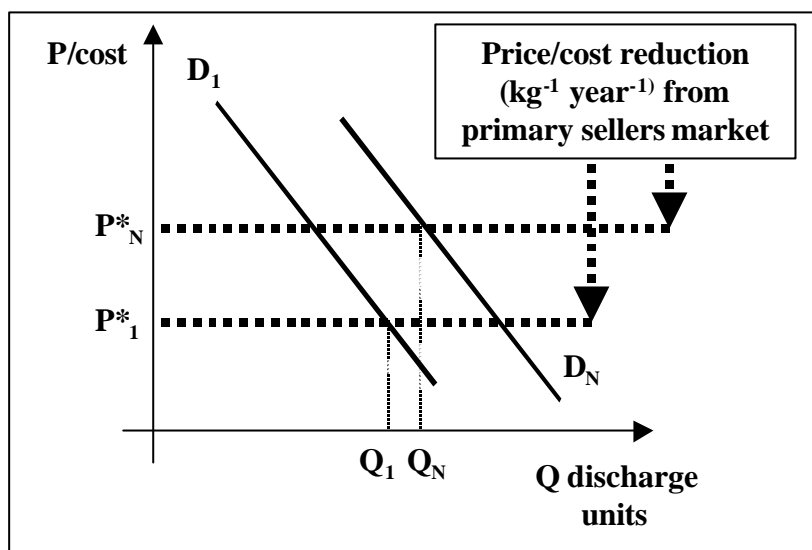


Figure 2. Primary buyers market

As noted above, the purpose of the seller's market is to provide price information to be used in the buyer's market. This is done by assigning a value to discharge transfers in this market using the price paid, either directly as an individualized contract or indirectly as a subsidy, and the modelled effect of the reduction. Ranking this information from lowest to highest cost allows the authority to assume that based on the principle of cost minimization, the highest cost per unit of discharge in this market represents the marginal cost of abatement. This is the price transmitted to the buyer's market in Figure 2. Therefore, when the agency chooses to sell a discharge permit in the buyer's market, the sale price represents the marginal cost of abatement for discharges to that catchment area.

Policies targeting pollution reduction based on economic incentives need to include an element of source control to create markets. For a market in TDPs to exist, dischargers must be choice constrained. In the absence of a cap there needs to be methods to regulate discharge levels or activities which will lead to a demand for source compliance either through purchase of permits or investment in abatement measures. Within the composite market system, sources are expected to be constrained incrementally over time. In the very long run the sum of these partial constraints may be equivalent to a discharge cap. In the short run the object for the catchment agency is to identify sectors which may be controlled in a cost efficient manner.

One source of constraints is of the type used in some offset programs (Hahn and Hester, 1989a). In this case an 'iron hand' is placed over changes in polluting activities permitted in the catchment (increases in stocks of animals or cultivated areas, new residential development etc.) unless the 'new' source can demonstrate that the proposed activity will lead to an acceptable level of discharges or alternatively that permits are purchased to allow the discharges. The catchment regulatory (management) authority determines the acceptable level and guidelines for calculating discharges, compliance liability lies with the discharge source. Regulatory constraints may also be imposed on existing sources. For example, a catchment agency may choose to mandate standards for existing individual household discharges (septic systems) or buffer strips on cultivated fields. Imposing standards forces these sources into a constrained choice; however uncertainty about the cost of abatement measures may impose high information costs on sources (Collentine, 2000a) as well as lead to extended litigation and lobbying against the imposition of standards and reduce the cost efficiencies in a TDP system. Including a repurchase agreement in the sale of permits in the primary buyers market is one way to lower these costs and facilitate implementation of standards.

## SECONDARY MARKET

This market is of the type often referred to as an exchange. The actors in this market may be dischargers or non-dischargers. While there may be non-dischargers that choose to participate in this market for speculative purposes, a more significant type of actor are those that actively purchase permits for the purpose of reducing permitted discharges.<sup>4</sup> The goods traded in this market are the discharge permits for the catchment in which the dischargers have an interest. A discharger faced with the constraint of either investing in abatement measures or alternatively purchasing the necessary corresponding permits has two options for purchasing permits; either directly from the controlling agency in the primary buyer's market or from a permit holder in the secondary market. Since the only permits available for sale in the secondary market have first been issued in the primary buyer's market, each of these permits carries a *fiat* value. Source *i* will never

<sup>4</sup> These may be NGOs, the catchment agency or other levels of government for example.

pay more for permits in the secondary market than the current price in the primary buyers market, therefore this price is a ceiling price in the secondary market. Where there is a repurchase agreement included in the permit contract, the holder of a permit will not sell a permit in the secondary market below the repurchase price and this then is a floor price in the secondary market. The combination of these facts results in a price interval in the secondary market as described in Figure 3 for the market clearing, equilibrium, permit price.

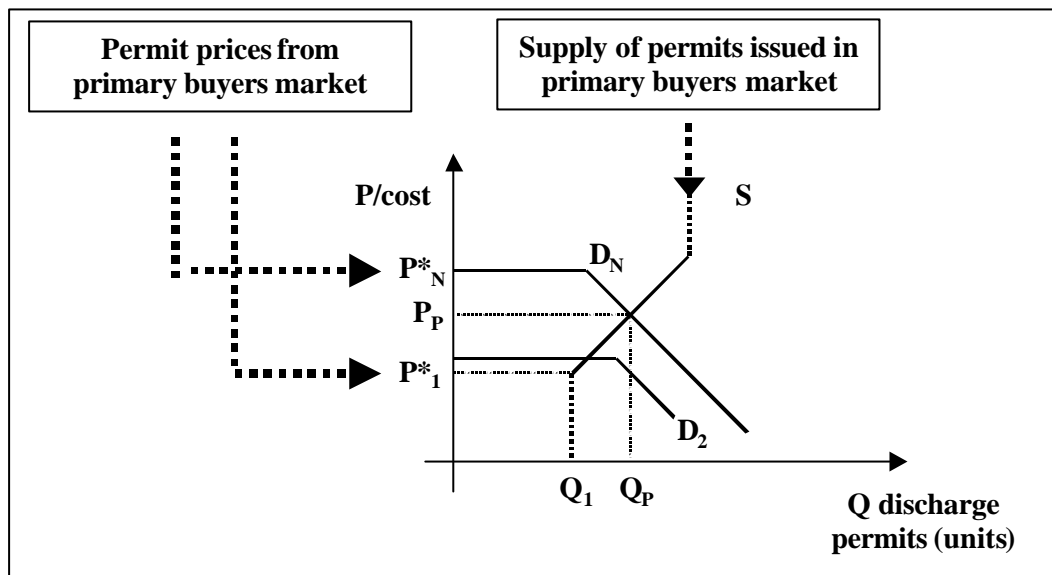


Figure 3. Secondary market

The ability to issue additional permits by the catchment agency decreases each time a permit is issued. Not only because theoretically, will no allocations be available when the total allocations transformed in the two primary markets are equivalent to a cap for total discharges in the area, but also because prices in the primary market are expected to increase over time. Over time, as transactions are executed in the two primary markets the permit price will rise.<sup>5</sup> As this price rises, the price interval in the secondary market widens (the ceiling rises) and allows for more movement of the market-clearing price.<sup>6</sup> The result is that while the narrow price interval limits transactions in this market at early stages of market development, as time goes on and more permits are issued more transactions will take place in this market. Eventually the price floor and ceiling in this market will have no effect on the clearing price and at this stage of development there will potentially be sufficient liquidity in this market so that this price will equal the current marginal cost of abatement for all sources. As the primary markets mature they will primarily serve to renew already transformed discharge contracts or to let these relapse at maturity and the secondary market will continue to offer flexibility to dischargers. In this way, the secondary market will appear more and more to be a true market for tradable discharge permits.

## DISCUSSION

The ultimate goal of a TDP program is to increase the amount of investment in discharge reduction measures, abatement, and thus improve water quality. Cost effectiveness is an economic criteria for evaluating policy alternatives such as a TDP system. Cost effectiveness is made possible in a TDP system through exploitation of the differences in abatement costs between sources. The composite market design described in this paper enhances the opportunity for TDP programs to achieve their goals by offering a market structure which reduces the transaction costs of information, assigns limited property rights and can be implemented in stages. These factors all contribute to realizing the potential offered by viable markets in discharge permits.

### Property rights

The composite market structure assigns and transforms property rights in the two primary markets. In the primary sellers market the regulatory agency, the buyer, assumes liability for controlling the terms of the transaction, that is, monitors and enforces the contractual agreement. For example, in the case of a uniform subsidy for a BMP such as spring tillage, the regulatory institution ensures that the recipient of the payment performs in accord with the agreement and is able to take actions if a violation of the terms is discovered. Therefore in this market the buyer, the agency, assigns limited property rights to the transaction by assuming the liability for control of the agreement. In the primary buyers market the regulatory agency, the seller, offers a permit, a license, for a specific quantity of discharge over a specified period of time. The limited property rights represented by the discharge permit are also transferable to another party subject to approval of the transfer by the issuer of the permit, the regulatory agency. The buyer's liability in this market is to conform to the limits

<sup>5</sup> Due to the upward sloping MAC curve in the sellers market.

<sup>6</sup> The actual market price will be depend on the ability of actors in the secondary market to capture economic rents based on abatement market information. Information which, is a combination of expectations and price movement in the two primary markets.

specified in the permit and to have agency approval before transferring the permit. These liabilities follow the permit in all transactions in the secondary market. There are no new property rights assigned in this market beyond those designated by the original permit issue. The control of the use of the permit, monitoring and enforcement, remains with the regulatory agency. Thus the sellers market transfers liability for control of discharge reduction activities to the buyer and the buyers market assigns a limited set of property rights to the permit purchaser that are not related to the control of reduction credits.

### **Transaction costs**

Transaction costs in TPD systems may be significant and prevent the market development necessary for establishing the reliability of the price signal generated in the market. The market-clearing price for permits provides the information needed by dischargers to make cost effective investments in abatement measures. Systems which are designed to establish markets for the direct trade of permits between sources are likely to lead to a set of bilateral, sequential trades and subsequently high transaction costs in the search for information. The lack of publicly held information in a market for permits may lead to liquidity problems in the market and negatively impact the incentive to use the market for transactions.

The composite market system minimizes transaction costs in several ways. The information and search costs for market actors for a trading partner are minimized through the primary markets. The permit price represents the relevant marginal cost of abatement for other discharge sources. The information costs for each source are limited to those for evaluating their own abatement cost for a particular level of reduction. If there is a repurchase clause in the permit then this information can be evaluated as it becomes available without incurring additional costs for the timeliness of the decision.<sup>7</sup> Finally, since all transactions in the two primary markets represent negotiation with the same agency, standardization of the contracts is possible which leads to falling transaction costs as the number of agreements increases.

In summary, the advantages of a composite market model are the flexibility which the model offers a catchment based agency for implementation of a TDP system. The model makes possible the development of TDP markets adapted to the particular needs and limitations of individual catchments. Implementation may take place over time without major new investments and adapt to new information and technological innovations as these become available. The model does not offer a quick resolution to reducing discharges to a target level. However, given the lack of progress in finding methods to reduce NPS discharges particularly from agricultural activities, any movement in this direction that improves water quality in a cost effective way is a step in the right direction. A composite market may not be the only solution but it does offer an alternative.

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<sup>7</sup> An example of this is the observation by Netusil and Braden (1993) that "waiting to contract [for abatement] may greatly reduce/enhance a landowners gains from contracting".

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