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AGRICULTURE: THE UNSEEN FOE IN THE WAR ON POLLUTION

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The Water Quality Act of 1965[1] initiated a concerted federal effort to clean up the nation's rivers and streams. It called upon each state to establish individualized water quality standards[2] covering interstate waters[3] within or bordering the state; upon approval by the Secretary of Interior, these standards were to be adopted as federal standards. All fifty states submitted standards,[4] and those of each state, at least in part, were approved and put into effect.

Agricultural wastes receive practically no attention under the new standards. Nearly all regulatory efforts are directed at municipal and industrial wastes, and agricultural pollution is regarded as primarily a research concern. There may be some justification for this position, since agricultural pollutants, which do not emanate from point sources, are not generally susceptible to conventional pollution control techniques. The need to identify, control, and prevent agricultural pollution, however, cannot be overemphasized. Commercial agriculture daily engages in practices having enormous water quality ramifications; in many parts of the country agricultural pollutants could, if unchecked, cancel gains achieved through municipal and industrial clean-ups.[5]

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1 33 U.S.C. § 466 (Supp. IV, 1969). For a brief analysis of the key provisions of the Act, see Hines, *Nor Any Drop to Drink, Public Regulation of Water Quality Part III: The Federal Effort,* 52 IOWA L. REV. 799 (1967).

2 These standards were to be based on the Federal Water Pollution Control Administration's test of "best practical treatment or control." FEDERAL WATER POLLUTION CONTROL ADMIN., U.S. DEP'T OF INTERIOR, GUIDELINES FOR ESTABLISHING WATER QUALITY STANDARDS FOR INTERSTATE WATERS 3 (1967). Such degree of treatment or control was required unless it could be demonstrated that a lesser degree would "provide for water quality enhancement commensurate with proposed present and future water uses." *Id.* This test was derived from the congressional directive that the standards "enhance the quality of water." Federal Water Pollution Control Act § 10(c)(3), 33 U.S.C. § 466g(c)(3) (Supp. IV, 1969).

3 Nearly all of the country's larger streams, rivers, and lakes are "interstate" (as defined by federal authorities) in character and therefore subject to federal supervision. *See* WATER POLLUTION CONTROL ADMIN., *supra* note 2, at 4.

4 18 C.F.R. § 620.10 (1969), *as amended,* 34 Fed. Reg. 7800, 15840 (1969).

5 For example, the nearly two billion tons of animal wastes produced annually on American farms are estimated to have a pollution potential equal to that of the domestic sewage of 1.9 billion people. *See* Rademacher, *Animal Waste Pollution—Overview of the Problem,* in FEDERAL WATER POLLUTION CONTROL ADMIN., U.S. DEP'T OF INTERIOR, PROCEED-

Taken together, the four major sources of agricultural pollution—animal wastes, chemicals, sediment, and salt—constitute a serious threat to the nation's ability to meet the timetables currently being created for compliance with the new water quality standards.[6]

I

ANIMAL WASTES—THE CONFINEMENT FEEDING PROBLEM

The yearly diet of the average American includes over 200 pounds of American-grown meat.[7] Steady increases in per capita meat consumption and continued population growth have caused agricultural technology to seek more efficient methods for producing meat animals. The result is the modern confinement feeding operation, in which large numbers of animals are scientifically fed and managed in tightly restricted quarters. Feedlots carrying more than 10,000 head of cattle or in excess of 20,000 birds are not unusual.[8] Iowa, the leading cattle feeding state, has nearly 46,000 beef feedlots,[9] of which several hundred may confine over 1,000 head. Current estimates project continued rapid expansion of confinement feeding operations.[10]

INGS OF ANIMAL WASTE MANAGEMENT CONFERENCE 7 (1969) [hereinafter cited as PROCEEDINGS]. The use of population equivalent estimates to quantify agricultural pollution may be misleading. Careful attention must be paid to the parameter on which the comparison is based. Biochemical oxygen demand is the characteristic usually selected for comparative measurement. *See* note 15 *infra*.

6 No effort is made herein to assess the industrial pollution resulting from either the manufacture of inputs to agricultural production or the processing of agricultural commodities. Both of these sectors of industry pose serious pollution problems in their own right. For example, wastes escaping from chemical plants manufacturing agricultural pesticides have accounted for some of the largest fish kills on record. *See* F. GRAHAM, DISASTER BY DEFAULT 107-35 (1966). The extent of the pollution problem created by food processing industries is described as having an equivalence to that of greater than 168 million people. U.S. DEP'T OF AGRICULTURE, CONTROL OF AGRICULTURE—RELATED POLLUTION; A REPORT TO THE PRESIDENT 3 (1969) [hereinafter cited as REPORT TO PRESIDENT].

7 Wadleigh, Farm Wastes 1, presented to Conference on the Role of Agriculture in Clean Water, Nov. 20, 1969, in Ames, Iowa.

8 REPORT TO PRESIDENT 25. Hog units of 1,500 or more are also common. *Id.* One commentator describes modern confinement feeding units as "mechanized meat factories." Robohn, *Major Problems of Water Pollution Created by Agricultural Practices* 5, in FEDERAL WATER POLLUTION CONTROL ADMIN., U.S. DEP'T OF INTERIOR, 2D COMPENDIUM OF ANIMAL WASTE MANAGEMENT (1969) [hereinafter cited as 2D COMPENDIUM].

9 Schliekelman, *Feedlot Pollution Control in Iowa*, in PROCEEDINGS 31.

10 Gray, *Regulatory Aspects of Feedlot Waste Management* 22, in 2D COMPENDIUM. Government estimates project an additional 172,000 beef cattle and 433,000 hogs for every increment of one million people in the United States population. 1 FEDERAL WATER POLLUTION CONTROL ADMIN., U.S. DEP'T OF INTERIOR, THE COST OF CLEAN WATER AND ITS ECONOMIC IMPACT 210 (1969) [hereinafter cited as 1 COST].

Unfortunately, waste management technology has not kept pace with improved-efficiency feeding operations. As a result, feedlot runoff is rated as a pressing pollution problem by state officials in the Cornbelt and in the Great Plains.[11] In yesterday's small feedlot operation, manure was a valuable by-product used to fertilize the land that produced the crops fed to the next generation of animals. This recycling technique is still used in many feedlot operations,[12] but the economic value of waste as fertilizer is increasingly insufficient to sustain its use or sale. Even if the feedlot operator grows the grain he uses, the mechanical and labor costs of spreading manure may make chemical fertilizers more economical. Thus a once-valuable production input has become a nonproductive cost item, and in the process a waste disposal problem of immense dimensions has been created.[13]

Feedlot wastes pose a variety of pollution threats to water, the three most important of which are oxygen depletion, pathogenic bacteria, and increased nutrient content.[14] Oxygen in water is essential to support aquatic-living organisms. Because feedlot wastes are very high in both biochemical oxygen demand (BOD)[15] and chemical oxygen demand (COD),[16] feedlot runoff is a serious hazard to aquatic life in the receiving waters. A heavy rain washing the surface of a feedlot

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11 *See* PROCEEDINGS 25-32.

12 The mammoth Monfort Feedlots in Greeley, Colorado, for example, spreads the manure from the 90,000 cattle in its pens over 10,000 acres on which it grows corn for cattle feed. Wadleigh, *supra* note 7, at 6.

13 Evidence of the problem is clearly visible in the form of the manure mountains rising around some feedlots. *See* Robohn, *supra* note 8, at 7. Also, federal statistics show that three of the eight major fish kills in 1967 were caused by animal waste drainage. Wadleigh, *supra* note 7, at 7. Of the 84 major fish kills occurring in Kansas between 1963 and 1967, 65% were attributable to animal wastes. Gray, *supra* note 10, at 3.

14 Additional deteriorating characteristics include solids that impede water filtration systems, chemical additives toxic or detrimental to living organisms, and taste and odor problems. *See* 1 COST 208-09.

15 BOD is a measurement of the concentration of oxidizable organic material that can be used by aerobic bacteria in terms of how much oxygen they will require to metabolize the material in a standard period (usually five days) and at a specific temperature (usually 20° centigrade). Miner & Willrich, Livestock Operations and Field-Spread Manure as Sources of Pollutants 2, presented to Conference on the Role of Agriculture, *supra* note 7. The BOD of animal wastes in holding tanks or pits may be 100 times that of domestic sewage, and feedlot runoff strengths will vary upwards from ten times the BOD of domestic sewage. REPORT TO PRESIDENT 26.

16 COD is another measure of concentration based on chemical rather than biological oxidation. COD will exceed BOD if the waste tested contains components resistant to complete oxidization by aerobic bacteria under the conditions of the BOD test. Miner & Willrich, *supra* note 15, at 2. Because its constitnents are fibrous in texture and therefore slow to oxidize, feedlot runoff, measured in COD terms, is grossly more potent a pollutant than domestic sewage.

and draining into a nearby stream can cause severe oxygen depletion for miles downstream.[17]

The bacterial level of animal wastes is similarly high. Organisms pathogenic to man and other animals may be transported to water in feedlot runoff.[18] Although instances of water-borne diseases are rare in the United States, over fifty diseases are known to be transmitted from animal to man via water.[19] As increased emphasis on water-based recreation creates new opportunities for this form of infection, feedlot wastes may become a matter of more serious public health concern.

Animal wastes perform the same nutritional function for aquatic organisms as they do for field crops; thus feedlot runoffs are suspected to be a prominent cause of the high levels of nitrogen and phosphorus that support flourishing algae populations.[20] The nitrate content of concentrated animal wastes is so high that nitrate poisoning of both surface and underground water supplies is an additional public health threat.[21]

Management of agricultural wastes poses two related problems. First, drainage from the feedlot area must be contained and treated in some manner before it can be permitted to discharge into a watercourse. Second, accumulated solid animal wastes from the feedlot must be disposed of. Stockpiles of wastes attract vermin, create possible air quality problems, and increase the danger of pollution to surface and underground water supplies. The pollution potential of animal wastes is greatest when they are allowed to accumulate or to be stored on the ground surface where rainfall and running water can leach and transport the material as surface runoff or soil infiltrate.

Agriculture's solid waste disposal problem seems to defy technological solution. Experiments in producing a commercially useful product from agricultural wastes have met with little success.[22] Nonsalvage disposal methods, such as incineration and landfill, have also proved

17 Studies in Kansas showed that after a one-inch rain the water in a stream one mile below a feedlot contained almost zero ppm (parts per million) of oxygen. Fish require a minimum of fonr ppm oxygen to survive. Wadleigh, *supra* note 7, at 7. In another Kansas feedlot pollution situation a researcher reported observing a stretch of polluted stream several miles in length where fish were surfacing to attempt to obtain oxygen and crayfish were crawling out of the water. Gray, *supra* note 10, at 3.

18 Miner & Willrich, *supra* note 15, at 3.

19 Gray, *supra* note 10, at 5.

20 *See* REPORT TO PRESIDENT 26; Wadleigh, *supra* note 7, at 9.

21 REPORT TO PRESIDENT 26; Miner & Willrich, *supra* note 15, at 5.

22 *See* Willrich, *Disposal of Animal Wastes*, in AMERICAN ASS'N FOR THE ADVANCEMENT OF SCIENCE, AGRICULTURE AND THE QUALITY OF OUR ENVIRONMENT 415-16 (N. Brady ed. 1967) [hereinafter cited as AGRICULTURE & QUALITY]. One experimenter has concluded: "It appears most doubtful that processing and retailing animal manure will

ill-suited to agricultural wastes.[23] Nearly all waste management experts agree that the time-honored technique of returning animal wastes to the soil through surface spreading is still the best available disposal procedure.[24] However, such constraints as seasonal restrictions on land spreading, competition with expanding recreation demands, and production of odors offensive to advancing urban populations prevent use of this method in a growing number of areas.[25] Another difficulty now being recognized is that, without careful management, broad-scale surface spreading of animal wastes may simply convert an overt point source of pollution to a more discreet nonpoint source. Diffused surface runoff from organically fertilized agricultural land has been identified as a major pollution source in some areas.

Pollution from feedlot runoff is an intermittent problem mainly associated with times of heavy rainfall or rapid snowmelt, when it may cause a severe sludging effect on the receiving waters. To date, methods of controlling and treating feedlot runoff rely almost exclusively on natural processes. Runoff is collected and held in a pond or lagoon or a series of such basins. Some biological degradation occurs, but the disposal design ordinarily contemplates slow reduction of the liquids through evaporation and seepage plus periodic removal of the precipitated solids.[26] To prevent overloading of the retention basins, good waste management procedures call for prompt pumping out of the liquid effluent for disposal on land surfaces through irrigation techniques. Because the potency of the effluent from a lagooning process is too great for direct discharge into receiving waters, consideration has been given to applying the advanced waste treatment techniques used to purify municipal sewage and high BOD industrial wastes. No

soon, if ever, constitute a really significant channel of disposition." G. L. Mehren, *quoted in id.* at 416.

23 Most animal wastes have a high moisture content and do not burn well unless thoroughly dried. Also, burning large quantities of animal wastes is likely to present air pollution problems. Sanitary landfills and using animal wastes as fill to reclaim marginal land have been found unsatisfactory as disposal methods because of the cost associated with hauling and dumping and the potential for groundwater pollution. *Id.* at 417.

24 Report of the Workshop Session, Animal Wastes as Water Pollutants, in Conference on the Role of Agriculture, *supra* note 7, stated: "After much discussion, it was apparent that no one wished to challenge the general concept of returning livestock wastes to the land." *Id.* at 1.

25 *See* Loehr, *The Challenge of Animal Waste Management*, in CORNELL UNIVERSITY CONFERENCE ON AGRICULTURAL WASTE MANAGEMENT 17, 18-19 (1969) [hereinafter cited as CORNELL CONF.]; Taiganides, *The Animal Waste Disposal Problem*, in AGRICULTURE & QUALITY 392-94.

26 *See* O'Brien, *Control Devices for Animal Feedlot Runoff*, in PROCEEDINGS 18.

system has yet been discovered that yields a satisfactory feedlot runoff effluent at a reasonable cost.[27]

Public regulation of feedlot wastes is in a relatively primitive stage because of inadequate information about feedlot pollution and technical uncertainty about the efficacy of various control designs. Although some states were able to describe or project animal waste control programs in implementation plans submitted in connection with federal water quality standards,[28] few states have developed full-scale regulatory programs for confinement feeding operations.[29]

Present feedlot regulations commonly require registration of existing feedlots whose size, animal density, proximity to a watercourse, or waste disposal system are such that a substantial water pollution potential exists.[30] Some provide that all proposed confinement feeding operations register before construction or operation of the lot.[31] Typically, the registration application elicits detailed information about the topography and drainage characteristics of the feedlot, the waste management procedures employed, and the primary receiving waters. In some states the registration requirement may provide the first reliable statewide inventory of feedlot operations.[32]

When information supplied by the registrant and investigations by state agencies show that control facilities are necessary to assure water quality below the feedlot, the registrant is usually required to obtain a permit before commencing or continuing operations. The permit will not be issued unless waste control works meeting agency

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27 *See* 1 COST 210-11.

28 *Id.* at 211.

29 Kansas and Arizona have legislated regulations. ARIZ. REV. STAT. ANN. §§ 24-391 to 97 (Supp. 1969); KAN. STAT. ANN. § 65-171 (1964), *as amended id.* §§ 65-171(d), (h), (i) (Supp. 1969). In most other states where the problem is receiving attention, regulation has been left to local pollution control agencies. For progress reports on feedlot regulations in nine states in the upper Missouri River basin, see PROCEEDINGS 25-31.

30 The Iowa regulation, for example, requires registration of feedlots when:

(1) The number of cattle confined in a feedlot exceeds 1,000 head;

(2) The feedlot contributes to a watercourse draining more than 3,200 acres of land above the lot and the distance to the nearest point on the affected watercourse is less than 2 feet per head of cattle in the feedlot;

(3) The runoff water from a feedlot or overflow from a lagoon or liquid manure storage tank flows into a tile line or other buried conduit, drainage well, pumped well, abandoned well or sinkhole.

Iowa Confinement Feeding Regs. 1.3(2)(a).

31 *E.g.*, 1 KAN. ADMIN. REGS., Board of Health § 28-18-2(a) (1968).

32 For a discussion of the importance of such an inventory, see Badalich, *How to Conduct a State Inventory*, in PROCEEDINGS 11; Peterson, *Inventory and Assessment of the Problem of Pollution from Feedlot Wastes*, in PROCEEDINGS 34. A weakness of some state

specifications are completed,[33] and it may be revocable for cause on short notice.[34]

It is at this juncture that deficiencies in animal waste management technology hamper regulatory efficiency. There is common agreement that wastes must be treated, but giving meaning to a criterion such as "best practicable treatment" is difficult, because systems currently receiving general acceptance appear to contain serious defects.[35] The regulations attempt to avoid this problem by stating requirements in terms of minimum acceptable procedures. For example, diversion of drainage prior to contact with the feedlot area or areas is generally required.[36] Terraces or ponds below the feedlot area capable of intercepting and holding sizeable volumes of surface runoff are also commonly required minimum control structures.[37] Express provisions may govern the methods and frequency with which wastes retained in the detention structures are to be disposed of.[38]

The present generation of feedlot regulations is probably about as refined as the current state of the art in animal wastes management permits. Perhaps they are most correctly viewed as stop-gap measures, based on the sound assumption that efficient use of existing knowledge will greatly reduce feedlot pollution.[39] Although their evolutionary nature makes them less than ideal bases for designing permanent control structures, the regulations promise to play an important role in

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regulations is a failure to provide sanctions for noncompliance with the mandatory registration requirement.

33 Iowa Confinement Feeding Regs. 1.3(3)(d). In determining whether or not a feedlot constitutes a pollution threat, the agency will consider soil type, distances to stream, use of land between feedlot and stream, slope of land, waste discharge in relation to stream flow, and distance to structures occupied by humans.

34 *E.g.*, 1 KAN. ADMIN. REGS., Board of Health § 28-18-2(e) (1968) (30 days). Revocation of a permit bars a feedlot operator from bringing in any additional animals but does not affect animals already on the premises.

35 For a discussion of these deficiencies, see Jones, *Theory and Future Outlook of Animal Waste Treatment in Canada and the United States*, in CORNELL CONF. 23; Biniek, Economics of Water Pollution Control Measures 11-12, presented to 24th Annual Meeting of the Soil Conservation Society of America, Aug. 1-13, 1969, in Fort Collins, Colo.; Taiganides, *supra* note 25, at 393.

36 Iowa Confinement Feeding Regs. 1.3(4)(a).

37 In both Kansas and Iowa the standard is retention structures sufficient to hold three inches of surface runoff. *Id.* at 1.3(4)(a); 1 KAN. ADMIN. REGS., Board of Health § 28-18-3 (1968).

38 Kansas policy is ten days after rainfall. Gray, *suprà* note 10, at 14. Iowa rules provide for disposal as soon as practicable to ensure adequate future retention capacity. Iowa Confinement Feedings Regs. 1.3(4)(a).

39 This is a point on which there seems to be almost universal agreement. *See, e.g.*, REPORT TO PRESIDENT 30-32; Resnik, *Animal Waste Management—Questions and Answers*, in PROCEEDINGS 33-34.

breaking the agricultural community to the reins of environmental quality control. As with other industries, the key to eliminating feedlot pollution is persuading producers to view expenditures for pollution control as one more necessary cost of doing business.

One regulatory technique that may ultimately be used to alleviate the animal waste disposal problem is systematic land use control. Gone forever is the day when feedlots could with impunity be located astride a stream to take advantage of the water to transport away wastes. Perhaps it is time to take the next step and bar the operation of a feedlot in land areas where it would pose serious threats to environmental quality. Feedlots could be zoned away from sensitive environmental quality areas just as heavy industries are now prohibited from locating in residential areas. A rational plan might call for the concentration of confinement feeding operations in certain areas of a state or region unsuited for a higher land use. Aggregation of feedlot operations near one another would create opportunities for consolidated waste treatment measures, and economies of scale might make feasible waste management techniques now too costly for individual lots.

Application of zoning-type regulations to feedlots is probably a remote contingency at best.[40] However, pollution control agencies may soon evolve parameters relating to such matters as soil porosity, slope, annual rainfall, class of receiving waters, and climate conditions, which will be applied in determining whether a feedlot will be permitted in a particular location.

II

Agricultural Chemicals

A. *Fertilizers*

The physical effects that the principal ingredients of commercial agricultural fertilizers have on water are undisputed. Nitrogen and phosphorus, the two chief nutrients in agricultural fertilizers, directly stimulate and feed the growth of algae, which reduce water quality in a variety of ways. Algae interfere with recreational use of water by imparting a green cast to water color and forming scum and floating mats. Heavy algae growth may compete with other aquatic life forms for dissolved oxygen, reducing fish populations.[41] Algae problems such

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40 The idea is occasionally advanced by pollution control officials. *See* Rademacher, The Alliance for Action 9-12, presented to Conference on the Role of Agriculture, *supra* note 7 (encouraging preparation of model feedlot regulations); Resnik, *supra* note 39, at 33.

41 *See* Report to President 45; President's Science Advisory Comm., Report of the

as the clogging of intake filters and creation of undesirable tastes and odors affect fifty-six percent of the total municipal surface water supplies in the nation.[42] Increased nutrient levels accelerate the eutrophication process by which lakes and reservoirs are converted into bogs and swamps.[43]

Considerable disagreement exists concerning the extent to which increased levels of nutrients in water are attributable to agricultural sources in general, and chemical fertilizers in particular. Those who point an accusing finger at agriculture cite the close parallel between the rise in water nutrient levels and the increased use of chemical fertilizers.[44] A persuasive study of water quality in Iowa streams draining agricultural lands detected sharp rises in nutrient levels after heavy rains. The absence of a corresponding increase in bacteria count suggested that the source of the nutrients was chemicals, not animal wastes.[45] Defenders of agriculture cite high nutrient levels present in watersheds where chemical fertilizers are rarely used and urge that nonagricultural sources are principally responsible for present eutrophication.[46] Notwithstanding the intensive use of chemical fertilizers, modern agricultural practices continue to mine the fertility of the soil[47]—more nutrients are removed in crops than are replaced through natural restorative processes supplemented by chemical addi-

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ENVIRONMENTAL POLLUTION PANEL, RESTORING THE QUALITY OF OUR ENVIRONMENT 174-75 (1965).

42 Baumann & Kelman, Effects of Agricultural Pollutants on Municipal Uses of Surface Waters 8, presented to Conference on the Role of Agriculture, *supra* note 7.

43 *See* Verduin, *Eutrophication and Agriculture in the United States*, in AGRICULTURE & QUALITY 163; Armstrong & Rohlich, Effects of Agricultural Pollution on Eutrophication 1-3, presented to Conference on the Role of Agriculture, *supra* note 7.

44 Fertilizer use has more than doubled in the last 20 years, and in the most productive agricultural regions it has increased to an even greater extent. American farmers currently apply about 40 million tons of chemical fertilizers annually. Fertilizer strength, in terms of the percentages of nitrogen and phosphorus in the compounds, has also been sharply increased. Smith, *Contribution of Fertilizers to Water Pollution*, in 2D COMPENDIUM 13.

45 *See* Morris & Johnson, Pollution Problems in Iowa 11, presented to Iowa Academy of Sciences Annual Conference, April 18, 1969, in Cedar Falls, Iowa. In 1967, a task group of the American Waterworks Association reported agricultural land runoff as the source of 60% of the nitrogen and 42% of the phosphorus in water supplies. Armstrong & Rohlich, *supra* note 43, at 18.

46 *See* Smith, *Fertilizer Nutrients as Contaminants in Water Supplies*, in AGRICULTURE & QUALITY 173; Willrich, *Management of Agricultural Resources to Minimize Pollution of Natural Waters*, in PROCEEDINGS OF THE NATIONAL SYMPOSIUM ON QUALITY STANDARDS FOR NATURAL WATERS 303, 310 (1966).

47 *See* Martin, Fenster & Hanson, Fertilizer Management for Pollution Control 3, preseuted to Conference on the Role of Agriculture, *supra* note 7.

tives.[48] Additionally, it is generally conceded that modern fertilizer application techniques result in minimum escapage of chemicals from the soil;[49] fertilizer that reaches water is usually carried there by eroded soil particles.[50]

Although the available evidence is sketchy, on balance it appears that chemical fertilizers do play an important role in supplying nutrients to our waters, and that this role will increase. The combination of natural sources and industrial and municipal discharges currently bears a slightly greater responsibility for nutrient levels,[51] but if water quality schedules are followed the contributions from industrial and municipal sources should be reduced substantially over the next five years.[52] Chemical fertilizer loss to water can be less than one percent and yet be of great consequence because of the volume applied and the small amount required to affect water quality.[53]

Present use of chemical fertilizers is limited only by the cost-benefit decisions made by individual farmers.[54] No regulation is imposed by either local or national government,[55] and a need for regula-

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48 A more subtle environmental danger from the intensive use of chemical fertilizers was described by Barry Commoner in recent congressional hearings. According to Commoner our soils may be becoming "hooked" on artificial nitrogen fertilizer to the point where microbiological action, which sustains the natural nitrogen-fixing process, terminates. Once it is destroyed, it may not be possible to restore this biological system. Statement of Barry Commoner, in *Hearings on S. Res. 78 Before the Subcomm. on Intergovernmental Relations of the Senate Comm. on Government Operations*, 91st Cong., 1st Sess. 233, 236-37 (1969).

49 *See* Martin, Fenster & Hanson, *supra* note 47, at 5.

50 *See* Smith, *supra* note 46, at 185; Armstrong & Rohlich, *supra* note 43, at 7.

51 *See* 1 COST 217; Baumann & Kelman, *supra* note 42, at 9-10.

52 Municipal and industrial wastes can be treated to remove 90%-95% of the phosphorus. If this were done, agriculture's contribution of phosphorus would be five times greater than that of cities and industries. Smith, *Effect of Agriculture on Water Quality* 5, in 2D COMPENDIUM. It has been questioned whether such treatment should be applied by cities and industries in view of the volume of nutrients of agricultural origin. Baumann & Kelman, *supra* note 42, at 33.

53 Phosphorus, in particular, need be present only in minute quantities to have a significant nutrient impact. *See* Verduin, Significance of Phosphorus in Water Supplies 1-3, presented to Conference on the Role of Agriculture, *supra* note 7. *See also* Martin, Fenster & Hanson, *supra* note 47, at 6.

54 Even this minimal check is not too effective. It is reported that conventional agricultural practice is to over-fertilize if any doubt exists concerning the proper amounts to be applied, on the theory that excess creates no harm. *See* Martin, Fenster & Hanson, *supra* note 47, at 16-17.

55 The regulatory disinterest of state governments is illustrated by Iowa law, which provides that fertilizer is to be regarded as an inert ingredient in pesticide-fertilizer compounds. IOWA CODE ANN. § 206.4(a) (1966).

tion is asserted only sporadically.[56] Considering the degree of reliance on chemical fertilizers for current high levels of agricultural production, severe regulation does not seem likely. Sound farm economic practices require the exercise of some care in the amounts and timing of fertilizer applications.[57] Maximization of fertilizer benefits is generally consistent with minimization of nutrient loss to water, so it is conceivable that regulations designed to promote these twin objectives could be imposed without too much resistance by a pollution control agency determined to do so. The major thrust of an effort to reduce the entry of agricultural nutrients would most profitably be centered on ameliorating conditions of soil erosion through improvement of land management practices, a topic considered in detail below.

B. *Pesticides*

The universal presence of pesticide residues in the nation's waterways is an established fact.[58] The level of pesticide concentrations in water is generally low,[59] but it cannot be assumed that minute quantities are insignificant. The environmental effect of prolonged exposure to sub-lethal amounts of pesticide materials is not known. Evidence is mounting that trace levels of pesticides in water are far from innocuous to aquatic creatures.[60] Furthermore, many of the most persistent pesticides are hydrophobic and escape from water as soon as possible. Low pesticide levels in water samples thus may not reflect accurately the availability of these compounds to living components of the hydrosphere. Bottom sediments may contain pesticide concentrations thousands of times greater than the overlying water.[61]

Although the precise means by which pesticides travel through the

56 *But see* the impassioned plea of Barry Commoner in *Hearings on S. Res. 78, supra* note 48, at 241-43.

57 Applying small amounts of fertilizer several times during the growing season has been shown to improve fertilizer efficiency and incidentally to reduce nutrient loss to water. *See* Workshop Session Number 3, Fertilizers as Water Pollutants 7-8, in Conference on the Role of Agriculture, *supra* note 7.

58 *See* Green, Gunnerson & Lichtenberg, *Pesticides in Our National Waters*, in AGRICULTURE & QUALITY 137.

59 *Id.* at 146-56. Levels are usually well below one part per billion. *See* Morris & Johnson, *supra* note 45, at 19.

60 Transovarially conveyed DDT was shown to have killed fish fry in a New York hatchery. Calcium imbalance resulting in eggshell thinning has been linked to DDT in studies concerning the rapid decline in fish-eating raptorial birds. Nicholson, The Pesticide Burden in Water and Its Significance 3-4, presented to Conference on the Role of Agriculture, *supra* note 7. *See also* CONSERVATION FOUNDATION, POLLUTION BY PESTICIDES 5-7 (1969).

61 Nicholson, *supra* note 60, at 6.

environment is not known,[62] agriculture's major role in their dissemination is generally admitted.[63] More than a billion pounds of pesticides are produced in the United States each year, of which agriculture uses about forty-two percent.[64] As with fertilizers, eroding soil particles are the major vehicles for transporting pesticide elements to waterways.[65] Thus, without regard to other forms of control, preventing soil erosion should greatly reduce the escape into water of pesticides applied to agricultural cropland.

The most effective approach for controlling pollution from pesticides is to regulate their availability and use. Aside from the rash of recent administrative and legislative actions restricting the use of certain persistent pesticides,[66] however, present regulation is concerned chiefly with safeguarding the public from accidental exposure to toxic amounts of pesticides. Primary emphasis is placed on ensuring accurate labeling of pesticides and proper instructions for their use, with testing and surveillance programs designed to protect against harmful residues in food products.

Registration with the Department of Agriculture is required for

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62 *See* REPORT TO PRESIDENT 68-71.

63 *See* Willrich, *supra* note 46, at 305-06.

64 ECONOMIC RESEARCH SERVICE, U.S. DEP'T OF AGRICULTURE, QUANTITIES OF PESTICIDES USED BY FARMERS IN 1964 v (Agric. Econ. Rep. No. 131 (1968)). Popular use of the term "pesticide" has tended to obfuscate the great differences that exist among the chemicals so classed. Over 10,000 commercial fungicides, herbicides, insecticides, and rodenticides are registered, but a handful of chemicals comprise a major share of agriculture's total use. In 1964, of the 170 million pounds of fungicides used, sulfur accounted for 80% of the total. *Id.* Among herbicides, 2, 4-D, and atrazine constituted over half of the 84 million pounds used. *Id.* at 5. Toxaphene, DDT, and aldrin made up 84 million of the 156 million pounds of insecticides used by farmers (*id.* at 6) although DDT use has been steadily declining in recent years. ECONOMIC RESEARCH SERVICE, U.S. DEP'T OF AGRICULTURE, DDT USED IN FARM PRODUCTION iii (Agric. Econ. Rep. No. 158 (1969)). It is principally this latter group of chlorinated hydrocarbon insecticides whose residues have so pervasive an effect on the environment. *See* Nicholson, *supra* note 60, at 8.

65 *See* REPORT TO PRESIDENT 69; Nicholson, *supra* note 60, at 7-8. For a report on an experiment concerning the escape of pesticides into water from cropland runoffs, see Morris & Johnson, *supra* note 45, at 13-20. Accidental spills and improper disposal of pesticide containers by agricultural users are also implicated. *See* REPORT TO PRESIDENT 71; Nicholson, *supra* note 60, at 10-11.

66 *E.g.*, 116 CONG. REC. S 1340-42 (daily ed. Feb. 6, 1970) (Sen. Nelson introduces a bill in the Senate to ban eight chlorinated hydrocarbon insecticides); 2 CCH CLEAN AIR AND WATER NEWS No. 3, at 11 (Jan. 14, 1970) (Ill. Interagency Committee on Pesticides prohibits use of DDT except by special permit); N.Y. Times, Jan. 9, 1970, at 16, col. 3 (Wis. Senate passes bill to ban all DDT uses in all but emergency situations—the Assembly had previously passed the bill); *id.*, Jan. 4, 1970, at 29, col. 1 (Md. Gov. bans use of DDT except when threat of epidemic); *id.*, July 23, 1969, at 47, col. 1 (Cal. Senate passes bill to outlaw DDT after 1971); *id.*, April 17, 1969, at 1, col. 2 (Mich. Agricultural Comm'n votes to cancel registration of all DDT-bearing products).

all "economic poisons"[67] involved in interstate commerce. A pesticide not intended for use in food crops will be registered for use in accordance with the instructions on its label if it is not "injurious to living man or other vertebrate animals, or vegetation, except weeds."[68] The same criteria apply when the pesticide is to be used on a food crop, if proper application results in no residue on the plant. If a residue does remain, a residue tolerance must be established by the Secretary of Health, Education, and Welfare before registration will be granted.[69] The registrant must provide experimental data documenting the effects of different levels of residue and submit a feasible method for removing residue exceeding the tolerance level established.[70]

State regulation of pesticides has paralleled the registration approach of the federal government, but without a comparable concern for pesticide residues in foodstuffs.[71] Nearly every state has laws requiring the registration of pesticide chemicals intended for use within the state.[72] A number of states have additional regulations governing the qualifications of commercial appliers of pesticides.[73] Responsibility for enforcement of the regulations is usually assigned to state departments of agriculture. Until recently, neither state nor federal

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67 Under the Federal Insecticide, Fungicide, and Rodenticide Act, 7 U.S.C. §§ 135-135k (1964), the Secretary of Agriculture is authorized to determine whether a substance is an economic poison. *Id.* § 135b. According to the Act:

> (a) The term "economic poison" means (1) any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any insects, rodents, nematodes, fungi, weeds, and other forms of plant or animal life or viruses, except viruses on or in living man or other animals, which the Secretary shall declare to be a pest, and (2) any substance or mixture of substances intended for use as a plant regulator, defoliant or desicant [*sic*].

Id. § 135.

68 *Id.* § 135(z)(2)(g).

69 7 C.F.R. § 363.11(a) (1969); *see* 21 U.S.C. §§ 331, 342(a), 346a (1964). For the function of the Secretary of Agriculture in the establishment of residue requirements, see *id.* § 346a(*l*).

70 21 U.S.C. §§ 346a(d)(1)(C)-(E) (1964); *see* 21 C.F.R. § 120.7 (1969). Secretary Finch announced that the use of DDT will be curtailed except for "essential" uses within the next two years. N.Y. Times, Nov. 13, 1969, at 1, col. 8. If the federal government were to end all DDT use, it would probably implement this decision by reducing the residue tolerance for that pesticide to zero. *See* 21 U.S.C. § 246a(b) (1964); 21 C.F.R. § 120.5 (1969). The administration's actions, however, have been stalled by the appeals of six pesticide companies. 2 CCH CLEAN AIR AND WATER NEWS No. 2, at 3 (Jan. 14, 1970); N.Y. Times, Jan. 8, 1970, at 14, col. 6.

71 Sigler, *Controlling the Use of Pesticides*, 15 J. PUB. L. 311, 318 (1966).

72 Note, *Agricultural Pesticides: The Need for Improved Control Legislation*, 52 MINN. L. REV. 1242, 1254 (1968).

73 *See, e.g.*, IOWA CODE ANN. § 206.5 (1966); MINN. STAT. ANN. § 18.032 (Supp. 1969).

regulation resulted in extensive testing or surveillance of agricultural pesticides.[74]

Increased restrictions on the use of agricultural pesticides seem almost certain. Although unproved assertions still far outnumber the fragments of available scientific evidence, conservation forces seem to be prevailing in their drive to ban the use of the hardest pesticide products. The reliance of modern agriculture on some of these chemicals and the importance of the production gains achieved through their use make discontinuance of pesticides a difficult step.[75] Nevertheless, the ubiquity of pesticides and the lack of knowledge about their long-term effects warrant at least a moratorium on their use pending more thorough evaluation of the potential environmental harm. Authorization for continued use of chemicals harmful to animal life should be granted only after an affirmative showing that they are harmless to humans. Even this standard ignores the ecologists' warning that our environment supports mankind like a delicate web, the destruction of any single strand of which endangers the whole structure. [76]

Forthcoming pesticide bans will probably be limited to those chemicals causing the most severe environmental hazards. Use of most pesticides will continue, but tighter regulations governing their use are probable. As research[77] produces more selective and short-lived chemicals and more effective biological methods of pest control,[78] their substitution for environmentally inferior products may be required. Similarly, as methods for using existing pesticides with greater environmental safety are found, these procedures may be imposed by regulation. The impressive achievements of agricultural technology in the twentieth century provide hope that increased regulation of pesticide use may not have as severe an impact on food and fiber production as might now be prophesied.[79]

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74 This seems to be a direct result of inadequate expenditures by the states. In 1962 total expenditures of all states in pesticide regulation were less than $800,000. Sigler, *supra* note 71, at 318. Federal Food and Drug officials inspect only about 1/8 of 1% of food products moving in interstate commerce in an attempt to detect violations of residue tolerance levels. Note, *supra* note 72, at 1253.

75 Estimates have been made that without pesticides basic food and fiber crop yields would be cut 10%-25%, and fruit and vegetable yields reduced by 40%-80%. Note, *supra* note 72, at 1245.

76 *See Hearings on S. Res. 78, supra* note 48, at 242.

77 *See* REPORT TO PRESIDENT 77-78, 82a-82g.

78 For a discussion of the promise of emerging biological pest control, see Peters, Pesticides and Pest Management for Maximum Production and Minimum Pollution 4-10, presented to Conference on the Role of Agriculture, *supra* note 7.

79 Some critics assert that selective pesticides will not be forthcoming until sufficient

III

SEDIMENT

It is paradoxical that silt, the most visible of agriculture's contributions to water quality degradation, is little recognized as a pollutant. The public tendency in the past has been to look on turbidity as an unavoidable natural phenomenon and to regard soil erosion as an agronomic problem.[80] Yet, in terms of quantity, sediment is the worst pollutant of the nation's waters.[81] Excess sediment in water impairs recreation, interferes with aquatic creatures, increases the expense of treatment for public water supplies, and is the major carrier of pesticide residues and chemical nutrients.[82] In addition, a great deal of sediment is deposited on the bottoms of our many reservoirs, using up a million acre feet of storage capacity annually.[83]

Although nonagricultural activities are significant, soil erosion from cropland is the largest source of sediment in our waters.[84] Agriculture's principal concern in controlling soil erosion has been to ensure that soil losses do not impair productivity of the land under cultivation. Judged by this standard, erosion losses of several tons of soil per acre have been considered consistent with sound soil management.[85] Turbidity limits in the water quality standards now being established are likely to require a rethinking of this position by agricultural producers. No implementation plan thus far submitted under state standards, however, includes a specific program for abating excess turbidity attributable to agricultural sediment.[86]

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demand for them is produced by halting the use of broad spectrum chemicals. *See, e.g.*, Peters, *id.* at 9-10.

80 *See* Workshop Session, Sediment as a Water Pollutant 20-21, in Conference on the Role of Agriculture, *supra* note 7.

81 Suspended solids reaching streams from agricultural lands are estimated to be at least 700 times the loadings from municipal sewage. Robohn, *supra* note 8, at 3.

82 *See* Glymph & Storey, *Sediment—Its Consequences and Control*, in AGRICULTURE & QUALITY 206-10.

83 REPORT TO PRESIDENT 11.

84 444 million acres are currently under cultivation in the United States. Grassland pasture and range, forested pasture and range, and areas occupied by farmsteads and farm roads bring the total land used for agricultural purposes to 1.3 billion acres. ECONOMIC RESEARCH SERVICE, U.S. DEP'T OF AGRICULTURE, MAJOR USES OF LAND AND WATER IN THE UNITED STATES WITH SPECIAL REFERENCE TO AGRICULTURE, SUMMARY FOR 1964, at 2, 3 (Agric. Econ. Rep. No. 149 (1968)).

85 *See* Workshop Session, *supra* note 80, at 5.

86 For a typical statement see IOWA WATER POLLUTION CONTROL COMM'N, WATER QUALITY AND PLAN FOR IMPLEMENTATION AND ENFORCEMENT FOR THE SURFACE WATERS OF IOWA (1968): "The lack of practicable methods for corrective action precludes the setting of a timetable without further research technology." *Id.* at 33. The statement goes on to

Stopping the transportation of sediment in the waters of an agricultural watershed requires the control of soil erosion in the upper reaches of the drainage area. The most practical method for accomplishing this result is the institution of appropriate soil conservation techniques in the cultivation of cropland from which soil is eroding. In some cases the degree of slope of the land or its soil character makes cultivation without substantial soil loss impossible, but full use of modern soil management methods is usually effective in reducing soil loss to a level that should be acceptable to water quality officials.

To date the governmental instrument for controlling soil erosion has been the soil conservation district. In the dust bowl years of the 1930's, the federal government, believing it lacked power to legislate direct regulations of land use, conceived the idea of attacking the erosion problem through spending desigued to stimulate the organization of conservation districts by local farmers.[87] These districts, as creatures of state law, would be delegated power to enact and enforce land use plans.[88] Federal financial support would be used to supply trained personnel to assist the districts in developing and implementing conservation plans and to reimburse most of the cost incurred by individual landowners in carrying out conservation measures.[89] The Standard State Soil Conservation District Law recommended to the states by the Department of Agriculture thus contemplated a two-pronged approach—encouragement of voluntary landowner participation in the district program through cost-sharing incentives and authorization of compulsory measures to bring recalcitrant landowners into compliance with the district's erosion control program. Somewhere between the drafting board and the operation of local districts, however, the compulsory aspect of the plan was almost uniformly ignored.[90]

Today there are 3,000 soil conservation districts.[91] However, only eight[92] of these districts currently exercise any regulatory power over land use. The approach of the soil conservation districts typically has

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cite plans for cooperation with soil conservation agencies to help prevent soil erosion. *Id.* at 33-34.

87 *See* C. HARDIN, THE POLITICS OF AGRICULTURE 70-71 (1952). *See generally* Ferguson, *Nation-Wide Erosion Control: Soil Conservation Districts and the Power of Land-Use Regulation*, 34 IOWA L. REV. 166 (1949).

88 W. PARKS, SOIL CONSERVATION DISTRICTS IN ACTION 147-49 (1952).

89 *Id.* at 15-24.

90 *See* Glick, *The Coming Transformation of the Soil Conservation District*, 22 J. SOIL & WATER CONSERVATION 44, 47 (1967). *But see* McGowen, *Wyoming's Proposed Soil Conservation Act*, 13 ROCKY MT. L. REV. 115, 120-22 (1941).

91 Glick, *supra* note 90, at 52.

92 Six districts in Colorado, one in North Dakota, and one in Oregon. *Id.* at 47.

been one of offering instruction and incentives for voluntary improvement in soil management techniques. Financial assistance is conditioned upon acceptance and performance of an approved soil conservation program. The voluntary approach has produced enormous improvements in the control of erosion,[93] but after thirty years of operation erosion is still a major problem. It is evident that a purely voluntary soil conservation program is not sufficient to achieve present erosion control goals, let alone to meet the demands for sediment reduction likely to be forthcoming from pollution control agencies. The need for a form of coercion is plain; whether the soil conservation district can be counted upon to supply the necessary prodding is doubtful.

The present lack of enforcement against landowners who fail to comply with local conservation plans is not fully attributable to a lack of statutory authorization, as a majority of state enabling acts provide for enforceable land use controls.[94] The problem lies in the institutional structure of the districts themselves. The districts are early examples of what is now tabbed with such euphemistic labels as "citizen involvement" or "participatory democracy," and decisions controlling land use require at least a simple majority vote of all landowners in the district.[95] Even though a majority of the farmers in a district comply with the local conservation plan, traditional agrarian abhorrence of limitations on freedom of action is likely to lead to rejection of a compulsory program.

If the soil conservation district is unable to respond to the challenge of moving ahead with compulsory land use regulations, some other agency must be developed to fill this need. No existing unit of local government (for example, county or regional planning commission, township or county government, drainage district, regional pollution control board, or state pollution control agency) seems suitable to enact and enforce conservation management regulations. One resource management proposal currently receiving wide discussion[96] and undergoing

93 *See* Wadleigh & Britt, *Conserving Resources and Maintaining a Quality Environment*, 24 J. SOIL & WATER CONSERVATION 172, 175 (1969). In 1954 additional incentives were provided by the Watershed Protection and Flood Prevention Act, 68 Stat. 666 (1954), *as amended* 16 U.S.C. § 1001 (1964), which, in encouraging the creation of small watershed programs, required all land in the watershed to be in compliance with a soil conservation plan.

94 Thirty-three states authorize the adoption of conservation ordinances (Glick, *supra* note 90, at 47 n.3); however, the requirements for passage of such ordinances vary considerably.

95 The majority vote required ranges from 51%-90%. Additional requirements may relate to the percentage of the acreage in the district represented by a vote or a minimum number of eligible voters participating. W. PARKS, *supra* note 88, at 149.

96 *See* Workshop Session, *supra* note 80, at 4.

some experimentation[97] is the watershed or river basin authority. The concept underlying these proposals is that maximum effectiveness in management of a hydrologically-defined area is achieved through comprehensive and coordinated planning and regulation of all facets of the water and water-related land resources.

If such agencies become a reality, they will be the ideal units to enact and enforce land use regulations.[98] Indeed, it is difficult to see how such an agency could regulate water quality effectively without land use control powers. Rural watersheds containing primarily agricultural water users may be the most practical place to test the watershed management model. Concentrations of people and industry create countervailing factors that weigh against organizing the management agency on a purely hydrologic basis.

IV

SALINITY

Excessive salinity is the one type of agriculturally-related pollutant that directly threatens agricultural productivity. This is especially so in the arid Southwest, where high evaporation rates concentrate salts in soils and surface waters, making rivers increasingly salty as they move from the mountains to the sea.[99] Irrigation, on which agriculture in this part of the country relies extensively,[100] compounds the problem. Application of already salty irrigation waters to saline soils not only deposits additional salts in the soil but, through leaching action and loss of water through evaporation and transpiration, increases the salt

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97 *See* MINN. STAT. ANN. §§ 112.34-.85 (1964).

98 [Management regulations] may include requirements for such engineering operations as construction of terraces, dams, and dikes, etc.; requirements for special cropping methods such as strip, contouring lister furrowing, etc.; requirements for specified programs and tillage practices, such as crop rotations; and requirements that highly erosive land be retired from cultivation.

W. PARKS, *supra* note 88, at 148.

99 Dissolved salts are carried by all of our major waterways. The Mississippi River system, for example, carries a much greater amount of dissolved salts than any western river, discharging over 123 million tons of salt compared with the 2.5 million tons discharged by the Colorado. But the enormously greater flow of the Mississippi prevents dissolved salts from being a pollution problem in its drainage area. This is demonstrated by comparing the relative concentrations of salt in the rivers. The Mississippi system carries only 221 ppm salts compared with 2,475 ppm in the Colorado. Thorne & Peterson, *Salinity in United States Waters*, in AGRICULTURE & QUALITY 222.

100 The western regions accounted for 35.1 million of the nation's approximately 38 million acres of irrigated farmland in 1964. G. PAVELIS, IRRIGATION TRENDS AND GROWTH FUNCTIONS FOR THE UNITED STATES 9 (Economic Research Service, U.S. Dep't of Agriculture 1969).

concentration of the return flows.[101] Each irrigator in turn thus boosts the salt level in the river as it passes downstream, making it more and more difficult for the next user to strike a satisfactory salt balance.[102] If an irrigator cannot achieve a satisfactory salt balance, the build-up of salts in his soil reduces the productivity of the land and may ultimately render it sterile. Although excessive salinity has other adverse effects,[103] the danger to the flourishing fruit and vegetable production of the desert Southwest causes the greatest concern.

Of all the agriculturally-related water quality problems discussed in this article, excessive salinity is the least responsive to regulation. A substantial portion of the salts comes from natural sources,[104] direct control of which is not practical. Salt loading resulting from human activity, chiefly agricultural irrigation, likewise poses sticky abatement problems. Restricting agricultural consumption of water is the most direct method of improving water quality, but such an approach would have a severe economic impact. Unless the appropriation law could be adapted to govern such a qualitative factor as salt loading, some type of regional watershed or river basin authority seems necessary to administer a control program based on cutbacks in allowable irrigation diversions.[105]

Mechanical desalination is unlikely ever to be a feasible alternative for irrigators. Diversion of highly saline irrigation return flows into evaporation ponds would reduce salt levels but, if practiced extensively, would greatly diminish the flows in western rivers. Large-scale modification of agricultural practices, such as changing to more salt-resistant or less water-demanding crops, could provide a partial solution, but such adjustments would be difficult to bring about.[106] Such difficulties as these, and the protests of states in the Colorado River

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101 *See* Gindler & Holburt, *Water Salinity Problems: Approaches to Legal and Engineering Solutions*, 9 NATURAL RESOURCES J. 329, 335-36 (1969).

102 A "salt balance" is an equilibrium between the amount of salts added to the soil from all sources and the amount carried away in irrigation return flows. Use of irrigation water to purge the soils of excessive salts aggravates the salinity concentrations of western rivers. *See* REPORT TO PRESIDENT 61-62.

103 Salinity, unless very high, generally has little effect on recreational and aesthetic values of water. Salinity in excess of 500 ppm is undesirable for drinking water supplies, although it apparently poses no health problem. Certain industrial uses of water, such as brewing, textile manufacture, and chemical production, require low levels of salinity. Otherwise, the main adverse effect of salt water is corrosion of pipes and metal parts coming into contact with the water. Gindler & Holburt, *supra* note 101, at 334-35.

104 *See* REPORT TO PRESIDENT 61.

105 *See* Gindler & Holburt, *supra* note 101, at 342-43.

106 *See* REPORT TO PRESIDENT 63, 66.

basin, prompted the federal government to forego establishment of salinity standards for the Colorado River in 1968.[107]

The one solution that captures the imagination of most Southwesterners is the importation of fresh water from another basin to dilute the salt-laden water of the Colorado. Proposals have been advanced for extensive diversions from the water-rich Columbia River system.[108] Besides entailing enormously expensive engineering works, these proposals raise vexing legal, economic, and political questions concerning the relationships of the importing and exporting basins.[109] For the time being, consideration of such a transbasin diversion project has been shelved by Congress.[110]

CONCLUSION

The force of the law has not been brought to bear on agriculture as it has on other major sources of water pollution. Agricultural pollution has thus far been ignored because it is less visible and more difficult to correct than is pollution from municipalities and industry.[111] Currently, only those types of agricultural pollution that are obvious and subject to effective direct control receive regulatory attention.

Public regulation of agricultural pollution will take three primary forms: *(1)* increased controls on point sources where on-site treatment is feasible, *(2)* direct restrictions on the use of chemical inputs to agricultural production, and *(3)* regulation of land use patterns and practices. An illustration of the first type is closer supervision of the

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107 "[S]alinity standards will not be established until we have sufficient information to assure that such standards will be equitable, workable, and enforceable." Secretary of Interior Udall, *Hearings on H.R. 3300 Before the Subcomm. on Irrigation and Reclamation of the House Comm. on Interior and Insular Affairs*, 90th Cong., 2d Sess. 705 (1968). The federal government has been conducting extensive studies of salinity in the Colorado River to provide information to be used in the development of quality standards. 1 COST 214.

108 *See* Clark, *Northwest-Southwest Water Diversion—Plans and Issues*, 3 WILLAMETTE L.J. 215, 239-48 (1965).

109 *See id.* at 254-62; Hanks, *Peace West of the 98th Meridian—A Solution to Federal-State Conflicts over Western Waters*, 23 RUTGERS L. REV. 33 (1968).

110 *See* Colorado River Basin Project Act, 82 Stat. 885 (1968) (codified in scattered sections of 43 U.S.C.).

111 This tendency to ignore agricultural pollution may be coming to an end. In his recent message to Congress on environment, President Nixon pointed to the urgency of the problem of agricultural pollution. The President directed the Council on Environmenal Quality to take appropriate action and recommended that federal funds be made available to solve the problem. N.Y. Times, Feb. 11, 1970, at 32, col. 1.

management of feedlot wastes. Examples of the second type of regulation are prohibitions or procedural limitations on the use of certain chemical biocides, fertilizers, and other additives. In the third category, land use regulations appear essential to effect a meaningful reduction in the soil erosion currently discoloring streams, constricting waterways, filling reservoirs with siltation, and transporting chemicals from field to watercourse. The ideal construct might involve the employment of land use controls by a comprehensive watershed management authority. If this does not come to pass, the granting of such powers to other local districts or to the local pollution control agency would be desirable.