Thematic Week: Water Economics and Financing

Thematic Axis: Water Markets

Title: The Institutional Framework for Transferable Emission Rights

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Abstract:

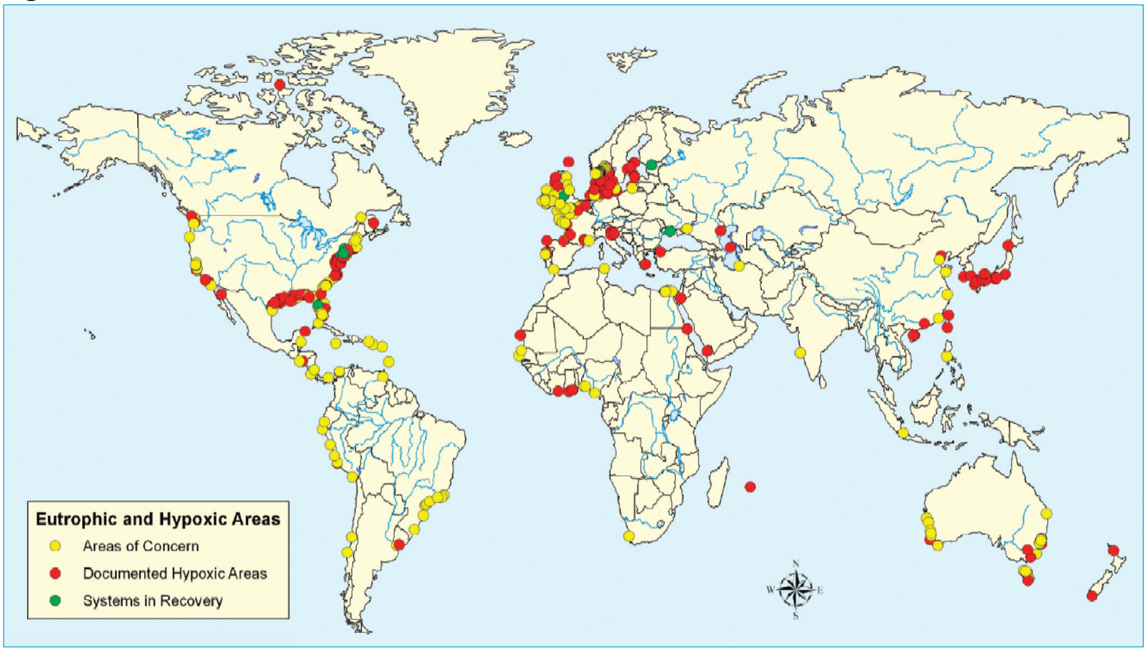
Transferable emission rights as a policy tool is widely known as a component of cap and trade, such as Greenhouse Gas emissions trading. Transferable emission rights are most applicable to water quality when addressing regional pollution from multiple polluters. Effective policy must include four components, 1) aggressive pollution reduction caps, 2) measurement of pollution emissions, 3) strong and swift enforcement, and 4) retirement of existing prescriptive or "command and control" policies. Policy makers considering the use of transferable emission rights must first ask themselves an honest question, "Will your policy be environmentally aggressive with mandatory pollution measurement and strong enforcement?" If the answer is no, then transferable emission rights should not be pursued. If the answer is yes, additional consideration should include the type of pollutants involved and how those pollutants impact localized water quality (i.e., "hot spots"). If properly applied, transferable emission rights result in "polluter pays" for all polluters involved. The advantage is that all polluters, thus society, pay an overall lower price to achieve the desired environmental outcome.

Keywords: transferable emission rights; water pollution; measurement; cap and trade.

INTRODUCTION

It has been estimated that worldwide over 400 water bodies are experiencing problems with eutrophication (Selman et al., 2008), which is an excess of nutrients (nitrogen and phosphorus) that cause harmful algae blooms, hypoxia (reduced levels of dissolved oxygen), and other water quality problems. Sources of excess nutrient pollution include in no particular order: burning of fossil fuels which transform atmospheric N_2 into bioavailable NO_X, animal waste manure, human waste, synthetic fertilizers used in agriculture and horticulture, soil and stream erosion that releases sediment bound nutrients, and the loss of healthy eco-systems capable of assimilating a portion of excess nutrients.

Figure 1



Because the sources of nutrient pollution include many economic activities often spread across thousands of km^2, nutrient pollution is if often considered a candidate for transferable emission rights policies. A classic example would be policies that mimic cap and trade policies envisioned for controlling Greenhouse Gas emissions. In such an example regulations would limit polluters to a finite allocation of nutrient emissions (i.e., cap) and allow polluters to trade allocations (i.e., trade) so long as the overall emissions are no greater than the total available allocations.

Other water quality issues are potential candidates for transferable emission rights policies. Consider for example soil and stream erosion. The negative impacts of soil and stream erosion include lower rates of food crop production, degraded freshwater drinking sources, negative impacts on aquatic biodiversity and biomass, and increased nutrient pollution due to sediment bound nutrients as mentioned above.

As technology evolves to continuously monitor stream turbidity (i.e., how “dirty” a stream is due to sediment) it may be possible to effectively allocate “sediment emission” rights among small watersheds. The surrogate indicator of soil and stream erosion could be a defined threshold of “dirty” as assessed by turbidity measurements. The threshold might be monthly peak turbidity, weekly average turbidity and so forth. All landowners would have an incentive to reduce soil and stream erosion. In this example there could be two trading scenarios. The first trading scenario is where landowners in one watershed collectively acquire allocations from landowners in another watershed. This example would be *inter*-watershed trading across two or more watersheds. The second trading scenario is where landowners within a watershed reach their own internal agreement (e.g., a transfer of funds and/or in-kind assistance) such that the whole watershed is able to meet its allocation limit. This example would be *intra*-watershed trading within a single watershed.

Stream temperature is yet another example of possible transferable emissions rights polices (Walker 2006). Consider power plants that use river water as cooling water. The water is discharged back to the river at a higher temperature, which causes thermal pollution that affects fish populations such as salmon and trout. Additional sources of thermal pollution include loss of forest cover adjacent to streams and rivers, and loss of groundwater which would otherwise moderate stream temperatures. The presence of multiple sources of thermal pollution spread across the landscape makes thermal pollution (temperature) a potential candidate for transferable emission rights policies.

Many of the above examples could be described using the terms cap and trade, or transferable emission rights, or water quality trading with supporting terms such as credits and allocations. Each term has a specific meaning and should only be used interchangeably with care. This paper will mostly use the terms transferable emission rights, cap, and allocations as they apply to pollution allocations as property rights under an enforceable pollution cap.

The above examples demonstrate that transferable emission rights policies are widely applicable to water quality issues. However, transferable emission rights policies can also be ineffective if not applied correctly (Stephenson et al., 1999). This leads to the question of why use such policies in the first place, which the most common reason cited is reduced compliance costs. As important as it is to reduce compliance costs, *the central rational for using these policies should be to accomplish widespread, significant pollution reductions that maximize the chances of success by allowing and encouraging innovation.*

EFFECTIVE TRANSFERABLE EMISSION RIGHTS POLICIES

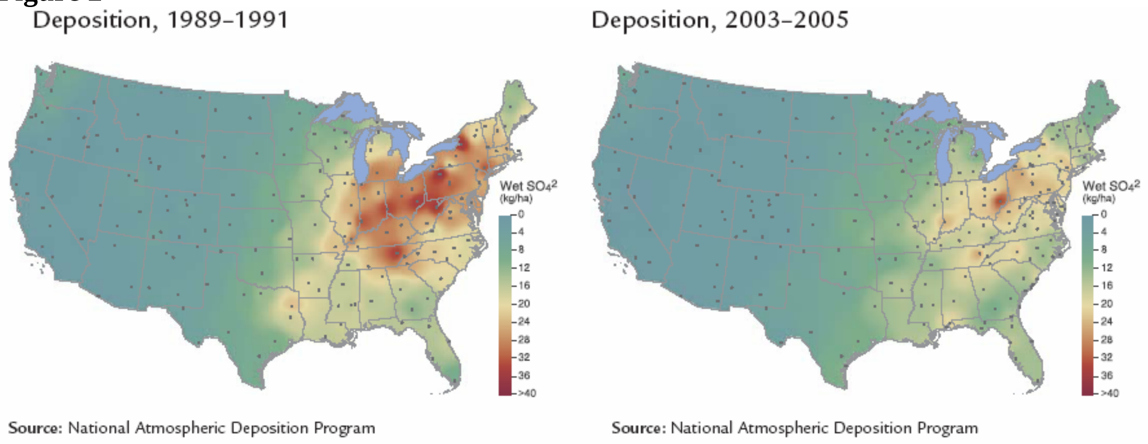
The four components for effectiveness discussed are 1) stringent pollution caps, 2) measurement of pollution emissions, 3) strong and swift enforcement, and 4) retirement of existing prescriptive or “command and control” policies. A well known example of these four components is the Acid Rain Program in the US, which has capped sulfur emissions from power plants since 1995. Literature exists describing the program design, compliance rates (over 99 percent), pollution reductions (roughly 50 percent), cost savings (estimated to be over 50 percent) and so forth (US EPA, 2005).

We first examine the importance of having a stringent pollution cap. As seen in Figure 2, in years 1989-1991 (left side of Figure 2) the eastern part of the US was essentially one large sulfur hot spot (the darkest areas). In 1989-1991 roughly 80 percent of sulfur originated from coal fired power plants. If the stated goal of the environmental policy is to reduce compliance costs, the simplest solution is to not require pollution reductions. If the stated goal is to significantly reduce the existing hot spot, the solution is a stringent pollution cap.

Figure 2 also shows the years 2002-2004 (right side of Figure 2). The improvement seen between 1989-1991 and 2002-2004 is the direct result of a stringent cap. It would be inaccurate to say that transferable emission rights caused the remaining hot spot in 2002-2004. More accurately, the stringency of the cap successfully addressed roughly 90 percent of the problem, but the stringency was insufficient to address the last 10 percent. An obvious solution is to make the cap more stringent. As of this writing a more stringent sulfur cap is waiting for final decisions concerning mercury emission caps and potential CO_2 emission caps.

Hot spots as presented in this paper are viewed to be the result of previously failed policies, or no previous policies. When viewed in this fashion the question is not if transferable emission rights will cause a hot spot, but instead how stringent the cap should be.

Figure 2



Another issue related to the stringency of the cap is the concept of "pay to pollute." Pay to pollute is a term used to denote a negative perception of trading. Without question some polluters will pay money to acquire allocations from others that are operating below their allocation limit. This is described as pay to pollute, which strictly speaking is an accurate description. Pay to pollute could also be described as "polluter pays". Under a stringent cap all polluters, one way or another, must pay for the fact they pollute. The most accurate description is that trading allocations tend to equalize all polluter's marginal costs of compliance. Negative perceptions of pay to pollute likely have their origins with policy makers whose stated goals are economic (i.e., reduced compliance costs) rather than environmental (i.e., widespread, significant pollution reductions).

An obvious challenge is how to politically arrive at a stringent cap. For environmental problems that have persisted for decades is it preferable to impose a less stringent cap phased in over five years or is it preferable to impose a more stringent cap phased in over 10, 15, or 20 years? Based on the discussion above the implied answer is preference for a more stringent cap phased in over a longer period of time.

The second component needed for effective transferable emission rights policies is the need to measure pollution emissions. For industries and wastewater treatment plants where emissions can be measured as they exit a pipe, measurement is relatively simple and provides enforceability and transparency. In the US one of the greatest challenges to water quality policies related to nutrients is the lack of measurement of nutrient runoff from the land. This fact applies equally to traditional policies as it does policies that allow trading allocations. Most examples in the US trade "credits", which are not treated as property rights the same way as allocations). Not measuring pollution runoff from land creates uncertainty and makes the overall policy less transparent. Not measuring runoff also requires prescriptive policies where landowners cannot be innovative, but instead must comply with narrowly defined practices.

Measuring pollution runoff as a performance-based outcome would allow landowners to find solutions that reduce runoff pollution that best fit their circumstances, which increases the chance of success. The last section will further explore pollution runoff from land.

The third component of effective transferable emission rights polices is strong and swift enforcement. This advice is true for all environmental regulation, and more so for the type of policies described. Not unlike stock markets, environmental markets that allow allocation trading do not like uncertainty. If 99 polluters all comply within the allocated pollution limits but one polluter does not comply and is not swiftly penalized, the value of all allocations can be undermined. The net effect is that not complying becomes a less expensive option than reducing pollution or even purchasing allocations. The effective value of allocations would be zero, undermining the integrity of the overall policy. Stock markets often drop 10 percent if investors suddenly believe there is uncertainty. With transferable emission rights policies, lack of enforcement introduces similar uncertainty. In the Acid Rain Program, penalties are swift and the cost of the penalties is adjusted each year for inflation. As a result all power plants know at all times the cost of non-compliance, which helps maintain a stable value for allocations.

The forth component for effectiveness is retirement of existing prescriptive or "command and control" policies. Consider that climate policies concerning CO_2 emissions tend to favor cap and trade or carbon taxes. Both policies are non-prescriptive. A closer inspection of climate policies reveals a zeal for "sub-policies" that are prescriptive. Case-in-point would be biofuel policies. The impacts of prescriptive biofuel policies has been little net reduction of CO_2, upward pressure on food prices, and negative environmental pressures on land use practices. There is no need for prescriptive biofuel policies under a stringent CO_2 cap or under a stringent carbon tax since biofuels would be pursued if they represent the best solution.

The issue is not trivial. In the US many people do not see a need for climate policy. These same people point to biofuels as an example of failure, and they are right. Biofuels are an example of why transferable emission rights policies are effective when other prescriptive policies are retired or eliminated.

PO RIVER BASIN EXAMPLE

In this section the Po River basin, Figure 3, in northern Italy is used as a visual aid. The discussion will be realistic, but hypothetical. The Po River basin covers an area of 74,000 km^2 primarily in northern Italy, and represents a major part of the Italian economy with agriculture, industry, and tourism. The Po River basin is also a major source of nutrients that impact water quality in the northern Adriatic Sea.

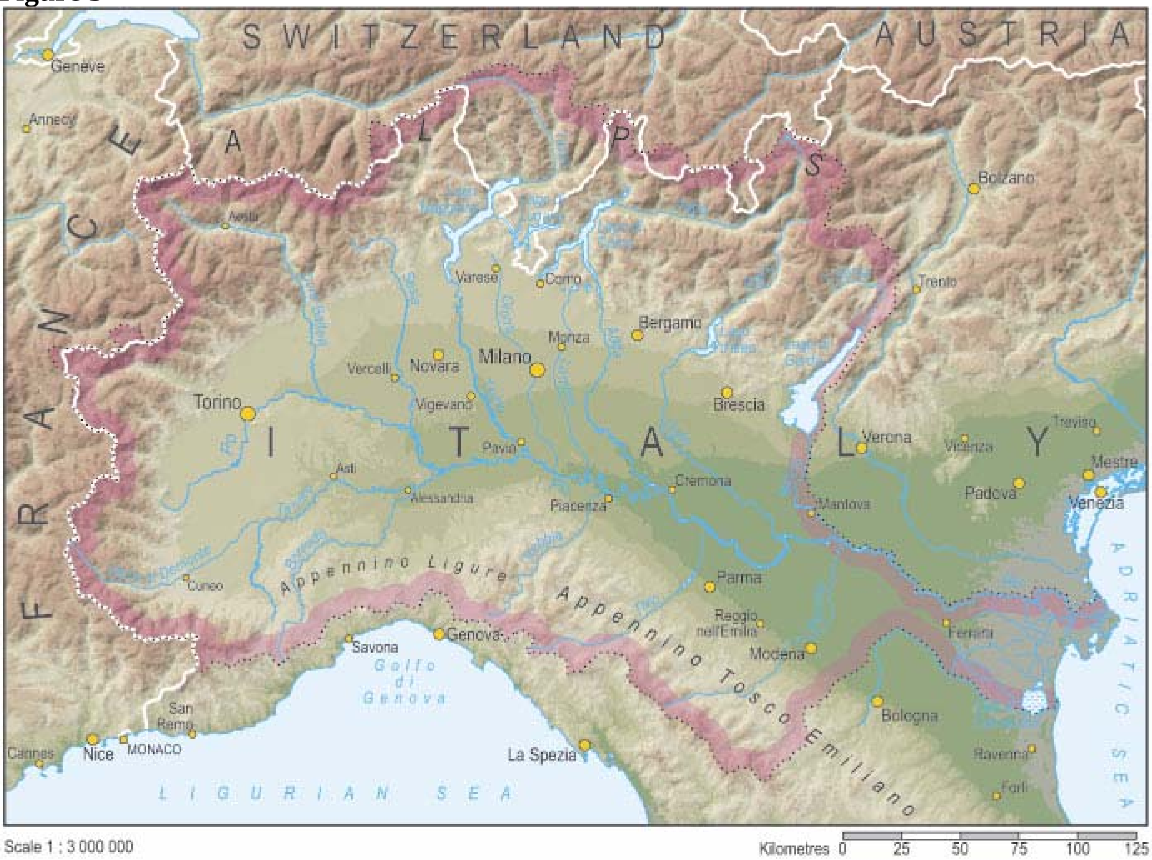
It is conceivable to design one regulation that would apply to all river basins that drain into the northern Adriatic Sea, and allow allocations to be traded across river basins. To understand the potentials the first step would be to identify the existing hot spots. We will limit our hypothetical example to the Po River basin to keep the example simple. We will also assume that excess nitrogen and phosphorous both play a major role in the water quality of the northern Adriatic. Within the Po River basin we will assume that excess phosphorus plays a primary role in water quality and that nitrogen plays a secondary role. The latter assumptions are typical when dealing with freshwater river basins that drain into estuaries mixed with ocean water.

We have already identified an existing hot spot as the Adriatic Sea (right side in Figure 3), caused in part by excess nitrogen and phosphorus from the Po River basin. To make the example more interesting we assume that some of the freshwater lakes in the northern Po River basin (top of Figure 3) are affected by excess phosphorus, and that nitrogen plays a secondary role. We also assume that in the location of the city of Alessandria (down and to the right of Torino in Figure 3) the river is affected by excess phosphorus and that nitrogen also plays a secondary role.

We are using the term hot spot to specifically identify areas that suffer the most from excess nutrients. In Figure 2, the hot spots in the US caused by sulfur pollution were the darkest areas on the map. If we produced a similar map for the Po River basin, the three hot spots (Adriatic, northern lakes, Alessandria) would also be the darkest in color. The proper way to assess transferable emission rights policies is to first identify the hot spots of greatest concern.

The simplest policy option would be to create a single nitrogen cap for the entire Po River basin and a single phosphorus cap. The caps would then be allocated to all regulated entities. As a result we would know with confidence that we will successfully address the Adriatic hot spot. We would not necessarily know if the northern lakes and the Alessandria hot spots would be reduced.

Figure 3



The simplest policy should first be examined. Based on estimated costs for each polluter to meet their allocation, policy makers can estimate the likelihood of polluters trading allocations. The analysis can be conducted for different stringencies of the cap. Such an analysis is a basic cost-benefit analysis that should normally be conducted. The added information would be estimating the number of allocations traded and where pollution reductions are most likely to occur.

In this example we assume that one cap for nitrogen and one cap for phosphorus would sufficiently address the Alessandria hot spot in addition to the Adriatic. This is realistic if there are a significant number of polluters upstream of Alessandria with sufficient capacity to reduce pollution at a relatively low cost. The same result might not apply to the northern lakes. Lakes tend to be more sensitive to excess nutrients compared to free flowing rivers. If the number of polluters upstream of the lakes is relatively small and the cost of reducing nutrients is relatively high it would not be surprising if the polluters purchase allocations from areas downstream of the northern lakes.

Although making the caps more stringent could help, there is likely a limit where the caps become more stringent than necessary to protect the Adriatic and begin to impose a higher cost for everyone. In this case we need a special provision to specifically ensure the lakes are protected. Because the primary issue for the lakes is phosphorus in this example, it would likely make sense to add a special provision for phosphorus only.

The overall policy would have two regional caps (nitrogen and phosphorus) designed to address the Adriatic hot spot, and one local cap (phosphorus) to addresses the northern lakes hot spot. The Alessandria hot spot would be protected by the two regional caps. The rules that govern the process would be fairly simple. All polluters could trade nitrogen and phosphorus allocations with all other polluters anywhere in the Po River basin (i.e., the two regional caps). Polluters within a specific lake's drainage basin could only purchase a limited amount of phosphorus allocations from polluters outside of that lake's drainage basin. It would not matter which polluter in the lake's basin purchased allocations from outside the lake's basin. It only matters that once the limit is reached no other allocations from outside the basin could be purchased. The special provision would not limit the trade of phosphorus allocations within the lake's basin.

The Po River example highlights the type of analysis necessary to create the least constraining policy that sufficiently addresses existing hot spots. As repeated many times a stringent cap is the best way to address hot spot issues. Also it would be necessary to retire other existing policies that are prescriptive. If the cap is stringent the incentive for polluters that have already installed control technologies will be to maintain their nutrient reductions.

Fate and transport refers to the fact that when a kg of nitrogen or phosphorus enters a river or stream an amount less than a kg will arrive downstream. There are many other terms used to describe this effect.

If we ignore fate and transport all polluters would have a relatively equal incentive to reduce nutrient pollution. This has been an implicit assumption in all the examples given. If we include the effects of fate and transport, the incentive would be for polluters downstream (closer to the Adriatic) to reduce pollution and polluters upstream to purchase allocations. The reason is that purchasing one kg of pollution closer to the Adriatic might be equivalent to reducing two or three kg of pollution upstream.

In the US the standard practice is to include the effects of fate and transport. However, including the effects of fate and transport does not guarantee anything. Experience suggests that including fate and transport complicates people's understanding and causes some polluters to feel they are being treated less fairly. The best advice is to first analyze the simplest policy option, which would ignore fate and transport as it effects trading allocations. An important caveat is that the analysis would always include fate and transport as a science issue when investigating the water quality impacts.

PERFORMANCE-BASED CONTROL OF POLLUTION RUNOFF FROM LAND

Some of the practical issues of using performance-based outcomes to control pollution runoff from land are being explored. In one study farmers that were asked a series of questions about their willingness to participate in group performance contracts where 5 to 15 farmers would cooperate to meet a threshold of pollution runoff measured in a nearby stream (Sohngen et al.). The scenario is this case was that farmers would receive payment for pollution reductions, as opposed to having to meet a regulatory limit. The size of the land area was proposed to be about 4 km^2. How the farmers would meet the goal would be entirely their choice. According to the findings the farmers questioned had an overall positive reaction to the idea. There concerns were how they would police each other within the watershed, but overall they believed they could successfully cooperate.

Group compliance as described requires identifying small watersheds where the impacts of a small group of landowners can be measured. Specifically it is desirable to identify headwater streams, in which no other streams enter the watershed and only one stream exits the watershed. Otherwise it would be necessary to measure streams entering and exiting the watershed instead of just measuring a single exit point.

For most environments around the world that are naturally forested, headwater streams and their associated watersheds account for the majority of the landscape. In other words, forested landscapes tend to be dominated by small, independent headwater streams the drain small independent watersheds. Roughly 75 percent of the land area of the Chesapeake Bay watershed in the US is composed of headwater watersheds, each about eight km^2 in size. Each watershed could be measured for nutrients and treated as one polluter. As mentioned in the introduction allocations would be traded across watersheds, and internal agreements would be used to effectively trade funds or in-kind assistance within a watershed.

There are lots of unknowns at this time, but the possibility exists to shift policies in favor of performance-based outcomes when addressing pollution runoff from land. Such a shift would move closer to transferable emission rights policies that truly create innovation and maximize chances of success.

CONCLUSIONS

The central rational for using transferable emission rights policies should be widespread, significant pollution reductions that maximize the chances of success by encouraging innovation. Policy makers already know from experience that weak regulations that are poorly monitored and poorly enforced ultimately fail. The same should be expected with transferable emission rights. In response effective policy should include 1) stringent pollution caps, 2) measurement of pollution emissions, 3) strong and swift enforcement, and 4) retirement of existing prescriptive or "command and control" policies.

The mistake often made is to assume that trading allocations creates hot spots. The proper way to assess the issue is to recognize that hot spots already exist and explore the stringency of the cap necessary to reduce the hot spots. Analysis should be used to determine if any special provisions are needed. Only after a complete cost-benefit analysis in which a stringent cap would not address all hot spots should policy makers add special provisions. Lastly, preference should be given to strict cap limits in favor of short deadlines.

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