AGRICULTURAL POLLUTION CONTROL AND ENFORCEMENT IN NEW YORK STATE

by

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I. INTRODUCTION

Agricultural pollution has recently been a subject of legislative interest on both the national and state levels. In 1972, over 80 bills relating to agricultural pollution were introduced in the New York Assembly and Senate. The objective of this report has been to summarize briefly the research that has been done to date on the extent, magnitude, control and enforcement of agricultural pollution which may be of interest to New York legislators.

A first priority was to determine the extent, location and types of agricultural pollution existing in the State. Section II deals with this issue and brings out the fact that sources of pollution, and their relative importance, vary from region to region, depending upon the area's general economic activity. The two most important problems appear to be wastes from food processing plants being dumped into state waters, and manure from dairy feedlots being washed into streams.

In addition to identifying the problems as they exist, a further objective was to determine what can be done to alleviate agricultural pollution. The various available means of abating pollution as well as new methods that might be developed through additional research efforts are described in Section III.

Enforcement of agricultural pollution was another issue felt to be of interest to policy-makers. The advantages and limitations of the commonly suggested methods of enforcement are examined in Section IV.

Efforts were also made to evaluate the costs that farmers or processing firms might be expected to incur if legislation were adopted requiring firms to meet certain minimum standards. The possible cost impacts are analyzed in Section V; however, the cost figures are very tentative due to a lack of adequate data concerning costs of pollution control.

The findings of the study are summarized in Section VI. Conclusions are drawn regarding further research needs and implications for policy-makers.

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II. DEFINING THE MAGNITUDE OF AGRICULTURAL POLLUTION IN NEW YORK

While agriculture creates a larger volume of waste than any other industry, agriculture's contribution to environmental pollution is relatively minor compared to other industries. This is particularly true of New York State, which is largely urban and industrial in nature.

Although the total amount of pollution has not yet been fully determined, agriculture contributes to pollution in certain locales and should not be overlooked. For example, food processing pollution is a problem in the western lakes region of the state, where most of the food processing plants are located. Dairy feedlots are fairly evenly distributed throughout upstate New York, excluding the Adirondacks. Animal waste water pollution is a particular problem where dairy feedlots are located near streams and runoff occurs. Crop production is also widely distributed throughout the state, excluding the Adirondacks Region. As a result, sedimentation and plant nutrient runoff from cultivated, fertilized lands might cause water pollution wherever excessive amounts of sediment and nutrients are washed into streams.

Determining whether or not state-wide regulations for controlling agricultural pollution will be necessary will require a careful consideration of agriculture's pollution potential in any given area. Such information would help indicate what type of control, if any, is needed, and what type of enforcement mechanism might be most advantageous.

The relative importance of agricultural pollution varies from region to region, depending upon the area's general economic activity. A water quality study of the Potomac River Estuary indicated that agriculture accounted for only 8 percent of the phosphorous and 31 percent of the nitrogen in the water, while urban, industrial and forest sources made up the difference.[1] A study of Canadaroga Lake in upstate New York found that land runoff accounted for 52 percent of the phosphorous and 91 percent of the nitrogen contaminating the lake.[2] Clearly, agricultural pollution is a serious problem in some areas, while it is relatively insignificant in others.

The magnitude of agricultural pollution in New York State cannot be fully understood in terms of aggregate figures. Rather, it is necessary to examine the particular problem of individual regions in order to determine whether state regulation of agricultural activities leading to pollution may be necessary.

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[1] C. R. Frink, "Plant Nutrients and Water Quality," Agricultural Science Review, Vol. 9, No. 2, U.S. Department of Agriculture, Washington, D.C., 1971, p. 17.

[2] Leo J. Hetling and Robert M. Sykes, "Sources of Nutrients in Canadaroga Lake," Technical Paper No. 3, Research and Development Unit, New York State Department of Environmental Conservation, March 1971, p. 32.

The most important agricultural pollution problems in New York State are:

(1) food processing wastes

(2) animal wastes

(3) sedimentation

(4) plant nutrients

(5) pesticides

(6) agricultural air pollution

A common cause of agricultural water pollution is the decomposition of organic matter. The pollution potential of organic matter is expressed in terms of biochemical oxygen demand (BOD). BOD refers to the depletion of oxygen in water supplies caused by the oxidation of organic matter. Among other things, oxygen depletion destroys fish and other aquatic life. The carbon dioxide produced by the decomposition of organic wastes along with plant nutrients may increase the growth of certain algal plants, which, as they die and decompose, further deplete the oxygen supply in the water. This process is called eutrophication.

BOD is expressed as the amount of oxygen the water will absorb in a five-day period at 68°F. Water that absorbs no more than one part per million (ppm) is very pure, three ppm fairly clean, and five ppm of doubtful purity. Waste from a pigpen has a BOD as high as 50,000 ppm. Barn and feedlots vary from 100 to 10,000 ppm. Untreated municipal sewage, on the other hand, has a BOD of about 100 to 400 ppm.

Food Processing Pollution

Food processing is an important enterprise in New York State. Over 34 different fruits and vegetables are processed annually in the state. In 1968, 240,000 tons of apples, 112,900 tons of grapes, 93,400 tons of beans, 92,000 tons of cabbage and 89,200 tons of beets were processed, which constituted, respectively, 20.4%, 3.8%, 14.8%, 39.9% and 33.1% of the U.S. total.[3] Approximately 3.2 billion gallons of waste paper per year is generated by fruit and vegetable processing in New York. The following table gives the amounts of solid and liquid waste produced annually for selected fruits and vegetables.[4]

[3] Y. D. Hang, D. L. Downing and D. F. Splittstoesser, "Pollution Problems in Processing New York's Fruits and Vegetables," Paper No. NAR71-371, Department of Food Science and Technology, New York State Agricultural Experiment Station, Cornell University, Geneva, New York, p. 1.

[4] Ibid., p. 8.

Fruit and Vegetable Processing Wastes

Product	Pounds of Solid Waste	Liquid Waste gal/case
Apples	28,800 - 132,000	29 - 46
Beans	11,208 - 18,680	30 - 51
Beets	22,300 - 35,680	31 - 80
Cabbage	23,000	3 - 20
Cherries	1,120 - 2,240	14 - 46
Grapes	11,290 - 22,580	-
Peas	896 - 8,848	16 - 86

In 1971, New York State ranked second in the nation in milk production. Receipts from the dairy industry totaled $631 million in that same year, which was approximately 57 percent of farm income. Dairy processing in NewYork was 920 million pounds of butter, cheese, milk, yogurt and sour cream, and 107 million gallons of ice cream and ice cream mix.[5]

Generally speaking, fruit, vegetable and milk processing wastes do not present special treatment problems. Waste material is largely organic and highly biodegradable. A few vegetables like beets and sauerkraut, however, create additional pollutants such as pigments, acids or salts.

Food processing wastes may be treated in several ways. First of all, a firm may have the option of depositng its raw wastes into a municipal sewage system, or it may have its own private waste disposal system. Various types of private systems utilized by fruit, vegetable and dairy plants surveyed in New York include the:

(1) unaerated lagoon

(2) aerated lagoon

(3) spray irrigation

(4) deep well diffusion

(5) package unit

(6) conventional system--private activated sludge or trickling filter

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[5] "New York Agricultural Statistics, 1971," AMA Release No. 129, New York Crop Reporting Service, Albany, New York, May 1972, p. 25 and p. 30.

Thirty percent of the firms interviewed in 1967 did not treat their wastes at all.[6]

Present research aimed at solving the problems of food processing waste management has several major objectives. The first is to reduce the quantity of waste water produced. Several studies have indicated that many processors use excessive amounts of water and that there is considerable opportunity for designing treatment processes which require less water than present systems do. For example, researchers are investigating means by which a firm may treat and reuse its own waste water.

A second major objective is to reduce the concentration of solid material in food processing wastes. One way to reduce solid wastes is to convert former waste-by-products into usable items. Considerable research has been devoted to discovering means of converting whey from the dairy processing industry into a nutritious product. Another method is to treat the by-products chemically so they are no longer toxic.

Unfortunately, little to no cost data are available at this time which might be used to estimate the relative cost of treating food processing wastes more extensively. Of the 55 plants surveyed by Zall[7] in 1967, only one knew its waste disposal volume, and only 16 had any conception of how much their waste disposal costs were. Of those 16 plants which reported costs, the cheapest system had an annual waste disposal cost of $1500 while the most expensive was $26,500. Further research is needed to estimate fully the costs, impacts and means of controlling food processing pollution.

Inspite of what has just been said, many agricultural scientists feel that food processing pollution controls or regulations may be easier to enforce than those designed to limit other forms of agricultural pollution because the former sources can be clearly identified and their impacts more easily measured. Effluent taxes and water quality standards are commonly suggested methods of enforcing controls for food processing wastes.

In summary present research indicates (1) that food processing is one of the most important sources of agricultural pollution in New York, (2) that more research is needed to discover economical ways of eliminating pollutants from food processing wastes, and (3) that food processing pollution may be the easiest form of agricultural pollution control to enforce.

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[6] Robert Zall, "Monitoring Waste Discharge, A New Tool for Plant Management," Ph.D. Thesis, Cornell University, June 1968, p. 16.

[7] Ibid.

Animal Wastes

In terms of quantity, agriculture generates more waste than any other industry in the country. The following table lists the volume of wastes and their sources produced in the United States in 1969.[8]

Annual Volume of Wastes Produced in the United States

Source	Quantity mil. tons/year
Residential, Commercial and Institutional	250
Industrial Wastes	110
Mineral Wastes	1,700
Agricultural Wastes	2,280
Total	4,340

As the above table indicates, agriculture produces more than one half of the total volume of wastes produced annually in the country. The real magnitude of the pollution problem, however, cannot be understood in terms of gross quantities. The scope of the problem lies in the concentration of wastes contaminating specific air, land or water resources under specific conditions.

Large concentrations of animal wastes create several pollution problems. For example, flies, insects, odors and manure dust can create great annoyance and potential health hazards. Improper cleaning and disposal methods or rainfall may result in runoff or leaching, thus polluting certain streams and ground water.

There are several different methods of disposing of animal wastes. Applying manure to the land as a fertilizer is the oldest and still the best known disposal method. If it is applied properly, there is very little danger of wastes running off into streams. This is one reason why agriculture creates fewer pollution problems than other industries, despite the volume of waste it generates.

Land disposal is a problem when feeding operations become very large and land for disposal is scarce. Another problem is that manure is often contaminated with weed seeds and therefore farmers may be reluctant to use it as a fertilizer. Since 90 percent of the dairy farms

[8]"Animal Wastes," Staff Report of the National Industrial Pollution Control Council, Washington, D.C., February 1971, p. 9.

in New York State have fewer than 60 cows, the problem is not so much one of land scarcity, but, rather, one of applying manure to the land properly so that it does not run off slopes and into streams.

Many agricultural engineers believe that pollution from animal wastes can be averted very simply, by having farmers follow certain common-sense guidelines, such as not allowing cows to wander in or close to streams and not applying manure to frozen land when spring thaws are likely to wash manure into streams. Management facilities which are supplemental to land include the use of storage tanks, lagoons, diversion ditches around animal feedlots, irrigation systems, etc.

A newer proposal, receiving a lot of attention, is to process and sterilize animal manure so that it can be used as an animal feed. Research has been done which indicates that cows and sheep can thrive on a diet that is up to one-third sterilized chicken litter and wood shavings. Additional work has been done on feeding other animal wastes to swine and chickens. Much of this work is still in the experimental stage, however, and cannot as yet be fully assessed. The most important problems with using animal manure as a feed are: (1) the consumer's reaction to food produced from manure; (2) the chemical effects on the animal over time; and (3) the cost of converting the manure to a feed.

Some work has been done on using animal waste as a fuel. In certain processes, manure has been converted to a gas or oil to be used as a source of heat for industrial processes. Again, research in this area is preliminary and cost data are unavailable.

A more expensive process is the proposal to adopt a sewage system to treat wastes much like the municipal waste treatment plants. The sewage system is much too expensive, given the size of most New York dairy farms. Moreover, the BOD content of animal waste water is so high that the environmental impacts are much worse for sewage disposal than for other waste management systems. At 90 percent purity, the BOD content of animal waste water is still higher than that of raw municipal sewage, due to the concentration of organic matter in the water. Handling all animal wastes in the United States using sewage systems would require treatment plants and water resources enough to service a population of two billion people.

Enforcing animal waste control is more difficult administratively than food processing waste control. For instance, the effluent tax does not appear to be a particularly efficient means of enforcing control of animal waste pollution, as it would be almost impossible to measure the runoff from the thousands of dairy farms all over the state, particularly since severe runoff may occur only one or twice a year. Water quality standards have been considered, as well as standards dealing with the physical location of pasture and barn sites relative to streams. This work indicates that physical standards are probably more practicable than water quality standards for controlling animal waste pollution in the state. Another possible alternative could be to have county extension agents educate farmers in environmental methods of animal waste management.

Sedimentation and Plant Nutrients

Sedimentation is the transportation of organic and mineral material from its place of origin by water, often causing the irreparable loss of soil, and the pollution of streams. From the standpoint of pollution, sediment is a problem because it carries plant nutrients--inorganic chemicals essential to plant mineral nutrition--into streams. Excessive nutrients contaminating a water supply may be hazardous to both human and animal health; in addition they can contribute to the undesirable growth of aquatic plants adversely affecting fishlife, recreation and human consumption.

Phosphorous and nitrogen are the two plant nutrients which account for most of the pollution. Nitrate nitrogen is soluble in water. It normally moves downward through the soil to groundwater unless it is removed by a growing crop or denitrification. Phosphorous, however, is retained by soils and moves largely into surface water supplies as the result of erosion. The relative important of these two nutrients as pollutants depends upon a combination of factors including soil types, fertilizer practices and crops under cultivation. The exact source of plant nutrients found in streams or ground water is still a subject of considerable controversy. At least one researcher believes that nitrogen pollution is not a serious problem in the Northeast, because the area planted to crops heavily fertilized with nitrogen is very limited.[9]

Phosphorous runoff is directly related to soil erosion and many researchers claim that erosion is no longer a serious problem in the Northeast since many steeper slopes are no longer farmed. These findings are borne out by a study of the sources of plant nutrients entering the Potomac River Estuary.[10]

Sources of Nutrients Entering the Potomac River Estuary

Source	% Nitrogen	% Phosphorous
Agricultural Runoff	31	8
Forest Runoff	16	4
Urban Runoff	2	1
Wastewater Discharge	51	87

[9]George L. Casler, "Measuring of the Contribution of Agricultural Production and Processing to Environmental Pollution," A.E. No. 39, Dept. of Ag. Econ., Cornell University, Ithaca, N.Y., p. 15.

[10]Frink, Op. cit., p. 17.

These findings cannot be transferred to other water basins in other geographic areas, however. Land runoff accounted for 52 percent of the phosphorous and 91 percent of the nitrogen entering Canadaroga Lake in upstate New York.[11] The sources of nutrients vary greatly, depending upon the land use in that particular area.

As has already been stated, the exact source of plant nutrients in water supplies is a subject of controversy. Once blamed on the extensive use of chemical fertilizers, nutrient runoff has, in some water quality studies, been found greater from forested lands than from cultivated, fertilized fields. Alternatively, it has also been claimed that since more nutrients are removed in crops each year than are applied in fertilizer, agriculture could not possibly be a major source of pollution. Unfortunately, some nutrient pollution does occur but this probably is a function of the timing of the fertilizer application, the amount of rainfall, and the general conservation techniques employed by farmers.

The solution to nutrient pollution from agricultural activity seems to be tailoring fertilizer applications to crop needs, i.e., applying the fertilizer when the crop requires additional nutrients. Studies in irrigated regions have shown that if this is done, ground water can actually be purified by withdrawing nutrients, through crops.[12]

Phosphorous pollution from agricultural land can best be controlled by limiting erosion. Nutrient runoff from forested land undoubtedly will continue but little can be done about it.

Like animal waste management, plant nutrient pollution is likely to be difficult to control from a governmental point of view. It is quite feasible that the Department of Environmental Conservation could be given the power to establish guidelines regarding the use and application of fertilizers, but enforcement of those guidelines might be extremely difficult, especially since most farmers apply fertilizer at the same time of year and enforcement personnel are not likely to be plentiful.

One alternative could be to make the County Extension Service responsible for notifying individual farmers of approved application procedures. Another could be for the Department of Environmental Conservation to conduct water quality studies all over the state in order to determine where agricultural nutrient pollution is a problem. Enforcement of standards regarding fertilizer application could then be left to local governments, under the guidelines established by the Department of Environmental Conservation.

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[11] Leo Hetling and Robert Sykes, Op. cit., p. 32.

[12] Frink, Op. cit., p. 23.

The use of water quality standards, (e.g., specifying the maximum amount of phosphorous that could enter a watercourse from a particular land area during a certain time period) is probably infeasible at this time. For one thing, it would require constant water quality analysis. For another, nutrient pollution is often related to unseasonably heavy rains and it is difficult to determine what an individual farmer's responsibility should be in the event of a natural catastrophe.

Pesticides and Agricultural Air Pollution

These two types of agricultural pollution were not included in this study. Although pesticides constitute a potentially serious problem, pesticide pollution is more easily measured and regulated than other forms of agricultural pollution. Many states have established guidelines which govern pesticide usage relative to wind velocity, timing of application and other factors. New York, of course, already has enacted specific laws and established guidelines regarding pesticide application.

Agricultural air pollution is a highly localized, rather insignificant problem compared to other forms of pollution. Excluding perhaps air pollution from food processing plants, agricultural air pollution control may more appropriately fall under the jurisdiction of nuisance laws, local zoning ordinances and similar legislation. Legislatively, it is very difficult to assess what constitutes an intolerably obnoxious odor.

III. MEANS OF CONTROLLING AGRICULTURAL POLLUTION

In the preceding section discussing the types of agricultural pollution that occur in New York State, it was brought out that excluding food processing, agricultural pollution could be relatively easily controlled using existing technology. Solving the problems of food processing will entail the research and development of new processing techniques to reduce the amount and toxicity of waste produced.

Since the problems of animal waste, sedimentation and plant nutrient pollution can be controlled rather simply, following certain common-sense guidelines, why have these guidelines not been followed before? First, the concern for the environment is of recent origin and many farmers have not been educated regarding the need to change waste management and fertilizer practices. Second there have been insufficient incentives to encourage farmers to adopt those practices which would limit pollution. Some but not all practices would require additional labor and capital from the farmer.

Voluntary and educational efforts may be sufficient to achieve a tolerable degree of control over pollution. But some additional action may be needed. If legislative and administrative action is to be effective, serious thought will need to be given to enforcement procedures. Are there effective ways in which food processing, animal waste, sedimentation and plant nutrient pollution can be controlled? In attempting to answer this question, the author consulted U.S. Department of Agriculture publications and drew upon the expertise of Dr. Raymond Loehr, Professor of Agricultural and Civil Engineering and Director of the Cornell Environmental Studies Program, and Dr. Robert Zall of the Cornell Department of Food Science and Technology.

Food Processing Wastes

Food processing firms can be divided into three general categories, according to their waste management systems: those handling their wastes through a municipal sewage system, those maintaining private systems of waste disposal, and those which do not treat their wastes at all. The use of municipal systems is generally regarded to be economically and environmentally advantageous, while private systems vary widely in cost and effectiveness. Naturally, the practice of depositing wastes into water or onto land with no treatment is not considered advisable.

Municipal Systems. If a municipal sewage system is approved, accessible, and capable of handling industrial wastes, it is usually advantageous for a food processing plant to dispose of its waste through the municipal system. A firm may be charged for this service on the basis of the amount of water it consumes, or by the total BOD load of the firm's waste. Sometimes plants are merely taxes on their assessed property value and allowed access to the municipal system. A practice that is becoming increasingly popular is one in which a firm will partially treat its waste before depositing it into the municipal system where it is further treated. For example, milk plants often must neutralize acid whey before the municipal system will treat it.

While use of the municipal treatment plant is economically and environmentally acceptable, a food processing plant does not always have access to such a system. If that is the case, a firm must maintain its own waste disposal system.

Private Systems. The preceding section describing types of agricultural pollution in New York listed six types of private systems utilized by food processing plants surveyed in the state. These were the unaerated lagoon, the aerated lagoon, spray irrigation, deep well diffusion, package unit and the conventional system of private activated sludge or trickling. The cost and effectiveness of the above systems vary widely, depending upon the size of the plant, the type and volume of wastes produced, and the ultimate destination of the wastes (land or water).

To illustrate, the unaerated lagoon (a lagoon without a mechanism to circulate the wastes and add air to speed the oxidation process) requires a certain amount of land to build the lagoon, and it may be very costly for a small firm. The unaerated lagoon also creates obnoxious odors. The spray irrigation system requires easy access to adjoining land. Moreover, the chemical effects of certain wastes on plant and animal life have not been determined. Deep well diffusion is generally undesirable since this process may lead to ground water pollution.

In short, the environmental impacts of the best practicable technology have not been fully ascertained, while the best available technology is usually economically infeasible. Further research is needed to determine the environmental impacts of various waste management systems. If certain systems are found to create undesirable pollution, then research will be needed to design systems which are both economically practicable and environmentally acceptable.

Animal Waste Pollution

The primary source of animal waste pollution in New York State is dairy feedlots. Over the past few decades, dairy herds in the state have become larger and fewer in number. The large concentrations of animal waste create several pollution problems, the most serious of which is water pollution occurring when waste from the feedlot is washed into streams.

The amount of runoff that may occur from any given feedlot is not merely a function of the quantity of manure produced. The waste production per animal, the number of animals in the feedlot, the frequency of cleaning, the amount of rainfall, and the moisture content and decomposition rate of the manure also determine the pollution potential of the particular feedlot.[13] Since any or all of these factors may vary from feedlot to feedlot, the required pollution control facilities may also vary. The following are measures which may be implemented to reduce runoff from feedlots.

Diversion. Diversion ditches which prevent water from flowing through the feedlot during rains markedly decrease the volume of feedlot runoff.

Retention Ponds. Ponds to retain and hold runoff from feedlots can also minimize water pollution. Variations on and additions to this method include use of solids settling basins, grass terraces, settling channels and porous dams to remove solids from the runoff. The waste water can be disposed of on the land through irrigation systems or spraying tanks.

Covered Confinement Buildings. Covered confinement buildings, while impracticable in some cases, can greatly reduce feedlot runoff since they protect the lot from rains and keep the wastes dry until the lot is cleaned. They also provide better animal protection in the winter months.

[13] Raymond C. Loehr, "Agricultural Runoff--Characteristics and Control," paper presented to the ASCE National Water Resources Conference, Atlanta, Georgia, January 25, 1972, p. 10.

Location. Feedlots should be located on flat or gently rolling land rather than on steep slopes to further decrease the likelihood of runoff occurring. In addition, the feedlot should also have enough land available for land disposal of wastes, as well as enough room to construct runoff control facilities.

Land Disposal. Depositing animal waste on the land is still considered the best method of disposal. However, certain precautions should be taken to insure that the manure will not be washed from the fields and into streams. Some commonly recommended procedures include the following:

(1) Wastes should not be spread on snow or frozen ground when thawing may cause runoff. The use of storage tanks may be necessary in some areas so that manure can be safely stored until it can be deposited on the ground. Not all researchers agree that storage is preferable to daily spreading, since storage creates severe odor problems.[14]

(2) Animal wastes should not be applied excessively to the soil since this can cause certain nutrients to dissolve and pollute ground water and can lead to salt buildup in the soil.

(3) Wastes should be incorporated into the soil after spreading to reduce runoff.

Sedimentation and Plant Nutrients

Efforts to decrease soil and water runoff will also decrease plant nutrient pollution since soil and water particles carry plant nutrients, crop chemicals and plant and animal bacteria to surface water. The following conservation practices may be adopted to conserve water, reduce the runoff rate and decrease erosion:

(1) Add crop residues and animal wastes to the soil. This increases the soil porosity, allowing it to absorb more water.

(2) Use vegetative cover and/or land modifications (terracing, strip cropping, contouring, diversions, etc.) to conserve moisture and decrease runoff.

(3) Avoid cultivation on steeper slopes.

(4) Encourage early growth of crops.

(5) Avoid exposing bare land surfaces.

[14] James J. Jacobs and George L. Casler, "Economic and Environmental Considerations in Dairy Waste Management Systems," Preliminary Draft, Dept. of Ag. Econ., Cornell University, Ithaca, New York, 1972.

The implementation of the above conservation practices may require public assistance beyond the contribution that can be reasonably expected from individual farmers. Moreover, erosion and plant nutrient runoff occurs from forested lands and it may be unreasonable to hold an individual farmer responsible for this "natural" form of pollution. A certain amount of public financial assistance, will probably be necessary in order to bring sedimentation and plant nutrient pollution under control. Consequently, one of the objectives of the New York Rural Environmental Assistance Program (in conjunction with the federal Agricultural Stabilization and Conservation Service) is to share part of the costs that individuals incur in taking measures to protect the soil and reduce air, water or land pollution.[15]

Fertilizers

In the past, there has been considerable speculation as to whether the use of chemical fertilizers causes water pollution. While this topic falls under the category "Sedimentation and Plant Nutrients," fertilizers are separately analyzed here since some people have proposed that fertilizerusage should be restricted due to its potential impact on water quality.

In general, it appears that nutrient runoff tends to be greater from cultivated rather than uncultivated land. Nevertheless, there is no definitive, quantifiable relationship between the amount of fertilizer applied to cropland and the amount of plant nutrient pollution in the surface waters of that area. The amount of nutrient runoff from cultivated, fertilized lands varies greatly, depending upon:

(1) the amount of rainfall in that area,

(2) the water holding capacity of the soil,

(3) the amount of nutrients naturally present in the soil, and

(4) the amount and timing of fertilizer applications.

Nutrient pollution is likely to occur from fertilizer applications when fertilizers or wastes are applied in ways that allow excess nutrients to accumulate in the soil. These excess nutrients reach surface waters by erosion or runoff.

The best way to ensure that fertilizer pollution does not occur is to tailor the application to the growing crop's needs and to follow good erosion and runoff control practices. More specifically, the following measures are recommended:

[15]New York Environmental Assistance Program, 1-NY(RE)(Revision1)," U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, N. Y. State ASCS Office, Syracuse, N.Y., March 10, 1972.

(1) avoid applying manure to frozen ground,

(2) limit the amounts of fertilizer to that needed by the crops,

(3) keep fall applications of fertilizers to a minimum,

(4) plan fertilizer applications to coincide with crop needs,

(5) spread manure on growing crops or stubble rather than on bare fields, and

(6) avoid applying manure to steeper slopes capable of rapid runoff.

IV. ALTERNATIVE MEANS OF ENFORCING AGRICULTURAL POLLUTION CONTROL

Since the extent and magnitude of agricultural pollution have not yet been fully determined, it would be premature at this time to offer specific recommendations regarding policies. But it may be useful to outline and discuss enforcement mechanisms which might be adopted should legislative action to control pollution be found necessary.

There are several enforcment policies which are commonly discussed in relation to agricultural pollution control. Some of the more common methods include:

(1) private legal action,

(2) water quality standards,

(3) physical standards,

(4) effluent charges, and

(5) education and extension programs.

Private Legal Action

Private legal action can be an important means of controlling pollution which directly threatens the health or general well-being of individuals or groups of individuals. The various laws which enable a private citizen to take a polluter to court are nuisance laws, trespass law, water laws and riparian rights, and certain federal, state and local laws which relate specifically to the environment.

Private action can be important to pollution abatement in two ways. First it can result in a court ruling which will stop a polluter's activities and, in this manner, lessen pollution. Second, the general agitation created by repeated lawsuits can stimulate comprehensive public policy in the area of pollution control. A polluter who faces the possibility of receiving a court injunction ordering him to close down his operations is likely to be more favorably disposed toward public legislation which would tend to equalize the pollution control costs and standards for similar firms within that industry.

Researchers who deal with citizen-initiated legal actions to improve the environment typically feel that private action is at best a very limited means of enforcing total pollution control. It is most effective in specific cases where pollution damages to private concerns are obvious and excessive. Private action is not an effective means of protecting the environment in general for the following reasons:

(1) Bringing suit against a polluter is a slow, tedious and costly process. Few individuals have the financial resources necessary to take legal action in order to stop pollution.

(2) A person or group of persons must often have a personal stake in the outcome of the controversy (the legal constraint of "standing to sue") in order to take legal action in the first place.

(3) In settling civil suits which relate to nuisance laws, trespass law, and water laws and riparian rights, a court generally weighs the relative interests of the parties involved in deciding upon a course of action. In other words, these laws do not relate specifically to the environment and are relatively ineffective as a means of controlling pollution.

Water Quality Standards

Another commonly proposed method of regulating pollution is the use of standards which establish minimum acceptable purity levels for water supplies. Such regulations could be used to prohibit the pollution of streams beyond a certain level.

Ideally, many researchers feel that water quality standards should vary from stream to stream, depending upon the number of people or firms using the water, the purpose for which the water is used, and the other alternatives available to downstream water users. The purpose of varying the standards according to these criteria is to make enforcement as flexible, efficient and fair as possible. The objective is to adjust standards of water quality so that the upstream cost of creating a unit of purity would be equal to the downstream benefit of that purity.

While a water quality standard like the one outlined above is theoretically designed to be flexible, efficient and fair, there are several difficulties with implementing such a standard. First it is difficult to compute the standard since so many different variables are involved, i.e., the number of upstream users, the quantity and type of pollutants, the upstream cost of cleaning up wastes, the distance between upstream and downstream users, the number of users, and so on. Second, if the variables which determined a standard change, the standard will become obsolete and will have to be changed again.

Water quality standards are particularly difficult to apply to agricultural pollution, although they may be feasible for food processing firms. One primary problem is that at this time, agriculture's impact on the environment has not been fully assessed. In some instances, agricultural pollution is non-existent; in others it is a serious problem. Another important problem with water quality standards is that agricultural pollution (animal waste, sedimentation and plant nutrient pollution) is non-point source pollution. That is, unlike a firm which discharges waste material from a single source, one farm could discharge waste at many different points along a stream. Thus, the use of water quality standards would require constant water analysis at many different points along a stream for each farm. Moreover, agricultural pollution is often a result of natural factors such as rainfall over which a farmer has no control so that it is difficult to determine standards which are equitable. Problems such as the ones outlined above make the use of water quality standards one of the lesser attractive methods for enforcing agricultural pollution control.

Physical Standards

Standards which regulate the physical features of a farm in order to minimize agricultural pollution appear to be more practicable than some of the other enforcement methods under consideration here. Physical standards seem to be particularly useful for controlling animal waste pollution, but may also be an effective means of controlling plant nutrient and fertilizer runoff, as well as erosion.

In the preceding section on controlling agricultural pollution, several recommendations were made to reduce animal waste pollution. These included the use of diversion ditches and retention ponds around feedlots to keep manure from washing into streams. In addition, guidelines regarding the locations of feedlots and methods of applying manure to the land in order to minimize waste runoff were recommended.

Since many agricultural engineers feel that animal waste pollution can be controlled by following practices such as those outlined in the preceding section, standards requiring that certain practices be adopted are a feasible means of regulating pollution. Physical standards could also be adopted to regulate fertilizer and plant nutrient pollution by requiring conservation practices aimed at reducing land runoff.

Physical standards have certain advantages over the other enforcement mechanisms. One is relative ease of administration. Physical standards would not require the constant surveillance that water quality standards would. A check one or twice a year to see that farmers are maintaining facilities to control pollution may be sufficient. Another advantage to requiring that certain facilities be adopted to control pollution is that agricultural scientists are fairly sure that the measures recommended above will effectively reduce pollution from agricultural sources.

On the other hand, physical standards have certain disadvantages. One important problem concerns flexibility. Physical standards may prove to be an unnecessary burden to farmers whose operations do not presently cause pollution. Research studies indicate that farmers who graze a few cattle over a large area of land cause little to no animal waste pollution. It may prove to be administratively difficult to establish standards which take such things as animal/land ratios into consideration. Another problem with physical standards is that the cost of adopting pollution control facilities may prove to be prohibitively expensive for smaller farmers. The cost of constructing a diversion ditch around a feedlot holding 30 cows will probably be nearly as much as for a feedlot holding 90 cows, yet a heavier economic burden will be placed upon the owner of the smaller feedlot.

The research results of this particular study indicate that physical standards are probably the most practicable means of reducing pollution from animal waste and may also be useful in reducing plant nutrient run-off. However, physical standards can, if they are inflexible, create inequities which might make them politically undesirable.

Effluent Charges

The effluent charge, an amount of money charged for each unit of pollutant deposited into a body of water or air or onto a section of land, is favored by many economists as an effective means of enforcing pollution control. Its relative effectiveness depends upon the ease with which pollution, and the costs associated with its control, can be quantified and identified. Its advantages are:

(1) An effluent charge requires less knowledge about costs associated with pollution than would certain other forms of control. For example, in terms of water pollution, one would only need to know the downstream costs of dealing with impure water in order to determine an effluent tax. Other methods of control might involve trying to assess point or diffuse sources of pollution and their relative impact on water quality.

(2) Firms or individuals could clean up their waste most economically and could choose to pay the tax if pollution control facilities are prohibitively expensive.

(3) Prices charged may be varied more readily than regulations involving physical or water quality standards. Many economists feel that flexibility of application is one of the most important features of a pollution control mechanism and favor the effluent tax because of its flexibility.

The disadvantages of effluent charges, as applied to agricultural pollution, are as follows:

(1) The environmental impacts of certain agricultural practices are still largely unknown and unquantifiable. Consequently, excluding food processing wastes, the effluent tax is an inappropriate means of enforcing pollution control. It is, however, relatively easier to apply the effluent tax to food processing pollution; unlike other forms of agricultural pollution, the source and amount of pollutants from food processing can be easily identified and quantified.

(2) Determining the charge that should be applied to each unit of pollutant from food processing is no easy task, since this requires knowing the downstream costs of dealing with impure water.

(3) Effluent charges are further opposed on the grounds that no person ought to have the right to purchase a license to pollute. One study reported that state governors generally opposed the idea of federal effluent charges on these grounds. (Of those responding, 33 governors opposed the idea, 5 suggested further study, and 8 gave their qualified approval.)[16]

(4) An additional problem is that the effluent charge, depending upon its relative expense, may or may not result in pollution control. Thus, if many polluters elect to pay the fine instead of cleaning up wastes (which is not entirely infeasible, given the fact that one purpose of the tax is to provide an economic alternative to adopting pollution control facilities), then it will still be necessary for some other agency to maintain pollution control facilities.

At present, it seems that the effluent tax could feasibly be applied to food processing wastes, but not to other forms of agricultural pollution. The effluent tax is easier to compute than water quality standards and may be more flexible than physical standards.

Education and Extension Programs

When current research projects to determine the magnitude and extent of agricultural pollution in New York State are completed, it is conceivable that researchers may find that agriculture contributes only a minimal, acceptable amount of pollution which can be reasonably expected from any sort of economic activity. If this turns out to be the case, legislative standards may be considered too drastic a means of enforcing agricultural pollution control. An alternative to legislation is to incorporate pollution control information into county extension programs.

Findings from this study indicate that agricultural pollution, again excluding food processing, can be relatively easily controlled from the

[16] J. M. Stepp and H. H. Macauley, "The Pollution Problem," American Enterprise Institute for Public Policy Research, Analysis No. 16, Washington, D.C., October 10, 1967, p. 47.

individual farmer's point of view. Often a farmer need only follow certain common-sense farm management practices to minimize pollution. As stated earlier, a farmer loses money if his fertilizer, pesticide or manure is washed into streams since he uses such inputs to improve the quality of his land. Since pollution control is fairly compatible with management practices to maximize a farmer's income, educating farmers in pollution control methods may be an adequate means of dealing with the agricultural pollution problem.

The above reasoning has certain weaknesses, however, since there are costs involved in constructing certain pollution facilities, especially around feedlots. In some cases, a farmer may decide that the cost of controlling pollution would not offset his potential gain. Education and extension programs could, however, encourage pollution control without resorting to legislation and enforcement.

V. ECONOMIC NATURE OF AGRICULTURAL POLLUTION CONTROL

It is extremely difficult at this time to estimate what controlling agricultural pollution would cost. Agricultural scientists are not even in agreement as to whether or not agricultural pollution is a serious problem. Most of the agricultural pollution research that is currently being conducted is devoted to ascertaining the environmental impacts of various agricultural enterprises.

If agriculture is found to generate more pollution than that which can be reasonably expected from any industry, standards may be established which will impose costs upon agricultural producers and processers. Obviously, the cost of meeting those standards will depend upon (1) the cost of technology available when standards are established, (2) the relative stringency of those standards, (3) the relative size of the firm or farm, and (4) the amount of time firms will be given to meet those standards.

The costs associated with food processing pollution control are difficult to determine since aggregate data estimating the cost of present systems are unavailable. As was stated in Chapter III, only 29 percent of the firms surveyed in 1967 could give figures indicating their waste disposal costs. Of those plants which did report figures, the cheapest system cost $1500 annually, and the most expensive, $26,500 annually. The study did not indicate which systems were better environmentally.

The U.S. Department of Agriculture published a report in June 1972 estimating the costs to poultry slaughtering plants of waste water treatment systems to meet likely future water pollution control standards.[17]

[17] James G. Vertrees, "The Poultry Processing Industry: A Study of the Impact of Water Pollution Control Costs," Marketing Research Report No. 965, Economic Research Service, U.S. Department of Agriculture, Washington, D.C., June 1972.

The results of their study indicated that the cost of the best available technology would be 0.64 percent of sales for broiler firms and 0.46 percent of sales for turkey firms. Existing treatment costs 0.21 and 0.14 percent of sales, respectively. Since the profit margins for the poultry processing industry are so narrow (0.66 percent of sales for broiler firms, and 1.08 percent for turkey firms in 1964), the costs of adopting the new technology would have to be passed directly to the consumer in the form of higher prices.

Research indicating the relative environmental impacts of food processing waste disposal methods must be completed before researchers can determine what changes, if any, in handling waste should be made. Likewise, the changes which may be needed must first be established before the costs of making those changes can be ascertained.

The costs of handling animal waste are not as difficult to determine as food processing waste costs. Where adequate land is available, farmers are advised to dispose of animal waste by spreading it on fields as a fertilizer. Land disposal is both the cheapest and the best environmental method of handling animal wastes. The relative cost of land disposal depends upon the proximity of available acreage for spreading, the size of the herd (very small herds have significantly higher spreading costs than larger herds), and the types of crops under cultivation.

Where adequate land for disposal is not available, feedlot operators must seek other means of disposing of their manure. Alternative methods include the use of lagoons, incinerators, activated sludge processes, sewage systems, etc. These methods are considerably more costly than direct land disposal and may amount to as much as $30 to $85 per cow per year according to a study done in Southern California.[18] In that same study, feedlot operators who were part of a fertilizer cooperative only paid $18 per cow per year. Ironically, some of the most expensive disposal systems happened to be the worst from an environmental point of view. Most of the alternative methods listed above are recommended for very large feedlots (300 to 25,000 head) and are probably inapplicable for most New York farms since 90 percent of the dairy farms have fewer than 60 head of cows.

Few data are available which might be used to estimate the costs of controlling sedimentation and plant nutrient pollution. However, one study showed that the cost of controlling phosphorous and sediment varies from zero to five dollars per acre, depending upon the level of constraints.[19]

[18] Alfred Grimm, "Dairy Manure Waste Handling Systems," Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Graphics Management Corporation, Washington, D.C., pp. 125-144.

[19] James J. Jacobs, "Economics of Water Quality Management: Exemplified by Specified Pollutants in Agricultural Runoff," Preliminary Report of Project No. 425-40-24-09-1925, Department of Economics, Iowa State University, Ames, Iowa, 1972. (Above cost data are given in the Abstract.)

In summary, it is extremely difficult at this time to estimate the costs of controlling agricultural pollution. If standards are established, they are likely to be more burdensome for smaller producers than for larger producers. In addition, the costs of controlling agricultural pollution will very likely be passed directly to the consumer if consumers have a high demand for the particular food product, and if cheaper substitutes or food products from other areas are not available. The producer will bear the cost burden if consumers buy considerably less as the cost of his product rises, or if substitutes are available. Competition from agricultural regions outside New York might be a serious problem if New York is one of the first states to adopt stringent pollution control standards.

VI. SUMMARY AND CONCLUSIONS

This study has brought together information on the location, magnitude and control of agricultural pollution problems in New York State. Broadly generalized, the findings of the project are as follows:

(1) Agriculture generates over half of the total volume of waste produced annually in the United States, yet its total contribution to the pollution problem is relatively minor compared to other forms of pollution.

(2) Agricultural pollution problems particular to New York State, in their order of importance, are food processing wastes, animal wastes from dairy feedlots, sedimentation, plant nutrients, pesticides and agricultural air pollution.

(3) Agricultural activity is diverse compared to other types of industry, and, as a result, agricultural pollution is difficult to measure and any control means adopted will be difficult to enforce.

(4) Excluding food processing pollution, agricultural pollution can be controlled relatively easily using existing technology.

Need for Further Research

Agricultural scientists do not agree as to the extent and magnitude of agricultural pollution. Current research efforts are largely aimed at resolving this issue.

Specific recommendations regarding control measures should be deferred until the impacts of agriculture on the environment are more fully determined.

If standards to control agricultural pollution are legislated, two generalizations can be made. First a greater economic burden will be placed on smaller producers than on larger producers. Second, the added costs of pollution control will probably be passed directly to the consumer if consumer demand is high and supply is fairly flexible. In some cases, the producer will have to bear the cost.

Implications for Policy-Makers

While the effects of agricultural pollution in New York State may have been overestimated, agricultural activities do have certain harmful effects on air, water and land resources. Generally speaking, it is possible to lessen the harmful effects of animal waste, sedimentation and plant nutrient pollution by using existing technology and following management practices oriented toward pollution-control.

Further research is needed to define agriculture's impact on the environment more clearly and to discover economically feasible methods of lessening harmful impacts (especially for food processing). If agriculture is found to contribute an unacceptable amount of pollution to the environment, legislative action of some sort will likely be necessary.

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