Market-Based Approaches to Pollution Control in the Lake Taupo Catchment in New Zealand

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Upananda H Paragahawewa
AgResearch Ltd, Ruakura Research Centre, East Street, Private Bag 3123, Hamilton, New Zealand

Summary

There are at least five general reasons why market-based policies fail to address some of the most basic environmental objectives. This study evaluates the available biophysical and economic data against these criteria and concludes that market-based approaches should be employed cautiously in pollution control under the present system and the available technology for farming in the lake area. The most effective market-based instrument to control pollution, in this case, seems to be negative incentives, as the public net cost of farming is extremely higher than the private net benefits. However, the intensity of taxes that would be effective in this regard would definitely results negative net farm benefits. The principle alternative, emission trading, would be effective with a highly regulated system given long-term political willingness to address the problem effectively.

Key Words- Pollution, Market –based policies, Emission trading

Introduction

The consideration of the use of market based policies (economic instruments) goes back to the early 1920s when Pigou addressed the issue of externalities and the possible use of charges or subsidies that could bring a market back into equilibrium. The theory behind the now popular market-based approach, the trade permit system to deal with pollution problems arose in the late 1960s in work by Dale (1968) and Crocker (1966). They argued that the right to emit pollutants or use natural resources would be distributed to stakeholders but could then be sold. Market negotiations between potential permit buyers and sellers would occur and results in the reallocation of these permits across the stakeholders. Woodward (2005) described a perfect version of such a program. Accordingly, a cap is first placed on total pollution emissions. Then permits equal to the cap are distributed to the polluters. Finally, a market develops in which the sellers are those firms with relatively low abatement costs who end up reducing emissions by more than initially required; buyers are those with relatively high abatement costs who end up reducing emissions by less than initially required. The text book result is an efficient market equilibrium in which a pollution target is achieved at lowest cost or a resource is used in a way that yields the most value to the society.

Proposed Waikato regional plan variation 5 (Waikato Regional Council Policy Series 2005/03) too suggests a N_2 emission trading approach to counter the pollution problem in the Lake Taupo catchment, the largest Lake in New Zealand. The lake Taupo is known for its dramatic vistas, deep clear near pristine waters, superb trout and volcanic heritage. However, Rae et al. (2000) reported that the water quality of the Lake is declining. Accordingly, development and intensification of the surrounding rural and urban lands started in 1930s has increased the amount of nitrogen entering the Lake through ground water and rivers. This has promoted algal and phytoplankton growth in the Lake.

Sundakov (2006) analyzed the Waikato regional plan variation 5 and indicated that the emission trading option suggested is not going to be effective due to two main reasons namely, grand parenting to allocate Nitrogen Discharge Allowance (NDA), and the major deficiencies of using Overseer (nutrient budgeting model) to estimate leaching. Sinner et al. (2005) explore three case studies (including transferable water permits in Tasman District and Waikato Region) in New Zealand to study the adoption of market- based instruments for resource management. The study concludes that market based instruments (MBI) are difficult to implement if they threaten the position of existing users, it is important to have clear objectives, and norms and values can be an obstacle to MBIs especially where they help to protect the interest of key stakeholders. However, value based opposition can be overcome if practical concerns are addressed.

This study, an evaluation of the water pollution problem in the Lake taupo with especial reference to the suitability of market based instrument to address the problem was based on the literature review on environmental markets and the related economic theories. In this regard, an analytical framework was developed base on the argument by Ackerman and Gallagher (2000). Accordingly, there are at least five general reasons why market based instruments fail to address some of the most basic environmental objectives. Further, an overview of water quality trading in the US was carried out by using the comprehensive survey data of water quality trading and offset initiatives in the US by Breetz et al. (2004). The special features of successful and unsuccessful trading programs were then compared with the lake Taupo scenario to judge the effectiveness of market base instruments in case of addressing the pollution problem in the Lake.

The limits of the market-based environmental policy approaches

During the 1990s, a near consensus emerged in policy making circles for a sharp turn away from past patterns of regulations towards the theoretically greater efficiency and lower cost of environmental taxes, tradable emission permits, and other market incentives (Stavins et al. 1988, 1991). According to Anderson and Leal (1991), the most passionate free marketers seek to roll back all government programs, laws, and regulations that affect business and property. For them the market is answer regardless of the question, and even irreversible climate change is just another opportunity for private profits. They suggest two avenues for dealing with global warming. The first take changes in the earth's temperature as given and ask whether individuals have the incentives to respond with innovative solutions. The second focus on the evaluation of the property rights to the atmosphere.

The blueprint offered by the market is explained in general equilibrium theory. Under a series of idealized assumptions, a competitive economy is guaranteed to have an equilibrium which is Pareto optimal, and every Pareto-optimal outcome is equilibrium for some set of initial conditions. According to Ackerman and Gallagher (2000), there is no guarantee that equilibrium of a general equilibrium model is either unique or stable. Intensive theoretical analysis has found no way around this problem, and in fact has found that that dynamic behaviour of small (mathematically manageable) general equilibrium models is not necessarily a guide to the behaviour of related larger and more realistic models.

Bergh et al. (2000) argues that in reality the assumption of general equilibrium theory are inconsistent with what we know about people, firms, and technology. The neo classical behavioural model and its assumption of well-informed narrowly defined maximization clash with the results of most social sciences and with common sense. According to Arthur (1994), major firms routinely failed to be as small and competitive as the theory requires; oligopoly and monopoly are obvious persistent facts of life. Path dependent technologies, involving learning by doing and network effects, further undercut the presumption that market outcomes are reliably optimal or efficient.

According to Ackerman and Gallagher (2000), the market as a blue print fails because there are significant public purposes that cannot be achieved by prices and markets alone. In some causes, society may intentionally and appropriately choose to get the prices wrong in order to pursue more important goals. Ackerman and Gallagher further emphasized on at least five general reasons why market based policies fail to address some of the basic environmental objectives. The details of these reasons and their relevant to proposed N_2 emission market of the Lake Taupo are discussed in the following sections.

a. Large, irreversible damages must be prevented

The main argument here is that the market does not guarantee that producers will always do the right thing; it only ensures that those who do the wrong thing too often will go out of business. Implicit in the perfect competition model is a process of trial and error in which unsuccessful producers may do the wrong things for a while before giving up and trying a different line of work. This is a useful way to make many resource allocation decisions if there is no great social cost or lasting harms caused by a few failed experiments (Koopman, 1951; Krutilla, 1967). In fact, it is hard to imagine a better way to choose which restaurants should serve our community; the economic and environmental impacts of unsuccessful restaurants are minimal. But the same process of trial and error is less attractive as a strategy for disposal of high-level radioactive waste, where it is essential to be right the first time and every time. When the potential damages are large and irreversible, as with radioactive waste, then society cannot afford the experimental learning process that is implied by market competition. Many environmental problems are more analogous to the urgent question of nuclear waste disposal than to the benign issues of consumer preferences and restaurant choice. Threat of extinction of endangered species, destruction of irreplaceable wildernesses and other ecosystems, and emission of toxic and carcinogenic pollutants, all involve large irreversible damages. The market can safely play a role on these issues only in a firmly regulated context, intentionally constrained by high minimum standards safeguard the interest of nature and humanity.

Scheffer et al. (2001) showed how natural ecosystems often respond in abrupt, sometimes catastrophic ways to prolong stress. In aquatic ecosystems this stress may arise from increased nutrient inputs, invasive species (e.g. 'oxygen weeds), extreme weather events and/or water level changes. According to Hamilton (2005), the cost of restoration amplify greatly once lake degradation exceeds a 'tipping point' when the lake switches into a low-water clarity state often characterised by loss of weed beds in shallow lakes or increase cyanobacteria (blue-green algae) populations in deep lakes. Blooms of blue green algae occurred in Lake Taupo in 2001 and 2003. These findings confirm that the possibility of large irreversible damages to the Lake Taupo if the current level of nutrient leaching going to be continued in the future.

b. Outcomes far in the future are important

Discounting, the standard method for comparison of cost and benefits that occur at different times, is indispensable for near-term decisions but nonsensical for the long run. However, by using a discount rate for various projects which have long term environmental impacts, the policy makers implicitly imposed a specific pattern of preferences regarding the relative welfare of present and future generations (Howarth and Norgard, 1993). In method of discounting, the benefits far in the future have a very small present value. Hartwick, (1977) and Solow (1986) argued that very low weight effect of discounting on the far future benefits had slow and minimize the current spending on the long-run environmental objectives. According to Bromley (1998), the only reasonable conclusion of using discount rates to weigh the cost and benefits in the future is that economic theory does not offer a reasonable understanding of our responsibility to future generations.

According to Hamilton and Wilkins (2005), Lake Taupo will respond only very slowly to changes in land use. It will take on average 45 years for stream inflow concentrations to reflect land use change in the catchment and around 15 years for levels of nutrients and phytoplankton in the lake to approach equilibrium with stream flow nutrient concentrations. Therefore, that present-day lake water quality has equilibrated with land use of the 1940s. These biological research findings emphasize the fact the relevance of long term effects in this case.

c. Many environmental values are not commodities that can be priced

By trying to value environmental goods economists assume that environmental values can be treated as commodities like any others. This approach is problematical on several levels. There are serious conceptual and technical critiques of the standard methods of monetizing environmental damages by economist and lawyers' alike (Diamond and Hausman, 1994; Harvard Law Review 1992). Economists frequently rely on "contingent valuation" surveys that ask people to place a hypothetical dollar value on some aspect of the environment; the question does not always produce a meaningful answer. According to Costanza (2006) these sorts of methods are useful but they are limited to the kind of services that people have some knowledge about, for example recreation, cultural amenities, aesthetic kind of services. But they may be not be very helpful for services that people do not know much about, like water supply, climate protection or soil formation. However, Costanza emphasized the importance of valuing these services by using broad range of methods and acknowledge that people may or may not be well informed about the contribution of ecosystem services to their welfare.

A problem is that every unit of commodity typically sells at the same price; five kilo of apple is worth five times as much as one. However, for pollutants with threshold effects or critical levels, five times of emission may have vastly more than five times the impact of one kilo of emission. According to Ackerman and Gallagher (2000), in contrast to traditional regulations, market based policies such as emission trading is more prone to creating "hot spots" where critical levels of pollutants are exceeded.

On the most fundamental level, there are deep ethical, philosophical, and religious objection to assigning dollar values to human or other life (Anderson, 1993: Kelman, 1981). For many people, the protection of endangered species and unique natural habitat, or the prevention of avoidable deaths and injuries, involve a realm of fundamental principles that transcend the market. Vant and Bromley (1994) argue that from this perspective, monetization of human life and health, or the existence of other species, is either meaningless or degrading. Accordingly, it is important to talk about these principles and their policy implications, but that conversation cannot be reduced to purely monetary terms.

Costanza et al. (1997) has attempted to value the world's ecosystem services and natural capital. The study included the current economic value of 17 ecosystem services for 16 biomes, based on published studies and few original calculations. For the entire biosphere, the value (most of which outside the market) is estimated to be in the range of US$ 16-54 trillion per year, with an average of US$ 33 trillion per year. According to them, because of the nature of uncertainties, this must be considered a minimum estimate. Interestingly global gross national product total is around US$ 18 trillion per year. There is no value estimation for the Lake Taupo. In this study, value estimation for the Lake and surrounding ecosystem was conducted by using the Costanza study data (Table 1). The value of the Lake and the surrounding forest ecosystem is estimated to be around 662 million US$ per year and this is around 1.04 billion NZ$ per year in current currency rates (1NZ$= 0.64US$). However, this is an under estimation of the real value as pointed out in the Costanza study. Environmental services assumed to be a normal good in that study and thus supply and demand curves and the total surplus is similar to the figure 1. However, many ecosystem services are substitutable up to a point and their demand curves probably look more like figure 2. In other words demand approaches infinity as the quantity available approaches some minimum necessary level of services, and thus the consumer surplus as well as the total economic value approaches infinity.

Table 1: Estimated Values for Different Ecosystem Services of the Lake Taupo and its Surrounding Forest.

Ecosystem Services	Value 1994 US$/Forest/ha /yr (US$/Lake/ha /yr)	Value* of forest ($/year x 10^2)	Value** of Lake ($/year x 10^2)
Climate regulation	141	200784	
Disturbance regulation	2	2848	
Water regulation	2 (5445)	2848	3354120
Water Supply	3 (2117)	4272	1304072
Erosion Control	96	136704	
Soil Formation	10	14240	
Nutrient Cycling	361	514064	
Waste Treatment	87 (665)	123888	409640
Biological Control	2	2348	
Food Production	43 (41)	61232	25256
Raw Materials	138	196512	
Genetic Resources	16	22784	
Recreation	66 (230)	93984	141680
Cultural	2	2848	
Total	969 (8498)	1379856	5234768
Grand Total			6614624

* Total area under forest is 142400ha

** Total area of the Lake is 61600ha

Fig 1: Supply and Demand Curves, Net Rents and Consumer Surplus for Essential Eco System Services

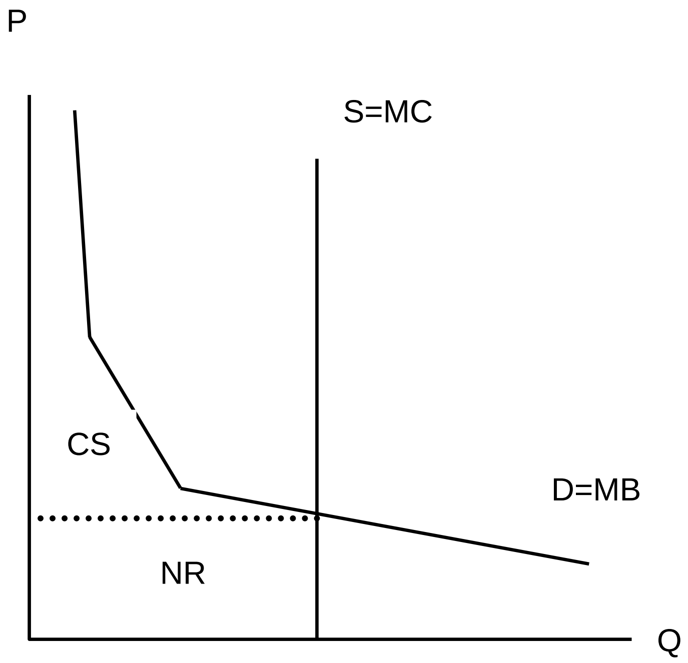
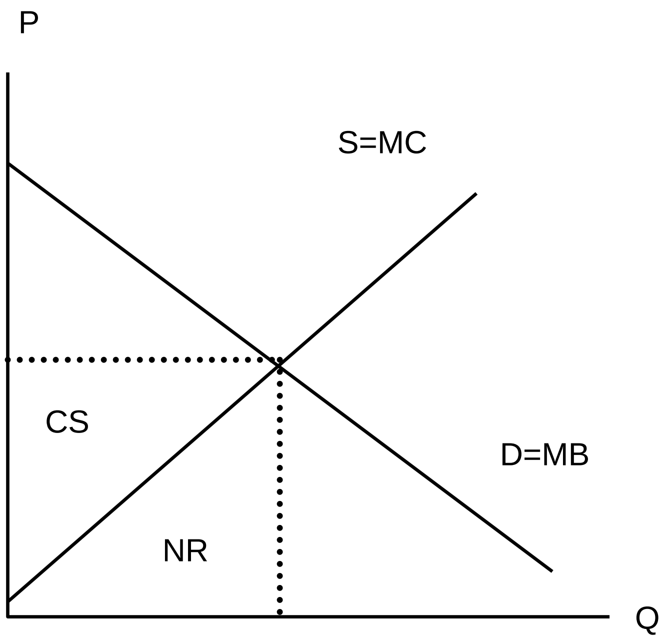


Fig 2: Supply and Demand Curves, Net Rents (NR) and Consumer Surplus (CS) for Normal Goods



d. Volatile market prices can cause wasteful misallocation

As stock market movements indicate the investment that made yesterday may no longer profitable today when the price change is extremely volatile. This problem can also affect the environment when volatile markets send mixed signals about the value of environmental policies and initiatives. Very high prices for recycled materials in 1995 inspired more than a billion dollars of investment in new recycled paper mills; by 1997 those new mills had closed, most of them bankrupt (Ackerman and Gallagher, 2000). High oil prices in the early 1980s drove the auto industry to retool for small car production, immediately after prices fell consumers went back buying big cars. The relevant of these criteria for the current study is negligible as there is no much volatility in the concerned market activities.

e. Relative importance of market based instruments and traditional regulatory approaches

The two strategies provide different benefits. The market maximizes consumer choice and creates incentives for cost minimization; the government can supply public gods, minimize transaction costs, and create a transparent standard of fairness. The relative importance of these contrasting strengths will differ from case to case.

Economist have analyzed the conditions under which market incentives are more or less effective; for example when pollution approaches threshold beyond which damages rise rapidly, the rational for strict emission controls becomes stronger. There is also some evidence that market incentives, like any other policy, are less effective in practice than they were projected to be in theory (Gustafsson, 1998).

Finally, market based policies frequently involve taxes. The principle alternative, emission trading, involves high start-up and transaction costs, and is not appropriate in every case. Traditional regulation, involving rules that lower or prohibit certain emissions, may be more politically feasible considering the sensitiveness of people to the taxes (Ackerman and Gallagher, 2000). The cause of Lake Taupo problem also a highly politically sensitive aspect as main activities responsible for the pollution is farming. Therefore, instruments like regulating might be more attractive than taxing both for farmers as well as politicians. The propose emission trading is blend of regulation and market activities and thus seems to be palatable for both farmers and policy makers to begin with.

Table 2 indicates a evaluation of the above mentioned five criteria for the most effective emission trading market in the history, the SO_2 market in the USA and for the propose emission trading market in the Lake Taupo. The effectiveness criteria for the use of market based instruments fit well in the case of SO_2 market, where as most of the criteria are not fit well in the case of propose emission trading market in the Lake Taupo area.

Table 2: MBI effectiveness criteria valuation in Case of SO_2 Market in the USA and Propose Emission Trading Market in the Lake Taupo Catchment

Criteria	SO_2 Market	Emission Market in the Taupo Lake
1. Damage	Seems to be reversible	irreversible or very costly to reverse after exceeding the tipping point.
2. Effect	prompt following emission	Long term, Take 40-60 years to appear
3. Humanity / Biodiversity	not prominent	Prominent
4. Prices	not volatile	not volatile
5. Regulation	expensive & Inflexible	Trading seems to be expensive due to high transaction cost (NPS-NPS trading)

Effectiveness of Emission Trading

Despite the above mentioned criteria been not well fit for market base approaches in most environmental related problems, the emission trading is a popular approach in many environmental related problems. The most important aspect of this approach is that it combines both regulatory and market approaches to address the environmental related issues. However, effectiveness of this approach dependent on how far the system is capable of sticking to the regulated levels while maintaining and encouraging efficient trading through adoption of environmental best management practices. In the literature, however, various factors were stated as probable obstacles to an efficient trading system to be operated.

The main concern is that the land and water use decisions by non point sources that cause local water quality problems are very different than the point source pollution problems. Most water emissions are difficult to measure, change with the weather, have different impacts depending on where they occur, and are the results of ever-changing locally made and locally regulated decisions. This is a complicated problem to attempt to address with trading. In fact, recent economic research suggests that in this type of situation a great deal of political and regulatory reform may be necessary to interest any one in trading.

Kydland and Prescott (1977) explained why and how people “game” regulatory programs; that is why and how they strategize to evade regulations and employ legal and political manoeuvring to avoid, delay, and reduce penalties for violating regulations they cannot avoid. The area of research in environmental enforcement economics also address how people “game” regulatory programs, but focuses specifically on that little benefit/cost calculation that each regulated entity performs to determine whether or not to comply with a regulation.

Studies show for an example (Stavins, 2004) that the acid trading program succeeded because precise individual SO_2 discharge limits were established and strictly enforced with 100% monitoring and severe penalties for violators. At present, most non point water pollution discharges are either unregulated or do not expect that violating regulations will be detected or will be very costly. In consequence, they have little incentive to get involved in allowance trading. Many of them are aware that accepting the notion that tradable discharge allowance (pollution rights) can be neatly defined and assigned to individual entities could undermine their long-term political and legal strategies for fending off regulations. This shows in the face of weak, rarely enforced emission discharge restrictions and penalties for non-compliance that are easy to avoid, few dischargers are interested in buying water quality credits. Where there is no demand for water quality credits, there is no incentive for anyone to try to supply credits. Thus, King (2004) argues that strategies to point / non point water quality trading should focus on demand-side and supply – side issues, rather than the institutional and technical issues that occupy the time of most water quality trading experts.

Demand side issues

Accordingly, in this case, it is useful to abandon the standard economist’s operating assumption that the potential buyers willingness to pay for a water quality credit is based on that entity’s marginal cost of complying with nutrient discharge restrictions (e.g., dollars per pound of nutrient discharge reduction). Instead, assume that the correct measure of an entity’s willingness to pay for a credit is expected cost of not complying with a government-imposed discharge restriction. If the expected cost of not complying is lower than the cost of complying by purchasing credits, there is no economic incentive to purchase credits. Most of the causes where water quality trading is being attempted, laws limiting nutrient discharges specially on non point sources are weak, rarely enforced, and involved such low penalties that the expected cost of non-compliance is near zero. The corresponding willingness to pay for nutrient discharge credits, therefore, is also near zero.

According to two 2004 Nobel-winning economists Kydland and Prescott, there is a problem of “time inconsistency” with many regulatory programs. They studied financial and real estate markets, flood insurance markets, and environmental compliance and observed that, people acting alone and groups, significantly discounted the expected cost (penalty) of not complying with a regulation if they believed that it would not be implemented consistently over time and could be influenced later. This indicates that people tend to believe that if government yields to one kind of political pressure to pass laws restricting their polluting behaviour now, they can expect to yield to other political pressure later that will prevent the enforcement of those laws or the imposition of meaningful penalties.

Kydland and Prescott's research showed that the success or failure of regulatory systems (market based or otherwise) depends overwhelmingly on bottom-up microeconomics decisions regarding opportunities to game those systems, and far less on macroeconomic governmental decisions about how those systems are supposed to work. Based on this research, it seems that enhancing the demand side of water quality markets will require mustering the political will to establish a credible system for enforcing individual allowances, and imposing meaningful penalties for exceeding them.

Supply side issues

The gaming model (as opposed to the marginal cost model) also explains what is inhibiting the supply side of regional water quality trading markets. In watersheds where agricultural sources are significant, it is usually assumed that they will be the primary suppliers of water quality credits. However, willingness of the farmers to supply water quality credits depend in critical ways on how it might affect their ability to continue receiving agricultural subsidies and green payments to and to fend off future environmental regulations. According to King (2004), the main problems farmers face here (although they do not refer to them in these terms) are what in environmental trading circles have become known as baseline / additionally issues.

To protect the integrity of trading programs, trading guidelines nearly always prohibit farmers from selling credits for undertaking land use/ land management changes that are legally required (by state regulation) or for which the farmer has already been paid (e.g., green payments). Setting the baseline for credits in this way reduces the ability of farmers in watersheds to supply low-cost water quality credits. It means producing water quality credits by implementing management practices that go beyond what they are already required to do will require farmers to somehow validate that these practices certainly reduce discharge levels. King (2004) emphasized the need to establish a baseline and show additionality poses two problems for farmers who are considering supplying water quality credits.

First, it requires that someone examine and document what farmers are already doing to meet their legal requirements in order to establish the baseline for measuring marketable water quality credits. Most farmers, for obvious reasons, are not interested in having government representatives or their agents examining, thinking, and talking about the legality of their on-farm land use / land management practices or their justification for green payments. Second, farmers know that their discharges are not regulated as much as discharges from most other sources, because presumably, farm discharges are too difficult to control or measure, too dependent on weather, and too expensive for farmers to manage. Selling credits requires farmers to provide evidence to validate that they can reduce their discharges and document the results. Many studies have addressed validation requirements in terms of their potential to increase transaction costs associated with completing market trades and the likelihood that these higher costs could drive a wedge between buyers and sellers.

The sources of these disincentives on the supply side of water quality trading are similar to those on the demand side. Weak, vague, and largely unenforced discharge restrictions inhibit potential suppliers from engaging in trading, just as they inhibit potential buyers. Study by Breetz et al. (2005) indicates that trust and communication barriers have contributed significantly to the lethargic performance of many point-non point source water quality trading programs. They have employed the social embeddedness theory to analyze three mechanism of communicating with farmers and conduct a case study analysis of 12 water quality trading programs. They revealed that employing trustworthy third parties or embedded ties may reduce farmers' reluctance to participate, although the most effective mechanism ultimately depends on local conditions and program objectives.

The proposed emission trading in the lake Taupo area is not an exception of the above mentioned theories. Further, the small size of the proposed market and the trading between NPS sources will certainly enhanced the ineffectiveness of the proposed system.

Water Quality Trading in the USA

A recently compiled survey data base by Breetz et al. (2004) was employed to study the unique features of water quality trading markets in the USA. The trading in the USA has been explored in the context of stringent discharge limits, or watershed-wide caps like Total Maximum daily Loads (TMDL). Most trading programs and policies focus on trading between point sources and non point sources (Table 3).

Table 3: Major Trading Types in the USA Water Trading Markets

Trading type	Number of programs	%
NPS-NPS	1	0.02
PS-PS	8	17
PS-NPS	21	46
PS-PS: PS-NPS	07	15
PS-NPS: NPS-NPS	04	08
PS-PS: PS-NPS: NPS-NPS	05	13

The nutrient trades were mostly nitrogen and phosphorus. In many cases, trading programs are in place for fairly large watersheds with many possible non-point trading partners. Point sources are often held liable for the trades with non-point sources. Uncertainty associated with non-point source control is frequently mitigated through trading ratios by requiring non-point sources to more than offset the increase in a point source loading. Trading ratios are also used to account for differences in the location of sources in a watershed and for ensuring a net water quality improvement from a trade. Total trade programs reported in the survey is 46. The total trading programs are consists of on-going offset trading programs; one time offset agreement, state and regional trading policies, and other projects and recent proposals that involve trading. Actual trade or offsets occurred in 19 cases (41%). Of the ongoing trading programs, only four (.08%) experienced a large number of trades. Only one program (.02%) reported trading between non-point source polluters. This program is based in the California and called the Grassland area farmers tradable load program. This is a regional consortium of seven irrigation and drainage districts in the San Joaquim valley, administers an internal cap-and trade program for Selenum. Each district in grassland area farmers is allocated a portion of the collective Selenium cap, which was established as part of the Grassland bypass project. The district level selenium cap forms the basis for trading. The unique feature of this program is that the selenium loading from irrigated agriculture is accurately measured at the drainage pumps, thus more or less similar to a point-point trading program. Further, individual farmers are not directly participating in trading. Selenium load allocation and accountability remains at the district level. Therefore, it is very difficult to conclude this program as a successful trading program between non point source polluters.

Expert in the literature often argue that the extent to which trading occurs depends, in part, on market size. A thin market like propose trading market in Taupo Lake area, one in which there are fewer buyers and sellers, may offer fewer opportunities for trading. Table 4 offers two indicators of market size for off set trading programs: geographic size and the number of sources in the watershed that can potentially trade. The geographic size of the watersheds ranges from 3200 acres to 4.1 million acre. Most of trading programs that allowed trading with non point sources have a large quantity of potential non traders. The exception to this is in cases where non point sources have been aggregated into irrigation districts. The Grassland area Farmers Tradable Load Program in California has seven irrigation districts, while the Lower Boise River in Idaho has eight irrigation districts. The number of point sources in a trading program ranges from 4 to 314.

Trades have occurred in 11 of the offset/ trading programs. Within these 11 programs, four programs have had only one trade, one program has had two trades, and two programs have had three trades since inception. The most successful programs in terms of the number of trades have been the Grass Land Area Farmers Tradable Loads (39 trades over a two year period), Long Island Sound (63 trades over a two-year period), Truckee River (33 trades over an eight year period), and the Red Cedar River (22 trades each year since 2001) programs. The total amount traded of a particular pollutant varies widely across programs. For the more active

Table 4- Geographic and Market Size of US Offset/ Trading Programs

Program Name	Size of watershed (acres)	Sources
1. Grassland farmers tradable program	97,000	7 I & D districts
2. Bear Creek, Colorado	83,700	14 PS
3. Charfield Reservoir, Colorado	1.92 million	7 PS & many NPS
4. Cherry Creek, Colorado	243,000	6 PS & many NPS
5. Lake Dillon	3,200	4 PS, 1000 NPS
6. Long Island Sound, Connecticut	3.5 million	79 PS, many NPS
7. Lower Boise River, Idaho	41,000	10 PS, 8 districts
8. Chales River, Massachusetts	197,000	
9. Kalamazoo River, Michigan	1.28 million	50 PS, many NPS
10. Truckee River Quality Settlement agreement	1.4 million	3 PS & many NPS
11. Passaic valley Sewrage Pre treatment trading, New Jersey	534,000	260 PS
12. New York City, watershed offset pilot program	1.26 million	100 PS & many NPS
13. Neuse River Basin, North Carolina	3.96 million	22 PS & many NPS
14. Tar-Pamlico Basin, North Carolina	2.88 million	16 PS & many NPS
15. Fox-Wolf Basin, Wisconsin	4.1 million	100s PS & many NPS
16. Red Cedar River, Wisconsin	1.92 million	18 PS & many NPS
17. Rock River, Wisconsin	1.15 million	60 PS & many NPS

programs, such as Long Island Sound, trading has resulted in a substantial amount of the pollutant has been traded each year (2.7 lbs of Nitrogen). In other cases, a very small amount of pollutant has been traded (for instance, only 2lbs. of Phosphorus were traded in the Chartfield Reservoir program).

The most common reason given for a lack of trades, even for programs that had trade, is that point sources have been able to meet their limits without trading either because the limits were not strict enough or other initiatives made trade unnecessary. The high cost of trades, regulatory obstacles, difficulty in identifying sellers, and uncertainty over trading rules are also listed as reasons why trades have not occurred. Table 5, extracted from Morgan and Wolverton (2005) describes the various reasons cited by the projects and proposals as the biggest challenges to implementing these programs. Two of the most common challenges are identifying participants for trading, and uncertainties related calculating the number of credits generated by non-point source activities. These two reasons could be identified as the main obstacles for the propose trading in the Lake Taupo case too. As pointed out by Sundakov (2006) the debatable issue of effectiveness of 'overseer' the nutrient leaching estimator would complicated the issue further in case of emission trading among the non point sources. The other challenges include negotiating trading rules, market and price uncertainties, and regulatory drivers.

Conclusion

Some of the basic principles that govern the effectiveness of market mechanisms to address the externalities are seem to be violating in the case of applying market based instruments to address the problem of Lake Taupo pollution. Despite this reality emission trading is being currently considered as an effective tool to counter the problem. Simply, emission trading is a blend of regulatory and market mechanism. The problem of regulatory part (20% reduction of current level of N_2 loading to the Lake) is that there is no enough evidence to prove that even a perfect achievement of this level will guarantee a healthy state of Lake. According to Hamilton and Wilkins (2005), for no net increase in nutrient loads to Lake Taupo over current levels, the 20% nitrogen reduction is likely to be conservative considering major recent intensification of fertilizer use for pastoral lands and the comparatively large contribution to the nitrogen load from unmanageable sources. The other main problem lies in the terms of high transaction costs due to the fact that trade is mainly going to be among non point source polluters. Further, demand and supply side problems will be considerable as the concerned market is very small and also due the possible gaming behaviour of farmers as explained by Kydland and Prescott (1977). In this regard, the research should be focused on the employing market base instruments to divert farmers from high leaching farming activities to environmental friendly non farming activities at least in the most sensitive areas of the Lake. Exploring the markets for environmental services by employing market base instruments might be a potential alternative in this regard.

Table 5: Biggest Implementation Challenges for Trading Programs

Program name	Biggest implementation challenge
Grassland Area Farmers, California	Establishing a reasonable price for trades
Bear Creek, Colorado	Reporting standards not met, compliance Issues for small farms
Chat field Reservoir, Colorado	Measuring water quality changes from NPS Reductions, NPS involvement.
Cherry Creek, Colorado	Lack of pressure on PSs.
Clear Creek, Colorado	No guidance on orphan site trading; financial Resources
Lake Dillon, Colorado	Limited demand for credits, NPS monitoring
Long Island Sound, Connecticut	Continued funding
Lower Boise River, Idaho	TMDL passage, NPS participation
Kalamazoo River, Michigan	Negotiation of trading rules; identification of PS and NPS participation.
Truckee River quality settlement	Water rights highly contentious, finding sellers
Tar-Pamlico Basin, North Carolina	Difficulty predicting cost share funds; staffing
Fox-Wolf Basin, Wisconsin	Lack of regulatory driver, high transaction cost
Red Cedar River, Wisconsin	Determine credits available from BMPs; Administrative costs; NPS participation.
Rock river, Wisconsin	Establishing trade ratios; limits on BMPs

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