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A COLLECTIVE RESPONSIBILITY APPROACH TO
NON-POINT SOURCE POLLUTION

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MAF Policy, Wellington

ABSTRACT

This paper examines management of environmental effects which are difficult or costly to attribute to individual sources. The primary focus is on diffuse farm runoff that impacts water quality; fishing impacts on marine mammals are also discussed. The paper suggests that, where effects cannot feasibly be attributed to individuals, responsibility should be assigned to a group which can collectively achieve the desired outcomes. This improves the scope for finding lower-cost solutions, and also provides a mechanism for joint investment by parties with common interests.

¹ The views expressed in this paper are those of the authors and are not necessarily the official views of the Ministry of Agriculture and Fisheries.

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INTRODUCTION: THE PROBLEM OF NON-POINT SOURCE POLLUTION

It has become a basic tenet of resource economics that environmental costs of production should be internalised to producers of goods and services in order to achieve an optimal use of resources. Internalisation of costs ensures that producers take into account the full costs of their resource use decisions. In most cases, it will not be efficient to eliminate pollution or other types of environmental damage entirely, because the cost of doing so (including foregone production) will exceed the benefits. However, accurate internalisation of costs will reduce adverse effects to the point where the costs of pollution are equal to the benefits derived from the resource use.

Coase (1960) argued that an optimal allocation of resources will be achieved if clear property rights are assigned and enforced. In other words, assigning and enforcing property rights is equivalent to internalising costs. The individual or community with rights to a resource will have legal redress to demand compensation for any damage, and costs are therefore internalised.

The Coase theorem rests on assumptions about transaction costs and access to information, and about the exclusivity and rivalry of the good in question (Randall 1987). In many cases these assumptions will not be met. In particular, when pollution originates from a large number of diffuse sources ("non-point source pollution"), such as sediment and nutrients from farm runoff, assigning property rights to water quality will not ensure an optimal result. This occurs because the information is not available, except at great cost, to determine which individuals are responsible and take action against them.

Thus, unless the information, enforcement and collective action problems are somehow solved, environmental costs of non-point source pollution cannot be effectively internalised to producers. As a result, pollution continues. This problem is broader than non-point source pollution, and extends to any environmental effects which cannot be directly attributed to a single person or legal entity.

AGRICULTURAL IMPACTS ON WATER QUALITY

The impact of agricultural activities on water quality are well-documented. Staff of regional councils in New Zealand rank agriculture as the most significant source of adverse effects on water quality, citing sedimentation and nutrient inputs as most serious, followed by faecal contamination and alteration of physical characteristics of water bodies (Sinner 1992a). The parties affected by this pollution include downstream farmers using water for livestock; trout and salmon fishers; marine farmers and shellfish gatherers; Maori who hold strong cultural values concerning water; swimmers, canoeists and others engaged in contact recreation; those who value aesthetic or ecological properties of clean water; and those taking drinking water from affected supplies.

Smith et al (1993) provided detailed evidence of these effects throughout New Zealand, the main findings being:

- Faecal contamination exceeding guidelines is widespread, the primary effect of which is to make waters unsuitable for contact recreation;
- Sediment and nutrient inputs commonly cause turbidity problems and profuse growth of nuisance plants in a number of waterways;
- Based on limited data, small stream ecology is reported to be "in very poor condition" in intensive dairy areas;
- Waterways in sparsely developed areas of New Zealand are generally in good condition.

Most of these water quality problems stem from agricultural non-point source (NPS) pollution. Local authorities have found it difficult to address NPS pollution because of the difficulty of attributing contaminants to any particular individual's activities or management practices. Instead, local authorities have relied upon soil conservation subsidies and promotion of better management practices, with varying degrees of success. Smith et al (1993) have shown that significant pollution continues despite these efforts.

A COLLECTIVE RESPONSIBILITY APPROACH

As noted earlier, to achieve optimal use of natural resources, environmental costs should be internalised in the costs of producing goods and services. For environmental effects that cannot be attributed to individuals, authorities face the challenge of finding other ways to internalise environmental costs. Establishing collective responsibility is one way to approach this problem. Although individuals cannot always be identified, authorities can usually identify a group of individuals whose activities cause effects which can be monitored and attributed to the group. In addition, authorities must be able to set an environmental standard for the group to meet.

New Zealand's Biosecurity Act 1993 provides a mechanism for establishing a pest management strategy that is binding on parties affected by, or responsible for, the pest. Further, there is a presumption that the strategy will be developed by those affected, rather than by the government. This recognises that pest management

requires collective action, and that pest control is non-excludable, ie is a public good.

Foran et al (1991) suggested that, where nonpoint source pollution is a problem, consortia be formed consisting of landusers and others discharging contaminants to water. These consortia would be responsible for achieving the water quality standards in the US Clean Water Act. If standards were not met by a stipulated date, a consortium would be required to show diligence in implementing further reductions. If diligence were not shown, the consortium would be in violation of its permit; the agency could fine the consortium and/or individual members, require "best management practices" (BMPs) for specific land use activities and assess fees for those activities.

The Murray-Darling Basin Commission uses a limited version of collective responsibility to manage salinity problems in Australia's largest river system. Each participating state has agreed to contribute to mitigation projects to reduce salinity in the Murray River, and to offset any increase in salinity discharge within its borders. The states are bound to prevent any irrigation, drainage or land management works that would cause its net contribution to exceed the agreed balance (MDBC 1992).

For instance, once initial credits are used up in New South Wales, new dischargers must offset their salt contributions (debits) by obtaining salinity credits privately or from the state government at full cost (DWR 1992). Landowners in any project area must therefore take collective responsibility for their salt discharge. A recognised shortcoming of the strategy in its current form is that nonpoint sources of salt discharge from outside scheme boundaries are not properly incorporated. This may make it difficult to enforce liability on the schemes themselves (Taylor, pers comm).

In another Australian example, some collective responsibility for nonpoint source pollution might be established in New South Wales. Kaine and Reeve (1993) propose a system of tradeable discharge permits to manage phosphorus loading of the Carcoar Reservoir. They suggest that, in addition to requiring phosphorus discharge permits for point sources, "common property" permits should be assigned to nonpoint source dischargers, eg groups of rural landholders, who would constitute corporate bodies.

The members of a group would be jointly responsible for complying with the permit and paying any fines. Kaine and Reeve recommend that all landowners in a defined sub-catchment be automatic members of the group, which would need to develop a management strategy including cost-sharing provisions. Kaine and Reeve also propose a system of "banking" unused discharge rights from one year to the next to allow for annual variations in weather which will cause actual phosphorus loadings to vary from the average.

Catchment management consortia to improve water quality

An approach similar to that suggested by Foran et al and by Kaine and Reeve could be used to address NPS water pollution in New Zealand, through collective responsibility. Such an approach could work in the following way:

- A regional council would identify a water body where diffuse (NPS) runoff is a major contributor to adverse effects on water quality, causing significant damage to other parties.

Regional councils have statutory responsibility for water quality in New Zealand. While agricultural runoff is a major contributor to water pollution in many areas, councils also need to identify other point and nonpoint sources, such as earthworks for urban development or roading.

- The council would consult with all interested parties and set water quality standards for the water body, based on analysis of costs and benefits.

Based on consultation, the council would set water quality standards recognising both the costs and benefits of resource use, to maximise net benefit from the water body (see Sinner 1991, 1992b). In the example in Figure 1 below, standards would be set at Q¹.

- The regional council would identify segments of the water body and the parties, including non-agricultural sources, contributing contaminants to each segment. The parties would have the option of joining a catchment management consortium (CMC) for their segment, or adopting BMPs.

Point source dischargers would be included as well as NPS dischargers. Parties who are identified as possible contributors of contaminants would also be required to join the CMC or adopt BMPs². All landowners in a segment (ie sub-catchment) would be required to participate unless they could provide good evidence that they contribute no contaminants to the water body.

Members would be allowed to "opt out" of the CMC by adopting a "best possible" management plan approved by the regional council. A party seeking such an exemption would bear the onus of proof for demonstrating that current or proposed management practices reduce discharges as far as practicable. BMPs for farmers could include a range of practices, depending on the council's determination of the nature and extent of runoff from the property. Because new information may come to light on the nature of the problem or possible solutions, the exemption should be for a fixed period of time. Members who "opt out" should therefore be allowed to participate in the local CMC as an observer, ie with no voting powers.

Parties who may contribute contaminants in the future (eg forest owners or road contractors) should be allowed to join the CMC at the beginning to negotiate an allowance for their future needs. Forest owners, for instance, could argue that the "pulse" of sediment that will accompany log harvest should be acknowledged by the CMC as a legitimate existing use that must be accommodated in devising a strategy.

- The council would assign permits to CMCs requiring compliance with water quality standards by a specified date. The permit would specify locations where standards must be met, eg at the bottom of the segment (or sub-catchment) and at points within the segment

² "Best management practice" is referred to in the Resource Management Act as best practicable option (BPO).

significant for in-stream and abstractive users. The council also specifies the duration of the permit.

If reductions in contaminant loadings are required to meet water quality standards, the burden of reductions should be shared fairly amongst all CMCs. Councils will need to recognise those who have already made reductions.

CMCs need to have confidence that any investments to improve water quality will not be made redundant by changes to their permits. Thus, permits should be valid for at least eight to ten years. To avoid a gradual increase in uncertainty as the expiry nears, the permit should be automatically renewed each year for the full period unless the council decides to tighten water quality standards. In this case, the new standards would take effect at the expiry of existing permits (ie after eight to ten years), unless the CMC agrees to implement the standards earlier.

- The CMC would monitor compliance with water quality standards, audited by the council.

Monitoring is useful not just to assess compliance with standards, but also may help the CMC to understand sources of contaminants. Although monitoring could be done by council staff, it would probably be at a higher cost, and more importantly there would be less acceptance and understanding of water quality issues by members of the CMC.

Unless substantial data is already available, or a problem is urgent, the council should allow for some period of time (eg one year) for the CMC to establish its monitoring programme and examine initial results before proceeding to the next step.

- If, from the outset, water quality were below the standards specified in its permit, the CMC would be required to develop a reduction strategy that meets approval by the regional council, designed to meet the standards by the date specified in the permit.

The strategy would state what measures will be taken, by whom, by what date, and how costs will be shared. It would also state the anticipated water quality results. Although these will not be known with certainty, there needs to be some estimate of expected results.

In the case of agricultural members of the CMC, practices to reduce runoff could include fencing and enhancing vegetation in riparian areas; grazing regimes which minimise runoff; fertiliser management to minimise runoff; and changes in land use for highly sensitive areas. Where practices involve direct costs, loss of income, or significant time demands, the CMC members would decide how the burden should be shared. A combination of practices on specific sites would be agreed upon by the CMC to get the necessary reduction in contaminant runoff at the least total cost.

- The CMC would be given powers to enforce management and funding decisions on all members of the CMC.

Unless new legislation is specifically provided, CMC decisions could be enforced through a legal contract between all members. Alternatively,

decisions could be incorporated as rules in regional plans. This would be cumbersome and inflexible, giving CMCs a strong incentive to enforce decisions by contract.

Voting and accountability rules would be needed, perhaps similar to those in the Companies Act. Rather than assigning one vote per person, it would probably be more fair to assign voting rights on the basis of rateable value of property. A "supermajority" (eg two-thirds or three-fourths) would be required for all mandatory management practices or funding decisions to be imposed on members. In addition, minority protection rules would be required, with appeal to the regional council, to prevent a majority from imposing unfair requirements on any single member or small group of members.

- If the CMC fails to develop a strategy which meets council approval, or fails to implement such a strategy, the council could impose fines against the CMC for discharges above the allowed amounts, or require BMPs by regulation.

If there are to be any fines, these should be set out in the permit from the outset. Fines can create a strong incentive to achieve reductions, and funds raised can be used to mitigate damage or compensate water users affected by the pollution. A schedule of increasing fines would be appropriate to reflect the increasing marginal cost of pollution.

Foran et al urge regulatory authorities to exercise flexibility in implementing this new approach, and suggest imposing fines only where diligence is not shown. Such an approach could be supported by modelling of the catchment to estimate contaminant flows under various practices, especially if CMCs agreed to accept the model's estimates.

However, relying on "diligence" rather than compliance with standards creates an incentive for the CMC to lobby for approval of a low-cost but inadequate strategy. Government must then either pay for research to disqualify the strategy, or to approve it and allow damage to go unpenalised.

- The CMC would also be responsible for maintaining standards, eg if standards are met initially and no reduction strategy is required. Violations of standards would result in fines or mandatory land use practices imposed on the CMC by the council.

The CMC is not required to develop a management strategy as long as standards are met. However, it may well be in its interest to do so to reduce the likelihood of fines. If the council does not intend to impose fines, it should require development of a management strategy that meets the council's approval.

- Adjacent CMCs would be allowed to alter the water quality standards at their common boundary by mutual agreement, subject to the approval of the council.

Trading between segments would involve raising or lowering the water quality standards at the point where the two segments meet, eg the upper CMC agreeing to meet a higher standard in return for compensation from

the lower CMC. The lower CMC would still be required to meet the standards at the bottom of its segment. In the case of controls on inputs to a lake, trading between all CMCs would be allowed. In either case, the council would have to be satisfied, possibly through a full consent process, that the overall objectives for the catchment would not be jeopardised.

Allowing such adjustments (trades) increases the scope for finding lower cost strategies to achieve necessary reductions. It may be less costly to reduce discharges in one CMC than in another, eg because of the cost of fencing or planting riparian margins. Trading within segments takes place informally between members of a single CMC, and would not alter the requirement for the CMC to meet the water quality standards at points specified in its permit.

Location-specific standards designed to protect abstractive or instream users would be adjustable only with the agreement of affected parties, and subject to approval by the council.

- CMCs would be allowed to merge with neighbouring CMCs, or to split into separate groups, according to efficiency of size (monitoring, group dynamics).

It may be difficult for a council to assess accurately the optimal boundaries of CMCs in a given catchment. Furthermore, situations can change with time. Although councils should set the boundaries initially, with experience the CMCs themselves will be in the best position to determine optimal size and boundaries. Any merger or split would require a supermajority approval by each affected CMC.

Legal issues

It may be useful to amend the Resource Management Act (RMA) to give councils the authority, where necessary to achieve water quality standards in designated water bodies, to deem diffuse runoff to be a discharge requiring a resource consent. This would allow a discharge consent to be issued to a CMC, stating water quality standards to be met. It might also allow a consent to be withheld from an individual who refused to join a CMC or adopt BMPs. Although this may be possible at present, the Act is not clear.

Alternatively, the "permit" described above could simply be a non-statutory contractual agreement between a CMC and a council, whereby the council agrees to forego any landuse restrictions as long as the CMC meets the terms of the contract. However, it would be difficult to impose any penalties for breaches of standards unless these were established in a statutory permit.

If landusers were found by the courts to have "existing use" rights for discharging nonpoint source pollution, this could prevent a council from requiring landusers to bear all the costs associated with meeting standards. In such a case, a council could provide public funding for some of the works or practices required, though the landusers should still be held responsible for compliance.

"NON-POINT SOURCE POLLUTION" IN FISHERIES

"Non-point source pollution" also occurs in some New Zealand fisheries. For instance, Hooker sealions, fur seals, and albatross are accidentally killed in various fisheries, and trawling and dredging might cause long term damage to seabed ecology. These adverse effects could be managed through collective responsibility.

Pearse (1991) and the Fisheries Task Force (1992) proposed that government devolve certain management responsibilities to associations of quotaholders, which would be required to meet environmental standards set by government. The principal standards would be sustainable catch limits, but standards could also be set to deal with adverse effects of fishing on marine mammals, seabirds, or the seabed.

The approach would be similar to that proposed above for water quality. Ownership of quota, by species and management area, provides an appropriate basis for assigning collective responsibility. Specific legislation could provide for enforcement of management and funding decisions of quotaholder associations, as well as specifying voting rules and minority protection provisions. Alternatively, decisions could be enforced through voluntary contracts or by government regulation.

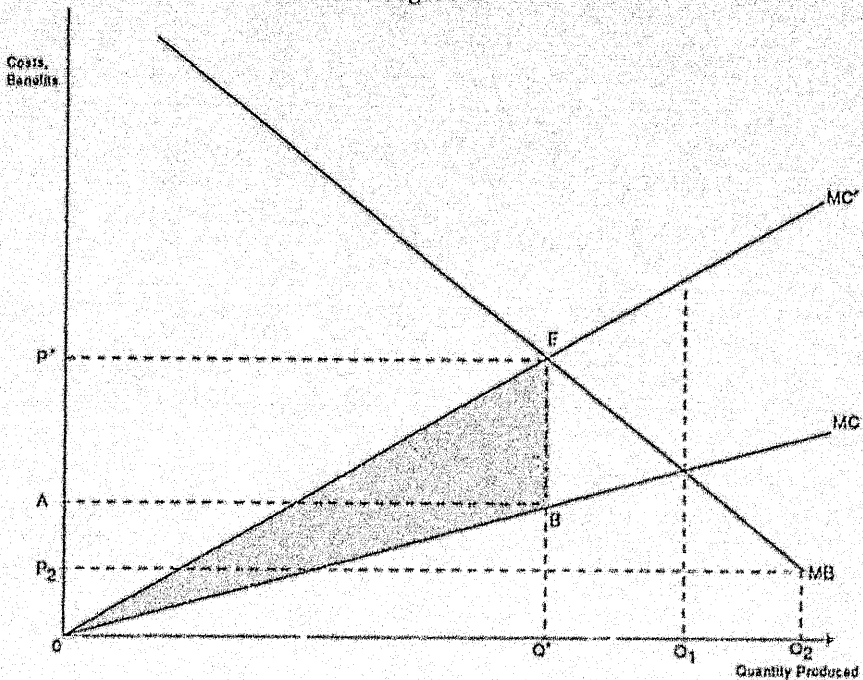
As with the water quality example, compliance could be based either on implementation of an approved management strategy ("diligence") or on actual performance, with fines for breaches of the standards. Similar arguments apply regarding the perverse incentives to lobby for approval of inadequate strategies if compliance is based on diligence.

MANAGING BY PRICE RATHER THAN QUANTITY

Figure 1 shows a simplified case of environmental costs which are not internalised to producers. MC is private marginal cost of production, and MC' represents marginal social cost, ie including environmental costs of production. MB represents the declining marginal benefit of production, assuming falling prices for additional units of output³. Without any policy to internalise environmental costs, output is Q_1 , whereas the optimal level of production is Q' , where marginal benefits equal marginal social costs.

³ If prices are determined exogenously, eg in the world market, MB would be horizontal at P' ; the results of the analysis would be the same.

Figure 1



In the above discussion, it is proposed that the regulatory agency sets quantitative standards to be met by catchment management consortia or fisheries quota-holder associations. Alternatively, the agency could use a price approach, ie environmental user charges, to achieve an optimal resource allocation⁴. For instance, the agency would estimate $P' - A$ (the marginal social cost of water pollution) and charge this fee for every unit of discharge. Polluters would then aim to limit their discharge to Q' , because beyond that point the cost of paying the charge exceeds the marginal benefits.

Note that if, for instance, all dischargers pay $P' - A$ for each increment of pollution, the agency collects revenue represented by the rectangle $AP'EB$. The cumulative cost of environmental damage is only the triangle OEB , because the damage increases gradually. To assess a schedule of increasing fines, however, could be unfair to individuals who cause the cumulative effect to exceed the standard, but whose actions were otherwise similar to earlier or upstream actions by others. Yet to assess an "average" charge, eg of P_2 , would not create the right incentive, because output would then tend towards Q_2 , with its higher level of pollution.

⁴ Repetto (1983) shows that the choice between price-based instruments, such as environmental user charges, and quantity-based instruments such as standards and transferable permits should be guided by the slope of the marginal cost curve. If marginal cost is inelastic, price related measures are preferable because an error in setting the charge will only have a small impact on the amount of pollution control chosen. If marginal cost is elastic, quantity-based controls are less likely to cause large efficiency losses from errors in calculation by the regulatory agency.

Collective responsibility provides a solution to this dilemma. Since the entire CMC would be held responsible for water quality, the agency can assess a schedule of increasing fines without "misattribution" problems. Using increasing fines, only the actual environmental cost, ie the area between MC and MC', would be collected in revenue. The CMC might still decide to charge its members P'-A for each unit of discharge, in order to ensure the right incentive for members to limit pollution. However, any excess revenue would be retained by the CMC, which could use it for whatever purposes it deemed appropriate.

The proposals for CMCs and quotaholder associations in the previous sections are in fact a combination of price and quantity approaches, in that a quantitative standard is set and fines are imposed for breaches of the standard. In this case, the fine should be greater than P'-A to accurately reflect the environmental damage caused by discharges or sealion mortality exceeding Q'. If charges are waived as long as the standard is met, the problem of the agency collecting excess revenue is avoided. However, such an approach also fails to provide compensation for environmental damage up to the standard.

INCENTIVES FOR RESEARCH

Managing through collective responsibility also creates incentives for private funding of research. Research to determine the extent of environmental damage, or to develop better management techniques to reduce damage, should be the responsibility of resource users, on the grounds that such research would be unnecessary if the resource use were not taking place.

This is a matter of efficiency as well as one of "polluter pays." If government funds all such research, industry will always ask for more, in an attempt to find ways to avoid or remedy adverse effects and thus maintain or increase their private benefit from resource use. If, on the other hand, a consortium of resource users is responsible, its members will consider whether the likely benefits from research warrant the costs. They may decide it is better to take a more conservative approach to resource use rather than spend large sums of money on research looking for ways to push the resource a bit further.

Research for determining total allowable catch (TAC) in fisheries provides an example. As long as government is paying for research on stock assessment, the fishing industry will lobby for more research if there is a chance that better understanding would justify an increased TAC. With user-pays for research, however, the industry would consider whether the likely net benefit of research exceeds the cost. The result is a more efficient allocation of research funds. This incentive can be established either through cost-recovery of government research expenditure, or by assigning collective responsibility to quotaholders (or CMCs) and leaving them to purchase research.

COLLECTIVE RESPONSIBILITY FOR INVESTMENT PURPOSES

The approach described above is designed to address "negative" aspects of resource use, by requiring resource users to take responsibility for damage caused. But collective responsibility is also a mechanism that facilitates investment for positive purposes, ie to enhance the income or other objectives of a consortium.

Thus, in fisheries, a quotaholder association, once formed, can agree to set aside a certain area as a breeding ground, or levy its members to fund research on more effective fishing methods. In catchments, consortium members could elect to invest in irrigation or flood protection projects.

In several instances, the New Zealand government has provided mechanisms for mandatory levies to fund "public goods" such as irrigation and drainage projects, commodity research and promotion, and pest management. In all of these cases, government has recognised that "public goods" should be paid for by those who benefit and/or those who generate the need, but that a mechanism of collective responsibility is needed to prevent free-riding.

The case for collective responsibility mechanisms to address environmental damage is at least as strong as the case for mechanisms for income-generating investments, although it may be less politically attractive.

THE CHOICE OF VOLUNTARY VS MANDATORY APPROACHES

When should landusers be required to meet environmental standards under threat of fines or enforcement action? When should they be offered incentives and encouragement, possibly subsidies? Foran et al suggested foregoing all penalties as long as a consortium demonstrates due diligence in attempting to meet standards. The question of the proper amount of coercion remains one of significant debate among government officials in New Zealand, at both central and regional level.

Bradsen (1990, 1991) argues that a voluntary approach to sustainable land management does not work. For example, he says, decades of soil conservation subsidies in the United States have failed to make a significant impact on soil erosion. At the same time, Bradsen considers that simply imposing rules and trying to enforce them through the courts will not achieve the desired results.

Bradsen advocates something in between: that landusers be given the tools to manage the adverse effects of their land use, and that they be required to draw up farm plans to do so. Fines would be an absolute last resort. A shortcoming of Bradsen's approach is that he does not explain how targets or standards should be set, or how compliance should be measured, making it difficult to determine whether a group has met its responsibilities other than in an administrative sense. (See Ackroyd (1992) for a further critique of Bradsen's ideas.)

Nonetheless, the approach to non-point source pollution must ensure that the responsible parties, acting individually or collectively, take appropriate action. Implementing collective responsibility for NPS pollution problems, with clear standards and clear consequences for failure to achieve them, accomplishes this. While catchment management consortia or quotaholder associations should be allowed sufficient time to initiate monitoring and to develop and implement a strategy, it is also important that the wider community have some assurance that progress will be made.

If the landusers or fishers themselves have been given an opportunity and failed to adequately address an issue, there will be greater moral authority, and therefore public support, for fines or regulatory controls on management practices. Thus, a regional council or fisheries management agency might start with an approach

based on diligence and eventually move towards fines if those responsible fail to resolve the problem. Some sociological research on compliance with regulatory controls vs voluntary measures in New Zealand would be useful.

CONCLUSIONS

New Zealand government agencies have had difficulty managing nonpoint source pollution in agriculture. Fishing impacts on marine mammals and other non-fish species are another case in point, being difficult or costly to attribute to individual fishers. Unless the environmental cost of such activities can be internalised into the cost of production, it will remain difficult for government agencies to develop policies which maximise net benefit from resources.

Establishing consortia of resource users with management responsibility is one way to internalise the costs of nonpoint source pollution. Catchment management consortia and fisheries quotaholders associations can be set up and required to develop strategies and to meet environmental standards. The consortia would need to be given legal power to enforce funding and management decisions upon individual members, subject to voting procedures and other rules protecting minority groups from unfair decisions. The consortia would bear the cost of compliance including the cost of research to find better management practices. Failure to comply with standards could result in fines and/or mandatory changes in management practices.

It has been said that "the best is the enemy of the good." Political decision-makers are faced with the task of enacting policies which improve public welfare. Fines for breaches of standards, in addition to requiring resource users to develop management strategies to address adverse effects, may be more than is politically possible when starting from a position in which neither is in place. A strong case can be made that fines or some other price-based measure are necessary to achieve the "best" solution. However, resource allocation would be considerably improved if resource users were collectively required to develop strategies for meeting quantitative standards, even if the prospect of fines were postponed for a few years.

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