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Factory Fields: Agricultural Practices, Polluted Water and Hypoxic Oceans

by

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FACTORY FIELDS: AGRICULTURAL PRACTICES, POLLUTED WATER AND HYPOXIC OCEANS

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> The History of Life on earth has been a history of interaction between living things and their surroundings. To a large extent, the physical form and the habits of the earth's vegetation and its animal life have been molded by the environment. Considering the whole span of earthly time, the opposite effect, in which life actually modifies its surroundings, has been relatively slight. Only within the moment of time represented by the present century has one species – man – acquired significant power to alter the nature of his world.
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> Rachel Carson[1]
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> I am convinced that both from a technical and from an economic point of view most point source pollution can and will be brought under control in this country in the next 5 to 10 years. As this happens, the problem of pollution from non-point or diffused sources will become our greatest challenge. In no area will the challenge be greater than in agricultural pollution. When we finally succeed in collecting and adequately treating our industrial and municipal wastes we will very likely find that many of our rivers are still dirty, unsafe, and unusable, perhaps because soil erosion makes the water muddy, or pesticide washoff harms the fish life, or reclamation return flow renders the downstream water so brackish as to be unfit for use.
>
> James M. Quigley[2]

I. FACTORY FIELDS: INTRODUCTION

"Factory farming" is a catch-phrase that is most often applied to contemporary practices of meat production in confined animal feeding operations (CAFOs),[3] but it may be even more relevant to apply the phrase to the manner in which farmers[4] in the United States and in most parts of the economically developed world manage their fields. The intensification of production practices so commonly associated with animal confinement has a direct parallel in cropped fields, and the resulting negative implications for human health and the environment exceed by a considerable degree those resulting from CAFOs. As was the case with chicken, hog and dairy farming, the development was incremental in its early stages, and for the most part the new practices were thought to be laudable. Beginning with a broadly

1. RACHEL CARSON, SILENT SPRING 5 (1962).
2. James M. Quigley, *Water Quality and Agriculture, in* AGRICULTURE AND THE QUALITY OF OUR ENVIRONMENT 134 (N.C. Brady ed., 1967).
3. *See, e.g.,* NATURAL RESOURCE DEFENSE COUNCIL AND CLEAN WATER NETWORK, AMERICA'S ANIMAL FACTORIES: HOW STATES FAIL TO PREVENT POLLUTION FROM LIVESTOCK WASTE (1998).
4. For purposes of this article, farming is a practice that is usefully distinguished from ranching. Whereas farming typically involves tilling fields and other intensive manipulations of the soil and water, ranching at least as practiced traditionally, relies on harvesting the natural forage produced by nature.

dispersed and richly varied system of crop production, there has been a steady intensification and narrowing. Some of these steps now seem to have been inevitable, such as the conversion of pasture to cropland when gasoline tractors replaced draft horses. The process has been continuing, however, until today we can observe, with the Pew Oceans Commission, that ". . . [t]he greatest pollution threat to coastal marine life today is the runoff of excess nitrogen from fertilized farm fields, animal feedlots and urban areas."

Many of the stages in the progression to factory fields are not well understood. Principal among these are the complex drainage systems which underlie a good part of our cropland. These systems represent extensive and precisely engineered interference with natural hydrologic systems. While the immediate economic benefits to the farmer or landowner are significant, the external cost imposed upon society is become evident.

The steady intensification of cultivation and drainage practices has been and continues to be facilitated by state laws. Foremost among these are surface water rules that are based upon the premise that the public interest is served when land development is encouraged. This private approach ignores noneconomic factors, including the impact on the public and general resource planning needs. A similar policy is reflected in state water rights law, which places no strong public interest limitation on the effects of development, and license the full use of public waterways to carry-off drainage water. State enabling laws which encourage the formation of public water districts as a vehicle to advance the private economic goals of farmers have, it is argued here, the single most profound effect in augmenting runoff pollution from factory fields.

In addition to the steady encouragement from state laws, the emergence of factory fields has been subsidized directly and generously by the United States. Federal programs which were initiated in the name of soil erosion control evolved into a subsidy program in support of production enhancing techniques, principal among which was field drainage. Thus, just as the federal government subsidized creation of the western irrigation economy, it subsidized the conversion of eastern and Midwestern agriculture to a system of factory fields built around extensive, subsidized land drainage. A second and far more generous layer of farm subsidies took the form of price and income support for farmers who grow "commodity" crops, one effect was to concentrate payments in the hands of larger producers, thus assuring that landholdings and farm businesses would steadily concentrate.

This facilitation of ever more intensive crop practices was continued when in 1972, Congress exempted drainage and field runoff from the regulatory provisions of the Clean Water Act, despite a full awareness on the part of the legislators that the problem of runoff pollution was perhaps the most difficult challenge of all.

Finally, the effects of factory fields are now pressing not only because of their cumulative effects, but by the looming dramatic changes in the agricultural land tenure system. The average age of the farm population is now in the range normally associated with retirement. Ownership by investors and non-residents is increased sharply, and may soon reach a level of fifty percent. The migration of population, including skilled farmers, from farming regions continues. Put simply, farming may soon be fully disconnected from the idea of land and land stewardship. Farmers and farming in the United States managed for a surprising long period to avoid viewing land as just another commodity to be bought, sold and traded for. It is suggested here that the changes now underway represent, in the new vocabulary of globalization, the full "commodification" of our agricultural land. With this, we will have the confirmation of fields as a place for factory production methods.

II. DRAINAGE BASICS

A. It Begins Somewhere

In the Gulf of Mexico there is a zone along the Texas-Louisiana coast where water near the sea floor suffers hypoxic conditions. Hypoxia means "low-oxygen," and in estuaries, lakes, and coastal waters low oxygen usually means a concentration of less than 2 parts per million. In many cases, hypoxic waters do not have oxygen in amounts sufficient to support fish and other aquatic life. This condition is typically caused by the presence of excess nutrients in water, resulting in intensive growth of algae. The consequences of this enhanced growth are reduced sunlight penetrating the water, a decreased amount of oxygen dissolved in the water, and a loss of habitat for aquatic life. The decrease in dissolved oxygen is caused by the degradation of dead plant material, which consumes available oxygen, and the overall effect is called eutrophication. Nutrients can come from many sources, such as fertilizers applied to agricultural fields, golf courses, and suburban lawns, deposition of nitrogen from the atmosphere, erosion of soil containing nutrients, and sewage treatment plant discharges.

The hypoxic zone in the Gulf is thought to be caused primarily by excess nitrogen delivered from the Mississippi River in combination with seasonal stratification (layering) of Gulf waters. There is general agreement that the runoff of nutrients from agricultural land has degraded the quality of water in the Mississippi Basin and has caused these hypoxic conditions.[5]

It begins somewhere.

According to the 2003 Report of the Pew Oceans Commission nonpoint sources present the "greatest pollution threat to our oceans and coasts:"

> The greatest pollution threat to coastal marine life today is the runoff of excess nitrogen from fertilized farm fields, animal feedlots and urban areas. Airborne nitrogen – from industrial smokestacks, automobile exhaust pipes, and ammonia rising from huge manure lagoons – is also deposited in the ocean.
>
> Just as they fertilize the land, nutrients fertilize coastal waters, and excess amounts can cause massive blooms of algae. These blooms can trigger a chain of events that deplete the ocean waters of oxygen, turning vast areas into hypoxic zones, also known as dead zones. Some of these algae

5. NATIONAL SCIENCE AND TECHNOLOGY COUNCIL, COMMISSION ON ENVIRONMENT AND NATURAL RESOURCES, AN INTEGRATED ASSESSMENT: HYPOXIA IN THE NORTHERN GULF OF MEXICO 19 (2000).

> blooms produce toxins that can be fatal to fish, marine mammals, and occasionally people.
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> * * *
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> [S]cientists now believe that nutrients are the primary pollution threat to living marine resources.[6]

The problem is not restricted to the Gulf of Mexico. Reports support a conclusion that agricultural runoff is the leading pollutant source for these hypoxic zones in 13 of the nation's 17 most polluted bays.[7] According to the Pew Oceans Commission, ". . . [m]ore than 60 percent of our coastal rivers and bays are moderately to severely degraded by nutrient runoff."[8]

Almost simultaneously with issuance of the report of the Pew Oceans Commission, the Bush Administration's U.S. Commission on Ocean Policy issued a comprehensive report which states:

> Coastal waters are one of the nation's greatest assets, yet they are being bombarded with pollutants from a variety of sources. While progress has been made in reducing point sources of pollution, nonpoint source pollution has increased and is the primary cause of nutrient enrichment, hypoxia, harmful algal blooms, toxic contamination, and other problems that plague coastal waters. Nonpoint source pollution occurs when rainfall and snowmelt wash pollutants such as fertilizers, pesticides, bacteria, viruses, pet waste, sediments, oil, chemicals, and litter into our rivers and coastal waters. Other pollutants, such as mercury and some organic chemicals, can be carried vast distances through the atmosphere before settling into ocean waters.
>
> Our failure to properly manage the human activities that affect the nation's oceans, coasts, and Great Lakes is compromising their ecological integrity, diminishing our ability to fully realize their potential, costing us jobs and revenue, threatening human health, and putting our future at risk.[9]

Similarly, a published review of the issue by the National Science and Technology Council:

> Hypoxia, and other symptoms of eutrophication, such as growth of nuisance or toxic algae and loss of submerged aquatic vegetation, are major stresses in many coastal ecosystems. Over half of the nations estuaries experience low oxygen and other symptoms of eutrophication. Almost all of these problems are caused or exacerbated by the increased flow of nutrients from land due to human activities. There is growing evidence around the world that low oxygen is having pervasive effects on shallow coastal and estuarine areas. While hypoxia can occur naturally and has existed throughout geologic time, its occurrence in shallow coastal

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6. PEW OCEANS COMMISSION, AMERICA'S LIVING OCEANS: CHARTING A COURSE FOR SEA CHANGE 2, 6, 60 (2003).
7. ENVIRONMENTAL DEFENSE, BRINGING DEAD ZONES BACK TO LIFE: HOW CONGRESS, FARMERS AND FEEDLOT OPERATORS CAN SAVE AMERICA'S MOST POLLUTED BAYS 3 (2001).
8. PEW OCEANS COMMISSION, *supra* note 6, at vi.
9. U.S. COMMISSION ON OCEAN POLICY, AN OCEAN BLUEPRINT FOR THE 21ST CENTURY xxxiii (2004).

> and estuarine areas appears to be increasing and is most likely accelerated by human activities.
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> The principal sources of nitrate in the [Mississippi-Atchafalaya River Basin] are river basins that drain agricultural land in southern Minnesota, Iowa, Illinois, Indiana, and Ohio. This is an area of intensive corn and soybean production, where large amounts of nitrogen from fertilizer and manure are applied to soils every year. Legumes and atmospheric deposition add nitrogen to the soils in this region, which also contain large amounts of organic nitrogen, some of which is converted to soluble nitrate each year. The nitrate accumulated from all sources and not used by crops or removed by biogeochemical processes is subject to being leached to streams and ground water by precipitation. Extensive use of tile drains in this region can intercept water with high levels of nitrate and accelerate its transport directly to ditches and streams.[10]

It would be wrong to assume that this vast accumulation of nitrogen and other pollutants originated from a pastoral setting of fields and pastures. Although a share of the pollutants which end-up in our gulfs and bays do originate from relatively natural areas, where there may be little in the way of capital infrastructure, the true picture is that of an agricultural production system which is based upon a complex system of institutions and engineering projects. In order to understand the magnitude of the challenge which confronts us in restoring our waterways, it is essential that we have an appreciation of both the source and the scope of the problem.

B. THE TECHNIQUES OF AGRICULTURAL DRAINAGE

1. *Definition and Purposes*

It begins somewhere. Beneath millions of acres of America's farmlands lie complex pipe systems which gather water and speed its flow toward streams and rivers. This system is comparable in its operational principles to a vast municipal sewer.

Agricultural drainage has been defined as the art and science of removing water from land to enhance agricultural operations.[11] One engineering treatise states that: "The main objective of agricultural land drainage is to remove excess water in order to improve the profitability of farming the land."[12] Another definition states: "The objective of drainage in agriculture is to create between the soil surface and the water table a partially saturated zone of optimum quality and extent for exploitation

10. NATIONAL SCIENCE AND TECHNOLOGY COUNCIL, *supra* note 5, at 12, 21-22.

11. L.K. SMEDEMA & D.W. RYCROFT, LAND DRAINAGE: PLANNING AND DESIGN OF AGRICULTURAL DRAINAGE SYSTEMS 39 (1984).

12. DRAINAGE FOR AGRICULTURE 311 (J. Van Schilfgaarde ed., 1974); *see also* G.O. SCHWAB ET AL., SOIL AND WATER CONSERVATION ENGINEERING 1 (3d ed. 1981) (1966). Drainage is the removal of excess water from wet land.

by plants and for the management of the soil and crops by the farmer."[13]

The incentives for constructing drainage structures on and beneath agricultural land are several. First, some soils, either due to their structure or their topography, are waterlogged during a portion of the growing season. In this condition plant roots do not receive adequate oxygen, soil is compacted, and crop growth is hindered; drainage can correct this problem.[14] Second, constructed drainage may lengthen the crop growing season on a particular farm. When fields are slow to lose the moisture that builds up after the spring thaw or heavy rains, the farmer must delay planting, weed control, harvesting, and other field work. If the land is seeded to pasture, there are delays in turning livestock in; drainage can correct this problem.[15] Third, drainage allows farmers to bring into production land which nature has otherwise claimed as swamp, wetland, slough or marsh.[16] Despite the resulting loss to water conservation and wildlife habitat, the opportunity to "make land" is an inviting prospect for the landowner, particularly when agricultural land values are high. Fourth, drainage is a device which allows farmers to improve the productivity of land already in production. For example, land that is naturally wet, and has supported only grass may, after drainage, be brought into row-crop production.[17] Fifth, agricultural drainage pipe systems are an essential engineering feature of most organized irrigation projects. Land under irrigation is exposed to the risk of waterlogging with resultant leaching of chemical salts into the plant root zone. By placing drainage pipes beneath the root zone, the risk of salinity is reduced. Salinity control may also be an objective of drainage on farms not served by irrigation.[18]

The farmer who drains farmland is influencing the hydrologic cycle by accelerating the flow of excess water from the land before it "damages" the soil structure and affects the crop.[19] This practice is well-accepted and is closely associated with good land husbandry.[20] The economic incentive for drainage by the individual landowner is compelling, for it presents an opportunity, at relatively low cost, to increase the production of a capital asset that is already owned. Despite the enormous acreage of land already drained in this country, the combination of intense economic pressure on farmers to improve production in order to achieve profitability, and, the ever improving efficiency and diminishing cost of drainage technology, creates an economic environment in which a rapid expansion of

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13. DRAINAGE FOR AGRICULTURE, *supra* note 12, at 311.

14. FIELD DRAINAGE: PRINCIPLES AND PRACTICE 21 (D. Castle et al. eds., 1985); DRAINAGE FOR AGRICULTURE, *supra* note 12, at 7.

15. DRAINAGE FOR AGRICULTURE, *supra* note 12, at 55.

16. FIELD DRAINAGE: PRINCIPLES AND PRACTICE, *supra* note 14, at 20; SCHWAB, *supra* note 12, at 1.

17. FIELD DRAINAGE: PRINCIPLES AND PRACTICE, *supra* note 14, at 20.

18. DRAINAGE FOR AGRICULTURE, *supra* note 12, at 93.

> It has been said that every irrigation project eventually becomes a drainage project. Ditches for the collection of waste water and its redistribution to other users, and for the drainage of what would otherwise become seeped and boggy lands, are commonly constructed as part of modern projects, or as additions to older projects, by drainage districts or by the irrigation district that distribute the water.

FRANK J. TRELEASE & GEORGE A. GOULD, WATER LAW CASES AND MATERIALS 232-233 (4th ed. 1986).

19. FIELD DRAINAGE: PRINCIPLES AND PRACTICE, *supra* note 14, at 69.

20. *See, e.g.*, Gross v. Connecticut Mutual Life Insurance Company, 361 N.W. 2d 259 (S.D. 1985).

drainage is under way.[21] Technical engineering sources hold that excess water continues to be a "major problem" on 25 percent of the total cropland in the United States.[22] Moreover, as more of America's productive farmland accumulates in the hands of larger operating entities, "bottom-line" demands for profit accelerate the expansion of agricultural land drainage.[23]

2. *Drainage Techniques*

Taken in the aggregate, the engineering features of drainage are far from simple, and represent extensive and precise interference with natural hydrologic systems. Their purpose is to move water quickly from where it is not wanted – farm fields – to watercourses which will carry it away from the area. A good portion of this water would, under natural conditions, remain in the soil and never reach a watercourse. This is particularly true in the Great Plains where, although annual rainfall is not great, the topography is such that soils retain the greatest part of precipitation rather than lose it to streams through runoff. Hence, agricultural field drainage not only speeds the flow of water to rivers and streams, it also augments flows in those rivers and streams well beyond natural levels, thus serving as a major contributor to flooding.

Typical drainage is not unlike a municipal sewer collector system. A large number of small pipes carry flows to larger conduits where the waters are gathered for disposal. The waters are collected on the surface and the subsurface of the land. Surface water passes rather quickly over the soil without infiltrating it. As it does so it picks up suspended and soluble material. Subsurface water moves slowly through the soil, and in so doing leaches chemicals from it.[24] Typical agricultural field drainage is accomplished by a combination of field shaping and leveling, as well as surface and subsurface pipes and drains. Each system will reflect the topography, climate, soil-type, cropping pattern and economics of the particular farm enterprise.[25] Surface ditches and pipe drains, in combination with open channels are the most frequent methods used.[26] Because drainage rarely honors surveyor's lines, it is customary for neighboring landowners to cooperate in developing drainage, and large special municipal drainage districts are commonplace.[27]

Subsurface drains are placed in the ground directly below the root zone. They may be spaced as closely as every four feet but typically are found in spacings of more than 20 to 30 feet. The pipe drains may be concrete, burned clay tile, corrugated plastic tubing or other perforated conduit. Corrugated steel is used where there is a heavy soil load or unstable soils, and to provide a stable outlet into open

21. Jon R. Luoma, *Twilight in Pothole Country*, AUDUBON, Sept. 1985, at 68, 75.
22. SCHWAB, *supra* note 12, at 5.
23. The potential for problems is world-wide, as so many countries are feeling pressure to bring new land into production in order to achieve domestic food requirements and compete for export markets. DRAINAGE FOR AGRICULTURE, *supra* note 12, at xv.
24. *Id.* at 490.
25. *Id.* at 93.
26. SCHWAB, *supra* note 12, at 8.
27. *See infra* note 74.

ditches.[28] Installation is by a variety of trenching methods. Recent advances in the technology of installation has made field drainage more available than ever before.[29] Rolled plastic pipe can now be buried on the move by trenching "pipe trains" which simultaneously dig the trench, install the pipe at the correct angle and cover it. "Lateral" drains are intended to receive water directly from the soil and pass it on to "main lines" which gather the flows. Main lines can be either surface or subsurface conduits.[30] The patterns for the layout of subsurface drains are usually described in four categories: (1) The herringbone, used in areas that have a concave surface or a narrow draw with the land sloping to it from either direction; (2) The gridiron, which is similar to the herringbone except the laterals enter only from one side; (3) The cutoff or interceptor, which is normally placed over the upper edge of a wet area; (4) The random design, used in smaller isolated areas.[31] The outlets for subsurface pipe drains are usually operated on gravity principles although pump drains are frequently used.[32] The benefits of subsurface drains are that they: (1) Do not interfere with farming; (2) Make more efficient those soils that do not drain naturally; (3) Aerate the soil; (4) Remove salts and other toxics from the root zone; and, (5) Reduce surface runoff.[33]

Surface drains (open ditches) are an essential complement to subsurface drainage.[34] Open channels provide outlets for tile and surface drains and also carry-off surface waters. They generally are earth-lined and drain much larger areas.[35] The open drain is excellent for rapid removal of large quantities of water, and also enjoys great cost advantages over covered drains.[36] A very common use of the open channel is to connect wetlands to drains so that the wetland areas can be farmed.[37] So used, the channel will rarely be more than one or two yards deep, and may be so shaped that it can be farmed or, at least, allow for the easy passage of farm vehicles. From an engineering standpoint, a properly designed open ditch should provide: (1) a velocity of flow that does not allow scouring or sedimentation; (2) sufficient capacity; (3) stable side slopes; and, (4) correct hydraulic grade.[38] Major channels, of course, may require substantial structures of concrete or other materials, the purpose of which is channel stabilization.[39]

Earth embankments and farm ponds are sometimes used as part of surface land drainage schemes. They normally serve to hold-back water so that it may be used for other purposes such as stock-watering or irrigation. Additionally, they serve the advantageous role of keeping waters from main channels where it can contribute to flooding.[40]

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28. SCHWAB, *supra* note 12, at 318-19.
29. *Id.* at 348-50.
30. *Id.* at 319.
31. *Id.* at 321-22. *See also* SMEDEMA & RYCROFT, *supra* note 11, at 50-95.
32. SCHWAB, *supra* note 12, at 322-23.
33. *Id.* at 314.
34. DRAINAGE FOR AGRICULTURE, *supra* note 12, at 101.
35. SCHWAB, *supra* note 15, at 290.
36. DRAINAGE FOR AGRICULTURE, *supra* note 13, at 99.
37. *Id.* at 101. *See also* Jon Luoma, *supra* note 21, at 69.
38. SCHWAB, *supra* note 12, at 290.
39. *Id.* at 186.
40. *Id.* at 211.

Random field drains are best suited for draining scattered depressions or potholes. The location and direction of these drains will be dictated largely by the topography. Side slopes are generally as flat as possible so that tillage operations can be performed through the channels. Erosion in the channel is generally not a problem because the grades are flat. Spoil from the channel should be spread or moved into the depression to reduce the depth of the drain.

Where fields are flat with slopes less than 1 or 2 percent, a system of parallel drains is often used. Where dead furrows are left by plowing lands at the same location for several years, the drainage system is known as "bedding."

C. THE EXPANSION OF FIELD DRAINAGE PRACTICES

Drainage has, of course, been practiced for more than two thousand years. Discussions of it can be found in Roman history and that of most other significant civilizations.[41] For example, in England a royal charter was granted in 1252 to a board of commissioners which sat as a court to maintain drainage, carry-out drainage improvements and resolve land drainage disputes.[42] But it is since the second half of the nineteenth century, with the development of drainage engineering theory and manufactured drain tile, combined with extravagant public subsidy that it has become commonplace. Moreover, with the importance of irrigation in the American West and the growth of irrigation as an eastern phenomenon, drainage is of increasing significance everywhere. So common is the practice of drainage that references to statistics hardly seems necessary. Observers of American farming are keenly aware that drainage engineering programs are an integral part of most successful farms, and that successful farming regions will inevitably boast of many organized drainage districts. The 1969 Agricultural census indicated that organized municipal drainage projects provided drainage over ninety million acres of land. Landowners invested in drainage systems on over 29 million acres of farmland in 1975-77. For those same years owners of 24 million acres of farmland reported investing about $2.25 billion for drainage. About 15 percent of all owners making drainage investments during 1975-77 participated in some type of drainage district. It is said that about 54 million acres of land presently in agricultural production in the United States could be made more productive by the application of drainage practices. About two-thirds of the land yet to be drained is in the South and the greatest amount of drainage has occurred in Iowa, Minnesota, Illinois, Indiana and Ohio.[43]

A continuing objective of drainage systems is to drain wetlands in order to bring land into production. A recent report points out that even before 1920 nearly one-half million acres of North Dakota wetlands were drained, and they continue to

41. *See generally* Wooten & Jones, *The History of Our Drainage Enterprises, in* U.S.D.A. WATER: THE YEARBOOK OF AGRICULTURE 478 (1955).

42. FIELD DRAINAGE: PRINCIPLES AND PRACTICE, *supra* note 14, at 222.

43. Lewis & McDonald, *Improving U.S. Farmland* , 482 U.S.D.A. AGRICULTURE INFORMATION BULLETIN (Nov. 1984); *see infra* note 74.

be drained at the rate of 20,000 acres per year.[44] One of the states most blessed with surface water – Minnesota – has lost 90 percent of its natural wetlands to agricultural drainage.[45]

D. THE CONNECTION WITH WATER POLLUTION

Land cultivation is a major polluting activity which among other things increases the amount of soil erosion.[46] Water from farm fields is also the primary carrier of pollutants from farmland. Drainage water or irrigation return flows carry sediment and chemicals[47] and the consequences of drainage will typically include a change in the quality of the drainage water.[48] All natural waters and soils contain chemical salts, which drainage water will collect and concentrate. Although the collection of salts in drainage water is most often associated with irrigation return flows where salts have the best chance to concentrate in evaporating desert water, this phenomenon is also associated with drainage of humid lands.

Drainage water will always gather sediment as well. One effect of most drainage systems is to accelerate the flow of water during spring thaw or immediately following rainfall. Waters that would naturally be retained in fields or flow quite slowly toward watercourses, are gathered rapidly and cast into watercourses. As flows accumulate in open channels the soil is scoured, and sediment loads increased. Soil particles in water not only indicate loss of soils by erosion, but they carry attached to them most chemicals found in the soils.[49] It is agreed that sediment is the major nonpoint (unregulated) pollutant of American waters.[50] Sediment directly damages waters but these waters also carry nutrients and pesticides from fields.[51] In the long term it is the presence of fertilizers, agricultural chemicals and trace materials attached to the sediment that make agricultural drainage a major source of water pollution. That which is a benefit in the field can be a disaster when transmitted to surface and groundwater.

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44. Luoma, *supra* note 21, at 69.

45. *Id.* at 75.

46. John C. Keene, *Managing Agricultural Pollution*, 11 ECOLOGY L.Q. 135, 137 (1983). *See also* Robert W. Adler, *Water Quality and Agricultural: Assessing Alternative Futures*, 25 ENVIRONS ENVTL. L. & POL'Y J. 77, 78 (2002); James Stephen Carpenter, *Farm Chemicals, Soil Erosion, and Sustainable Agriculture*, 13 STAN. ENVTL. L. J. 190, 209-10 (1994); John H. Davidson, *Little Waters: The Relationship Between Water Pollution and Agricultural Drainage*, 17 Envtl. L. Rep. 10074 (1987); J.B. Ruhl, *Farms, Their Environmental Harms, and Environmental Law*, 27 ECOLOGY. L. Q. 263, 274-292 (2000); David Zaring, *Agriculture, Nonpoint Source Pollution, and Regulatory Control: The Clean Water Act's Bleak Present and Future*, 20 HARV. ENVTL. L. REV. 515, 516-521 (1996). The landmark article remains, N. William Hines, *Agriculture: The Unseen Foe in the War on Pollution*, 55 CORNELL L. REV. 740 (1970).

47. SCHWAB, *supra* note 12, at 387.

48. DRAINAGE FOR AGRICULTURE, *supra* note 12, at 3.

49. SCHWAB, *supra* note 12, at 388.

50. R. BEASLEY ET AL., EROSION AND SEDIMENT POLLUTION CONTROL 3 (2d ed. 1992) (1984). In six of the ten EPA regions, pollution from such nonpoint sources as farms is the principal cause of water quality problems. *Resources for the Future*, RESOURCES 24 (Winter 1984).

51. BEASLEY ET AL., *supra* note 50, at 3.

E. The Connection With Soil Erosion

If agricultural drainage water carries salts, sediments and agricultural chemicals to our rivers and streams, there is an inevitable connection with soil erosion. Erosion, of course, is a primary source of the sediments that travel to streams.[52] Reports are that at least three billion metric tons of soil are washed annually from fields and pastures.[53] Other observers report much higher rates.[54] Such soil loss contributes large pollutant loads to receiving waters. Curiously, soil erosion control techniques are well understood by scientists and engineers and, lessons that were well established by 1939 are still available for those willing to listen.[55] The observation has relevance since to the extent that sediments can be contained in fields a good portion of the concern over pollution is resolved. Although the methodology is understood, it has not been used correctly, despite federal soil conservation expenditures in the billions of dollars.[56]

III. STATE LAWS FACILITATE THE DEVELOPMENT OF FACTORY FIELDS

A. SURFACE WATER RULES

In the early days of agricultural development in this country, there prevailed a presumption in favor of drainage.[57] So common were disputes and so careful were the courts to promote land drainage, that a common law of surface water drainage emerged as a particular subset of the common law. During the early part of United States history, courts decided these drainage disputes on the basis of the so-called common enemy rule, which creates an absolute entitlement to use and improve land by declaring that the right to alter drainage patterns is incidental to the landowner's absolute dominion over property.[58] Thus, any damages incurred by neighboring landowners afforded no cause of action.[59] In its pure form, the common enemy rule

52. *See generally* James L. Arts & William L. Church, *Soil Erosion – The Next Crisis?,* 1982 WIS. L. REV. 535 (1982). *See also* Victor John Yannacone, Jr., *Agricultural Lands, Fertile Soils, Popular Sovereignty, The Trust Doctrine, Environmental Impact Assessment and the Natural Law,* 51 N.D. L. REV. 615 (1975).

53. SCHWAB, *supra* note 12, at 3.

54. Others suggest a figure of four billion tons. BEASLEY ET AL., *supra* note 50, at 12.

> In 1982, forces of erosion moved almost 3.1 billion tons of soil from America's cropland, 1.4 billion by wind and 1.7 billion by water. This loss of topsoil is replenished at a rate of less than one inch in 200 years. *** Depending on a variety of factors, between 25 and 40% of soil that erodes from a field will reach a water body.

J.B. Ruhl, *supra* note 46, at 277-78.

55. *See generally* H. BENNETT, ELEMENTS OF SOIL CONSERVATION (1947).

56. The figure easily exceeds $30 billion. K. MEYER ET AL., AGRICULTURAL LAW: CASES AND MATERIALS 776 (1985).

57. Robert E. Beck, *Drainage, Flooding and Wetlands Preservation, in* 5 WATERS AND WATER RIGHTS 727-728 (R.E. Beck ed., Supp. 1998).

58. Peter N. Davis, *Drainage, in* 5 WATERS AND WATER RIGHTS 739-740 (R.E. Beck ed., 1998). *See also* John H. Davidson & Martin Weeks, Jr., *Drainage in South Dakota: Wetlands, Lucas, Watersheds, and the 1985 Drainage Legislation,* 42 S.D. L. REV. 11, 15-17 (1997).

59. Peter N. Davis, *supra* note 58, at 739.

constituted something like a rule of non-law,[60] although it did define the property rights of adjoining landowners with the greatest certainty.

The common enemy rule led inevitably to drainage wars. The resulting disruption, combined with changing conditions in society, caused many courts to alter the rule. One common reform was adoption of a "natural flow" rule, sometimes referred to as the civil law rule. This rule, also based in property concepts, creates a servitude which requires landowners to accept waters naturally flowing from higher lands. In other words, the upper landowner can release waters into their naturally occurring drains or courses, but may not increase the volume of the natural flow or alter its course.[61] This rule also resulted in a predictable property interest, but was seen, eventually to hinder land drainage and development[62] and as the result a broader "reasonable use" rule evolved which is considerably more tolerant of land developments which augment natural flows and alter natural courses. Setting aside rules based on property rights and concepts, the new rule is based on the tort principle of reasonableness.[63] "Improving" landowners are free to make reasonable use of their land, even if this causes changes in surface water flows. In a leading reasonable use case the court laid down the test:

> that each possessor is legally privileged to make a reasonable use of his land, even though the flow of surface waters is altered thereby and causes some harm to others, but incurs liability when his harmful interference with the flow of surface water is unreasonable.[64]

That court went on to describe its rationale for adopting the rule:

> The rule of reasonableness has the particular virtue of flexibility. The issue of reasonableness or unreasonableness becomes a question of fact to be determined in each case upon a consideration of all the relevant circumstances, including such factors as the amount of harm cause, the forseeability of the harm which results, the purpose or motive with which the possessor acted, and all other relevant matter. . . . It is, of course, true that society has a great interest that land shall be developed for the greater good. It is therefore properly a consideration in these cases whether the utility of the pcssessor's use of his land outweighs the gravity of the harm which results from his alteration of the flow of surface waters. . . . Social progress and the common wellbeing are in actuality better served by a just and right balancing of the competing interests according to the general principles of fairness and common sense which attend the application of the rule of reason.[65]

The private drainage law approach presumes in favor of drainage and, no doubt, has lent support to an idea that drainage of land is an unassailable property right. The difficulty is that this approach ignores noneconomic factors, encourage

60. R.S. HARNSBERGER & NORMAN W. THORSON, NEBRASKA WATER LAW AND ADMINISTRATION 158 (1984).

61. Davis, *supra* note 58, at 740-41.

62. D.H. Cole, *Liability Rules For Surface Water Drainage: A Simple Economic Analysis*, 12 GEO. MASON L. REV. 35 (1989).

63. Davis, *supra* note 58, at 741-743.

64. Armstrong v. Francis Corp., 120 A.2d 4, 8 (1956).

65. *Id.* at 10.

externalization of significant costs, and focuses exclusively on the short term.[66] As between individuals an element of public interest is interjected, but rarely resolved the matter.

B. WATER RIGHTS LAWS

Closely related in effect, but existing as a legal category distinct from common law rules of land drainage are the rules by which states allocate the right among competing claimants to the use of water. Historically the states in the water abundant eastern regions have followed rules known as "riparian," and states in the arid and semi-arid regions have followed rules known customarily as "prior appropriation." Both today are typically re-structured and exist within an administrative system, but the underlying concepts retain substance.

In riparian states, the right to use flowing water is tied to ownership of the adjacent ("riparian") land.[67] The right is a property right, yet is "temporary and usufructuary" in character. The amount a riparian gets is a function of the amount available, the purpose contemplated, and the amount that other riparians are using. Thus, in general, all riparian landowners have a right to make use of a reasonable amount of the water in a stream. Each controversy is fact-specific and resolved after consideration of a variety of factors. The ultimate goal is, however, the maximum utilization of the stream. Even the earliest riparian cases recognized that "[i]t is for the public interest that all our streams be improved as far as they can be" and "the rule to be adopted is one that will promote the largest possible utilization of waterpower."[68]

In contrast to riparianism, the western state's doctrine of prior appropriation separates the right to use water from land ownership and allocates the right according to priority of use, as measured at the point in time and by the amount of water diverted and applied. Thus, in times of shortage, competing users must yield to the "senior" user. In other words, a property right is created by the diversion of water and its application to be "beneficial" use. Water can be used at any location. The overall purpose of prior appropriation is to ration a scarce resource, and to encourage development by describing a property right with certainty.[69]

Closely associated with these rules describing the allocation of the right to use water are those describing the right to use the watercourse. As Judge Posner wrote in Okaw Drainage District v. National Distillers and Chemicals Corporation:

> A riparian owner may use the river and its waters for drinking, drainage, recreation, transportation, powering a mill, dilution of pollutants, and a

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66. R.E. Beck, *Drainage*, *in* 5 WATERS AND WATER RIGHTS 513-517 (2d ed. Supp. 1991). Professor Beck writes: "The difficulty with the private drainage law approach is that it tends to ignore other relevant, but noneconomic, factors and to focus on too limited a horizon – the particular, individual landowners – rather than on general resource planning needs." *Id.* at 513.

67. On riparianism, *see generally* Joseph W. Dellapenna, *Introduction to Riparian Rights*, *in* 1 WATERS AND WATER RIGHTS 6-1 to 6-185 (R.E. Beck ed., Supp. 2001).

68. Mason v. Hoyle, 14 A. 786, 789, 793 (1888).

69. On prior appropriation generally, *see* Owen L. Anderson et al., *Prior Appropriation*, *in* 2 WATERS AND WATER RIGHTS 11-1 to 11-53 (R.E. Beck ed., Supp. 2001).

> variety of other activities – but is one of these other activities the use of the river as a conduit for water that the owner pumps into the river for his use downstream? We have found no case on this point, either, but we can think of no reason why it could not be a lawful riparian use.[70]

The Court concludes that a riparian owner has a right to use a watercourse for drainage and can enforce that right against "unreasonable interference from another riparian owner."[71] Thus, the water rights laws of the states clear the way for the public waterways to be used to carry off drainage waters from farm fields, free of practical legal limits.

Drainage of farm fields is not limited to the humid regions of the east and south-east, and "[e]very irrigation project eventually becomes a drainage project:"[72]

> Adequate drainage – whether natural or provided through installation of drainage systems – is a necessity to maintain irrigated agriculture overtime. Without leaching, the concentrations of salts dispersed in soil solutions continues to increase and can become sufficiently high that it prevents crops from absorbing water. Without drainage to remove the leaching water, the water table will rise. The end result is a waterlogged, saline soil. [73]

It is, therefore, essential to intensified contemporary agriculture that the public watercourse be available to accept drainage water, free of legal impediment; such is everywhere the case.

C. CREATION OF SPECIAL DISTRICTS

1. *Introduction*

The conversion of farm fields to a form of factory production is heavily dependent upon the collective action made possible through special municipal districts. Physically and economically it is usually unfeasible for an independent farming enterprise to carry out large scale drainage or irrigation; cooperation with surrounding landowners is essential. In recognition of this, all state legislatures have enacted enabling laws for special districts which provide generous police and financing powers to supplement the land development enterprise. Rural America is today governed by thousands of local government units which function apart from the traditional and more familiar county, municipal, and school district entities. Formation of districts is usually motivated by the need to raise initial construction capital or by the need to compel reluctant landowners to participate.[74] A leading commentator summarizes:

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70. Okaw Drainage District of Champaign and Douglas County, Illinois v. National Distillers and Chemical Corp., 882 F.2d 1241, 1246 (7th Cir. 1989).

71. This riparian principle applies even in prior appropriation states.

72. DRAINAGE FOR AGRICULTURE, *supra* note 12, at 99.

73. NATIONAL RESEARCH COUNCIL, IRRIGATION – INDUCED WATER QUALITY PROBLEMS: WHAT CAN BE LEARNED FROM THE SAN JOAQUIN VALLEY EXPERIENCE 39 (1989).

74. John H. Davidson, *South Dakota's Special Water Districts – An Introduction*, 36 S.D. L. REV. 499, 539-549 (1991).

> Regardless of their size, locality, and functions, special districts always exhibit the following identical characteristics: (1) they exist as separate corporate entities, though they may have been created under any one of several types of formation procedures; (2) they are entrusted with the performance of one or more governmental functions or proprietary services vested with a public interest, although these may range from the operation of a mass transit system to the control and eradication of noxious weeds; (3) they are entrusted with corporate powers commensurate with the performance of their activities; (4) they are governed by a board of directors; . . . (5) their jurisdiction, with a few exceptions, is delineated by territorial boundaries; (6) they are possessed of one or more revenue sources and financial powers found in conventional units of local government.[75]

The public special district addresses the need to achieve both economic and political feasibility. Special districts are economically feasible because economies of scale can be achieved and capital formulation facilitated. Property taxes are levied by the district, and tax-benefited municipal bonds can be issued. Capital facilities are typically exempt from general property taxation, and the districts are eligible to benefit from an impressive menu of federal grants and subsidies.

Special districts are politically feasible because their methods of governance allow for mandatory dispute resolution processes, which are essential where a large number of diverse water users are involved. Political control of the district is secure because the constitutional doctrine of one-person-one-vote does not apply.[76]

Governmental in form, and exercising governmental powers, special districts serve predominantly private purposes. This fact was recognized by Justice Stewart in 1981 when he wrote that: "though the state legislature has allowed water districts to become nominal public entities in order to obtain inexpensive bond financing, the districts remain essential business enterprises, created by and chiefly benefiting a specific group of landowners."[77]

2. *Irrigation and Drainage Districts*

The overall contribution of special districts to the factory fields phenomenon cannot be over-emphasized. According to the U.S. Department of Agriculture, more than 65 million acres of farmland were drained by organized drainage districts in 1985.[78] The greatest increase in such projects occurred between 1945 and 1985.[79] Agricultural land in drainage districts is concentrated in the Great Lakes, Midwest, Lower Mississippi Valley, Gulf, Delaware and South Florida regions.[80]

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75. MAX A. POCK, INDEPENDENT SPECIAL DISTRICTS: A SOLUTION TO THE METROPOLITAN AREAS PROBLEM 10-11 (1962).
76. Ball v. James, 451 U.S. 355 (1981).
77. *Id.* at 368.
78. George A. Parelis, *Economic Survey of Farm Drainage*, *in* FARM DRAINAGE IN THE UNITED STATES: HISTORY, STATUS AND PROSPECTS 112 (U.S.D.A., Econ. Res. Serv., Misc. Pub. No. 1455, Dec. 1987).
79. *Id.* at 113.
80. CARMEN SANDRETTO, *Drainage Institutions*, *in* FARM DRAINAGE IN THE UNITED STATES: HISTORY, STATUS AND PROSPECTS 101, 104 (1987); *see also* Mary R. McCorvie & Christopher L. Lant,

To the abundance of drainage districts can be added special irrigation districts which as has been observed also function as organized drains. In 1969 special districts delivered around 68 million acre feet of water for all purposes in the 17 western states, 93 percent of which went for irrigation.[81] In that year, 687 irrigation districts were operating in the west.[82]

D. STATE POLICE POWER IS NOT EMPLOYED TO PROTECT TOPSOIL

Despite the obvious fact that topsoil represents the principal production resource in many states, the police power is only rarely brought to bear to protect it against loss by the processes of erosion. When states do address soil erosion, it is in the interest of protecting the water resource from sediment pollution rather than protecting the soil for its own sake. The reason for this inaction can only be speculated upon. One reason may be that, except in cases of the most severe abuse, the effects of soil erosion are not apparent to the public. Unlike other critical resources over which states do exert regulatory control, such as water, air and wildlife, soil is privately owned and is not perceived generally as vested with a strong public interest.[83] Soil loss is incremental and does not pose an immediate threat to agricultural production.[84] In the short-term, losses in soil productivity are compensated for by increasing the application of commercial fertilizer.

Because farmland is privately-owned and subject to open market forces, the prevailing economic theory is that those markets create the incentive to protect long-term productivity of the soil resource.[85] If markets have failed to do so, as the case appears, it may be because farmers make economic decisions within a much shorter time frame than the larger society[86] and also because farmland purchasers may not have information that allows them to take erosion into account.[87] It is likely that most farmland purchasers assume that in the near-term they will compensate for topsoil loss with artificial fertilizers. Nonetheless, this does appear to state lawmakers as a case of market failure affecting a fundamental societal resource.[88] It can also be speculated that state policymakers have shied-away from an area of regulation which looks much like direct control of land use decisions. Intervention in such cases can be successful, but typically only when the states share in the cost of implementing regulatory activities, a financial undertaking that few states are able or willing to make.[89] Finally, it is likely that the states have simply yielded to the federal government incentive programs which have been active since the 1930s.[90]

Drainage District Formation and the Loss of Midwestern Wetlands, 1850-1930, 67 AGRIC. HISTORY 13 (Fall, 1993).

81. A.D. TARLOCK ET AL., WATER RESOURCE MANAGEMENT 746 (5th ed. 2002).

82. John D. Leshy, *Irrigation Districts In a Changing West – An Overview,* 1982 ARIZ. ST. L.J. 345-353 (1982).

83. A.D. TARLOCK ET AL., *supra* note 81, at 312-342.

84. Arts & Church, *supra* note 52, at 539.

85. Carpenter, *supra* note 46, at 207.

86. *Id.* at 208.

87. *Id.* at 207.

88. *Id.*

89. Woodbury County Soil Conservation Dist. v. Ortner, 279 N.W.2d 276 (Iowa 1979).

90. *See Infra* note 111 and accompanying text.

One type of police power intervention by some states is in sediment control laws which apply to various earth-disturbing activating such as construction, road-building and farming. In general, these statutes attempt to require interim measures to control runoff during periods when earth is exposed during construction. While by their terms they apply to agriculture, enforcement is rare, is limited to extreme ("bad actor") cases, and compliance is voluntary; they are no impediment to factory field methods of production.[91]

IV. EARLY FEDERAL FARM POLICY SUBSIDIZED FACTORY FIELDS

Although it is often forgotten or ignored, modern American agricultural history includes a major effort at nonpoint source control which incorporated best management techniques, land use controls and watershed management. That effort originated out of a great environmental crisis which today we call the Dust Bowl. In the midst of a general economic depression, persistent drought conditions struck the Great Plains. The black bizzards, denuded fields, choked waterways and demoralized human communities associated with this epic are written into the national history and need not be recounted here. What is important is that the nation turned to organized soil erosion control as one part of the remedy.[92] Although the remedial efforts did not solve the soil erosion problem, they do provide the agricultural community with some important lessons to use in addressing the current water pollution problem, for with agriculture, the control of soil erosion is the control of nonpoint source pollution.

Out of the experience of the 1930s emerged a soil conservation establishment which has now evolved and developed into the Natural Resources Conservation Service (NRCS), known earlier as the Soil Conservation Service (SCS), of the United States Department of Agriculture. In its early days the SCS was energetic and creative, possessed with a sense of mission.[93] The procedures and methods which it developed for dealing with serious soil erosion problems remain the fundamental methodology for controlling soil erosion and, concurrently, what has come to be known as nonpoint source pollution.

The effort of the 1930s began with research, including the development of basic measurement methodologies and the initiation of a system of surveys which

91. *See* John H. Davidson, *State Soil Erosion Control Laws, Conservation Plans and Nonpoint Pollution*, 1 GREAT PLAINS NAT. RESOURCES J. 421 (1996); Larry C. Frarey et al., *Conservation Districts as The Foundation for Watershed-Based Programs to Prevent and Abate Polluted Agricultural Runoff*, 18 HAMLINE L. REV. 151 (1994); John Charles Kluge, *Farming By the Foot: How Site-Specific Agriculture Can Reduce Nonpoint Source Water Pollution*, 23 COLUM. J. ENVTL. L. 89 (1998); and, Mark A. McCarty, *Control of Soil Erosion and Sedimentation: Establish "Best Management Practices" As Standard for General Permits For Land-Disturbing Activities*, 12 GA. ST. U. L. REV. 39 (1995).

92. Batie, *Policies, Institutions and Incentives for Soil Conservation*, *in* SOIL CONSERVATION POLICIES, INSTITUTIONS AND INCENTIVES 25-29 (H. Halcrow et al., eds., 1982).

93. For an eloquent example from those times, *see* H.S. Person, LITTLE WATERS: A STUDY OF HEADWATER STREAMS AND OTHER LITTLE WATERS, THEIR USE AND RELATIONS TO THE LAND (1935). This small volume was published by the Soil Conservation Service, Resettlement Administration and Rural Electrification Administration, and provided impetus for the New Deal program in erosion control and watershed development. It remains an eloquent statement of the need for management and preservation of our soil and water resources, and has been reprinted in full at 2 GREAT PLAINS NAT. RESOURCES J. 83 (1997).

identified the most critical erosion problems.[94] The first major technique employed was terracing. Although not a universal cure to soil runoff, it remains a basic tool.[95] Terraces, of course, are ledges of varying sizes constructed in the side of hills to capture water that would otherwise run down a hill with sufficient force to carry away soils and nutrients. After terracing, the SCS stressed cropping techniques, especially plowing and cultivation on the contour which, like terracing, deters runoff and holds the water, soil and other nutrients on the hillside. The most important soil erosion control practice advocated, however, was crop rotation, in which a farmer divides a farm into smaller acreages and alternates different crops among the acreages from one year to the next. Crop rotation has enormous advantages. Then as now, its greatest advantage is that it substantially reduces the amount of pesticides and fertilizers that a farmer requires. By moving different crops from field to field, insect populations are unable to accumulate around a host crop. Weeds that are associated with row cropping are displaced when row crops are followed by grasses, small grains or pasture. Crops such as alfalfa and soybeans, which add nitrogen to the soil, follow nitrogen-depleting crops such as corn and cotton. Nitrogen is thus reintroduced to the fields without the need for extensive artificial fertilizer. Finally, arranging fields in an appropriate contour and strip pattern controls soil and water erosion.

Other representative innovations of the 1930s and '40s include the use of grass waterways – the seeding to stable grasses of low ground over which diffuse surface waters tend to flow. More extensive use of pastures was advocated, particularly in fields where the soils were prone to erosion or in need of rebuilding. The SCS recommended stubble mulch to reduce rill erosion. Tree nurseries assured that farmers could plant wind breaks (shelter belts) to achieve protection of soils from the wind and to conserve waters on high ground. Research developed new species of soil conserving crops, including the reintroduction of native species.[96]

The SCS also considered how to gain acceptance of these new methods. The cooperation of private landowners was critical and was encouraged by substantial federal subsidy of conservation improvements. We can now only speculate whether farmers would have cooperated in the absence of financial aid.

Soil conservation special districts were advocated by the SCS in order to organize landowners, thus allowing them to develop common solutions to common erosion problems. The 'whole farm conservation plan' – an integrated plan of soil erosion control practices for an entire farming operation – was developed and complemented by soil capability classifications.[97]

Given the severity of today's agricultural runoff problems, it is apparent that soil conservation measures were either unsuccessful at the outset or were not continued. There is likely no specific answer. Perhaps conservation measures worked where they were used but were not universally adopted or continued; why they were not is debatable. Certainly an end to the drought followed by the

94. R. HELD & H. CLAWSON, SOIL CONSERVATION IN PERSPECTIVE 60-61(1965).
95. *Id.* at 64.
96. *Id.* at 64-66.
97. John H. Davidson, *Conservation Plans in Agriculture*, 31 Envtl. L. Rep. 10501, 10502 (2001).

agricultural prosperity associated with war and post-war economic growth affected the adoption and use of conservation measures, as did the advent of the post-war consolidation of agricultural land holdings and the trend toward grain crop specialization. It has been argued, however, and with some considerable proof, that the primary reason for agriculture's general abandonment of soil conserving practices is that the lead federal agency—the Soil Conservation Service—shifted its emphasis from soil erosion control to production enhancement. As Held and Clawson conclude:

> Gradually during the general period 1935 to 1950, and to some extent subconsciously, the emphasis of the whole group of soil conservationists, in both public and private programs, shifted from the control of soil erosion to the management of the land for greater productivity. This was in many respects a natural evolution, yet it greatly changed the basic purpose of the soil programs, especially when viewed from a national or social point of view.
>
> . . . The first programs were primarily for the maintenance of the existing basic productive capacity in the land, especially by preventing the loss of soil material through wind or water erosion. While such programs resulted in some increases in productive capacity, this was not their primary emphasis. But the later programs clearly indicate major concern with the building of additional productive capacity and with adding to current inputs as a means of affecting output. This shift in emphasis often made good sense to the farmer. Generally speaking, he was less interested in saving his soil, as such, than in increasing his income. Measures to reduce soil erosion to prevent loss of income at some future date were less appealing than measures to increase his output today or tomorrow. In many cases, small adaptations of erosion control programs led to substantial increases in output.
>
> Similarly, the shift in emphasis made good sense to SCS, primarily because it was a means of interesting farmers in the agency's program and in making them more favorably disposed to the agency. Since SCS was engaged in serious conflict with bureaucratic rivals. . . throughout this period, it needed to build popular and political support wherever and however it could. Adapting its program to what farmers were interested in was surely one effective device. Presumably, SCS advocated only programs in whose technical soundness it strongly believed; its emphasis upon planning for the whole farm, which often led to controversy with other agencies and farmers, seems proof of this. But, within the range of technically sound programs, a public agency is often wise to push popular programs; in this way, it not only assures its own health and continued existence, but obtains the means for carrying out later programs which currently seem less popular.
>
> But this shift in emphasis of the SCS program is much more dubious from a national or social viewpoint. To the extent that it was effective on the lands to which it was applied – and we must assume that it was effective to a considerable degree – it surely increased total agricultural output of those lands over what it otherwise would have been. Except for the war years,

> these were years when the national agricultural program was concerned with limiting total agricultural output to meet effective demand at politically acceptable prices. Various expensive programs were being directed to this end. Whatever may have been the public statements of the Secretaries of Agriculture during this period, a fundamental conflict in purpose and in results of programs existed. One part of the Department of Agriculture was spending large sums of public money to control output; other parts were spending smaller, but still substantial, sums to increase it—and no small part of the rationale for the latter expenditures was the need for public support in the continued struggle of SCS for existence practices.[98]

With the shift to production enhancement, SCS deferred to the abandonment of crop rotation and other land conserving practices. What farmers desired and what the federal agricultural establishment provided, with the support of lavish appropriations from the U.S. Congress, was a system of subsidies for production enhancing practices, and foremost among these practices was the installation of field drainage systems. In what the SCS came to refer to as land "reclamation" programs, the federal government provided not only the money for the drainage construction, but also the project planning expertise in the form of government employees trained in engineering, drainage and agronomy. Behind them were the federally-subsidized land-grant colleges and their schools of agricultural engineering, which also supported land drainage as the principal tool of production enhancement. Thus, just as the federal government subsidized creation of the western irrigation economy, it subsidized the conversion of eastern and midwestern agriculture to a system of factory fields based upon extensive, subsidized land drainage.[99]

V. THE FEDERAL CLEAN WATER ACT EXEMPTS FIELD RUNOFF AND DRAINAGE WATER

The facts are familiar, but they fit at this point. When, in 1972, Congress enacted legislation to regulate water pollution, it made a policy choice to focus on pollution generated by industrial plants and municipal sewers.[100] Through a closely

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98. HELD & CLAWSON, *supra note 94,* at 69-73.

99. On the evolution of U.S.D.A. conservation programs, *see* the landmark article remains Craig L. Williams, *Soil Conservation and Water Pollution Control: The Muddy Record of the United States Department of Agriculture,* 7 B.C. ENVTL. AFF. L. REV. 365 (1979). "In the 1950s it was still considered an engineering triumph when very wet sections, thought not worth capital investment, were drained out and made into profitable farming enterprises. The U.S.D.A. . . . subsidized wetland drainage by sharing the cost of tiling until at least 1956." McCorvie and Lant, *supra* note 80, at 23. SCS provided technical assistance for wetland drainage until 1972 and financial incentives until 1977. Although the focus of this outline is upon the connection between factory field practices and the degradation of oceans and coastal waters, the same practices have resulted in the near total elimination of one of the largest and most diverse ecosystems in the hemisphere. The ecosystem known as the Tallgrass Prairie occupies the same geography in which factory field practices are nearly universal. The "Tallgrass" once covered 250 million acres and support 1500 types of plants and grasses on the Northern Great Plains. Today, 96 percent of this ecosystem has been converted, principally for field agriculture. As a result it is asserted that factory fields have led to destruction of this ecosystem – perhaps the most endangered ecosystem in the hemisphere. *Id.* at 23-34.

100. Robert Zener, *The Federal Law of Water Pollution Control, in* FEDERAL ENVIRONMENTAL LAW 766 (Erica L. Dolgin & Thomas Guilbert eds., 1974).

defined and tightly structured permit system, great strides were taken.[101] Although imperfect – reflecting the complexity and diversity of pollution – the permit system has proven to be workable. The Congressional policy emphasis, however, inevitably left other polluters less regulated. Particular among these are polluters who contaminate groundwaters, and those whose pollution originates on farms. Pollution of groundwater was largely ignored by the 1972 Clean Water Act.[102] Pollution generated by farms was addressed in the legislation but effectively exempted from the regulatory and discharge permit system. The now familiar statutory dichotomy is "point source" and "nonpoint source." "Point sources" are described in the statute as: "any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating facility, from which pollutants are or may be discharged."[103] Pollution discharged from a point source is prohibited unless the polluter first obtains a permit, which in turn is conditioned upon compliance with industry-wide effluent limitations. Nonpoint sources, which are any pollution source found not to be point sources, were addressed only in planning provisions. Generally, the effect has been that a source of pollution which evades legal definition as a point source also evades effective regulation and control.

The distinction drawn between point and nonpoint sources was political and does not reflect biological principles or the state of technology. Regardless of this, nonpoint source pollution is among our worst water problems.[104] However large the problem, it seems that waters from agricultural field drainage systems have to date been treated as nonpoint sources and not subjected to the regulatory permit program. The result has been a thirty year delay in addressing the question of how we will respond to the wave of effluent generated by field agriculture.

In addition, the federal Clean Water Act generously broadens its exemption for agricultural runoff to include two types of discrete discharges – irrigation return flows and agricultural stormwater discharges.[105] Although there is not judicial precedent, there is general acquiescence to the idea that runoff channeled into the pipes and ditches of organized drainage district retains its exempted status as unregulated nonpoint runoff.[106]

VI. THE INHERENT PROBLEM OF INCREMENTALISM.

It is easy enough to criticize the judgment of Congress for its decision to exempt agricultural runoff from the regulatory provisions of the Clean Water Act,

101. *See generally* R. Beck & C. Goplerud, *Water Pollution And Water Quality Legal Controls*, *in* 3 WATERS AND WATER RIGHTS 133 (R. Clark ed., 2d ed. 1985).
102. *Id.* at 266-267.
103. 33 U.S.C. § 1362(14) (2000).
104. DRAINAGE FOR AGRICULTURE, supra note 12, at 3.
105. 33 U.S.C.A. § 1362(14); David Zaring, *Agriculture, Nonpoint Source Pollution, and Regulatory Control: The Clean Water Act's Bleak Present and Future*, 20 HARV. ENVTL. L. REV. 515, 521 (1996); Ruhl, *supra* note 46, at 295.
106. *See* John H. Davidson, *Commentary: Using Special Water Districts to Control Nonpoint Sources of Water Pollution*, 65 CHI.-KENT L. REV. 503 (1990).

but the criticism comes after the fact and Congress may have had its reasons. Nonpoint source pollution is, in fact, a complicated matter from a technical point of view. The technical complications are compounded by the fact that the number of potential polluters in any given watershed may be enormous, causing unique logistical and administrative problems. In addition, a significant portion of the polluters will be making only a marginal contribution to the pollution as a whole. Even where the public harm may be large – as is the situation with our rivers, bays and estuaries – a solution that is acceptable to a large community of polluters, each of whom is adding but a small increment to the problem, is not easily defined or implemented. In other pollution statutes such as RCRA (household waste, small quantity generators, farm waste) CERCLA (de minimis contributors) and SDWA (small water systems), Congress has elected to ignore the small incremental polluter, and in this company the Clean Water Act exemption is consistent. Each of these exemptions will, however, become large problems in the future – one has only to consider domestic landfills; the issue of this small incremental polluter does not disappear as the result of a legal exemption.

Another situation in which we encounter the problem of incrementalism is in the gradual elimination of wetlands, sloughs, and playa lakes. In that case Professor Rodgers has summarized the issue in words that are fully transferable to nonpoint agricultural runoff.

> In the regulation of wetlands, as with most environmental regulation, the benefits are broadly shared while the costs are concentrated, assuring an angry loser class with a distinct desire to set things right. The situation also is one where the conduct condemned used to be praised – it was called land reclamation – and this reversal of professed values obviously leaves strong pockets of resistance. There is more – the benefits of wetlands protection are often incremental, sometimes marginally invisible, are not linked to human health, all considerations raising the ante of adequate justification; and as the regulation creeps inland assumptions about protecting the public commons shift to expectations of private entitlement – in maintaining the farm, building the home, and improving the ranch,. . ."[107]

In the case of wetlands, the regulating agencies appear to have taken a cue from other pollution statutes and looked for means by which to extend some form of exemption to the small projects. Thus, the Corps of Engineers, which has so-called "Section 404 dredge and fill" regulatory responsibility under the CWA, has managed to avoid a large number of small projects by granting them Nationwide Permits,[108]a form of automatic license. The Corps partner in wetlands regulation is the Natural Resources Conservation Service in the U.S. Department of Agriculture which is charged with delineating those wetlands which, if drained, will place the violator in violation of the "swampbuster" provisions of farm legislation.[109] Through a mind-numbing series of interpretations, this agency is able to avoid regulation of the

107. WILLIAM H. RODGERS, JR., 2 ENVIRONMENTAL LAW: AIR AND WATER 183 (1986).
108. 33 C.F.R. § 330 (2004).
109. 16 U.S.C. § 3821, 3822 (2000).

smaller wetlands drainage projects.[110]

Neither Congress, the agencies, public interest groups or academic commentators have engaged the issue of incrementalism in a comprehensive manner, but the scale of the cumulative effects of agricultural drainage and runoff may force the discussion. As one part of any solution to the effect of factory fields, there will be a recognition of this issue.

VII. FEDERAL FARM PRICE AND INCOME PROGRAMS CONSISTENTLY CREATE INCENTIVES FOR MORE INTENSIVE CULTIVATION PRACTICES

It is impossible to accurately describe contemporary agriculture in the U.S. without paying attention to the price and income support programs provided for farmers by the federal government. So pervasive is the influence of these programs, and so perverse the incentives which they offer, it can certainly be said that "[i]n the United States and the rest of the developed world, commodity-support programs have had by far the most significant – and often negative – impact on agricultural practices."[111] These programs have evolved across 75 years into an arcane maze the details of which are a challenge to even the most careful policy and legal analyst.[112]

The basic structure of farm support programs can be traced to the historic legislation of the New Deal era. The early Agricultural Adjustment Act of 1933 provided direct benefit payments to farmers who entered into agreements to adjust their production based on individual farm allotments. The purpose was to improve the price of commodities, and a processing tax was levied to generate revenue to pay for the benefits. This legislation was struck down by the Supreme Court in the historic decision, United States v. Butler (Hoosac Mills),[113] and was hurriedly replaced by The Soil Conservation and Domestic Allotment Act of 1936[114] which introduced a different tactic to sidestep the Supreme Court's objections. The new legislation called for the submission of "adjustment" (conservation management) plans, oriented to soil and water conservation objectives and for payment to farms on submission of proof that plans had been completed. Funds for execution of the conservation measures on farms were provided directly by Congress, rather than through a dedicated processing tax. This new approach meant a change from a price objective to an income objective. By enacting the new law Congress acquired authorization for making direct payments to farmers, but it did so on the basis of the more popular soil conservation objective rather than the less popular one of deliberately raising prices.

110. John H. Davidson & Philip P. Chandler, *The Minimal Effects Exemption and the Regulation of Headwater Wetlands Under Swampbuster, With a Coda On the Theme of SWANCC*, 31 Envtl. L. Rep. 11417 (2001).

111. David E. Adelman & John H. Barton, *Environmental Regulation for Agriculture: Towards a Framework to Promote Sustainable Intensive Agriculture*, 21 STAN. ENVTL. L.J. 3, 31 (2002).

112. For the full early detail, *see* Howard B. Pickard, *Price and Income Adjustment Programs*, 1 AGRICULTURAL LAW 1 (J.H. Davidson ed., 1981).

113. U.S. Butler, 297 U.S. 1 (1936).

114. 49 Stat. 1148 (1936).

The 1936 soil conservation law was, however, a short-term expedient and was followed by the Agricultural Adjustment Act of 1938,[115] in which Congress attempted more comprehensive legislation for adjustment of agricultural production and support of on-farm income. The new act retained the soil conservation features of the 1936 Act and beefed up the system of conservation administration through county and state committees. It then put in place a comprehensive system of policies on production control (to enhance price) and price supports (to enhance income). This new law survived constitutional scrutiny in the familiar decision of Wickard v. Filburn,[116] in which a Commerce Clause challenge was brought by a farmer who faced penalties for producing wheat in excess of the marketing quota established for his farm. The Court recognized that the legislation had been drafted in the context of "ruinously low prices resulting from the excess supply. . . ." In its opinion the Court described the circumstances that gave rise to the legislation in language which, with a few relatively minor adjustments, can describe the situation today:

> The wheat industry has been a problem industry for some years. Largely as a result of increased foreign production and import restrictions, annual exports of wheat and flour from the United States during the ten-year period ending in 1940 averaged less than 10 per cent of total production, while during the 1920's they averaged more than 25 per cent. The decline in the export trade has left a large surplus in production which in connection with an abnormally large supply of wheat and other grains in recent years caused congestion in a number of markets; tied up railroad cars; and caused elevators in some instances to turn away grains, and railroads to institute embargoes to prevent further congestion.
>
> Many countries, both importing and exporting, have sought to modify the impact of the world market conditions on their own economy. Importing countries have taken measures to stimulate production and self-sufficiency. The four large exporting countries of Argentina, Australia, Canada, and the United States have all undertaken various programs for the relief of growers. Such measures have been designed in part at least to protect the domestic price received by producers. Such plans have generally evolved towards control by the central government. In the absence of regulation the price of wheat in the United States would be much affected by world conditions.[117]

Although the economic depression of the 1930s concluded, the farm legislation has been regularly revised and renewed. The key ingredients of the early legislation remain in place: (1) income supplements to farmers; (2) attempts to stimulate price by controlling production; and (3) employing soil conservation as the rationale for supplemental payments to volunteering farmers.

Key provisions of current farm legislation would be recognizable in substance to those who wrote the farm legislation of the 1930s. Although nomenclature changes, the familiar ingredients remain the same. Target prices are politically determined price levels. If market prices for specific commodities fall below these

115. 52 Stat. 31 (1938).
116. Wickard v. Filburn, 317 U.S. 111 (1942).
117. *Id.* at 125-126.

target prices, the federal government makes up the difference through cash payments based on the historic production level of each farm. Some form of nonrecourse loan is also found. With these, politically determined government loan rates are the prices a farmer receives at harvest for such commodities as cotton, rice, corn, soybeans, wheat, other feedgrasses, and sugar. If the market price is below the loan rate at the end of the contract period (usually nine or ten months), the government essentially buys the commodity at the loan rate (i.e., the government has "no recourse" upon default when the price at harvest is below the loan rate). An inevitable part of these price and income support programs is an attempt to restrict production through some sort of acreage reduction program, or crop "set-aside." Since the 1930s, the periodic farm legislation has continued the policy distinction between "commodity programs" and "conservation," each topic usually occupying separate titles. This is of more than organizational significance. Farmers were eligible to receive price and income support payments without any requirement that they participate in conservation programs, and conservation was viewed historically as a voluntary undertaking. This pattern was altered just slightly in the 1985 farm bill when Congress responded to renewed public concern about soil erosion and water runoff with four new provisions. First, a Conservation Reserve Program was created. It provided annual payments to landowners and operators who voluntarily contracted to retire highly erodible and other environmentally critical lands from crop production for a period of ten years. Second, a Conservation Compliance Program required that producers who grow commodities on highly erodible land implement USDA-approved soil conservation plans or lose eligibility for price support and other commodity program benefits. Third, a new "Sodbuster" program required that farmers who convert highly erodible land to cropland for the production of commodities do so under an approved erosion control plan or forfeit their eligibility for the government programs. Fourth, the "Swampbuster" program barred farmers who drain wetlands to grow crops from receiving payments. This new idea of "cross compliance" between the commodity and conservation programs was, by farm bill measures, a bold step but, except for the CRP, has not been amplified in succeeding farm bills.

The most recent effort by Congress and the President passed under the name of The Farm Security and Rural Investment Act of 2003.[118] In a nutshell, it provides the familiar categories of payments to farmers who grow the commodity crops (wheat, feed grain, cotton, rice, oilseeds): direct payments, counter-cyclical payments and marketing (non-recourse) loans. The Act is, however, unique in the absolute munificence of its financial terms.

There are also separate price and income support programs for sugar, peanuts, and dairy products. The latter lumbers forward under a system of "federal milk marketing orders" (FMMOs) that was established in the 1930s when milk producers (prior to effective refrigeration) had no alternatives to selling their milk to local handlers and were often captive to unfair buying practices and subject to highly variable seasonal demand and supply. FMMOs are regulations to level the playing

118. Pub. L. 107-171, 116 Stat.134 (2002).

field while also ironing out seasonal income variations. An FMMO, which covers only Grade A fluid milk (about 95 percent of milk production), is a geographically defined fluid milk demand area. Within each region handlers' milk sold in the milk marketing order is "pooled" to generate a uniform average price, called the blend price. FMMOs set monthly minimum prices for different uses of milk employing a complex system. The resulting blend price becomes the minimum that handlers must pay producers. The essential ingredient is, however, direct federal support. Whenever the price of milk drops below a politically specified level, the USDA immediately begins to purchase cheese, butter, and nonfat dry milk until the price rises, thus assuring a floor beneath the FMMOs.[119]

Although description of farm support programs remains a challenge there is surprising agreement on many of their more severe negative effects. As stated in a recent report by the Congressional Research Service:

> Current programs tend to tilt benefits most heavily toward highly efficient commercial farms (which enables them to expand operations and lower costs even more), with no direct relationship between benefits and a farm's financial need. Landowners, not necessarily farm operators, benefit the most through higher land values and higher farmland rental rates caused by current support programs.[120]

Typical farm programs focus almost entirely on supporting so-called "commodities" – animal feeds, small grains, and cotton, ignoring such activities as cattle raising and production of fruits and vegetables.[121] The commodity programs stimulate crop surpluses by assuring farmers a good price even in the face of an adverse market.[122] Because payments to commodity farmers are partially based upon the amount grown in prior years, there is a constant incentive to increase production. One means to do this is to apply increasing amounts of fertilizers and pesticides. Another way to do this is to bring new lands into commodity production. This latter incentive assures that land is steadily cultivated "at the extensive margin" that would have otherwise remained in pasture, wetland, range, delta, and forest.[123] John K. Hosemann, retired chief economist for the Farm Bureau, observes in a recent speech:

> Aided by government farm programs, farmers clearcut and drained large tracts of forest land, particularly in the Mississippi River Delta region but also in the mid-Atlantic states. In the heartland, taking advantage of rising grain prices, farmers converted pastureland to cropland. Historically, pasture has generally been land with rougher terrain that is more prone to erosion.[124]

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119. For the complete history of milk orders, *see* John H. Vetne, *Federal Marketing Order Programs*, *in* 1 AGRICULTURAL LAW 75 (J.H. Davidson ed., 1981).

120. CONGRESSIONAL RESEARCH SERVICE, THE LIBRARY OF CONGRESS, THE 2002 FARM BILL: OVERVIEW AND STATUS 6 (July 3, 2002).

121. ENVIRONMENTAL DEFENSE, FOOD FOR THOUGHT: THE CASE FOR REFORMING FARM PROGRAMS TO PRESERVE THE ENVIRONMENT AND HELP FAMILY FARMERS, RANCHERS AND FORESTERS iv (2001).

122. *Id.*

123. J. Bishop Grewell, *Farming to the Future: Agriculture's Next Generation*, PS-26 POLICY AND ENVIRONMENTAL RESOURCES CENTER POLICY SERIES 15 (2002).

124. JOHN K. HOSEMANN, AGRICULTURE AND THE ENVIRONMENT: THE MIXED LEGACY OF

This effect is aggravated when it is combined with the specialization that has occurred in the animal industry. Before specialization (industrialization) most farms raised small herds or flocks, which in turn required that land – usually marginal – was dedicated to pasture and hay. Crop fields were fenced to allow animals to forage following harvest. With concentration, commodity farmers seldom raise animals. As a result, their marginal land is converted and their fencerows – traditionally rich in wildlife habitat and valuable as barriers to runoff – were removed to allow yet more commodity production. These perverse incentives are now spreading into semi-arid and arid rangelands. As ranchers suffer from drought and low cattle prices they see the federal commodity programs as an economic refuge. By plowing native grasses and planting commodity crops, they raise the value of their land while qualifying for farm payments.

Finally, enriched by the stabilizing effects of federal farm payments, farmers have lobbied hard for additional support programs. These take many forms but are best represented by the current subsidy to ethanol, promoted less as a substitute for gasoline than as a benefit to corn growers. The subsidies take the form of tax credits and reductions in federal fuel excise taxes to the fuel blenders who add ethanol to gasoline.[125] Ethanol fails almost any test of efficiency or environmental protection. It fails to provide cleaner air, its production results in a net loss of energy, and the overall result is more factory fields – intensive production, using marginal land and water resources.

VIII. LOOMING CHANGES IN AGRICULTURAL LAND TENURE FAVORS EXPANSION OF FACTORY FIELD METHODS

Before suggesting some possible responses to the issues presented by factory fields, it is necessary to point out that any steps that are undertaken will occur in a context of change and uncertainty. Because the concern here is with land, land use malpractices and policies, one fact that looms large is the inevitable change in the agricultural land tenure system. In general, change in land tenure occurs gradually across time and goes unremarked-upon until the result is apparent. Since the mid-point of the twentieth century the migration from farms and rural areas has been steady, with certain periods of accelerated migration, as occurred most recently in the late 1980s. The result is always an increase in the size of farming operations.

According to the 2002 Census of Agriculture 3 percent of the nation's farms are producing more than 60 percent of America's agricultural goods. Some 70,600 farms (and ranches) with annual sales of more than $500,000 produced about 62 percent of the nation's agricultural products in 2004, an increase from 56.6 percent in 1997. Between 1997 and 2002 87,000 farms were lost.

While this concentration in farm size often involves the purchase outright of additional crop land, the role of leasing requires notice as well. About 44 percent of agricultural land is rented from retired farmers, family members of deceased

FEDERAL INTERVENTION 4 (2002).

125. Grewell, *supra* note 123, at 16; Ted Williams, *Drunk on Ethanol*, AUDUBON, July-August 2004, at 26.

farmers, or individuals and firms investing in land for its return on and increase in capital.[126] Federal farm programs encourage investment in farmland by non-farmers because they hold up return of investment even in the face of declining crop prices. Also, payments that are intended to support farm income may be used to increase rents in the competition for rental land.[127] As we shall see, the trend toward leasing – ownership by non-farmers – is very likely to increase sharply in the near future, the result of an aging farm population.

According to the 1997 Census of Agriculture, 26 percent of farmers were then over 65 years of age. At that time, farmers under the age of 35 represented less than 8 percent of all farm operators. Between 1987 and 1997, the number of young farmers decreased by 46.4 percent.[128] In 1997, 23 percent of the active farmers in Iowa were ages 55 to 64, and another 29 percent were over 65 years of age.[129] It thus goes, almost without saying, that we are on the verge of one of the greatest changes in agricultural land tenure since homesteading days, or, perhaps, the Dust Bowl. At least half of the land in the United States, in excess of 907 million acres comprised of cropland, pastureland and rangeland owned by farm families and farm businesses will, in one way or another, soon change hands. Although we can only speculate about the nature and effect of this change, it is difficult to deny its importance and its potential implications for both farm and environmental policy. Most likely the change will occur in a variety of ways. In many cases, existing family-owned farm businesses will acquire additional lands, by either lease or purchase. It is possible that individual non-farm investors will see in farmland an investment opportunity, and purchase with the intention of leasing to area farmers. It is also possible that "outside" investment capital will flow toward agricultural land, as money seeks safety, steady return, and the chance for eventual capital gain. Heirs of retired farmers will in many cases hold on to inherited farmland, leasing to farmer neighbors, and enjoying the income.

What is less probable is that an abundance of land on the market will lead to lower land prices with resulting opportunities for younger and entry-level farmers. As long as federal farm commodity programs exist, they are capitalized into land values, holding up prices and creating a barrier for young farmers.

This clear trend appears to be a concentration of farm production in the hands of larger firms, many operated by non-farmers, and with land ownership increasingly in the hands of investors rather than resident farmers. A principal change is that henceforward we must assume that a majority of agricultural land owners will view the land as an investment, and will judge performance principally on the basis of financial return. If factory field practices lead to maximum return, the preference will be set. Similarly, large farm operators are likely to be heavily dependent for economic success on their ability to compete successfully for available leases. If

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126. ROGER CLAASEN ET AL., AGRI-ENVIRONMENTAL POLICY AT THE CROSSROADS: GUIDEPOSTS ON A CHANGING LANDSCAPE 11 (2001); John Cole & Larry Janssen, *South Dakota's Cropland Share Leasing Market*, 443 ECONOMICS COMMENTATOR (S.D. State University) Nov. 19, 2003.

127. Cole & Janssen, *supra* note 126.

128. Institute for Agriculture and Trade Policy (Jan. 2. 2001), *available at* usfarmers@iatp.org.

129. Michael Duffy, *Changes in Iowa Farm Structure* (Jan. 19, 2005), *available at* www.extension.iastate.edu/agdm/articles/duffy/DuffyOct97.htm.

factory field practices assure production levels sufficient to support high lease bids, the preference will be likewise set.

A third seldom-discussed factor is human, or social, capital – the people who know how to farm properly. Just as farming has gone from family farms to factory fields, farmers are changing from skilled artisans to interchangeable assembly-line workers. Whereas an artisan brings a unique and creative skill to a problem, the new assembly-line farm worker punches a time clock and carries-out instructions. The changes now occurring in agriculture then represent the loss of a skilled class of artisans who, across the last century, represented the true strength of a productive agricultural system. The political parable spoke of "family farms," but the true reference was to skilled farmers – people who were in touch with land.

To summarize these great changes, it may be best to say, simply that farming is soon likely to be disconnected from the idea of land and land stewardship. Farmers and farming in the United States managed for a surprising long period of time to avoid viewing land as just another commodity to be bought, sold and traded for. It can be argued that the changes now underway represent, in the new vocabulary of globalization, the "commodification" of agricultural land. With this, we will have the confirmation of factory fields.

IX. CONCLUSION

The purpose of this brief essay-outline is to describe the fact that field agriculture has been almost thoroughly converted to a form of industrialized production. As Purdy describes it: "[t]hroughout the country, we have turned an activity that is at once productive, nonpolluting, and self-renewing into one that is only productive."[130] It is remarkable indeed that farm-state politicians and farm organizations continue to describe the production system as one based upon family farming. Yes, many of the farms continue to be organized around family-owned businesses, and these families continue to provide some active management and labor. But these family-owned farm businesses have become just one odd link in a chain that involves many of the world's largest and most concentrated industries.[131] These large corporations derive direct benefits from the system of dispersed production and land ownership, and therefore tolerate it. This system, after all, relieves these companies of the need to tie-up their capital in permanent land ownership. Because crop production involves considerable risk, it is equally desirable to let smaller farm businesses absorb that risk, knowing that Congress can be relied upon to provide disaster assistance. Most important, because Congress has been consistently willing to provide supplemental income to farmers when crop prices are low, the large farm corporations are unaffected by what would otherwise be potentially disruptive effects upon their production system. In effect, the system of so-called "family farms" is a type of Potemkin village, which allows Congress to subsidize large industrial firms under the flag of the politically-accepted notion of

130. Jebediah Purdy, *The New Culture of Rural America*, 11 THE AMERICAN PROSPECT 26 (Jan. 20, 2005), *available at* http://www.prospect.org/print/V11/3/purdy-j.html.

131. *Id.*

family farms.

In the area of farm production that has not benefited from direct public subsidies -- meat production – the farm corporations have been drawn into the open, and the result has been that factory methods have been forced upon the producer. Even in this situation, however, the corporations found a way to benefit from dispersed land ownership and relatively small operators. By "contracting out" poultry and hogs to smaller landowners, the corporations avoided the heavy capital costs of land and buildings, dispersed the risk of loss to disease or weather, all while recruiting a labor force that was willing to exploit itself in order to remain independent upon the land. A similar process is underway in the fields, as a majority of the commodity grain crops are now using patented seed containing genetically modified organisms. Farmers must use this seed in order to remain competitive with neighbors, and in order to use the seed they must execute a contract by which the patent holder retains control over the production and marketing of the seed.[132] The farmer thus finds that if he wants to produce animals, he can do so only under contract with large meat companies, employing production methods dictated by that company. If the farmer wants to grow commodity grains, he can do so only by contracting with the seed patent holder. In order to survive as a grain producer the farmer participates in the federal farm programs, which are laden with incentives that reward only one thing – more intensive cropping practices. Farm programs deliver financial support according to overall production, thus assuring that larger farmers will always have the capital necessary to buy-out the assets of smaller competitors. Because the federal income assurances prop-up land values artificially, entry level opportunities are few. All of this has occurred with few, if any, legal obligations to assure responsibility for resulting harm to the environment. It is necessary to confront the fact that there is in place a near fully-industrialized system of crop production. So far as accountability to the environment and public health, field agriculture has to date been operating under frontier conditions.

Conventional pollution control laws do not wrap neatly around the problems posed by factory fields. Our legal response to controlling industrial pollution has been, generally, smart. With stops and starts, successes and failures, this response has initiated a process that is proving to be sufficiently adaptable to make space for fresh ideas and experiments. In contrast, we have yet to develop a process by which we address environmental harm that results from improvident land use decisions and practices. The CWA places limits on specific effluent discharges, and this is successful so long as it is cost-feasible because it does not interfere with land development. This distinction is essential to understanding the successes as well as the failures of the CWA. The industrial point source discharge program[133] works because it does not halt land development and land conversion. The "dredge and fill" permit program under Section 404 of the CWA,[134] in contrast, runs into trouble because of its potential to restrict or block land use decisions. The extension by

132. *See generally* Nicole C. Nachtigal, *A Modern David and Goliath Farmer v. Monsanto: Advising a Grower on the Monsanto Technology Agreement*, 6 GREAT PLAIN NAT. RESOURCES J. 50 (2001).
133. 33 U.S.C.A. 1341 (2001).
134. 33 U.S.C.A. 1343 (2001).

regulation of CWA jurisdiction to include wetlands and headwaters has proved controversial not because of strong opposition to the idea of protecting wetlands, but because it was viewed as a form of land use control. This distinction explains, at least in part, why Congress chose to exempt nonpoint sources of pollution from the full regulatory reach of the CWA. Such sources of pollution are usually the result of land use practices, and can be eliminated or reduced only when the landowner makes changes on the land. The view of Congress, then as now, is that the police power of the respective states is the appropriate vehicle for implementing land use controls.

It is not by accident that this essay has drawn attention to the role of state law in promoting and facilitating factory field practices. The nearly total absence of police power controls over this emerging source of environmental degradation has contributed to the frontier conditions in which factory fields have developed. Although federal and international policy may ultimately play roles in addressing this issue, a starting point is in the states.

There are a variety of potential avenues by which society may address the environmental solution created by factory fields. International response is impractical for several reasons. First, the problem will need to expand in magnitude by a considerable degree before world leaders find reasons to address it in some mutually acceptable way. Second, the direct pollution effects of factory fields are found principally in domestic waters and waters within the 200 mile limit. It is also possible to imagine a specifically-crafted federal law but the possibility of this too, seems remote, given the reluctance of Congress to initiate new environmental programs, and to enter the arena of land use controls.

It is possible to imagine that in the near term Congress might provide an expansion of subsidy and incentive programs sufficient to have some positive impact. The likely candidates are in the conservation provision of the federal farm bill. A generous program deal targeting a reduction of all forms of polluted runoff from agriculture has been shown to have a beneficial effect. It is even possible that the added incentive of sequestering carbon through farm programs will move Congress in this direction.

The short-term response with the greatest potential may be, however, that large sources of nonpoint runoff are, as a result of judicial and regulatory decisions, wrapped into the administration of the existing CWA, and this returns the subject to drainage and irrigation districts. As has been observed here, one institution which has contributed to factory fields is the special district, usually in the form of drainage and irrigation districts. As creatures of state law, special districts can be adapted to assume new duties and responsibilities, especially in the control of runoff and water pollution. Special districts were originally organized to serve essentially private purposes – the improvement of private land by entrepreneurs – but, because the economic success of these enterprises was at the time closely associated with the public interest, certain essential powers and benefits of government were made available to advance the purpose. The proprietary function of the districts was paramount during the formative years, but in many cases circumstances have changed. People or interests located outside of a district but affected by its external effects may seek a voice. Perceptions of the public interest will also change and external effects of district operations will come under scrutiny.

Special water districts are well suited to the unique function that nonpoint source control requires. Organized locally and frequently along the lines of natural watersheds, they are, by purpose and experience, the experts in local water management. Although their potential to solve runoff problems is no doubt limited and imperfect, it seems to compare well with that of most, if not all, existing governmental entities.

Districts have the capacity to bring economies of scale to nonpoint source control and to mitigate the effect of the argument that farmers, being "price-takers" in the marketplace, are unable to pass the cost of pollution control regulation on to consumers. Drainage and irrigation districts can develop systematic pollution control measures for all lands within their jurisdiction and implement those plans in accordance with their corporate financial ability. The cost of pollution control can then be spread across all the landowners in the district, with a greater share being assumed by landowners who receive a proportionally larger share of district benefits. In addition, such districts can qualify to issue tax-exempt financial instruments and receive subsidized loans from the USDA as well as from state government. In fact, special water districts are in large part designed to finance local land management improvements efficiently and fairly, and that is exactly what the control of nonpoint sources of water pollution requires.

Another feature of special water districts that is essential to nonpoint source control is flexibility. The notion of Best Management Practices[135] recognizes implicitly that uniform or general control standards cannot be used to regulate land management. Instead, site-specific and flexible controls are needed which can consider local climate, geology, and cultural practices. Landowner-controlled districts can be subjected to district performance standards by, for example, being asked or required to reduce the flow of sediments into a river or lake by a specific percentage. How such a result is achieved can be left to the managers who know not only the land in the district, but also its farmers and its management history. That special water districts are typically organized along watershed lines is obvious but basic. Political boundaries are irrelevant to flowing water, and whatever entity is ultimately assigned the task of controlling nonpoint pollution will necessarily have authority to operate throughout the relevant watershed.

By merging nonpoint source control into existing water management institutions, significant and practical governmental efficiency may be achieved. Ultimately, all water management goals and practices would be integrated. It is an artificial act to separate the function of delivering irrigation water from that of assuring that return flows do not pollute receiving watercourses. Water management is a multi-objective undertaking, and this needs to be reflected in the laws which state legislatures use to authorize special water districts to operate. Irrigation and field drainage should not be separated from other water management concerns such as recreation, wellhead protection, wildlife habitat protection, water right

135. *See* David Zaring, *Best Practices as Regulatory Regime: The Case of Agricultural Nonpoint Source Pollution,* 34 Envtl. L. Rep. 11025 (2004).

management, flood control, and so forth. Special water districts are in the best position to merge multiple water management objectives. The alternative to the merger of purposes is a continued "layering" and balkanizing of governmental districts, corporations, and departments, each attempting to achieve specified water management purposes. The fairness in asking that special water districts manage themselves for public purposes is that they have been given a preferred status – private management with governmental authority – in order to pursue the private economic advantage of their landowner-members. In exchange, they should be required to internalize the costs of the pollution which their pollution activities generate.

For technical expertise, special water districts have traditionally relied on the USDA's Agricultural Extension Service and the land grant college system, institutions normally associated only with production enhancement. If districts sought their help in developing water quality plans, these institutions could possibly be diverted to the important task of arresting agriculture's pollution.

Two reasons why the United States EPA has supported the continued exemption of agricultural runoff from point source regulation is that the number of permits required could be enormous and uniform standards would be difficult to apply on a case-by-case basis. In the development of nonpoint control programs, the states should consider whether this concern is legitimate when applied to most special water districts. In the first place, the techniques for controlling the flow of pollutants from agricultural land are well understood and have been agreed upon for many years.[136] Drainage and erosion control engineering is proven and predictable. There is nothing speculative about the nature of the practices that will work. Terracing, grass waterways, contour farming, strip cropping, crop rotation, water conservation, preservation of natural sloughs, and responsible use of chemicals are techniques that were known in the 1930s and they have been regularly improved upon since that time. The existence of special water districts helps to moderate the problem of a large number of small landowners. A permit or similar regulatory control need only be required at the points where the irrigation or drainage district finally empties into a watercourse. One district may combine hundreds of farm operations into one system of outlets and bring them under a single permit. How the district chooses to meet permit requirements can be addressed flexibly by the people who know the land best – the district members. By demanding performance, but leaving the solution to the district members, it may be possible to achieve a middle ground between voluntariness and coercion.

The designation of irrigation and drainage districts as CWA point sources may, indeed, be no longer speculative. In the case of South Florida Water Management District v. Miccosukee Tribe of Indians[137] the Supreme Court granted certiorari on the issue of whether the CWA NPDES program applies when a pollutant originates from a point source, not when pollutants originating elsewhere simply pass through the point source. The Court clearly held that the definition of "discharge of a

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136. *See generally* BENNETT, *supra* note 55.

137. South Florida Water Management District v. Miccosukee Tribe of Indians, 124 S.Ct. 1537 (2004).

pollutant" include "point sources that do not themselves generate pollutants."[138] The Court noted, further, that nonpoint pollution sources are not specifically excluded from the NPDES program if they also fall within the point source definition.[139]

As applied to special districts – drainage districts in particular – Miccosukee supports a conclusion that such districts are point sources. Although runoff leaving individual fields and farms may be nonpoint, when they are merged with similar waters in a system which then passes them into a watercourse through a pipe or culvert, a point source exists which is subject to the permitting requirements.

138. *Id.* at 1543.
139. *Id.* at 1544.