The Effect of Uncertainty on Compliance with Environmental Performance Standards: Total Maximum Daily Loads in Michigan

Final Report to the Great Lakes Protection Fund

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Abstract

Interest in flexible environmental performance standards for regulating nonpoint source pollution has been increasing. Part of the reason for this increased interest is the perceived benefits of flexible environmental performance standards. These include dynamic incentives to firms for technological innovation as well as improving the cost-effectiveness of environmental legislation. In the case of nonpoint sources of pollution, however, transaction costs – due to compliance uncertainty – may be so high that they may negate any possible benefits, rendering flexible environmental performance standards infeasible as a policy tool. Whether flexible environmental performance standards are superior to technology-based environmental policies depends at least in part upon uncertainty and attendant transaction costs. Yet, there is a dearth of empirical knowledge as to how uncertainty will affect the feasibility of environmental performance standards in controlling nonpoint sources of pollution.

This study examines the effect of compliance uncertainty and its associated transaction costs on the effectiveness of flexible environmental performance standards to curb nonpoint source pollution. This examination will be done through an *ex ante* game theoretic analysis of a hypothetical implementation of total maximum daily loads (TMDLs) by Michigan regulators and the hypothetical compliance response by dairy farmers. Total maximum daily loads are studied since they are an example of a flexible environmental performance standard. Furthermore, this study considers the applicability of the Porter Hypothesis to agriculture by examining the relationship between flexible environmental performance-based agro-environmental policies and induced innovation in the context of total maximum daily loads.

Data were gathered through interviews with Michigan regulators and dairy farmer focus groups, and were analyzed within the game theoretic framework. This analysis can provide insights into the TMDL regulatory process designed to reduce nonpoint source pollution from Michigan agriculture. The analysis suggests that, in order to reduce transaction costs due to uncertainty, regulators appear inclined to implement the total maximum daily loads with a technology-based standard. Farmers also showed a preference for technology-based water quality standards. Policy and research implications of this analysis are discussed.

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1. Introduction

Nonpoint sources of pollution have been identified by the Environmental Protection Agency (EPA) to be the main cause of the remaining surface water quality problems in the United States (EPA 1998). Furthermore, since agricultural production is the largest nonpoint source of water pollution in the U.S. (EPA 1998), it is being subjected to increasing policy attention.

Flexible Environmental Regulations

Historically, environmental management in the U.S. has been based upon a *command-and-control*[1] philosophy. Those regulations which embody this philosophy specify what is to be achieved, as well as how to accomplish the desired outcome. Although this approach has led to environmental improvements over the last three decades (e.g.,

Adler et al. 1993; Houck 1999), economists have criticized the *command-and-control* framework for being expensive, inflexible, and for stifling technological innovations. As a result, policymakers have begun searching for new pollution prevention approaches.

It has been argued that under certain conditions, agro-environmental policies that incorporate flexible incentives may allow farmers to attain desired environmental goals in a cost-effective manner (Batie and Ervin 1999; Segerson 1999; Portney and Stavins 2000). Flexible incentives are "environmental management tools that specify objectives but … do not dictate how the environmental objective is to be achieved" (Batie and Ervin 1999, p. 56). This flexibility allows policymakers to accommodate diverse natural resource conditions, heterogeneous production systems, and other factors that may vary spatially and temporally. Furthermore, flexible incentive-based environmental regulations remove the onus on regulators to determine the "best" technology that must be used by the regulated firms.

One example of such an incentive is a *flexible environmental performance standard*. An environmental performance standard establishes the environmental concentration limit for potential pollutants. Typically, an environmental performance standard is based upon either human health criterion or an ecosystem criterion, or a combination of both (NRC 2001). For water quality, a performance standard specifies the ambient concentration of a pollutant, such as phosphorus, in a defined body of water.

To assure flexibility is associated with performance standards, no design standards based upon approved technologies should be specified (i.e. no use should be made of technology-based standards). Ideally, with a flexible environmental performance standard, farmers would be free to implement the technology or production method that is most cost-effective for their situation in meeting the water quality standard.

The two most significant potential advantages of flexible environmental performance standards over the traditional *command-and-control* approach are (1) dynamic incentives exist for technological innovation and its diffusion (2) and pollution control technologies more cost-effective (Stavins 2000). In some cases, this dynamic incentive for technological innovation may even allow farmers to increase their profits. The concurrent outcomes of environmental improvements and a reduction, or offset, in compliance costs through the adoption of new technology is defined as an *innovation offset*. If farmers are actually able to generate innovation offsets while meeting an environmental performance standard, then their costs to comply with the environmental regulation decreases, making the flexible environmental performance standard potentially more attractive to farmers than technology-based environmental regulations.

The potential for innovation offsets is an important implication of the "Porter Hypothesis" (Porter and Van der Linde 1995). According to the Porter Hypothesis, "policies mandating strict environmental compliance have [the] potential to make American firms and industries more competitive" by encouraging technological innovations and change (Thurow and Holt 1997 p. 20). The Porter Hypothesis contends that environmental regulations can provide necessary dynamic incentives for technological innovations by inducing firms to innovate. Researchers have debated as to whether the Porter Hypothesis does in fact hold in most situations (e.g. Gardiner and Portney 1994; Palmer, Oates, and Portney 1995; Jaffe and Palmer 1997). These studies, however, have examined the manufacturing sector; they have not focused on agriculture.

The Effect of Transaction Costs

Whether performance standards are actually superior to technology-based agro-environmental policies depends in parrt upon transaction costs (Batie and Ervin 1999; Norris and Thurow 1999**;** Shortle and Dunn, 1986). The crucial role of transaction costs is especially important in the case of stochastic nonpoint source pollution where compliance uncertainty may be an issue.

These transaction costs exist for both regulators and farmers. A transaction cost can be defined to include "the

costs of gathering and processing the information needed to carry out a transaction, of reaching decisions, of negotiating contracts, and of policing and enforcing those contracts" (Williamson 1981). Transaction costs arise because of a lack of sufficient information – the pervasive uncertainty in the world prevents firms and individuals from making perfectly informed decisions.

For regulators, transaction costs such as information, monitoring, and enforcement costs can be significant with flexible environmental performance standards. Among other informational requirements, regulators must understand the pollutant transport process[2], the absorptive capacity of the ecosystem in question, and the extent of any environmental degradation.

Given these transaction costs, it can be challenging for regulators to even determine what "being in compliance" means from an agro-environmental enforcement perspective. That is, with flexible environmental performance standards, regulators do not specify technologies to be used by regulated farms, rather they specify only an environmental standard. Thus, in most cases, the regulator can only check in an indirect manner as to whether a firm is in compliance. For example, suppose a regulator periodically samples the impaired water body and measures the ambient pollutant level for phosphorus. If the ambient level exceeds the specified standard, the regulator only knows that the aggregate effluent level must be reduced; this observation does not help the regulator answer questions like: "Which farm must reduce its phosphorus pollution the water body?" or "How much must each farm reduce pollution"[3]. Consequently, it may be difficult for the regulator to define compliance at an operational enforcement level. Compliance uncertainty thus poses a major challenge for regulators in managing nonpoint sources of pollution using flexible environmental performance standards.

In contrast, technology-based standards tend to be easier to administer, thus reducing certain transaction costs for the regulator. Once the technology-based standard is specified, (e.g. "install filter strips") the regulator simply has to observe whether each farmer is in fact correctly employing the required technology. If a farmer is not, he is in violation of the environmental regulation; if he does use the technology, then the farm is in compliance.[4] The actual ambient pollutant level is of secondary importance with technology-based regulations. Indeed, achieving the desired ambient level may require adaptive implementation strategies of experimentation and adjustments[5] (NRC 2000).

Flexible environmental performance standards also result in transaction costs for farmers. Informational costs dominate. In order to comply with flexible environmental performance standards, farmers must possess superior knowledge about the nature and extent of effluent from their farm at their source, as well as the relative cost-effectiveness of different pollution prevention management practices. In practice, it is extremely difficult for farmers to ascertain whether they are in compliance with a flexible environmental performance standard due to the nature of nonpoint source pollution. This difficulty can be contrasted with compliance with technology-based environmental regulations. Since the farmer is usually told what pollution prevention technology to use, he clearly knows whether he is in compliance. If he does not adopt the specified technology, then he is not in compliance, otherwise he is. Thus, many informational transaction costs, which exist with flexible environmental performance standards are eliminated with technology-based environmental regulations.

This compliance uncertainty stems from the diffuse nature of nonpoint source pollution. With nonpoint sources, the effects of discharges is not often observed immediately; these effects can be spatially and temporally removed from the pollutant source. Weather events can also compound the uncertainty surrounding links between management practices and compliance. This uncertainty creates a cost for farmers, since it means they are less likely to be able to link their actions with compliance with the performance standard. This compliance uncertainty may in fact prevent farmers from complying with the flexible environmental performance standard, thereby reducing the likelihood that water quality goals will be met.

Thus, the feasibility of using flexible environmental performance standards to control or minimize nonpoint source pollution is ambiguous. On the one hand, they provide incentives for technological innovation, and they may reduce compliance costs through ensuing innovation offsets, thereby ensuring farmer interest. On the other

hand, transaction costs due to compliance uncertainty of farmer compliance may be so high, that they may negate any possible benefits, effectively rendering flexible environmental performance standards infeasible as a policy tool to control nonpoint sources of pollution. There has been a paucity of empirical experiences, however, that has limited the examination of this ambiguity.

Total Maximum Daily Loads (TMDLs)

The United States Environmental Protection Agency is now attempting to control nonpoint sources of pollution throughout the country under provisions of the 1972 Clean Water Act the Total Maximum Daily Loads (TMDLs) program. This program relied on environmental performances standards for surface water[6], (NRC 2001). Michigan, along with other states with delegated authority, are beginning to implement TMDLs to meet state water quality goals and comply with the Clean Water Act. [7] The new TMDL program is not currently directed at farmers *per se* but, at sometime in the future, pollution from operations may be identified as a source that is responsible for non-attainment of a TMDL water quality standard in some watersheds. Thus, the existence of the TMDL program provides a unique opportunity to study the possible reactions of both producers and regulators to environmental performance standards as well as to investigate the implications of uncertain and attendant transactions costs to preferred program design. That is, the TMDL program is not hypothetical, so potentially affected parties can relate to potential imparts of the program. However, the TMDL program is not currently affecting the vast majority of farm operations in Michigan, so producers and regulators can speculate on preferred program instruments to achieve TMDL goals.

The Michigan situation, then provides an opportunity to investigate agro-environmental performance standards - - an area about which there is little empirical research (Schmitz et al. 1995; Thurow and Holt 1997). Consequently, this study contributes to this nascent literature by examining whether flexible environmental performance-based agro-environmental policies will effectively address nonpoint sources of pollution in meeting water quality goals in Michigan.

Section 2 outlines the research questions that are addressed in this study. In Section 3, an overview of the Clean Water Act and total maximum daily loads is presented. The effect of uncertainty and its attendant transaction costs on both regulators and farmers is analyzed in detail (Section 4). In Section 5, the Porter Hypothesis and innovation offsets are examined conceptually. A simple game theoretical analytical framework is used to predict the response by regulators to TMDLs (Section 6). Using data collected through interviews with state regulators and focus groups with Michigan dairy farmers, empirical results are presented in Section 7. Finally, Section 8 summarizes the major findings of this study. Policy and research implications of this analysis are discussed as well.

2. Research Questions

Despite the recent theoretical and regulatory interest in flexible environmental performance standards, there is a dearth of empirical knowledge as to how uncertainty will affect their feasibility in controlling nonpoint sources of pollution. This study examines the effect of uncertainty and its associated transaction costs on the effectiveness of flexible environmental performance standards to curb nonpoint source pollution. This examination will be guided by an *ex ante* analysis of the implementation of total maximum daily loads by Michigan regulators – as an example of a flexible environmental performance standard – and the compliance response by dairy farmers. This study is an *ex ante* study because Michigan has yet to implement a TMDL process that currently impacts dairy producers in the state. This analysis can provide insights into the regulatory process that attempts to reduce nonpoint source pollution from agriculture in order to meet water quality goals.

As such, two key research questions that will be examined are:

1. ***How will compliance uncertainty potentially affect the implementation of flexible environmental***

performance standards by Michigan regulators?

2. ***How will uncertainty potentially affect Michigan livestock farmers' compliance with flexible environmental performance standards?***

These research questions will be analyzed in the context of total maximum daily loads programs – one of the few examples of flexible environmental performance standards that apply to agriculture in Michigan. The agricultural sub-sector to be examined is the dairy sub-sector.

Additionally, this study proposes to consider the applicability of the Porter Hypothesis to agriculture by examining the relationship between flexible environmental performance-based agro-environmental policies and induced innovation in the context of TMDLs.

The pollutant of interest in this study with respect to total maximum daily loads is phosphorus. Nutrients are major pollutants that impair lakes and reservoirs throughout the nation, and agriculture is the leading source of pollution in assessed surface waters (EPA 1998). In fact, agriculture contributes to 59 percent of reported water quality problems in impaired rivers and streams. Phosphorous is of interest because it becomes a pollutant when it enters surface waters in substantial amounts; it contributes to the excessive growth of algae and other aquatic vegetation, leading to the accelerated eutrophication of lake habitats and ecosystems. Eutrophication is the process by which a body of water becomes rich in dissolved nutrients, and hence deficient in dissolved oxygen. This resultant oxygen depletion can lead to fish kills and other water quality problems. In fact, phosphorous is most often the limiting nutrient in freshwater aquatic systems (NRC 1993). Thus, excessive phosphorous can damage intricate habitat interrelationships, thereby degrading the complex Great Lakes ecosystem. Dairies can be major contributors to excessive phosphorus in water runoff.

3. The Clean Water Act and Total Maximum Daily Loads

If flexible environmental performance standards, such as a total maximum daily loads, can cost-effectively address the degradation of water quality in the Great Lakes ecosystem in Michigan from the livestock agricultural sub-sector, then policymakers can be encouraged that they are following the right course. But if TMDLs do hold such a promise, why were they not implemented before? Why are they just being implemented now? To answer these questions, a brief overview of U.S. water regulations is necessary.

History of the Clean Water Act

Federal involvement in controlling water pollution actually began in 1899 with the Rivers and Harbors Act – commonly known as the Refuse Act[8]. This act, however, did not deal with water pollution as thought of today; rather, it prohibited the discharge of refuse of any kind into the navigable waters of the United States. Congress enacted the first federal legislation to explicitly contend with water pollution in 1948 – the Federal Water Pollution Control Act (FWPCA). The federal government, however, had no authority to establish water quality standards, limit discharges, nor engage in any enforcement. The Act recognized states' primary authority over water pollution. The FWPCA was amended five times between 1948 and 1972.

It was apparent by 1970 that the FWPCA was ineffective in improving the waters of the United States. A dramatic symbol of the lack of success of the FWPCA occurred on June 22, 1969, when the heavily polluted Cuyahoga River in Cleveland burst into flames. Congress passed a major revision to the FWPCA in 1972. The Senate committee that reported the 1972 amendments found that "there had been an almost total lack of enforcement of the FWPCA and that new measures were required to curtail the use of rivers, lakes, and streams as waste treatment systems" (Battle and Lipeles 1998, p. 13). The total maximum daily load process was specified under Section 303(d) in the 1972 amendments, but was not enforced because the Clean Water Act has primarily been used to

control *point sources* of pollution over the last 30 years.

The Clean Water Act defines a *point source* to be “any discernible, confined and discrete conveyance, such as a pipe, ditch, channel, tunnel, conduit, discrete fissure, or container. It also includes vessels or other floating craft from which pollutants are or may be discharged. By law, the term point source also includes concentrated animal feeding operations...” (EPA 2000a). Concentrated animal feeding operations (CAFOs) are currently defined as 1,000 animal units, which translates into 700 milking cows. Thus under the federal Clean Water Act, all dairy operations with 700 milking cows or more are considered a point source under the Clean Water Act, and are regulated entities[9].

The EPA has defined *nonpoint source* pollution as pollution that “is caused by diffuse sources that are not regulated as point sources and normally is associated with agricultural, silvicultural and urban runoff, runoff from construction activities, etc. Such pollution results from human-made or human-induced alteration of the chemical, physical, biological, and radiological integrity of water. In practical terms, nonpoint source pollution does not result from a discharge at a specific, single location (such as a single pipe) but generally results from land runoff, precipitation, atmospheric deposition, or percolation” (EPA 1987).

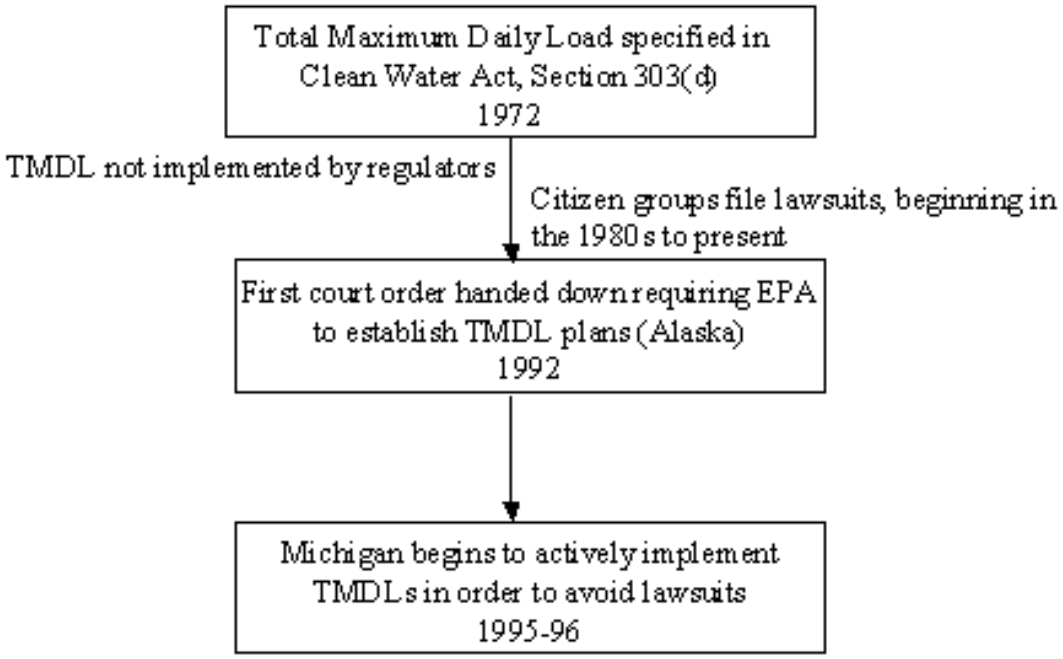
In 1977, Congress included an exemption for farms in the Clean Water Act, and redefined point source to exclude return flows from irrigated agriculture. Due to these exemptions, farms are free to discharge soils, animal wastes, fertilizers and other pollutants into surface waters under the Clean Water Act (Ruhl 2000); however, other legislation such as state legislation frequently forbid such pollution. Thus, with the exception of concentrated animal feeding operations, there are few restrictions on agriculture posed by the Clean Water Act. This situation is beginning to change, however, as section 303(d) of the Clean Water Act, which specifies total maximum daily loads, is starting to be implemented around the country.

Implementation of Total Maximum Daily Loads

Section 303(d) was largely ignored for the first twenty years – since the 1972 amendments to the Clean Water Act – due to inaction by the states and the lack of enforcement pressure by the EPA (Battle and Lipeles 1998; Stephenson, Shabman, Geyer 1999; Ruhl 2000). But beginning in the 1980s, citizen groups – or third-party groups – began to sue the EPA for failing to implement the total maximum daily load process. In an effort to improve water quality, these citizen groups have been using legal avenues to make the EPA enforce TMDLs.

The EPA and states continued to ignore TMDLs until they were faced with a “virtual avalanche of litigation in the mid-1990s” (Battle and Lipeles 1998)[10]. To date, there have been 40 legal actions in 37 states. The EPA is under court order or consent decree in many states to ensure that TMDLs are established, either by the state or by the EPA (EPA 2000b). This timeline of events with respect to Michigan is summarized in Figure 1. Although the EPA did not require the TMDL process to come into effect until October 2001, the Michigan Department of Environmental Quality (MDEQ) has already developed Michigan’s TMDL implementation schedule (begins in 2000, ends in 2011)[11]. The MDEQ has been delegated authority from the EPA to implement TMDLs in Michigan.

Figure 1: Implementation of Total Maximum Daily Loads



Source: U.S. EPA website, various pages.

Section 303(d) requires states to identify and rank water bodies for which technology-based effluent limitations have not been successful in reaching or maintaining water quality standards. These water quality standards have been set by the Michigan Department of Environmental Quality (MDEQ) to protect surface waters based upon intended uses, that is, recreational, public water supply, agricultural, or industrial uses. The list of impaired waters is known as the "303(d) list" or the "dirty waters" list. States must then develop a TMDL plan or process for each of these impaired water bodies so that they attain their state-designated water quality standard.

The TMDL process requires states to do a number of things: 1) set the maximum amount of pollution that a water body can receive without violating state-designated water quality standards (including a margin of safety to account for technical uncertainties); 2) develop a quantitative assessment of water quality problems, pollution sources, and required pollutant reductions; and 3) address *all* pollution sources – both point sources such as factories and municipal plants, and nonpoint sources such as runoff from agricultural lands, forests, and roads.

TMDLs are an example of a flexible environmental performance standard since the legislation does not specify the technology that must be used by farms of a certain size.[12] In the case of non-CAFO dairies – that is, dairies with less than 700 milking cows – a TMDL could be specified as a flexible environmental performance standard. If such standards were to be used, innovation offsets become a possibility within agriculture. Thus, at least theoretically, TMDLs provide an opportunity for flexible environmental performance standards to be applied to agriculture.

4. Uncertainty and Transaction Costs

Whether flexible environmental performance standards are actually empirically superior to technology-based agro-environmental policies depends, in part, effects of uncertainty and its attendant transaction costs. Regulators and farmers do not have perfect information about how the future will unfold; this lack of perfect information, or

uncertainty, creates transaction costs.

Environmental policy design will affect who bears the transaction costs – the regulator or the farmer. The cost burden is based upon the property rights structure that assigns responsibilities for environmental outcomes (Batie and Ervin 1999). Flexible environmental performance standards can be implemented so that either the regulator bears the bulk of the transaction costs, or the farmer does, or the costs could be shared by these two decision makers. Since the incidence of the transaction cost will determine the political feasibility of flexible environmental performance standards, the manner in which the policy design matters. For the following discussion, it is assumed that the transaction costs are divided between both parties.

Types of Transaction Costs

There are two types of transaction costs: 1) *ex ante* transaction costs, and 2) *ex post* transaction costs. Examples of *ex ante* transaction costs are: 1) the costs of gathering information about the environmental performance standard, 2) the costs of processing that information, and 3) the costs of coming to a decision about the environmental performance standard. Examples of *ex post* transaction costs are: 1) monitoring costs, and 2) enforcement costs.

Due to the lack of information, the regulator can incur both *ex ante* and *ex post* costs when implementing a flexible environmental performance standard. The *ex ante* costs that the regulator could incur are outlined in Table 1; selected costs associated with a TMDL are used as an illustration.

In order to implement the TMDL process, the regulator must gather biophysical data to ascertain the appropriate level of phosphorus for a specified body of water, given its designated water uses (e.g. water quality standard); then the regulator must process that information in order to determine the actual ambient level of phosphorus and its relationship to discharges. Finally, the regulator must decide how to allocate the allowed effluent (i.,e., TMDL) amongst the dischargers into the body of water (NRC 2001).

Table 1: Selected *Ex ante* Transaction Costs Incurred by Regulator

Data Gathering Costs	**Data Processing Costs**	**Decision Costs**
- Data to determine appropriate ambient phosphorus level	- Determination of appropriate ambient phosphorus level	- Determination of how TMDL will be allocated amongst dischargers
- Data to determine actual phosphorus level	- Determination of actual phosphorus level	- Determination of penalty level
- Data to determine who is discharging, and their effluent levels	- Determination of who is discharging, and their effluent levels	

Some of these *ex ante* transaction costs can be high with respect to nonpoint source pollution. The data gathering and processing costs that the regulator must bear in order to determine individual discharge sources' effluent levels are of special interest. The diffuse nature of nonpoint source pollution makes it difficult to determine the sources, let alone how much effluent each discharger is releasing. In response to these *ex ante* transaction costs caused by uncertainty, the regulator may implement flexible environmental performance standards and leave the choice of pollution prevention/control technology to the discharge, or the regulartor may pursue a *command-and-control* strategy such as requiring on-farm technologies that control or prevent pollution.

Table 2 illustrates selected *ex post* transaction costs that the regulator might incur. With this example, the regulator must monitor the water body to ensure that the specified phosphorus level is maintained; additionally, the regulator must enforce any required reductions and assess relevant penalties. If subsidies are used as an incentive measure, then they must also be assigned. But, there will be uncertainty generated by nonpoint source

pollution for the regulator in determining who is in compliance.

Table 2:Selected Ex post Transaction Costs Incurred by Regulator

Monitoring Costs	Enforcement Costs
- Monitoring ambient phosphorus level - Monitoring effluent from discharge sources - Determining who in compliance	- Enforcing required reductions - Assessing penalties/subsidies

This uncertainty results in large *ex post* costs for the regulator, both in terms of monitoring and enforcement costs. Nonpoint source pollution implies numerous, diffuse sources of nutrient effluent or loadings, making it almost impossible to perfectly monitor behavior and enforce the ambient pollution level (Hanley et al. 1997). As a consequence, the regulator may also wish to reduce these significant *ex post* transaction costs associated with compliance uncertainty by increasing compliance certainty.

Furthermore, given the nature of nonpoint source pollution problems, the effect of *moral hazard* on monitoring and enforcement is especially noteworthy. Moral hazard exists when the regulator can not observe the actions of individual farmers. As a result, the regulator will have difficulty in linking effluent from individual farms to aggregate environmental damages; this asymmetric information, in turn, leads to enforcement problems for the regulator. Consequently, moral hazard implies that there is an incentive for farmers to fail to disclose, deceive, or hide information from the regulator. Moreover, if the regulator can not ascertain which farmer is generating effluent and which farmer is not, then some farmers may choose to not comply with the TMDL.

Thus, the regulator's inability to monitor all farmers in a watershed implies that moral hazard transaction costs may be notable, which increases the enforcement costs for the regulator. Where moral hazard exists, where costs of compliance may be high where penalties of being out of compliance are not prohibitive, some farmers may decide to ignore the TMDL requirements. In order to "perfectly enforce" the TMDL in such a situation, in-field manure "police" would have to be stationed permanently at all fields that received manure applications (Innes 1999). But, such "perfect enforcement" is obviously neither politically nor financially feasible.

These high *ex ante* and *ex post* transaction costs imply that that regulator may be unable to effectively implement the TMDL process, if it is designed as a flexible environmental performance standard. The potentially result is failed environmental outcomes such as diminished water quality. If water quality does not improve due to poor TMDL implementation, the regulator becomes vulnerable to lawsuits from citizen groups for failing to implement the Clean Water Act. The possibility of lawsuits may cause the regulator to seek ways to minimize compliance uncertainty when it implements the TMDL process. Consequently, mandating and enforcing strict environmental compliance may not be possible in most cases of nonpoint source pollution[13].

Similarly, farmers also face uncertainty with respect to the pollution that they generate and compliance with the total maximum daily load process. Unlike the regulator, however, they do not incur any *ex ante* transaction costs. Farmers react to the TMDL's water quality – thus they only incur transaction costs after TMDLs are in place. Assuming no other water quality legislation applies, then, until the TMDL is implemented, water is a free – or unpriced –input into their production process, so they are unlikely to consider most of the degradation costs associated with its use[14].

Once the TMDL standard is in place, farmers incur *ex post* transaction costs, due to compliance uncertainty. As already mentioned, it is difficult, and hence costly, for farmers to link the effects of their management practices to runoff from their lands. For instance, even if farmers spread manure onto their lands at a rate below the upper limit specified in Michigan animal waste guidelines[15], a severe storm can result in significant soil erosion into the

water body. Phosphorus binds to soils, so if enough soil is washed into the water body, the phosphorus limit specified in the TMDL process could be exceeded.

Furthermore, even if livestock farmers make expensive investments in manure management systems, regulators will find it difficult to distinguish the effects of each farmers' actions, so an individual farmer may still be found to be out of compliance due to the aggregate effluents from a group of farmers, regardless of his own effluent level. Thus, the chance that a farmer will comply with a total maximum daily load could decline. Some farmers may choose to not comply because they may be tempted to *free ride* – to let others undertake pollution abatement measures while they share in the benefits of reduced nutrient loadings in the lake. Some farmers may choose to *free ride* because of the compliance uncertainty that exists for regulators. As a consequence, significant compliance uncertainty may dissuade farmers from making investments in innovative technology that could result in innovation offsets. Moreover, it would appear that strict compliance by farmers may not be possible with a flexible environmental performance standard targeted at nonpoint source pollution.

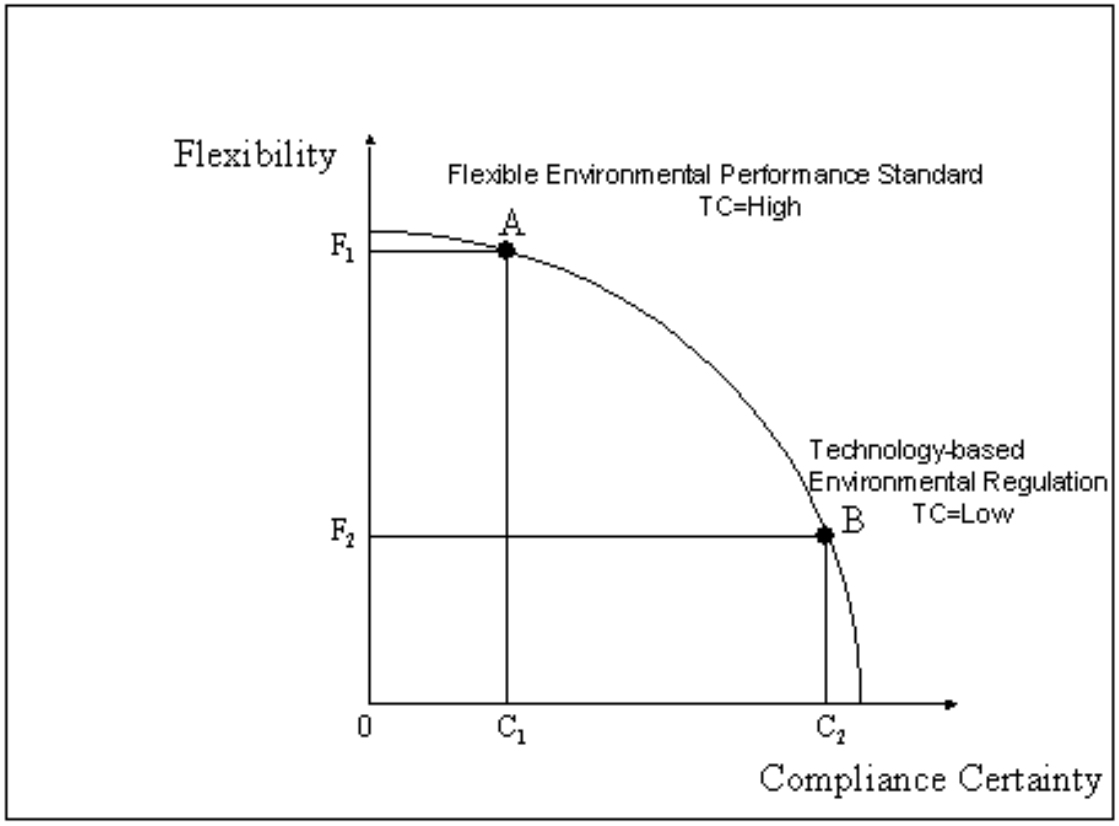
On the other hand, some farmers may want to comply, but only if compliance uncertainty is eliminated. Why is this? Under the Clean Water Act, a third-party can sue a farmer or any other firm for violating the Clean Water Act. This situation is particularly relevant for Michigan, where in the summer of 2000, the Sierra Club gave "notice to sue" to five dairies in the state. If compliance uncertainty is eliminated so that it is easy for regulators and third parties to determine who is in compliance with a flexible environmental performance standard, then some farmers will be interested in complying in order to reduce the likelihood of being sued. Farmers thus may seek ways to increase compliance certainty, thereby reducing transaction costs associated with uncertainty.

Flexibility and Compliance Certainty Trade-off

Thus, "flexibility" in flexible environmental performance standards leads to compliance uncertainty for both regulators and farmers and this compliance uncertainty, in turn, results in transaction costs. There appear to be trade-offs between flexibility and compliance certainty embodied in environmental performance standards like total maximum daily loads that attempt to control nonpoint source pollution.

One way to analyze this trade-off is via a *production possibilities frontier* (PPF), illustrated in Figure 2. The frontier curve shows the various combinations of compliance certainty and flexibility that can be provided by, or "produced" by an environmental regulation. Compliance certainty for both farmers and regulators is measured on the X-axis; it increases as one moves from left to right. Flexibility for farmers is on the Y-axis. The production possibilities frontier is downward-sloping because of the trade-off between flexibility and compliance certainty. For an environmental legislation to "generate" – or allow – more compliance certainty, the level of flexibility produced – or allowed – by it must decline. The tradeoff exists because of limited regulatory budgets. That is, the agency does not have enough funds to assure that water quality is monitored frequently nor that the linkage of changes in water quality changes to changes in farm practices is well established and known.

Figure 2: Flexibility-Compliance Certainty Trade-Off Frontier – The Case of Agricultural Nonpoint Source Regulations



As one moves north along the Y-axis, the amount of flexibility provided the farmer by the environmental regulation increases, while compliance certainty as seen by the regulator decreases. As such, point A corresponds to a flexible environmental performance standard since the amount of flexibility allowed the farmer is quite high – F1 – but it results in a relatively low level of compliance certainty for both farmers and regulators. That is, both parties are uncertain as to whether the farmer's actions will meet the water quality standard., C1. At point A, however, regulators can take advantage of this regulatory flexibility for farmers by accommodating diverse natural resource conditions and heterogeneous production systems. Additionally, flexible environmental regulations remove the onus on regulators to determine the "best" technology to be used by farmers. For farmers, the flexibility provides dynamic incentives for technological innovation and cost-effectiveness through possible innovation offsets. At Point A, however, transaction costs for both regulators and farmers tends to be high.

Point B on the frontier corresponds with a technology-based environmental regulation with a greatly diminished level of flexibility (F_2), for farmers in their choice of pollution prevention technology, but a much higher level of compliance certainty results for both farmer and regulator, C_2. At point B, compliance uncertainty is dramatically reduced, but at the cost of reduced flexibility for both parties. Despite the diminished level of flexibility at this point, both regulators and farmers may prefer point B. However, here compliance is measured by farmers' adoption of prescribed technology, which may or may not result in adequate improvement of water quality. At Point B, because regulation and farmers can more readily determine if pollution prevention technologies have been adopted, transaction costs tend to be low.

If the regulator is willing to trade-off flexibility in order to reduce his *ex ante* and *ex post* transaction costs through an increase in compliance certainty, he will want to implement the environmental performance standard with a technology-based requirement; that is, he or she will specify the technology that farmers must use.

Whether farmers will embrace the flexibility aspect of flexible environmental performance standards and seek out least-cost pollution abatement technologies, thereby benefiting from innovation offsets, is unknown due to this trade-off between flexibility and compliance certainty. If the Porter Hypothesis is relevant for agriculture, then the

political feasibility of TMDLs may be enhanced, since environmental quality improvements are achieved in conjunction with benefits to farmers through innovation offsets. Farmers become an integral part of the overall strategy to resolve agro-environmental problems once they have the incentive to maintain a healthy, sustainable, and agriculturally productive Great Lakes region. But will Total Maximum Daily Load programs result in innovation offsets? A closer examination of the Porter Hypothesis and innovation offsets will provide insights into this question.

5. Porter Hypothesis and Innovation Offsets

The Porter Hypothesis has generated considerable debate. Porter and van der Linde contend that innovation offsets are likely to be common and large, while others have disagreed (Gardiner and Portney 1994; Palmer, Oates, and Portney 1995; Thurow and Holt 1997; Jaffe and Palmer 1997). For example, Palmer et al. (1995) note their strong dispute with the Porter Hypothesis; they argue that environmental regulation does indeed involve trade-offs, and that the cost of regulation will be neither negligible nor non-existent. These issues are examined and clarified below.

Behavior Implications

How will farmers react to the new flexible environmental performance standard? Can farmers offset their increased production costs which stem from compliance with the new TMDL water quality requirements? Hicks' induced innovation hypothesis provides theoretical insight:

A change in relative prices of the factors of production is itself a sign to invention, and to invention of a particular kind -- directed to economizing the use of a factor which has become relatively expensive (Hicks 1932).

The change in property rights due to the new water quality requirements has, in effect, caused the relative cost of water to increase for farmers. It follows from Hicks' induced innovation hypothesis, that a farmer will respond by selecting a technology that changes his production process and reduces the amount of water that his farm uses for pollution disposal. Farmers have an incentive to invest in ways to meet the new water disposal constraint at lowest cost possible.

The implications of Hicks' induced innovation hypothesis, however, is not straightforward in the case of nonpoint source pollution. In this situation, the farmer's action in response to the environmental regulation may not result innovation offsets. With nonpoint source pollution, the occurrence of innovation offsets depends upon the effect of compliance uncertainty with a performance standard. Since it is difficult to link investments with positive environmental outcomes, the farmer may not be given credit for economizing on water use. Without this benefit, the farmer or his agent may not seek out innovative ways to reduce his water use, thereby precluding innovation offsets.[16]

Instead, farmers may ask for a list of specific approved technologies from the regulator to reduce their compliance uncertainty-related transaction costs. If the regulator also wishes to increase certainty and reduce its transaction costs, then the flexible environmental performance standard may be converted into a technology-based environmental regulation. Since specified technologies preclude induced innovation and innovation offsets, the question is whether uncertainty will prevent innovation offsets? Will innovation offsets be a straightforward result of strict environmental regulations as Porter and Van der Linde assert? Or will they be negligible? Do trade-offs exist? A simple model is presented next to help answer this question.

A Simple Model of Innovation Offsets

To some extent, the debate over the Porter Hypothesis is due to a lack of clarity regarding the baseline to be used in determining whether innovation offsets can occur as a result of environmental regulations. Is the appropriate baseline the net profit that a farm earns before the regulation is implemented, or is it the net profit level *less* the compliance costs that a farm earns after the regulation is in place? The following simple model clarifies this question and provides a straightforward definition of innovation offsets[17].

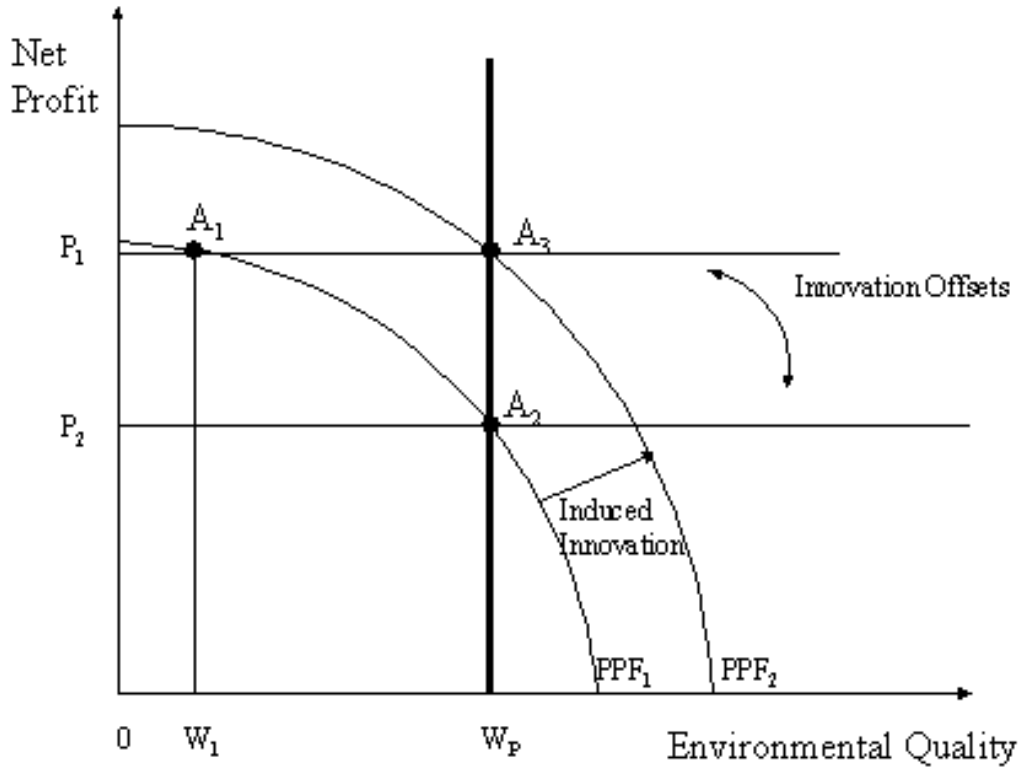
With the implementation of an environmental and with the change in property rights, pollution is now a cost for farmers. Economic theory predicts that a farmer will reduce his use of the water resource for disposal, in order to minimize costs due to the new environmental performance standard, and perhaps reduce compliance costs. Figure 3 illustrates the effect of this induced technical change. The production possibility frontier (PPF) depicts the feasible set of water quality and net profits that are produced by a livestock farm, say Farm A, with a given technology. Farm A uses the same technology as long as it is on the same production possibility frontier, and is able to produce different levels of water quality using this technology. Water quality is measured on the X-axis; it increases as one moves from left to right. Profit is on the Y-axis.

Before the environmental regulation, Farm A is at point A_1 on the production possibility frontier labeled PPF_1. At this point Farm A earns P_1, in net profits and generates a water quality level equal to W_1.[18] Since water disposal is a "free input" for Farm A, it will likely be close to the Y-axis, since it does not bear any direct costs from water degradation.

Now let a flexible environmental performance standard, such as a total maximum daily load, be implemented. Assume the TMDL process specifies the maximum amount of ambient phosphorus that can be allowed from Farm A. Let the minimum level of ambient water quality that Farm A must meet be W_P. Assume that the regulator is able to strictly and perfectly enforce the flexible environmental performance standard at the farm level.

From its initial point of A_1, it is clear that Farm A is producing too much pollution and must move to at least A_2 along the frontier PPF_1. Here Farm A earns P_2 , net profits, which is less than P_1, but it produces less pollution. The difference in P_1 and P_2 is the cost Farm A incurs to be in compliance with the new flexible environmental performance standard.

Figure 3: Induced Innovation and Innovation Offsets: Case I



Adapted from Srivastava and Batie (1999).

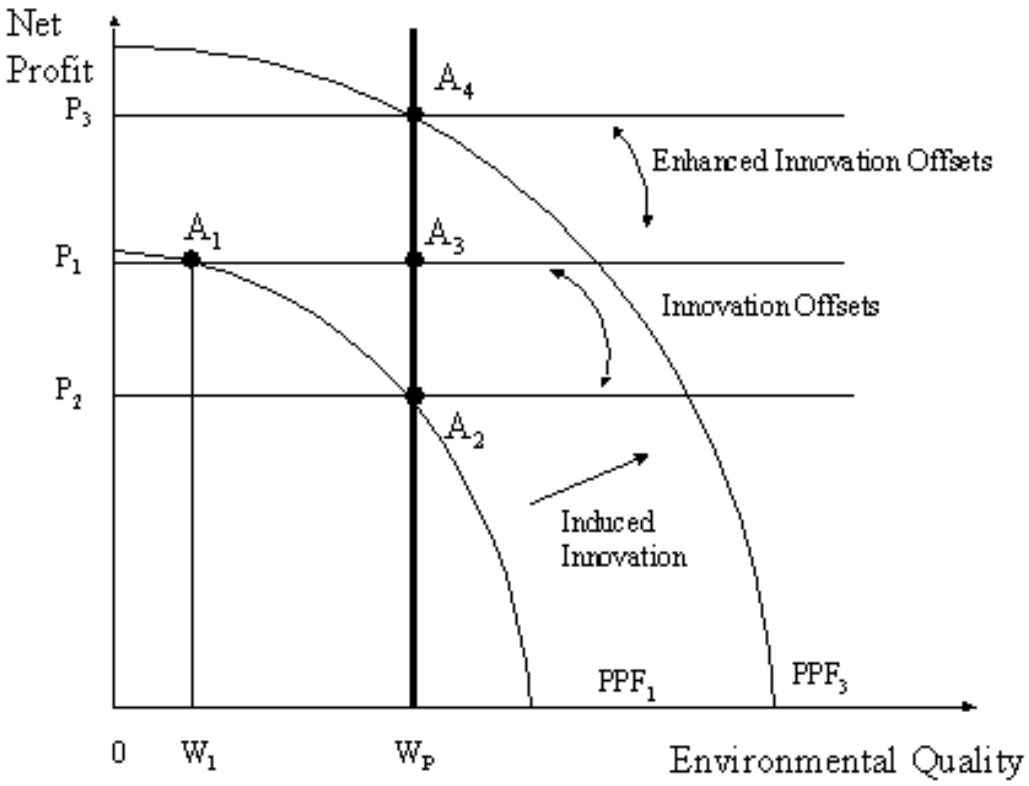
Since Farm A is on the same production possibility frontier as before, this reduction in profits is *not* due to any technological change. That is, water quality has improved without improvements in technical efficiency, contrary to the contention by some critics of the Porter Hypothesis. These critics argue that improvements in efficiency- - not environmental regulations- - result in improved environmental outcomes. Yet from Figure 3 it is clear that the change in property rights has forced Farm A to use its current technology to produce a different set of output levels than when it was owner of the property right to "pollute". Nevertheless, it is clear that there is a trade-off between net profits and improved environmental quality for Farm A since the costs of complying with the TMDL have reduced Farm A's net profits.

But Farm A is a profit-maximizing firm, and Hicks' induced innovation hypothesis says it will seek out technologies that lower compliance costs (and improve water quality). If this happens, the firm shifts out to a new frontier, labeled PPF_2[19]. This shift in the production possibility frontier is an *induced innovation*. But where will Farm A be on the new production possibility frontier? There are several possible cases for where Farm A may be on the outer production possibility frontier. Two are discussed below.

Case 1 – At P_1: Assume Farm A moves to A_3 on the outer production possibility frontier in Figure 3-1. At A_3, environmental quality improves relative to A_2, as do net profits. Farm A has reduced its compliance costs *and* improved net profits relative to point A_2, after implementation of the flexible environmental performance standard and before the induced innovation occurred. Such positions are defined to be *innovation offsets* since water quality has improved at the same time that the farm has managed to reduce its compliance costs through induced innovation. Farm A's profits, are the same as at A_1, where Farm A earns P_1 level of net profits *before* the TMDL is enforced. (However, if the production possibilities frontier had shifted less from PPF, than did PPF_2, then the farm would be meeting the water quality standard at a higher net profit more than P_2 , but less than $P_{1.}$)

Case 2 – Above P_1: If the Production Possibilities Frontier has a dramatic shift to the right of PPF_1, then there can

be again in net profits ***and*** improved water quality. Farm A's net profits increase due to technical innovation and environmental quality improves. Points such as A_4 in Figure 3-2 are defined as *enhanced innovation offsets* since the firm is better off, in terms of higher profits, P_3, than its initial situation A_1, before implementation of the performance standard.



Does this mean that Porter and van der Linde were correct and their critics wrong? Not so. Critics (Gardiner and Portney 1994; Palmer et al. 1995) are correct in stating that "we cannot have it all". This conclusion is seen from Figure 3-1 and 3-2. There is an opportunity cost to any position along all frontiers; there is a trade-off between profits and environmental quality due to scarcity of resources. In fact, this trade-off will always exist, regardless of the technology that is adopted. If the environmental performance standard did not hve to be met, the farm could improve net profits at the cost of lower water quality. Regardless of this trade-off, the change in property rights due to the environmental legislation can make a farm more profitable, if previously unexploited technologies that result in enhanced innovation offsets can be identified and adopted.[20] Whether innovation offsets and enhanced innovation offsets will be common and large, or will be negligible, is an empirical question. The above analysis just clarifies that they can exist.

An alternative scenario to the environmental performance standard, is the situation in which the regulator provides farmers with a list of approved practices, (i.e., a technical sheet) to meet the environmental performance standard. The reason for doing so might be in an attempt to minimize transaction costs associated with compliance

uncertainty. If the regulator does provide a technical sheet to farmers, he has effectively converted the total maximum daily load process from a flexible environmental performance standard to a technology-design standard. This technical sheet contains a list of practices that the regulator approves for use by farmers. Farmers choose those practices that are best suited for their farm situation. The regulator may believe that the technical list assures that the specified water quality standard, W_p, will be reached. It is questionable whether the technologies specified by the regulator on the technical sheet will improve profits from its pre-regulation position or from the net profit position it would have been able to obtain with a flexible environmental performance standard. That is, the technical list will probably mean that the farm will remain on the initial production possibilities curve PPF, and, therefore, any improvement in water quality from the initial position (A_1) will reduce the farm's net profits.

6. Analytical Framework of Interviews

Returning to the research questions of how compliance uncertainty will affect the actions of both regulators and farmers, an economic analytical framework is developed that allows the reader to examine how important uncertainty and transaction costs enter in the decision making process of both parties. This analytical framework was used in devising interviews of both Michigan regulators and dairy farmers.

In order to address the effect of compliance uncertainty on the actions of regulators and dairy farmers, as specified in the research questions, straightforward but hypothetical economic *games* are analyzed. These games are used to account for the compliance uncertainty and transaction cost issues that are present when regulators attempt to control nonpoint source pollution through total maximum daily loads – an example of a flexible environmental performance standard – and require agricultural operations, such as dairy farms, to meet TMDLs in Michigan. This analytical framework was used then to identify the questions that were asked of regulators and dairy farmers, and in interpreting interview results.

An Introduction to Game Theory

Economic *games* are based upon economic game theory. Game theory attempts to study decision making where agents behave strategically, and thus can be used effectively to analyze issues of compliance uncertainty, transaction costs, and innovation offsets in this real world issue of total maximum daily loads. In the real world, economic agents like regulators and farmers make strategic decisions with respect to their actions. Strategic decisions are made because both regulators and farmers have only imperfect information concerning the consequences of alternative actions. A *game* can be defined to be a competitive situation where two or more *players* pursue their own interests, and no one *player* can dictate the outcome. Economic *games* are composed of: the *players* (or economic agents), the *rules of the game*, the *payoffs* of the game, and the information conditions that exist for the duration of the game[21]. Specifically, the player is a decision-making unit and can be an individual or an organization. The *rules of the game* describe how the resources can be used. A *strategy* is a complete specification of what a player will do under each contingency of the game. Players receive a *payoff* which specifies the game's outcome for the players. Each player's *payoff* depends upon the strategies that each player chooses to follow.

This analysis is not intended to be a comprehensive reflection of all the intricacies in this situation; rather, it is intended to provide insight into the incentives that result from uncertainty and transaction costs when flexible environmental performance standards are used to control nonpoint source pollution.

With no uncertainty, there are few transaction costs. By definition "all is known". That is, environmental damages can be observed, and compliance can be relative easily determined. As implied by Hicks' induced innovation hypothesis, with complete certainty, flexible environmental performance standards will ensure that the desired environmental outcome is achieved, while providing farmers with the incentive to seek out the least-cost

set of effective pollution prevention practices for their unique farm situation.

As a result of this induced innovation, farmers may be able to decrease their compliance costs through innovation offsets or even increase net profits, as illustrated earlier in Figure 3-1 and 3-2, resulting in clear benefits for farmers, while also improving environmental quality. But does this result seem to hold in the presence of compliance uncertainty? In order to determine how regulators' and farmers will react to flexible environmental performance standards, two separate scenarios are analyzed; in the first scenario, the players have to contend with compliance uncertainty, but not in the second scenario.

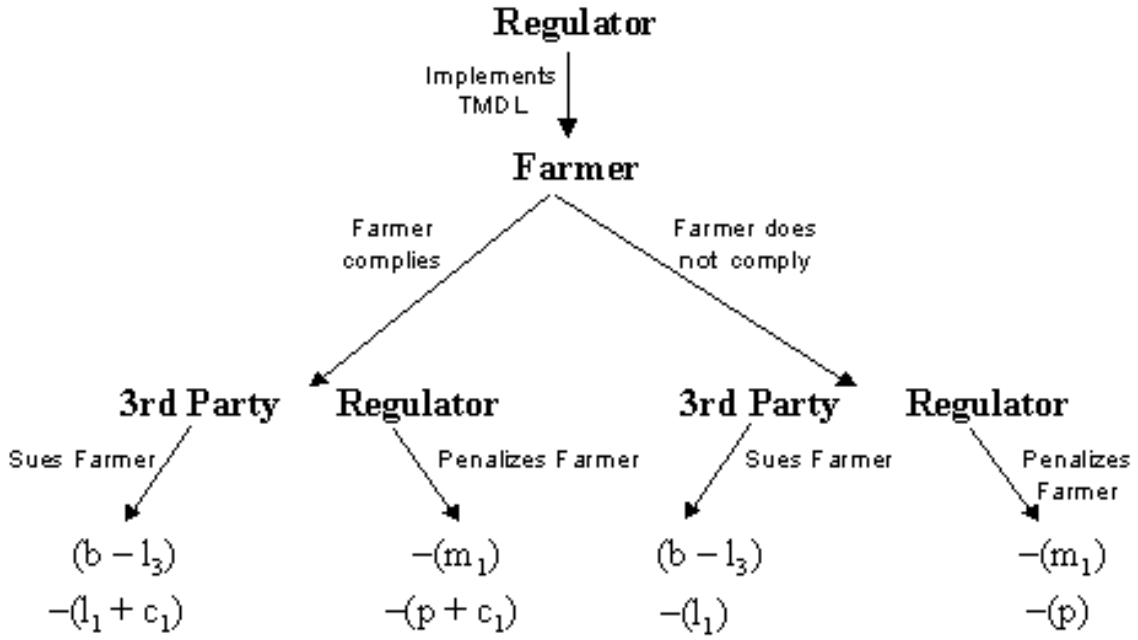
Analysis with Compliance Uncertainty

A *sequential, extensive-form game* for the implementation of total maximum daily loads under uncertainty is shown in Figure 4. In a *sequential* game, each player moves in turn, they do not take actions at the same time. An *extensive-form* game is simply a decision tree representation of the sequential game. This visual depiction makes it easier to envisage the sequence of actions and events.

The three players in this stylized game are the state regulator, the farmer, and a third-party citizens' group. A third-party citizens' group is included in the analysis because they have been the catalyst in ensuring the implementation of total maximum daily loads by states and the EPA. Some third-party groups use lawsuits to motivate both regulators and farmers in complying with the requirements of the Clean Water Act. The Sierra Club lawsuit notices to Michigan dairy farmers do appear to have increased concerns amongst dairy farmers regarding their compliance decisions with environmental regulations.

In Figure 4, the last row of the tree is the hypothetical *payoff* to the farmer of actions related to TMDL requirements[22]. The payoffs are measured in dollar values; the farmer's *payoff* is always the last row. The payoff above the last row is the payoff to either the third-party group or the regulator, depending upon which player is indicated above the arrow.

Figure 4: Analysis with Compliance Uncertainty



b: benefits to third-party group from suing farmer

l_3: legal costs incurred by third-party

l_1: farmer's legal costs

c_1: farmer's compliance costs

m_1: regulator's monitoring and enforcement costs

p: penalty farmer must pay to regulator

The equilibrium concept used in this analysis is Nash equilibrium. A Nash equilibrium exists if each player is employing his *optimal*, or best, strategy, given all the other player's strategies; in other words, each player chooses to play his best response to what everyone else is doing. With a Nash equilibrium, no player has an incentive to deviate from its strategy, so the equilibrium is *stable*. Thus, with a Nash equilibrium, each player is satisfied that it has made the best decision possible for himself, given the decision of the other players, and has no incentive to change its decision.

In this first scenario, the state regulator implements the TMDL standard, but does not provide a technical sheet listing approved practices, so compliance uncertainty exists for both the regulator and the farmer. The regulator incurs a significant level of *ex ante* and *ex post* transaction costs. Similarly, the farmer also incurs transaction costs due to compliance uncertainty.

The regulator requires nonpoint sources to reduce their effluent, or phosphorus loadings, into a surface water body. For simplicity, assume this water body is a lake. The farmer can no longer use the lake as a free sink, or a free input, into his production process.[23] The TMDL environmental regulation has now increased the value or price of the water from zero to some positive value for the farmer; it is no longer an unpriced input into the farmer's production process.

The farmer then decides whether to comply with the load reduction requirements. The legislation can induce him to comply by changing existing production practices, seeking out and adopting innovative technologies, or by designing his own new technology and employing it. This induced innovation, as shown in Figure 3-1 and 3-2, can result in lower compliance costs. Let c_1 be the compliance cost of whatever strategy used by the farmer.

On the other hand, as shown in Figure 4, the farmer may choose to **not** comply because the farmer assumes that the regulator will be unable to confirm his non-compliance due to the high *ex post* monitoring transaction costs associated with compliance uncertainty. Or, the farmer may choose to *free ride* – or rely on other farmers to comply with the TMDL. The farmer is able to choose to not comply because of compliance uncertainty on the part of the regulator. If the farmer chooses not to comply, he does not incur any compliance costs.

Due to the uncertainty related to nonpoint source pollution, and the difficulty in determining compliance with a flexible environmental performance standard, assume the farmer can be sued by a third-party group, or penalized by the state regulator, under ***both*** possible choices. Although this outcome may not happen, from the farmer's perspective, there is a distinct possibility of penalties-- so it is included in the analysis. If the farmer complies with the TMDL standard, he may nevertheless be sued by a third-party group, in which case his *payoff* would be the sum of his legal costs, l_1, and his compliance costs, c_1, $-(l_1 + c_1)$. Depending upon how the lawsuit is resolved, the legal costs could be prohibitively high, and potentially put the farmer out of business. The third-party group's *payoff* is the benefits the group receives from reducing environmental damage, b, less its legal costs, l_3, $(b - l_3)$.

The farmer may be penalized by the state regulator for not being in compliance since the definition of compliance is not well defined in the presence of compliance uncertainty. In this case, the farmer's *payoffs* are the sum of the penalty he pays, p, plus his compliance costs, c_1, $-(p + c_1)$. It is assumed that any penalties that he pays will be less than any legal fees he pays, that is, $l_1 > p$. Nevertheless, since third-party groups use public records, such as compliance violations and fines, on which to base their lawsuits, any penalty the farmer receives from the state regulator may lead to lawsuits. Thus, the farmer has an incentive to avoid government penalties as well. The regulator's *payoff* is in terms of the transaction costs from monitoring and enforcement, $-m_1$.

If the farmer does not comply, the *payoffs* are the same for all players, except that the farmer does not incur the compliance cost c_1. Since compliance is not well defined, the regulator can not tell the farmer what to do to come into compliance, so it can only levy the fine, p. Under this restrictive scenario, where no assurances are given farmers that they are in compliance, it is clear comparing the farmer's payoffs, that the profit-maximizing farmer will choose to ***not*** comply with the TMDL since his *payoff* will be higher. With compliance uncertainty, that is, with no assurances that an action equates compliance, the environmental quality TMDL goal will not be met, induced innovation will not occur, nor will innovation offsets result.

Analysis with Compliance Certainty

Under this second scenario, the regulator eliminates compliance uncertainty – that is, the regulation achieves certainty – in order to reduce the transaction costs associated with regulation. This scenario is illustrated in Figure 5. Again the regulator implements the TMDL process, but now the regulator provides farmers with an approved technical sheet of approved practices.

With this technical sheet, the flexibility embodied in the TMDL is removed. The regulator and farmer are at a point similar to point B in Figure 2. By converting the TMDL process to a technology-based standard, the approved technical sheet has greatly reduced the transaction costs incurred by both the regulator and farmer.

Figure 5: Analysis with Compliance Certainty

m_2: regulator's monitoring costs

c_2: farmer's compliance costs

b: benefits to third-party group from suing farmer

l_3: legal costs incurred by third-party

l_2: farmer's legal costs

m_3: regulator's monitoring and enforcement costs

p: penalty farmer must pay to regulator

With compliance certainty, the regulator can now easily determine who is in compliance by simply ascertaining whether the farmer is using the practices specified on the technical sheet. The lower monitoring –transaction cost is reflected in Figure 5, where the regulator's *payoff*, the monitoring costs that it incurs, $-m_2$ is less than $-m_1$ ($m_2 < m_1$). The latter's M_1 is the monitoring **and** enforcement costs that the regulator incurs in the presence of compliance uncertainty shown in Figure 4. Furthermore, m_2 is less than m_1, since the regulator does not incur any enforcement costs when the farmer complies with the TMDL process.

Again, the farmer can choose to comply with the TMDL standard, or not. If he does, his payoff is the compliance costs c_2 that he incurs. His payoff may be less than, equal to, or greater than c_1 (c_2 ? c_1). This outcome occurs due to two opposing forces. Under the first scenario of uncertainty represented in Figure 4, innovation offsets are possible as a result of induced innovation stemming from the flexibility built into the performance standard. But because of the technical sheet of uncertainty, there can be no innovation by the farmer. Without innovation and innovation offsets, the farmer may not be able to reduce his compliance costs, so c_2 may be greater than c_1.

On the other hand, the farmer is able to easily determine whether he is in compliance with the total maximum

daily load process– he is in compliance as long as he is using the practices on the approved technical sheet, he is in compliance. This reduction in transaction costs may cause c_2 to be less than or equal to c_1.

Whether compliance by farmers as defined by adoption of approved technologies actually results in meeting the water quality standard is a separate issue. A case can be made that if farmer's compliance fails to meet water quality standards, then the regulator will adjust the technical requirements. This readjustment is a dynamic uncertainty that is real, but which is not considered in this highly simplified analysis.

The regulator will not penalize the farmer if he complies, so the farmer does not incur any additional costs if he does follow the TMDL requirements. Additionally, the farmer will not be sued by a third-party group, since the regulator has approved the practices. If the farmer happens to be sued by a third-party group, the farmer simply refers the group to the regulator. Thus, the approved technical sheet allows the farmer to shift liability costs to the regulator. Compliance certainty thus reduces transaction costs for both the farmer and the regulator if the farmer complies with the TMDL in this scenario.

If, however, the farmer chooses to not comply with the TMDL process, he may be sued by the third-party group, or be penalized by the state regulator. If he is sued, he incurs legal costs l_2. These costs are most likely to be greater than compliance costs c_2 (l_2 ³ c_2) since the uncertainty with regard to a lawsuit – how long it will last, what will the damages assessment be, what will the legal fees be, the mental anguish sustained by the farmer – generates transaction costs that will likely be greater than costs incurred by implementing approved practices. This result will hold even in the case of practices that require a large sunk costs (i.e., manure lagoon structures) since these practices have some salvage value, and cost-share options do exist. Again, the third-party group's *payoff* is the benefits it receives from reducing environmental damage, b, less its legal costs, l_3, ($b - l_3$).

Alternatively, the farmer who does not comply may be penalized by the regulator with the TMDL requirements. In this case, the farmer incurs a penalty, p, which is assumed to also include a requirement that he follow the approved list of practices. This additional requirement is now feasible, since the regulator can tell the farmer what he must do to be in compliance – the regulator now has a technical sheet that can be used to determine compliance. In this case, the farmer's *payoff* is $-(p + c_2)$. The regulator incurs monitoring and enforcement costs m_3 which are higher than m_2 since enforcement action is required. Nevertheless, m_3 will be less than m_1 since m_1 also includes enforcement actions. It is less costly for the regulator to monitor farmers with compliance certainty than without it. The enforcement (which are exclusive of monitoring costs) costs are assumed to be equal across both scenarios. As before, since public records of violations and penalties are used by third-party groups in lawsuits, the farmer has an added incentive to not be penalized since public records may be used as evidence in future lawsuits.

With compliance certainty, the regulator's monitoring and enforcement costs are lower than with uncertainty. Thus, it would seem the regulator may prefer to convert the flexible environmental performance standard into a technology-design standard, especially if he believes that the technical sheet will ensure that water quality goals are met.

Farmers will incur a higher *payoff* if they comply with the TMDL requirement by following what is on the approved list of practices. Thus, by providing certainty, the regulator can regulate nonpoint source pollution since the farmer will comply with the TMDL requirement, but at the cost of loss of flexibility for both entities. Thus, induced innovation does not occur, nor do innovation offsets, and the Porter Hypothesis does not appear to hold in the case of nonpoint source pollution with many contributing farms. In fact, this is true under both scenarios, with and without compliance certainty.

Thus these two stylized scenarios suggest the need to reexamine the economics literature—which concludes that, when ambient environmental performance standards are coupled with flexibility for polluters in the choice of pollution prevention/control technology, there will be cost-effective outcomes. This outcome is more likely with better information sets and low transaction costs—both conditions are highly unlikely in nonpoint

pollution.

The next section then reports on survey research that examines the outcome when actual farmers and regulators consider their responses to an existing environmental performance standard, that is, the TMDL process. While the process exists, it is in the formative stages and is not yet defined for agricultural sources. Therefore there is a unique opportunity to investigate the role of imperfect information, transaction costs, and uncertainty.

The key research questions remain:

1. ***How will compliance uncertainty potentially affect the implementation of flexible environmental performance standards by Michigan regulators?***

2. ***How will uncertainty potentially affect Michigan livestock farmers' compliance with flexible environmental performance standards?***

7. Interview Findings

This analytical in Section 6 framework was used to develop interview questions for Michigan regulators and for focus group and exit survey questions for dairy farmers about the effectiveness of environmental performance standards, and total maximum daily loads. Both state regulators in Michigan and dairy farmers were interviewed in order to determine the effect of uncertainty on compliance with TMDLs, and the effectiveness of flexible environmental performance standards.

Interviews with informed representatives from agencies were conducted to determine how total maximum daily loads were being implemented in Michigan: The agencies included were the Michigan Department of Environmental Quality, the Michigan Department of Agriculture, and the Natural Resources Conservation Service. These interviews were conducted from December 1999 until Spring 2000.

Data were collected through focus groups with dairy farmers in each of the six top milk-producing counties in Michigan: Clinton, Sanilac, Huron, Allegan, Ottawa, and Ionia. These counties are identified in Figure 6. The participants were identified with the assistance of Michigan State University Extension Dairy Agents.

Figure 6: Counties in Which Dairy Farmer Focus Groups Were Conducted

Results of Interviews with Regulators

A list of the issues that was discussed with regulators appears in Appendix A. The topics discussed included such matters as: how will compliance be determined, how will loading reductions be divided amongst dischargers, and how will the monitoring and enforcement be implemented. Across all the agencies, the interviewer thought that the definition of compliance was the most problematic issue. This response provides some empirical evidence for the compliance uncertainty complications discussed earlier in this document.

Interviewed regulators indicated a desire to minimize monitoring and enforcement costs. Although the level of enforcement will be determined by the public, one regulator mentioned that they did not want to be “policemen” looking to punish farmers. Indeed, at the time of the interviews. it had not been determined which agency would undertake monitoring activities, and various personnel indicated that the resources had not been allocated in their budgets. One regulator stated that that monitoring activities may have to be contracted out to private firms.

More fundamentally, the interviewed regulators were vague and unsure regarding the definition of compliance with respect to total maximum daily loads. On the one hand, they expressed significant interest in the potential flexibility embodied within the TMDL process, since it would allow them to deal with different situations and site specific factors as necessary. They recognized that "one size will not fit all" farm and environmental situations. Nevertheless, it appeared that the regulators preferred to assess the practices – or the technologies – used to determine compliance, as opposed to actually monitoring ambient water quality in degraded water bodies. One regulator even stated that he did not want a "Cadillac Plan" to monitor and enforce flexible environmental performance standards; rather he wanted a practical technical list that can be used to easily check whether a farmer is in compliance. However, this assumption that the selected technologies will actually result in the desired water quality outcome, hence regulators do not emphasize the need to check actual water quality outcomes. That is, the regulators might not recognize that the science which links farm practices to ambient water quality outcomes is incomplete.

Interviewed regulators believed that farmers want to clearly know what compliance means, that they want a streamlined system of determination, and that they need technical help to achieve compliance. A straightforward technical list of approved practices would fulfill these requirements for the farmers, and give farmers certainty. One regulator commented that such a process would be more predictable for farmers than their neighbors. The implication was that an approved technical list would allow the farmer to minimize his exposure to liability from third-party groups (such as irate neighbors), and that farmers could more easily plan expected business expenses. In addition, regulators feel that by using approved practices, farmers will be able to indicate to other levels of government that their practices are sanctioned by the state, and that they are conducting their business as they should; this ability may help them, for instance, in complying with township zoning requirements.

In terms of innovation, regulators clearly indicated that little room is envisioned for farmers to be innovative in terms of the technology that they can use to comply with the flexible environmental performance standard. Thus, these interviews provide some evidence that Michigan regulators are interested in moving to a technology-based standard . (This standard corresponds with point B in Figure 2.)

However, this conclusion may be only true for the short run, as the TMDL process is first implemented. Regulators felt that as they gain experience and knowledge in dealing with nonpoint sources and are able to reduce transaction costs associated with TMDLs, eventually a flexible performance standard that relates to water quality outcomes would be employed. Thus, the total maximum daily load may be put into operation as a technology-based standard only in the short run. Essentially, regulators want to ensure that the process is *initially* implemented cost-effectively with as little friction in the "delivery mechanism" as possible.

Results of Dairy Farmer Focus Groups

Dairy farmers were interviewed via a focus group technique. In total, 47 dairy farmers participated in these focus group discussions, which ranged in size from 5 to 12 dairy farmers. While the selection process was not random and the focus groups are not statistically representative of dairy farmers in the state, the individuals interviewed had, for the most part, consistent conclusions and therefore may represent the views of many others. The average number of milking cows owned by the participating farmers was 163; the smallest herd was 15 head and the largest was 1550. The state average herd size is approximately 81, while the largest number of milking cows are on farms in the 100-199 herd size range. (Census of Agriculture 1997). Each focus group began with an explanation of total maximum daily loads. Then questions related to water quality issues, including third-party lawsuits were addressed. Participants were also asked to complete a short written survey, individually, after the discussion. A copy of the focus group script and the written exit survey is in Appendix B.

The farmers in the focus groups expressed numerous concerns with regard to the implementation of total maximum daily load programs. These concerns ranged from how these water quality regulations might affect their

farm practices and profits, to how these rules might be implemented, as well as whether these efforts will actually result in improved water quality. The details of these discussions were published in an article in the Michigan Dairy Review, a copy of which is in Appendix C. Despite the wide range of concerns that were expressed across the focus group discussions, a common theme emerged relating to uncertainty[24].

Uncertainty

As one Farmer lamented: "Nobody knows what we're supposed to do…that's the biggest unknown thing". Participating farmers wanted to know "What will compliance with total maximum daily loads mean for my farm?" As of now, the answer is not known because the TMDL process is just beginning in Michigan. The participants mentioned aspects of the regulatory process that they believe must be included to reduce uncertainty. These criteria are shown in Table 3, and include such things as "regulators must clearly tell farmers what is expected of them", and, that "clear guidelines should be given" as to how to comply[25].

Furthermore, this desire for certainty was reinforced by the participants when asked why they would comply with a TMDL process in the exit survey (Appendix B). Table 4 shows the weighted rankings of the top three motivations.

Table 3: Perceived Criteria Necessary to Reduce Uncertainty

1. Regulators must clearly tell farmers what is expected of them.
2. Clear guidelines should be given to farmers on what they can do to comply with the total maximum daily load process.
3. These guidelines should be comprised of common sense practices, they should be affordable, they should *not* be mandatory, allowing farmers to do what they think is best for their operation.
4. Farmers want to know the penalties for a violation of the TMDL process.
5. Farmers want assurance that if they are in compliance with a TMDL, they will be safeguarded against future regulatory changes and local zoning requirements.
6. If they have to make any necessary investments both in terms of time and money, farmers want assurance that the water quality regulations will result in improved water quality outcomes.
7. Farmers must not be punished for past environmental investments that they have made in good faith.
8. Ideally, the regulations would allow farmers to self-monitor their performance so that they can clearly see the results of their management practices and make any necessary changes in a timely manner.

Participants indicated their desire to be responsible stakeholders as their main reason for complying with the water quality regulation out of ten possible reasons. Farmers rated the need to avoid lawsuits as a close second. Avoiding government fines and penalties and the desire to reduce the probability of being "caught out of compliance" were tied by interviewed farmers for third place. Lawsuits and government fines and penalties are transaction costs associated with being out of compliance. But since at present compliance is not well defined, these transaction costs are not completely avoidable and thus weigh on farmers' minds.

In light of the recent lawsuit notices given by the Sierra Club against five Michigan dairies – all of whom had discharges as recorded by Michigan public agencies – it is not surprising that farmers were anxious to avoid third-party lawsuits. Most interviewed farmers were more worried about lawsuits than government fines because they believed a lawsuit could be of indeterminate length and could potentially put them out of business; whereas, government fines typically will not. Additionally, most participants felt that the state government is more willing

to work with farmers, unlike third-parties such as neighbors and citizens' groups.

Table 4: Weighted Ranking of Reasons Farmers Would Comply with TMDL

Reason	Weighted Ranking Value
1. I need to protect our water resources for future generations	95
2. I want to avoid lawsuits	92
3. I want to avoid penalties and fines	85
3. I want to reduce the chances of being caught out of compliance	85

Further evidence for the desire for certainty arose within focus group discussions. For instance, many participants felt that if a farm is found to be in violation of a TMDL requirement, the farmer should be told what the problem is, told how he can fix it, be provided with adequate technical assistance to tailor a solution to his farm, and be given an adequate amount of time to fix the problem. If these steps were not taken, respondents thought it it would be unfair to penalize the farmer. In essence, farmers indicated a desire for a technical sheet of approved practices coupled with technical assistance. In the eyes of the farmers, this technical sheet provides compliance certainty, and was preferred to a flexible interviewed environmental performance standard.

Even those farmers who simply did not trust any type of approved practices put forth by government regulators, and who felt such efforts have been ineffective and expensive in the past – did want certainty with respect to compliance. One farmer said unless there was a meter at the end of his fields that could clearly tell him whether he exceeded his phosphorus limit and exactly how much he had to reduce his effluent, he would have to have an approved list. In his own words:

Well…if …there's a meter there right next to the creek that's telling us that we got to reduce 10%, so when the meter dips 10% we know where it is. So I guess I trust my own ideas as much as I would anything the government is going to come up with…Those approved lists are going to strap you to more expense. Where if you did it on your own and the meter is there at the other end that [tells you that] you've dropped 10%, then I'd be confident [in my own judgment].

This quote is interesting because this farmer valued the ability to choose his own solutions. Thus, the farmer wanted a technology – a meter – that would provide him with compliance certainty and the ability to limit his liability exposure. A meter also would provide considerable independence of response. Of course, he knew that such a meter was not available.

This farmer understood the tradeoff between freedom of choice (flexibility) and compliance certainty, but most interviewees did not. That is, most interviewed farmers expressed a strong desire for certainty, but also wanted flexibility in the regulations. On the one hand, they wanted clear guidelines for what they must do to be in compliance and be protected against lawsuits, but on the other hand, they wanted these guidelines to be flexible (Table 3, point 3). They did not appear to recognize the trade-off between flexibility and compliance certainty illustrated in Figure 2, or they felt comfortable that their choices could be proven as good at pollution prevention as could prescribed ones. Another hypothesis is that they thought any good-faith effort on their part would be viewed as being in compliance.

Farmers were asked if they would be prefer to hire consultants. Feelings were mixed regarding how helpful consultants could be. The main concern was whether consultants would "stick their necks out" and assume responsibility for what they told farmers to do. Many interviewed farmers felt that whoever provides technical information, whether it be a government agency person or a private consultant, should take on some legal liability responsibility, since they have advised farmers on how to come into compliance. Understandably, farmers want to be able to shift their transaction costs due to compliance uncertainty (including liability) onto others.

This evidence from focus groups and the rankings in Table 4 illustrate the farmers' desire for certainty and a technical list, and it lends evidence that farmers want to move from point A (i.e. a flexible environmental performance standard) to point B (i.e. a technology-based environmental regulation) in Figure 2. They would like to go choose the left-hand side path in Figures 4 and 5. But in the face of compliance uncertainty, from Figure 4, it is clear that despite any investments that the farmer makes to comply with the total maximum daily load process, a third-party can still sue him or he can still be penalized by the regulator. This possibility contradicts a sense of fairness that was also important for farmers. As one respondent said: "You want to see [the rules] be fair to everybody"

The farmers in the focus group discussions felt that the regulations, monitoring efforts by the regulators, and enforcement of the water quality rules should not be arbitrary. For example, participants stressed that the monitoring of lakes and streams by state regulators should be fair and should reflect reality. It was suggested that water samples should not be taken during extreme storm events, and samples of every lake or stream should be taken at several places, and at different times of the year. By using this method, it is less likely that a farmer using effective manure management practices will be wrongly accused of discharging. Across most of the focus groups, farmers repeated the sentiment to use good science in the regulatory process. But with compliance certainty, it may appear to farmers that monitoring and enforcement are arbitrary.

As a consequence, farmers' concern for fairness might cause some to refuse to comply with a TMDL process. Interviewed farmers considered it unfair that they could be left vulnerable to lawsuits and government penalties if they were to make efforts in good faith to comply with a TMDL requirement. They felt that they should not have to bear any legal fees or penalties in addition to their own compliance costs. In addition, farmers had many by cost concerns, as illustrated in Table 5.

Table 5: Weighted Ranking of Reasons Farmers Would not Comply with TMDL

Reason	Weighted Ranking Value
1. I have to carefully consider the costs of suitable water protecting practices	75
2. Current milk prices affect the water-quality related practices that I can undertake	72
3. I have to consider the costs of a consultant because of financial constraints	57

In the exit survey, farmers were asked to rate reasons why they would *not* comply with a total maximum daily load process. Cost considerations ranked amongst the top three in terms of importance. If costs and fairness are important issues that affect whether farmers will follow water quality regulations, then discussion with farmers imply that, with severe compliance uncertainty, there is little incentive for farmers to comply with a TMDL standard. Subsequently, it appears from these focus group discussions that fairness and cost concerns could cause farmers to go down the right-hand side path in Figure 4 – i.e. not comply with the TMDL process – resulting in failure in meeting the environmental quality TMDL goal, no induced innovation, and no innovation offsets. Enforcement penalities would clearly be of major importance in this discussion.

8. Conclusion

The environmental economic literature has contended that flexible environmental performance standards are cost-effective and also encourage technological innovation to occur. As such, they can be superior to design- or technology-based standards embodied in traditional environmental regulation. This result may be true for some point sources of pollution, where the pollutant level is observable and easily quantified. This ease of measurement eliminates most uncertainty as to whether point sources are in compliance with the environmental regulation. Thus, there are few transaction costs that need to be contended with by either the regulator or the manager of the point source.

In the case of non-point sources of pollution, however, it appears that this outcome may not usually hold. The very nature of non-point source pollution makes observation and direct measurement impossible, or very costly. With limited regulatory budgets, the diffuse nature of non-point source pollution results in uncertainty with regard to compliance. Consequently, it is difficult to accurately assess who is in compliance with the flexible environmental performance standard. This uncertainty raises transaction costs for regulators, in terms of monitoring and enforcement costs, as well as for farmers who have to incur information costs to find technologies that can be implemented. Farmers can not ensure they are in compliance with the performance standard.

Both regulators and farmers will try to achieve certainty in an effort to minimize transaction costs. In other words, both regulators and farmers are looking for certainty with respect to managing non-point source pollution. This certainty and attendant lower transaction costs may be easily obtained through a technical sheet or list of approved practices. This list of practices determines compliance; if a farmer follows the practices on this list, or a subset that is best suited for his farm, he is considered to be in compliance with the water quality standard. At least initially, the actual environmental outcome becomes a secondary issue. Thus, although this list reduces the transaction costs for both the regulator and the farmer by increasing compliance certainty, there may be limited environmental improvement if the practices adopted do not link well with water quality concerns.

Compliance certainty, in turn, ensures that farmers will not be penalized by regulators. More importantly, however, this compliance certainty allows farmers to shift liability costs onto the state regulators if they are sued by a third-party group. As long as the farmer follows the list of approved practices – approved by the state regulator – then the state regulator implicitly assumes responsibility for the environmental outcome. Thus, a third-party or citizen's group that is concerned about violations of the Clean Water Act, perhaps because the ambient environmental performance standard has been exceeded in a body of water, may not have any recourse with respect to the farmer, but may still be able to sue the state regulator.

A technical sheet of approved practices reduces monitoring and enforcement costs for regulators. It is not too difficult to verify whether a farmer is following a list of approved practices, and thus determine whether he is in compliance is easily observable. This method of examining practices, as opposed to actual environmental outcomes, is also easier for regulators to do since no institutional change is necessary. The Michigan Department of Environmental Quality (MDEQ) has essentially been conducting design-inspections for the past 30 years in its efforts to monitor point sources that have National Pollutant Discharge Elimination System permits. Thus, an approved list of practices requires few institutional changes by the MDEQ.

The transaction costs associated with uncertainty surrounding flexible environmental performance standards and nonpoint sources of pollution may reduce the practicability and usefulness of these standards from a policy perspective. If regulators – with limited budgets to monitor and enforce environmental regulations – want to reduce their transaction costs, they will likely develop an approved list of practices. This approach also ensures that by providing compliance certainty to the farmer, the farmer is more likely to undertake pollution abatement actions than if such a list did not exist. This list, however, precludes any induced innovation from occurring and may limit environmental improvements, depending upon how well the adoption of approved practices correlates with water quality improvements.

In the case of non-point source pollution, the transaction costs associated with uncertainty results in (a) no induced technological innovations, (b) no innovation offsets, (c) potentially higher compliance costs for the agricultural industry, but (d) lower monitoring and enforcement costs for regulators. The evidence from this study indicates that the desire for certainty and resultant policy design can negate the possibility of the Porter Hypothesis from holding in the dairy sector in Michigan in response to an environmental performance standard.

If the total maximum daily load process is to achieve its objective, considerable research needs to be undertaken to investigate ways in which the transaction costs associated with compliance uncertainty can be reduced, for both the regulator and farmers in Michigan. For instance, regulators and dairy farmers need to be able to link practices with resultant water quality outcomes in a cost-effective and equitable manner. Currently there is insufficient

information and knowledge available to target enforcement on the major sources of pollution, including farms, and tailor solutions to their needs. Monitoring of water bodies and enforcement by regulators will must be undertaken; research may help to reduce these *ex post* transaction costs for regulators. Research efforts can help fill these knowledge gaps to ensure that the benefits of flexible environmental performance standards, such as total maximum daily loads, are realized, thereby ensuring continual water quality improvements cost-effectively.

Appendix A

Survey with Regulators

Issues for Regulators

1) Implementation of TMDL

a) When will they be implemented here in MI?

b) How is the threshold being specified?

c) What will compliance mean?

d) How will compliance be determined?

- E.g. +/- 10% 80% of the time?
- How flexible will they be?
- How will they know who is in compliance?
- How will they be able to detect if the threshold is not being met?
- How will monitoring be carried out? Agency personnel, or say if there is a complaint?
- Will farmers be given a suite of technologies, and that is considered to be “in compliance”
- Will discharges be measured from fields?
- Will farmers be given permits?

e) How strong will enforcement be?

- What’s the probability of being caught? Of being punished?

f) If the TMDL is not being met, what is the consequence?

- Mandated technologies? If so what?
- Do they know what the costs will be?
- How do they follow-up?

g) What is EPA making them do?

h) Does everyone have to be in compliance?

- Dividing TMDL evenly by all the people? or?

i) Are they following a model from elsewhere (e.g. Oregon?)

j) Do they have an idea of how farmers will respond?

k) What do farmers think of TMDLs?

- Have any been involved in the public comment phase?

l) What incentives are they providing to farmers to meet the TMDL?

m) Cost-sharing for adoption of abatement technologies to meet TMDL?

2) Third Generation BMPs

a) What are they?

b) What are the costs of implementing these BMPs?

c) How much P does each BMP reduce? %, quantity ?

3) Legal issues

d) Who can sue whom?

e) What is the connection between CWA and Michigan Right to Farm Guidelines?

f) Does liability insurance exist? Are farmers using it?

Appendix B

Materials for Farmer Focus Groups

Environmental Performance Standard Script

Presented by Lorie Srivastava, **Graduate Student, Dept. of Agricultural Economics**

Introduction

Welcome. I would like to thank all of you for participating today. I know this is an extremely busy time of the year, so I really do appreciate you taking the time to come. Let me first introduce myself and explain the purpose of this discussion. My name is Lorie Srivastava, and I will serve as the facilitator for this meeting. I am a Ph.D. student in the Department of Agricultural Economics at Michigan State University. I would also like to introduce Corey Risch. Corey is a Masters student in the Dept. of Agricultural Economics. She is from a dairy farm in Ingham county. They milk 175 cows. Corey will be making notes of what is said during this meeting, so that we can see keep track of our discussion. In a moment I will describe my role in more detail, but first I would just like to say a few words about why we invited you here.

Purpose

Today's meeting is part of my Ph.D. research. As part of my research, I am looking at how Michigan dairy farmers might be affected by federal water quality regulations that are being implemented in Michigan under the Clean Water Act, and how important issues like third-party lawsuits, and pollution insurance affect farmers. I will be

holding 6 discussions like this in the 6 largest milk producing counties in Michigan to gather the concerns and opinions of dairy farmers. I will be speaking with farmers from a variety of farm sizes – small, medium, and large, people who intend to stay in dairy for the next 15-20 years, and people who will be retiring soon. I want to talk to a variety of dairy producers because the industry is made up of different kinds of operators, who are making different kinds of decisions.

The intent of today's roundtable discussion is to ensure that **your** knowledge and concerns are incorporated into my research. Does this mean that what is said here will be written up and forgotten in the library at MSU? No! After all the roundtable discussions are held, I will summarize what you tell me and disseminate the information to various policy makers so that they can be informed of dairy farmers' perspectives when they implement water quality regulations in Michigan.

I should mention that I do **not** work for MDA, DEQ or the EPA, and have no plans to do so. As I said before, this work is for my Ph.D. research. I want to admit right up front that I am not an expert in dairy, which is why I am asking you for your help with my research. My research is funded by the Great Lakes Protection Fund, which provides funds for a variety of research issues pertaining to the Great Lakes. I would also like to mention that this has nothing to do with the Michigan Agricultural Environmental Assurance Program (or MAEAP), in case any of you were involved in those focus groups.

Lorie: keep in mind the policy makers are MDA, DEQ – and they can in turn inform EPA

I want let you know that I am not doing this research because I think water regulations for agriculture are a good or a bad thing, or that mandatory water quality regulations are needed for agriculture. Rather, I believe that there has been a lot of research on voluntary environmental programs, but less on potentially mandatory environmental programs like those that we will discuss today. And, as far as I know, there has been almost no research done that directly asks dairy farmers what **they** think about possible mandatory water quality programs, what **they** think the costs will be, how **they** think their operation will be affected, how **their** production decisions might change, and what **they** think the benefits are. The water quality regulations that are discussed in the LSJ article have not been implemented in Michigan yet because it is still being designed and debated, so this is an opportunity for farmers to let their concerns be known, which I think is important.

I am here to facilitate this discussion and to listen to you – I am not here to judge you in any way. I just want to hear directly from **you** what concerns you about upcoming water quality legislation, lawsuits, and how you believe these will affect you. Let me give you some background.

Background

It looks like farmers – particularly livestock farmers – are faced with increasing regulatory pressures because of agricultural contributions to water pollution, and that such pressures will become stronger with time. The regulatory pressure is in response to the declining acceptance by the general public of many current farming practices because of perceived water pollution from agriculture. The cover story in the Aug. 20th issue of the Lansing State Journal talks about agriculture's contribution to water pollution, and how new legislation will change it. The implication is that runoff from agriculture **has** to stop because runoff, along with other sources, is causing Michigan waters to be unsafe.

Lorie: hold up newspaper

An example of this public concern recently happened here in Michigan. As you may know, on July 25th of this year, the Sierra Club gave notice that it is suing four Michigan dairies under the Clean Water Act.[26] The Sierra Club contends that these dairies have repeatedly discharged manure into Michigan's waterways, which is a violation of the federal Clean Water Act[27].

In Michigan, it is commonly thought that using the Generally Accepted Agricultural Management Practices (GAAMPs) specified under the Right to Farm Act (RTFA) protects farmers from environmental complaints and from too many inspections from state regulators. It is, however, possible that a farmer using GAAMPs could have a discharge of wastes into surface waters, and if so, they could be penalized. So, RTF does not actually protect farmers from violations of the Clean Water Act.

So where does that leave us? What will future water quality regulation for agriculture look like? This is a big unknown right now. It is likely that in the future, at least those farmers with significant potential for pollution discharges will increasingly be asked to change management practices so as to further protect water quality for drinking water, fish habitat, and to reduce sediment runoff. Water quality regulations may continue as in the past with voluntary programs with incentives to get farmers to participate, or instead it might be composed of mandatory requirements with required management practices. A third possibility is that agriculture may be governed by what policy makers call ***environmental performance standards***.

Lorie: hold up visual – a flow diagram

So, what are environmental performance standards? It is a standard that sets a limit on how much of a certain pollutant can enter a surface body of water, by surface body I mean a lake, or a stream, or creek, something on the surface, as opposed to groundwater. Let me illustrate with a hypothetical case of phosphorus in a lake. An environmental performance standard would set a pre-determined amount of phosphorus that can legally exist in the lake. If a state regulator (such as MDA/DEQ) were to check the phosphorus level, and they found that the amount of phosphorus in the lake was ***below*** the allowed standard, then no further action is taken. If, however, the regulator tests the water and finds that there is ***more*** than the allowed level, then there would have to be a cutback in the amount of phosphorus entering the lake. I am using phosphorus as an example because it promotes rapid algae growth, and when the algae dies and decays, the oxygen in the water is used up, causing fish kills and other creatures to die. It is the main concern from agricultural runoff, along with sediments. Any questions?

One type of environmental performance standard is a total maximum daily load process, or so called TMDLs (some people pronounce it *timdls*, others TMDLs, I will say TMDLs). How many of you have heard of total maximum daily loads, or TMDLs?

In order to direct the discussion, I would like to focus on totalMDLs since it is the only example of an environmental performance standard in agriculture. Also rules are being developed for it, so I am interested in how farmers may react to it, if it is implemented. First, let me explain a totalMDL. A totalMDL is a process that is specified under the federal Clean Water Act. The current totalMDL process calls for each state to set an environmental performance standard for every surface water body within its jurisdiction (this has already been completed in Michigan). Different water quality standards are set for waters that are used for different purposes, such as drinking water source, recreation, fishery, etc. The EPA is letting states decide whether to use mandatory or voluntary approaches to implement any clean up plan. They have 10 years to do so. I should add that government authorities expect all sectors of the economy to be regulated with TMDLs, not just agriculture.

Lorie: Go through the visual

The TMDL process calls for the state to regularly check each water body and see if it meets its environmental performance standard. As an example, can you look at the handout of the lake that I have passed around? There are two lakes, which are surrounded only by farms – no waste water facilities, or urban golf courses, nor anything else, are near the lakes. The smaller lake meets its designated water quality standard, and so does not exceed its allowable level of phosphorus. Hence Farm E does not have to change any management practices. The larger lake, however, does **not** meet its water quality standard. There is too much phosphorus in this lake – so as you can see in this example, Farm A has to cut back its phosphorus by 15%, farm B and C by 40%, and Farm D does not have to change any practices. These amounts would be determined by a regulator, along with a timeline for when the changes must be completed. Questions?

Since TMDLs have not been implemented in Michigan yet, how it will be specified is not known. There are a few options: 1) they may be implemented so that only major polluters have to reduce their pollution, not everyone. In this case, only those farms that are a major source of water pollution will have to reduce their runoff, not all farms; 2) farmers may be given a lot of flexibility to meet a needed reduction. So it may be up to the farmer to find a cost-effective way to bring the farm into compliance – for example, the farmer can change hauling practices, build additional storage, etc. 3) **Or** TMDLs can be implemented so that farmers have to follow specified practices – they can not choose their practices.

In July of this year, the EPA issued a final rule on how to implement the TMDL process. Since August 1999, the EPA has considered over 34,000 comments on changes that it proposed to the TMDL process. Here in Michigan, the DEQ and the EPA are going back and forth on how TMDLs will be implemented, with no resolution. A major bone of contention is the issue of discharge permits. The EPA is pushing DEQ to issue discharge permits to agricultural operations, as called for in the Clean Water Act[28]. But the DEQ does not grant discharge permits to agriculture, since technically agricultural enterprises are not allowed to discharge into Michigan waterways at all. So the DEQ is arguing with the EPA about discharge permits.

What do TMDLs have to do with lawsuits like the ones being filed by the Sierra Club? Third-party lawsuits against firms (such as farms and processors) are used to put pressure on regulating agencies like the EPA and DEQ to implement sections of the Clean Water Act that have been ignored until now, like totalMDLs.

I would like to now begin the questions, but want to point out that there are no right or wrong answers to the questions that we will be discussing today. I just want to know what you believe are the important issues for your farm with regard to water pollution.

If you are wondering why you are here – you have been selected from a nomination list submitted by extension dairy agents. I'm not trying to pick on you or anything! Finally, I know I can not fully compensate you for your time, I do want to recognize your contribution, so you will be paid $100 for your time today.

Procedure

Before we begin our discussion, I would like to explain a few things.

There are several things that I need you to do to help improve my research:

1 I would like to hear from everyone, since I expect that there are a variety of opinions in this room, some in disagreement, some in agreement. All your opinions are valid –they're just based on different experiences – so I am genuinely interested in hearing what all of you have to say. Please don't worry about offending me. You won't! Although a roundtable discussion format allows us to have an open discussion, and a chance to bounce ideas off each other, we have a limited amount of time to get through a full list of questions. So there may be times when I ask you to summarize or shorten your remarks to make sure that everyone has a chance to give their input. If I change the subject, it's not because I'm not interested in what you have to say. It just means that we have to move forward in order to be done by noon.

2 I hope that you will feel comfortable enough to share your honest opinions. Your identities will remain confidential, through the following 3 means:

· no names will be used in the analysis

· though I will be taping our conversation so that I can have an accurate record of what is expressed, I will remove all references to peoples' names and replace them with number codes when I transcribe the tape

· I am asking that you treat comments made today by other participants as confidential as well

· I would ask that you be honest in your answers. I will take every precaution to ensure the confidentiality of what is said here today. No one will be able to trace back any comments that you make to you. I will not be recording your names in my dissertation. I only need your names so that the accounting folks at MSU can issue you a check.

3 I would ask that everyone try to speak up and speak clearly so that the tape can pick up your comments.

4 At the end of our discussion, I would ask that you complete and leave a short questionnaire that should only take about 10 minutes.

5 Does anyone have any questions before we begin?

Questions

Attitudes towards water quality issues

1 What kinds of production decisions are influenced by water quality considerations, e.g. day to day decisions, planning for the season, or when planning an expansion?

Probe one individual or groups of individuals:

If so, in what way?

Probe one individual or groups of individuals if none:

If not, why not? What comes to mind first?

In a good financial year, how high a priority would improving your manure handling system be? Top 3, top 5?

a) What affects how high a priority it is for you?

In general, do you feel that serious water quality problems stem from dairy farms in Michigan? Why or why not?

Concerns about water quality regulations

Lorie: Hold up TMDL visual

Thinking of your farm, if you were to make an investment that reduced runoff (such as equipment/facilities and additional training for you and your employees), would there be any advantages for making these investments and being in complete "compliance" or even "overcompliance" with a TMDL? If so, what would be the main advantage?

Now I am going to present you with a hypothetical scenario. Suppose that a state regulator determines that a water body in your watershed is being polluted above an acceptable standard that is set by the state. Suppose there is evidence that there is animal manure and other dairy farm wastes runoff entering this water body. Assume your farm is contributing to this pollution, like farm A. Would you be more worried about being sued by a third party (like a neighbor or an citizen group), or being fined by the government, or would neither be a concern?

If so, which is the bigger concern? Why?

Actually, before we move on, have any of you heard of fines by DEQ and/or the EPA being assessed against dairy operations here in Michigan? Were they large fines? I know I can look it up, but does anyone know?

Lorie: hold up TMDL visual again

What do you think of TMDLs?

a) What is your biggest concern regarding a water quality performance standard for agriculture, such as a TMDL process?

a) Do you think TMDLs are appropriate for reducing runoff?

b) ***Show TMDL 2 visual***: If there is a TMDL process, should an agency assign responsibility to exceeding a water body's TMDL limit to an individual farm?

*A discharge permit specifies the steps that farms have to take to minimize water pollution. As long as you follow the permit requirements, you are protected to some extent against law suits. Do you think it is appropriate for the state of Michigan to issue discharge permits to dairy operations. If so, which farms and why?

*If the TMDL process is implemented next month, and you are told by the state regulating agency that you have to reduce phosphorus loadings by 10%. Say you decide to follow the TMDL process as closely as possible, which of the following would you do?

i. Would you evaluate your operation and devise new practices on your own to comply with the TMDL and cutback phosphorus by 10%?

ii. Say DEQ/MDA/NRCS develops a list of approved practices where you could use those that are best suited for your farm and cutback phosphorus by 10%. If you use the practices on this list, you would be protected from lawsuits to some degree. Would you like to be given this list of approved practices and apply those that are suitable to your farm?

iii. Now suppose, that you come up with a way that can significantly reduce the runoff from your farm, so that you meet the allowed phosphorus limit in a TMDL, but MDA and NRCS are unfamiliar with it, and it is not on their list of approved practices. And let's say that your practice is cheaper to use than those on the approved list – would you use yours or the more expensive approved practices? Why?

Pat said that I may need to clarify that a perf std. specifies an outcome (i.e. control of P), and not which practices are used – since farmers are used to NRCS and FSA checking practices

iv. Would you rather hire a consultant? Why?

Probe:

If you would hire a consultant, how much would you pay to ensure that you are in compliance with the law?

I explained earlier that things are in flux with regard to water quality laws both federally and here in Michigan at the state level. Laws change, different people are elected into office, who knows where exactly it will all end up. Imagine you are Farm A, do you think you would: 1) do something immediately, 2) wait for things to settle down to do something, or 3) ignore it.

Probe those who say will wait: What are you waiting for and why?

<u>How will regulations affect your farm</u>

Now let's assume that an environmental performance standard such as a TMDL process which I talked about earlier were implemented **next** month, and assume your farm is assigned the responsibility of reducing, say phosphorus, any way you can.

If the TMDL process is implemented next month, and you are told by the state regulating agency that you have to reduce phosphorus loadings by 10%.

c) What would you do to comply with the TMDL process? In terms of: management changes, new investments, seek out information?

d) Where would you seek assistance?

e) Would your efforts to comply with the TMDL process be different if it is enforced by an honor system like now where you are not checked unless there is a complaint, where there would be little monitoring by state regulators, vs. a system that is enforced with periodic inspections? Which do you prefer?

f) Would it matter who did the enforcing, DEQ or MDA? Why and who do you prefer?

Concerns about law suit uncertainty

Let's return to the situation of the Sierra Club giving notice to sue those four farms in Michigan. Do you worry about such lawsuits being filed against you? Why or Why not?

g) If so, what actions, if any, have you, or might you undertake to reduce the likelihood of a lawsuit against you?

Do you think regulations like totalMDLs will have any effect on lawsuits being filed? How?

Do you think there will be more lawsuits like this one in the future – do you see this as a trend?

Probe those who say yes:

h) If you think there is a trend towards more lawsuits, do you think you will change how you farm? How?

How many of you have special provisions in your insurance against a pollution event such as a lagoon breaking that leads to a fish kill?

i) Why did you get it?

j) Do you think it is adequate for environmental pollution events?

k) Do you believe your special insurance will provide you with some financial protection against environmental lawsuits?

Do you have any further thoughts on the Sierra Club lawsuit that are relevant to today's discussion?

Finally, is there anything else you would like to tell me today?

Wrap-up

This completes our discussion today. Thank you very much for participating. Before you leave, there is a brief questionnaire that I need you to complete. PLEASE DO NOT PUT YOUR NAMES on it. We want your answers – like your comments here today – to remain anonymous. I would like to thank you all for sharing your thoughts on these questions.

Appendix C

Michigan Dairy Review Article

Michigan Dairy Farmers Focus on Latest Water Quality Regulations: Reactions to Total Maximum Daily Loads

Lorie Srivastava[1] and Sandra S. Batie[2]

Introduction

New federal water quality regulations could have significant effects on Michigan dairy farms. In the Clean Water Act of 1972, Congress specified the total maximum daily load (TMDL) process which limits pollutants entering lakes, rivers, and streams in the U.S. The TMDL process requires states to do a number of things: 1) set the maximum amount of pollution that a water body can receive without violating state-designated water quality standards (including a margin of safety to account for technical uncertainties); 2) develop a quantitative assessment of water quality problems, pollution sources, and required pollutant reductions; and 3) address *all* pollution sources – both point sources such as factories and municipal plants, and nonpoint sources such runoff from agricultural lands, forests, and roads. Water quality standards have been set by the Michigan Department of Environmental Quality (MDEQ) to protect surface waters based upon intended uses, that is, recreational, public water supply, agricultural, or industrial uses.

Although TMDLs have existed since 1972, they have only recently been implemented. Although EPA is not requiring the TMDL process to come into effect until October 2001, MDEQ has already developed Michigan's TMDL implementation schedule (begins in 2000, ends in 2011), and a pilot program is underway in Lake Macatawa in Ottawa County. The MDEQ has been delegated authority from EPA to implement TMDLs in Michigan.

There is much that we do not know about how the total maximum daily load process may affect farms in Michigan. Examples of unanswered questions are: Will runoff be traced back to individual farms? How will reductions be divided between point and nonpoint sources? We undertook this research to answer questions like these, but perhaps more importantly, since the program is still being developed, this is an opportunity to find out how farmers they feel about this new water quality regulation so that they can have input into its design. To this end, we conducted roundtable discussions with Michigan dairy farmers in September, 2000 to hear their views about the TMDL process and related water quality issues. We will disseminate the results to state regulatory agencies so that they can be informed of dairy farmers' perspectives when they implement TMDLs in Michigan.

This article has two objectives: 1) to summarize the findings from the roundtable discussion groups and inform Michigan dairy farmers, government agencies, and others of the results, and 2) ensure that Michigan dairy farmers are aware that although the details of the total maximum daily load process are unknown, since it is required by federal law, it will be implemented in some fashion in Michigan.

The Roundtable Discussions

Six roundtable discussions were held, one in each of the six top milk producing counties in Michigan: Clinton, Sanilac, Huron, Allegan, Ottawa, and Ionia. The participants were identified with the assistance of Extension Dairy Agents. In total, 47 dairy farmers participated in these roundtable discussions, which ranged in size from 5 to 12 dairy farmers. The average number of milking cows owned by the participating farmers was 163; the smallest herd was 15 head and the largest was 1550. Each roundtable discussion began with an explanation of what total maximum daily loads are, then focused on questions related to water quality issues, including third-party lawsuits. Participants were also asked to complete a short written survey, individually, after the discussion.

What are Farmers Worried About?

The participants in the roundtable discussions expressed numerous concerns with regard to the implementation of total maximum daily loads. These concerns ranged from how these water quality regulations will affect their farm practices and profits, to how these rules will be implemented, as well as whether these efforts will actually result in improved water quality. Despite the wide range of concerns that were expressed across the roundtable discussions, two common themes emerged relating to 1) fairness, and 2) uncertainty. Both these themes can be

further divided into sub-themes, shown in Table 1. It should be understood that this is just a summary of the comments made. Not all participants even necessarily agreed with these comments, and some even disagreed.

Table 1: Roundtable Discussion Sub-Themes

1. Fairness:

1. Problems with Bad Actors
2. Arbitrariness in Rule-making, Monitoring Efforts, and Enforcement
3. How much Responsibility for Nonpoint Clean up would be Assigned to Agriculture

2. Uncertainty:

1. Regulatory Uncertainty
2. Lawsuit/Fine Uncertainty

Theme One: Fairness -"You want to see [the rules] be fair to everybody"

As seen in Table 1, within the fairness theme, the participating dairy farmers mentioned three issues. They felt that: 1) the Michigan dairy industry suffers from a few *bad actors*, 2) water quality regulations should not be arbitrary, in rule making, monitoring, nor enforcement, and 3) agriculture alone should not bear the burden of having to ensure clean water from nonpoint sources in Michigan.

1. The Dairy Industry Suffers from a Few Bad Actors

A common feeling expressed by the participants was that most dairy farmers are making honest and effective efforts to minimize any water quality problems that may originate from their farm. But, farmers believe that there are a few *bad actors* in the dairy industry, including some larger dairies, whose problems are appearing in newspapers. This unwanted attention means that all dairy farmers have to deal with a tarnished image.

Many of those interviewed were quite concerned that large farms – those with 301 or more milking cows – are quite visible to both the general public and to regulators. These farms attract attention to themselves because of their size, especially if they have an insufficient land base relative to their manure, or if they have absentee owners. As one farmer stated, "…as the farms get bigger and you're…multi-miles away from your home base, you are not a [good] neighbor." Participants suggested that for the TMDL process to be fair, regulators should target monitoring and enforcement efforts towards those who significantly pollute.

2. Regulations, Monitoring and Enforcement Should not be Arbitrary

The farmers at the roundtable discussions felt that the regulations, monitoring efforts by the regulators, and enforcement of the water quality rules should not be arbitrary. One suggestion was to use good science in the regulatory process, to help minimize politics from biasing the rule making process. For instance, some participants were worried that the political agenda of citizens' groups might take precedence over scientific studies in the TMDL process, and may hurt those not responsible for water quality problems.

Also, if a farm is found to be in violation of the TMDL, many of the interviewed advocated that the farmer should be told what the problem is, told how he or she can fix it, be provided with adequate technical assistance to tailor a solution to his or her farm, and be given an adequate amount of time to fix the problem. Otherwise, it would be unfair to penalize the farmer.

Also, many interviewed farmers felt that whoever provides technical information, whether it be a government agency or a private consultant, should also take on some legal liability responsibility, since they have advised farmers on how to come into compliance.

Even if compliance is required by law, participants felt that they should receive financial assistance. One farmer said that there are number of things he would love to do, but if Michigan wants farmers to comply, he said "[Michigan must] give us the [financial] assistance to do it."

Participants stressed that monitoring of lakes and streams by state regulators should be fair and should reflect reality. It was suggested that water samples should not be taken during extreme storm events, and samples of every lake or stream should be taken at several places, and at different times of the year. By using this method, it is less likely that a farmer using effective manure management practices will be wrongly accused of discharging.

The interviewed farmers wanted any TMDL regulators to be knowledgeable about the agricultural industry. For these reasons, virtually all the farmers prefer that the Michigan Department of Agriculture (MDA) be the lead agency in enforcing TMDLs, since MDA is perceived as knowing agriculture, and was thought to be more likely to be respectful of farmers.

3. Others Should Share the Burden with Agriculture

The participants recognized that the dairy industry does contribute to water degradation in Michigan, but the vast majority felt it did so only to a small extent when compared to municipalities, factories, and home owners.

The participants ranked the worst contributors to surface water quality in the their respective counties, given in Table 2. The higher the index value, the worse the entity was ranked as a polluter. Only 2 out of the 36 responding farmers felt that small (100 milking cows or less) and medium (101 – 300 milking cows) dairies should be on this list (not shown).

Sewer overflow, waste water treatment facilities, industry, and urban residents were perceived to be much larger contributors to pollution than were agricultural sources. For this reason, participants feel these contributors should help clean up Michigan's waterways, and perhaps their share should be more than agriculture's.

Table 2: Index of Worst Contributors to Water Pollution

Source of Pollution	Index Value
1. Sewer overflow from urban areas, into surface water bodies during storms	72
2. Waste water treatment facilities	42
3. Industry or manufacturing facilities	40
4. Urban residents (e.g. lawn maintenance, golf courses)	38
5. Large dairies (301 or more milking cows)	16

Theme Two: Uncertainty – "Nobody knows what we're supposed to do…that's the biggest unknown thing"

Table 1 shows that two sub-themes emerged from the roundtable discussions with regard to uncertainty: a) regulatory uncertainty, and 2) uncertainty relating to lawsuits and government fines.

1. Regulatory Uncertainty

Participating farmers wanted to know *What will compliance with total maximum daily loads mean for my farm?* As of now, the answer is not known because the TMDL process is just beginning in Michigan. The participants mentioned aspects of the regulatory process that they believe must be included for it to be credible. These criteria are shown in Table 3, and include such things as clear guidelines, as well as safeguards against future regulatory changes.

The Generally Accepted Agricultural and Management Practices (GAAMPs) specified under the Michigan Right-to-Farm Act could reduce some uncertainty for farmers since they specify approved manure management practices. Nevertheless, few participating farmers mentioned the GAAMPs as an existing set of voluntary guidelines that can help them fix any existing problems, and/or reduce regulatory uncertainty by reducing the possibility of pollution runoff.

Table 3: Perceived Necessary Criteria to Reduce Regulatory Uncertainty

1. Regulators must clearly tell farmers what is expected of them

2. Clear guidelines should be given to farmers on what they can do to comply with the total maximum daily load process
3. These guidelines should be comprised of common sense practices, they should be affordable, and they should *not* be mandatory
4. Farmers want to know the penalties for a violation of the TMDL process
5. Farmers want assurance that if they are in compliance with a TMDL, they will be safeguarded against future regulatory changes and local zoning requirements
6. If they have to make any necessary investments both in terms of time and money, farmers want assurance that the water quality regulations will result in improved water quality outcomes
7. Farmers must not be punished for past environmental investments that they have made in good faith
8. Ideally, the regulations would allow farmers to self-monitor their performance so that they can clearly see the results of their management practices and make any necessary changes in a timely manner

2. Lawsuit/Fine Uncertainty

In light of the recent lawsuit notices given by the Sierra Club against five Michigan dairies – all of whom had discharges as recorded by Michigan public agencies – it is not surprising that farmers are anxious to avoid third-party lawsuits. Most interviewed farmers were more worried about lawsuits than government fines because they believed a lawsuit could drag on and potentially put them out of business, whereas government fines typically will not. Additionally, most participants felt that the state government is more willing to work with farmers, unlike third-parties such as neighbors and citizens' groups. Although concerned about lawsuits, few participating farmers had investigated purchasing insurance for environmental liability or clean up costs.

Paradoxically, the interviewed farmers expressed a strong desire for certainty, but wanted flexibility in the regulations. On the one hand, they wanted clear guidelines for what they must do to be in compliance and be protected against lawsuits, but on the other hand, they did not want these guidelines to be mandatory (Table 3, point 3). Some participants felt that discharge permits may help, mainly with protection from lawsuits and fines, providing more certainty. In a written survey, which the participants completed at the end of the roundtable discussion, farmers were asked: "Do you think the state should issue discharge permits to dairy farms in Michigan?". Of the 30 farmers who answered, nine said yes, nine said no, and twelve were unsure. At least two farmers felt permits should be issued, but did not want them to be called "permits".

Research and Policy Implications

The total maximum daily load process potentially could meet many farmers' concerns as expressed in these roundtable discussions. Ideally, the TMDL process will focus on water quality in watersheds as well as on the multiple pollution sources (e.g. municipal, industrial, homeowners, farms). The flexibility is given by EPA to the state to design a "clean-up" strategy – one that includes credit for voluntary approaches – which could therefore be tailored to the needs of the identified source, and to the physical, cultural, and economic situation of the states' sub-regions.

Clearly if the TMDL process is to achieve its objective, there is considerable research that needs to be undertaken to investigate existing water quality and contributions from various pollution sources. For example, are large dairies the main contributors from agriculture, as some of the roundtable participants believed? Or, do medium and small dairies have significant contributions in some watersheds? Once municipalities finish separating their street and storm water runoff pipes from sewage collection pipes, will pollution from municipalities significantly decline? If so, what will that decline mean for dairy farms and any pollution that they may generate? Is enough information available to target enforcement on the major sources of pollution, including farms, and tailor solutions to their needs?

Presumably, these research gaps will slowly be filled. Nevertheless, the farmers' desire for fairness and certainty clearly are important criteria by which to judge TMDL state policy design, implementation, and enforcement.

Textbox 1: A Final Thought on What Dairy Farmers Can Do Now – Michigan Agricultural Environmental Assurance Program (MAEAP)

Despite the current ambiguity in the resolution of environmental management regulations, there are options available that help you begin to reduce your environmental risks. The newly announced voluntary Michigan Agricultural Environmental Assurance Program (MAEAP) for livestock farms can help you be proactive in reducing your potential environmental liability by helping you to fine tune your manure management practices in a self-paced, voluntary manner, with technical and financial assistance. For further information on MAEAP, call any of the following people:

1. Ray Wagester, MAEAP Program Director: 517-353-1758, or

2. Scott Piggot, Michigan Farm Bureau's Natural Resources and Co-Chair of MEAEP: 800-292-2680 ext. 2021, or

3. Vicki Pontz-Teachout, Director of Michigan Dept. of Agriculture's Environmental Stewardship Division: 517-373-1883.

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Footnotes

[1] Some authors have argued that the nomenclature surrounding environmental policies is not truly reflective of environmental regulations. For instance, Russell and Powell contend that command-and-control is a pejorative term that does not adequately describe the range of environmental policies, since not all such regulations specify both what is to be achieved (i.e. command) and how it is to be achieved (i.e. controlled) (Russell and Powell

1996). Driesen argues that the command and control/economic incentive dichotomy must be replaced with a more nuanced analytical approach to both types of programs in order to create a more dynamic and effective environmental law (Driesen 1998).

[2] Pollutants may follow complicated transport pathways from the source to the water body, and may change qualitatively along the way.

[3] Pollutants may follow complicated transport pathways from the source to the water body, and may change qualitatively along the way.

[4] The authors recognize that there are many women farmers and women regulators, but the masculine pronoun will be used for simplicity.

[5] Administration and political difficulties may arise, however, if the water quality fails to improve, and the regulator "readjusts" the technology through adaptive management.

[6] TMDLs have existed since 1972 in the Clean Water Act, but they have only recently been implemented. This is explained in further detail in Section 3.

[7]The Year 2000 303(d) report for Michigan provides an updated list of Michigan water bodies that are threatened or do not meet Michigan's Water Quality Standards and require a Total Maximum Daily Load (TMDL). It is available at http://www.deq.state.mi.us/swq/gleas/docs/tmdl/2000tmdl.html. A geographical summary of Michigan's TMDL program is available at: http://www.epa.gov/owow/tmdl/states/mi.html, and impaired waters is at: http://www.epa.gov/owow/tmdl/states/mimap.html.

[8] This section is adapted from Freeman 2000, and Battle and Lipeles 1998.

[9] The definition of a concentrated animal feeding operation, however, may be redefined in the future to be less than 1,000 animal units, therefore in the future more operations may be regulated by the Clean Water Act.

[10] USEPA has approved TMDLs for Lake Macataw, Ore Lake, Brighton Lake and Kent Lake. .

[11] A Michigan pilot program is underway in Lake Macatawa in Ottawa County.

[12] A state must design corrective actions for those waters not meeting water quality standards. There is no legal requirement that the flexible performance standard approach be followed. A state could require the adoption of certain pollution prevention or pollution control techniques.

[13] The Porter Hypothesis maintains that strict compliance is necessary to encourage technological innovations.

[14] This is not to say that the farmer will not care about any of the social costs of the water degradation; he may well consider the effects of any water degradation that he causes even though he does not directly pay for the degradation; he may consider these effects due to his own ethical beliefs, or due to legal liability concerns.

[15] Under the Michigan Right to Farm Act (1981), the Michigan Commission of Agriculture develops and adopts Generally Accepted Agricultural and Management Practices (GAAMPs) for farms in Michigan. These are voluntary practices meant to protect farmers from nuisance suits. The Manure Management and Utilization GAAMPs can be viewed at: http://www.mda.state.mi.us/right2farm/Manure/manure.htm.

[16] In agriculture, many innovations do not come directly from farmer investments. Rather, they come from university research and development which is responding to farmers' relative prices. The argument that innovation offsets may not result from a performance standard remains apt in the presence of considerable uncertainty. More likely, would be University research and development efforts that would reduce the uncertainty. That is, with an environmental performance standard, universities are more likely to invest in research that identifies the links between on farm practices and resulting water quality actions, thereby reducing

farmer and regulator uncertainty as to performance standard's outcomes.

[17]Adapted from Batie 1997.

[18] If the farmer only cared about net profits with absolutely no concern about water quality. Point A. would be located where the PPF intersects the Y axis. This point is the highest net profit possible but with no water quality improvements. Instead, it is drawn here to show that a farmer will take some care of the environment despite some reductions in net profits.

[19] The technology that is adopted by Farm A could be biased towards profits or environmental quality, in which case the outer boundary would be closer to the respective axis. For illustrative purposes though, the production possibility frontier is assumed to take the shape shown.

[20] There could also be an improvement in both net profits and environmental quality if the farm had many inefficiencies (i.e., the farm was not operating on the production possibilities frontier) that were corrected with better management.

[21] Adapted from Mansfield 1988.

[22] This analysis does not assume any probabilities associated with the alternative actions taken by the players in these games. For example, it assumes that compliance does not reduce the probability that a farmer is sued by a third-party or penalized by the regulator. An extended analysis that accounts for expected outcomes using probabilities is in Lorie Srivastava's forthcoming dissertation.

[23] These stylized discussions assume there are no other legislation or incentives to reduce pollution, other than that which emanates from the TMDL process.

[24] It should be understood that this is just a summary of the comments made. Not all participants necessarily agreed with all of these comments.

[25] The Generally Accepted Agricultural and Management Practices (GAAMPs) specified under the Michigan Right-to-Farm Act could reduce some uncertainty for farmers since they specify voluntary approved manure management practices. Yet interestingly, few participating farmers mentioned the GAAMPs as an existing set of voluntary guidelines that can help them fix any known problems, and/or reduce regulatory uncertainty by reducing the possibility of pollution runoff.

[26] In case it is asked, the 4 dairies are: are Bruinsma Farms, River Ridge Farms, Walnutdale Farms, and Bradford Dairy Farms – Kent county, Ottawa County, others??

[27] Lorie: Sierra Club is just making the point to explain the need for federal enforcement

[28] this is for confined operations of over 700 mature dairy cows