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Nonpoint Pollution: Tractable Solutions to Intractable Problems *

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The Special Challenge to Economic Thinking

Nonpoint pollution goes right to a chink in the armor of conventionally trained economists (like myself) who are overtrained towards becoming protagonists of the price system. The very name "nonpoint" pollution suggests that economists see this as just an odd bit of clutter, something "non-regular" in their tidy world. Indeed, all pollution was an exception, an "externality", until recently. Then economists learned you can meter effluents and tax them, or create and trade effluent rights like private property. Thenceforth they could fit pollution into existing models and ideologies with minimum intellectual strain. Unfortunately, we can't meter runoff, it comes from areas, and its damages are spread unequally over other areas, differentially populated. Economists are ill-equipped and un-disposed to face such problems.

Conventional price theory has been accused of mocking physics because it uses some elementary calculus, but if so, it is a poor imitation: it deals with an imaginary world abstracted not just from friction but from space and time themselves. Space is relegated to one subdiscipline (location theory) and time to another (finance) (Gaffney, 1962). Most price theory is spaceless. Even location theory, at least the most common kind, conventionally treats cities as Euclidean points: the math is simpler that way. Newton could get away with it explaining planetary motion; students of urban sprawl cannot.

Economists are also ill-equipped to deal with ecology. Economists' "externalities" pour into a biosphere of interdependencies at least as complex as what economists purport to understand. Economists are too disposed to underrate the sensitivity, passion and numbers of Nature's votaries, and the real economic value of the philosophical values these votaries celebrate. Fisheries economists are a notable exception, although they probably impose more economics on biology than vice versa. But most economists treat "eco-freaks" as noisy nuisances.

Economists, regardless, are often useful citizens. As a budgeteer allocating limited resources among competing ends -- his favorite posture -- it is often the economist, the "soft scientist", who makes hard choices among hard scientists with soft programs. Another good use for economists interfacing with natural scientists is to temper extremism among those susceptible to technofascination. But sometimes a positive-thinking economist develops affirmative enthusiasms of his own for social and political programs that transcend particular technologies. Then he may need natural scientists to temper his zeal, as you may temper mine in what follows.

The Search for Surrogates

The frustrated economist, unable to impose an excise tax or effluent charge on runoff itself, looks for surrogates to tax that move through a market, such as pesticides, fertilizers, or salt. Thus we "internalize the externalities" and, in theory, have "proper pricing of inputs" to create incentives for correct "trade-offs" in the "production functions".

A few problems remain, however. One is that many economists don't like the effluent charge approach anyway, even for point sources. They follow Dales (1968) and Coase (1960) and prefer to grant pollution entitlements to be traded in a free market. In principle, they profess not to care who gets the original entitlements but, in practice, established polluters tend to appropriate them. The EPA now calls these "offset rights" inside airshed "bubbles", a new form of property. In the Los Angeles Basin (South Coast Air Quality Management District), a few corporations have grown rich by establishing their respective histories of pollution which they can now sell as rights to others.

But what of those needing air to breathe? According to the theory, they can enter the market, buy up offset rights and retire them. Thus is fulfilled Robert Ingersoll's forecast of a century ago that if some corporation could bottle the air, they would charge us to breathe (Greeley, 1983, p. 79). It seems to confirm the dour warning from a former Secretary of Labor:

We soon discovered . . . the danger of allowing economic policy to be dominated by business or financial interests or, which usually comes to the same thing, orthodox economic analysis (Marshall, 1987, p. ix).

Offset rights have not gained public acceptance. To simplify, therefore, I am not going to speculate how the Dales/Coase theory might be applied to nonpoint sources, but just ignore it. I will treat effluent charges, and taxes on surrogates, as the conventional economic solution to pollution.

But before leaving this, there is a lesson in it. The holders of offset rights have demanded compensation to stop polluting (Polakovic, 1987). They will probably get it, for if the system be changed, there will be a taking of something, which they claim is property. Such is the force of current social values, that unearned gains are sacred, even those originating with something as unworthy as the generation of pollution. Many economists write calmly and blandly about the desirability of "bribing" polluters to stop. This philosophical approach explains why effective control seems so expensive.

The surrogate approach may work through regulation and prohibition as well as taxation. Banning DDT and other organochlorines after 1972 has solved or prevented a lot of nonpoint problems. We may also tax or ban other pesticides of long residual life, stimulating a predictably successful quest for pesticides that self-destruct after doing their job. But economists balk at absolutes. While admitting that regulation has achieved some notable successes, most economists are convinced that things would be better with more tempered, measured responses. They prefer taxation to regulation: it inhibits rather than prohibits. It is more flexible, leaving latitude for applicator adaptation, recognizing the smoothness and continuity of production and damage and substitution functions.

They would point out, for example, that making pesticides costlier would discourage the present practise of routine preventive or "insurance" spraying, and provide incentives to farmers to spray only when the pests are up to an "economic threshold". Regulation to achieve the same end would be much more difficult (Hall and Duncan, 1984). Economists would point out that inhibition rather than prohibition is compatible with Integrated Pest Management (IPM), the optimizing solution.

This is the traditional theory; it is arguable (Headley and Lewis, 1967). We can inhibit nonpoint pollution, in some ways optimally, by controlling surrogates. But let's look at the problems that would remain.

1. Taxes overlook the locational element, whereas damages vary according to the site of the runoff. A tax imposed only in critical areas is avoidable by importing the input from tax-free zones. We could tax uniformly everywhere;

but a uniform tax on, say, nitrogen fertilizer would, in order to protect certain waters, reduce yields from all lands. Presently that would pull more acres into use, worsening other problems.

2. Taxes raise revenue, and recipients develop interests in the revenue, interests which may come to override the regulatory purpose of the tax. For instance, the main issue of 19th century tariff debates was regulation versus revenue.

3. Excise taxes are not leakproof. The volume of bootleg cigarettes should give us pause, and I (a small fruit grower) have been tempted more than once with illicit supplies of the herbicide Roundup. There is a huge underground economy in this country.

There is a grand tradition of bailing out sellers with stocks on hand when a product is taxed or banned. Chlordane is a recent example. Dairy producers have been compensated when they could not sell their pesticide-contaminated milk (Carlson, 1977, p. 319). To sell existing stocks tax free, when new ones are banned or taxed, creates a nice windfall. The 1972 Federal Pesticide Act also "provides for compensation to holders of patents on pesticides when registration removal occurs" (Carlson, p. 319). The problem is that this whets the appetite for future windfalls. It is something like a treadmill where a perverse incentive is created to develop new harmful products whose future prohibition or taxation will endow the creator with more windfalls. There are more than 50,000 agricultural pesticides registered in the U.S. (Gianessi, 1987, p. 1), giving a notion of the possibilities. This is a second kind of "pesticide treadmill".

It has been optimistically noted that herbicides are becoming more specific, tailored to certain crop problems (Nicol and Heady, 1977, p. 339), but many such chemicals, such as Roundup, are anything but that.

4. A tax on nitrogen could be avoided by growing legumes. This is not a bad idea, perhaps, but it just scratches the surface of the kinds of substitution, some of it unpredictable, that can occur when you tax a surrogate rather than the damaging effluent itself.

5. Taxing a surrogate fails to distinguish among individual applicators. It taxes the best for the sins of the worst, and credits the worst for the virtues of the best. Even if the rate be set optimally, it will overtax the good and undertax the bad, and will not motivate anyone towards greater care and conscience to avoid harmful practices (Hall and Norgaard, 1973).

6. The objectivity and moral authority of the professionals on whom we must rely to evaluate pesticides is not unquestioned. This is a delicate area, but we must face a certain public skepticism. The University of California recently lost a case in which they were accused by California Agrarian Action Project, and convicted in Alameda County Superior Court, November 17, 1987, of violating the Hatch Act by favoring agribusiness over family farmers. What would happen if their objectivity were questioned on the grounds that they accept large, directed grants from the same pesticide producers who bankrolled the fight against California Proposition 65, the Anti-Toxics Initiative of 1986 (Jacobs, 1986)?

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U.C. Entomology Professor Robert van den Bosch has referred to the dominance of what he called "the pesticide mafia". His *Pesticide Conspiracy* (1978), although tendentious, cites enough specifics to impugn several administrators, other universities, the USDA, many congressmen, bankers and food processors, farm employers, most producers, salesmen and lobbyists. It is not a reassuring picture. Moral authority or not, there are questions of efficiency and expedition. The mills of the EPA may or may not grind exceedingly fine, but they certainly grind exceedingly slowly. Since 1972, EPA has arrived at suspending only 79 active ingredients. Most of its "reregistration" reviews are still in some interim stage (Gianessi, 1987, p.3). Since industry advances new chemicals much faster than EPA reviews them, the inventory of pending reviews can only grow.

7. The case for "proper pricing of inputs" is most persuasive when we can show that everything else in the system is working right first, as the optimal background we are to avoid distorting. But that is conspicuously untrue. When the system is balanced wrong anyway, what is one more distortion? It might even make things better, a viewpoint labelled "the theory of second best" (Lipsey and Lancaster, 1956-7).

In fact, land use decisions are superimposed on a settlement pattern based on massive market failure in land. The phenomena rather imprecisely called "land speculation" and "absentee ownership" betray market failure; and no one disputes there is massive regulatory failure in pricing and subsidizing transportation which, in turn, determines land rents and values. The result is that the land market is not efficient; land is not properly priced and allocated to begin with. This is the thread I will follow.

Sources of Nonpoint Pollution

All pollution is originally "nonpoint". It only becomes "point" pollution when someone has taken the trouble of gathering it at a small orifice in order to control it, often for the benefit of others. If we then tax point polluters while exempting nonpoint, we will impair the incentive to control. That of course is why we consider taxing surrogates. Taxing and banning surrogates has a place, perhaps a big place, in any control program. But it may not touch many sources of nonpoint pollution. Let's list them here; see what damage they do (next section); and then see what remains unsolved by taxing and banning surrogates.

Major sources of nonpoint pollution include: agriculture, forestry, mining, a few kinds of recreation, paving and rooftops, roads, lawns and gardens, onsite industrial waste dumps, and the military. To these I would add the class of moving point sources, like autos and vessels and aircraft, which have part of the elusive character of nonpoint sources. I would also add septic tanks, and moonlight dumpers and everything served by a storm sewer, or no sewer at all.

"Construction" is usually added, but construction per se is innocent and should not bear the onus. It is rather grading, the destruction that precedes construction on new lands, that denudes land and allows runoff and blowing. Filling can be noxious, too, when it takes wetlands that otherwise help filter runoff before it hits shellfish beds and beaches.

So nice a distinction may seem picky, but it is heavy with policy meaning. The Sears Tower and the Empire State Building probably caused less runoff than any modern subdivision. We can have needed construction without grading and filling by renewing and infilling our cities instead of promoting more urban sprawl. Milwaukee, for example, has lost 20% of its population since 1960, while its suburban counties grow. Inside Milwaukee itself, population has moved toward the borders while old Milwaukee decays. Buildings are boarded up and land lies vacant while bulldozers and scrapers tear up new land upstream of it. Perhaps a fourth of Milwaukee should be renewed forthwith, obviating much of the random lateral expansion onto new land whose runoff now causes so much grief (Gaffney, 1970).

Within agriculture it is common to hear that tillage is the problem; the solution, evidently, is grazing. On some lands that is true, but the generalization is not. On other more fragile lands, grazing causes runoff. Not for nothing are sheep called "woolly maggots". Exploitive high-grading grazing, leaving weeds to take over the range, is another form of pollution -- biological pollution,

depleting the gene pool. As with all land problems, "where" and "when" are as important as "what". "A place for everything, and everything in its place", the slogan of land economics, is the proper watchword.

We sometimes hear that good organic manure is the answer. But on feedlots, too much of a good thing becomes a nonpoint pollutant. Cities in the upper Santa Ana River basin in California must provide tertiary sewage treatment, but the largest concentration of dairy cattle in the world, in the Chino basin, drains into the same waters. (Chino, ironically, is in an agricultural preserve, virtually tax-exempt, to enhance the environment.) These feedlots also overlie what might be one of our most usable aquifers, in a region in sorest need of water storage.

Cities like Milwaukee are painted as victims of nonpoint pollution, but within cities the great anomaly is that the output of sanitary sewers is monitored and treated while that of storm sewers is not. In downtown Milwaukee you can see coal and salt stored in the open, draining directly into the harbor with each rain.

In Riverside, California, lying along the upper Santa Ana River, sanitary sewage water gets tertiary treatment, making it drinkable straight from the plant. It is our storm runoff that's dirty. Some cities of course have only one set of sewers, but that creates problems of its own. In Riverside we have also poisoned many of our own water wells with toxic percolation from farm and industry wastes.

What Problems are Created?

If the old problems of biochemical oxygen demand (BOD), bacteria, nitrogen, sedimentation and phosphates are partially mitigated, new ones are upon us: toxic metals, new pesticides, ammonia, and organic supertoxins (Harkin, 1985, p. K-II-4). Salt accumulation is almost irreversible, and BOD, although perhaps mitigated inland, is still lethally high in Long Island Sound and Chesapeake Bay (Business Week, October, 1987).

Damage is affected by reconcentration. Beneficial concentration of runoffs in dumps, to minimize damage, is inherently unlikely. Much of the damage does come from reconcentration of toxics in waterways and fats, but the damage is not restricted to riparian owners or fish and other biota since water supplies for large downstream cities depend on river waters. Cities can treat polluted waters, of course, but at considerable cost, and substantially reduced consumer satisfac-

tion with the product. The last often leads to extremely high-cost projects to import remote, pure waters.

Sediment silts up harbors. To handle this problem we first need recognize that we have too many harbors as a result of logrolling in Congress and the activities of the Army Corps of Engineers. Rivers and harbors are the classic porkbarrel vehicle of Congress. Wisconsin alone may have as many harbors as the whole Pacific Coast. Part of any solution here is to stop subsidizing dredging. Subeconomic harbors would close; others would finance their own dredging, with this bonus for the welfare of all: they would redirect their lobbying budgets from the zero-sum game of soliciting federal funds to the constructive game of promoting runoff control.

Sediment also silts up reservoirs; and again we have too many, thanks to a long history of subsidizing water supply in western states. Of course there are many good and useful dams, and real waste in losing reservoir capacity and abrading turbines. But in the logic of true values we should probably put even more weight on other damages, such as that land and people are poisoned, and beauty made ugly. Species are destroyed or constricted, leaving the natural world to surviving coyotes, crows and carp. High-grading the forests leaves weed trees to inherit the earth, a form of genetic pollution.

It is the shame of economists that some of them make the world equate economist with "materialist". Economics properly deals with how to meet human desires; staying alive in a healthy, pleasing environment ranks high among those. Even an economist can read Aldo Leopold (1949), who makes a certain amount of sense from which micro theory might benefit.

In macroeconomic theory, the received view is that raising GNP is prerequisite to providing necessary resources to pay for cleaning the environment. But GNP is too gross a measure, and pollution is a systemic problem (Commoner, 1971). Even today, national income accountants have still not modified their definition of GNP at all, after decades of informed, sophisticated criticism from environmental economists.

Several writers treat salt runoff lightly. It may be of small concern in parts of the Midwest, but it is of monumental moment in the arid west. Downstream water becomes unusable, and water pooling and exchanging, from which so many economies could result, become much harder to negotiate. While we can't blame Washington for everything, much salt runoff comes from Federally subsidized water. Kesterson Refuge is poisoned by runoff from the Westlands

Water District, irrigated under heavy Federal subsidy from the Central Valley Project (in spite of its long violation of acreage limitation provisions of the Reclamation Act). The worst problem on the Colorado is salt runoff from the Wellton-Mohawk project, near Yuma, a subeconomic project from start to finish. All extant Colorado River salt problems are now aggravated by the subsidized Central Arizona Project.

Other salt problems come via underground water. Irrigation water applied upstream percolates underground and resurfaces at lower elevations, evaporates and leaves salt residues, sterilizing certain lands (e.g., below the Fresno Irrigation District). But more ominous, aquifers themselves are impaired, and maybe destroyed forever. Americans have yet to hear this alarm bell, and take a frighteningly insouciant attitude toward groundwater.

A common view is that pesticides hurt us only by being concentrated via the food chain (Nicol and Heady, p.335). But in southern California, many aquifers are being impaired, perhaps lost forever by "downward runoff" or percolation of water laced with toxics. I wish I could report this has made the western states more conscious of the problem than easterners. The Metropolitan Water District of Southern California (MWDSC), the apex of our water establishment, which should be leading a militant defense of our aquifers' integrity, isn't.

Damage to lakes and impairment of riparian values is notorious and needs no laboring here. We see some progress in protecting inland lakes, but now the oceans themselves are threatened. There is worsening damage to salt-water estuaries, gulfs, bays, and wetlands. Shellfish and finfish supplies are diminished and contaminated; beaches are littered; swimming is restricted; riparian amenities are impaired.

Urban invasion of coastal wetlands is one aspect of the problem. Wetlands have served as filters protecting the ocean: urbanize them and more raw sewage reaches the ocean. Here again the culprit is not "construction" as such, it is filling. Cuts in the hills increase runoff; fills in the wetlands reduce filtering. The combined effect creates a serious problem.

Wind drift is an episodic problem. Where there are windless days, it is controllable except for mindless operators. It only takes one human error, and in Hemet, California, in 1974, 2500 ducks were wind-drifted to death. Bees are routinely lost in large numbers. In Hawaii or Wyoming, lacking many windless days, one wonders about the extent of the problem. Wind erosion from bare land is something else. Land laid bare stays bare in all weather.

Insects fly across property lines, wind or no. Nonpoint entomological pollution is a by-product of the pesticide treadmill. The biocide-by-pesticide of natural predators, followed by exploding populations of previously minor pests, has turned oversprayed fields into baneful insectaries spawning new problems that cross property lines.

What Sources and Problems are Untouched by Excise Taxes on Surrogates?

Summarizing from the two prior sections, here is a list of nonpoint sources and problems calling for solutions other than taxes on surrogates.

- a) Soil runoff, a problem in itself and a vector for adsorptive pollutants
- b) Denuded forest land
- c) Forest roads
- d) Mining: pit drainage, heap-leaching, drilling fluids, tank cleaning, oil spills
- e) Open storage of materials: coal and salt in Milwaukee; sulfur in Vancouver and Texas; etc.
- f) Return flow of irrigation water, with salts and toxics
- g) Inappropriate tillage: non-contour, steep land, erosive soils, eroding climates
- h) Inappropriate grazing: overgrazing, high-grading the herbage, steep land, compacting the soil, etc.
- i) Dumping of all kinds
- j) Septic tanks and cesspools
- k) Leaking gasoline tanks
- l) Land-grading: destructive scalping techniques in inappropriate places
- m) Filling wetlands

- n) Flooding, channel-scouring, etc.
- o) Transportation of all kinds: a long subcatalogue
- p) Animal waste
- q) Industrial waste from unsewered areas
- r) Paved lands and rooftops
- s) Burned-over land: forest, brush, grass
- t) Hyperpotent toxics and hypervulnerable individuals
- u) Aquifer loss
- v) Irreversible human damage and loss
- w) Worker exposure
- x) Nursing new pests due to predator destruction

The Case of Forestry

The inadequacy of surrogate pollution taxation is exemplified by forestry. The main purposes of watershed protection have long been to regulate water flows, to reduce flooding and erosion, and sustain flows during droughts. Minimizing pesticide runoff is a worthy additional purpose, but not the sole one.

Denuded land is the source of most forest runoff problems. Erosion results from a combination of logging roads (too many, too long, on land too steep); clearcutting; and slow replanting.

Slow replanting is the central problem. It slows the supply of second-growth timber, and thus creates pressure to invade submarginal areas. Foresters should harvest the low, flat, warm lands early and often because: (a) regeneration is economical there, it pays for itself where trees grow fast; (b) regeneration is fastest there, minimizing the exposure period of bare land; (c) logging roads may be shorter and less erosive there, because they are nearer to markets and on level land; (d) the temporary loss of scenic beauty is less severe; (e) the exposed bare land is less steep; (f) logging is cheaper and less destructive; selective logging is

more feasible; (g) fire control is easier; and (h) younger stands are more vigorous and naturally resistant to pests.

The last point bears underscoring here. It points to how good forest management can minimize pest damage without heavy reliance on toxics. The spruce budworm, for example, wreaks damage mainly on trees weakened by age. To protect those older trees, whole forests, millions of acres in the northeast are sprayed, with tragic treadmill results. The tussock-moth, over which so much organochlorine has been shed in the fir forests, damages trees mainly on poor growing sites. Trees on good sites withstand defoliation, green up, and grow with renewed vigor. The moral: stay off the poor sites. The method: utilize the good sites fully. Why aren't the good sites harvested early, replanted quickly, and utilized fully? One major reason lies in the tax system.

1. Replanting cost is not expensable for income tax, it must be capitalized, hence not written off until decades later when timber is harvested. The timber lobbies have deliberately traded this off to keep what they prize more, the capital gains treatment of timber sales.

2. Most states have substituted the yield tax for the property tax. The result is a bias against early harvesting. When you look at the whole system it also pushes cutting pressure out to marginal lands. But a yield tax at a high rate wholly destroys any incentive to restock marginal lands, once cut: it makes them subeconomic to replant.

3. Some states have virtually eliminated the land value part of the property tax on timber, removing an incentive to early reforestation. A tax based on land value continues at a steady level during the sterile downtime of land between harvest and replanting, thus pricking holders in the most compelling way to restock, while not taxing them at all for actually restocking. On marginal land the tax base is zero (it being based on land value) so it does not cause abandonment, nor make replanting any less economic than it already is.

4. When timber is standing, the value added by growth is partly unrecognized as taxable income. Timber has been a "capital asset" for income tax purposes since 1944. Not only is much of the gain unrecognized as income, but any tax is deferred until harvest. After timber is felled, value-added in the mills and markets is "ordinary" income and bears the full brunt of the tax rates.

When timber is standing there is no property tax, so it need only grow fast enough to pay interest on its value. After it is cut, it must yield a rate of return

high enough to cover a property tax, too, not just on its stumpage value, but also on the value-added by harvesting, hauling, milling, shipping, storing, merchandising, and constructing (Gaffney, 1980).

Thus the dual result of income and property taxes is to defer harvest, increasing the volume of old, disease-prone timber standing on good land, and pushing logging pressure out to marginal lands. Many marginal lands are non-regenerable. Logging there is simply mining, leaving the terrain denuded and open to the elements indefinitely.

Forestry on public lands, ironically, manifests similar biases, from a different set of incentives. William Hyde (1980), Marion Clawson (1976) and others have documented the pattern: undermanagement of superior sites accompanied by premature invasion of steep, remote sites as the Forest Service internalizes all its profits from timber sales to build more roads.

An optimal solution would constructively combine and synthesize two apparently contrary concepts of land stewardship:

Thesis: Concept A says "Conserve for the future."

Antithesis: Concept B says "Stewardship means highest and best use." Landholders are responsible to use land now, in order to employ others (generate incomes), to produce goods (combat inflation), and pay taxes (avoid deficits).

Synthesis: Concept AB says "do both, but in different places." Use the good lands intensively, grow timber early and often, thus relieve human pressure and help conserve the vulnerable, erosive lands.

Until this is done, will optimal taxes on aerial sprays do much good? Some good, no doubt. But the main problems are deeper rooted and call for bolder measures. That is my basic message. Forestry suffers from cutting sprawl, quite analogous to urban sprawl. The center is neglected, so the action moves to submarginal fringes and damages what's left of the center. Let us now look at two more cases, urban sprawl itself, and agricultural sprawl, where the source of problems is analogous, and the implied solutions the same.

The Case of Urban Settlement

The central problem here is urban sprawl; the solution is compactness. More land urbanized means more urban runoff. But more people on given land

may even mean less runoff per acre, e.g., at the threshold where sewerage can economically replace a collection of septic tanks and leach lines. It certainly means less runoff per capita. It means better control of any given runoff.

A compact, synergistic city is resource-saving; sprawl is resource-wasting, using up more land, capital, materials, fuels, and air/water quality to substitute for direct human contacts and cooperation. Here are some items that sprawl maximizes or worsens:

- (a) the number of car-miles for any given level of urban linkage, with smog generated in proportion.
- (b) paved areas, with salt and roadside litter both spread in proportion.
- (c) sudden death. Auto accidents, the ultimate "negative externality", kill some 40,000 Americans per year, and maim many times more.
- (d) the grading and denuding of new lands, generally upstream and more sloping. Three-quarters of the pollutant loadings in Wisconsin's Menominee River come from urban non-point sources. Developing urban areas cover only 2.6% of the watershed, but contribute 37% of the suspended solids and 48% of the phosphorous (Bauman et al. 1980, cited in Falk, 1985, p. P-II-B-2).
- (e) an increased number of homes on septic tanks.
- (f) the diversion of sewer funds from treating sewage to collecting it.
- (g) larger lots and lawns, longer driveways.
- (h) inhabited areas without good fire protection, with more grass and brush exposed to humans. To protect dwellings in emergencies, bulldozing fire lines goes to extremes which do worse damage than fire itself (Pavicic, 1987).
- (i) private wells puncturing aquifer caps.
- (j) settlement and industry beyond gutters and storm drains.
- (k) the withering of mass transit.

- (l) longer, wider utility rights-of-way, with higher voltage and pressure and hazard.
- (m) the filling of wetlands.
- (n) occupying floodplains, so more flood control reservoirs are needed.

Automobile dependency also creates its own treadmill effect. The car itself is the major consumer of urban space; space which must in turn be traversed, using still more car-miles. Mass transit withers away. The market does not lead us to optimal outcomes in such a world.

Suburbs abate their own problems at the expense of central cities, e.g., by getting sewers they could not pay for themselves. Milwaukee Metropolitan is as good an example as any. Systemwide that is a dubious gain, when the central infrastructure goes to ruins. The titles of some seminal works on this subject tell the story quite well: *America in Ruins* (Choate and Walters, 1981); *The Costs of Sprawl* (Real Estate Research Corporation, 1974); "Cost-push of Urban Sprawl" (Schechter, 1961); and "The City as a Distorted Price System" (Thompson, 1968). Solutions to urban sprawl will involve at least three courses:

1. Marginal-cost pricing of city services, with a spatial or locational component. Examples include: a water-rate surcharge rising with pressure zones, and cheap city services in the center, encouraging infill and centralization.

2. Renewal-oriented tax policy, especially in central cities. Renewal-oriented property taxation imposes higher tax rates on land than buildings (Breckenfeld, 1983). Former Mayor Dan Hoan (1936, pp. 26-27) of Milwaukee favored this policy. Renewal-oriented property *assessment* accomplishes the same end by apportioning a higher share of assessed value to land, and less to buildings. During Hoan's tenure, the City Assessor accomplished it by using the "building-residual" method of apportionment. He drew up, reproduced, and publicly distributed land value maps, on which every parcel was valued at its highest and best use, as determined by comparable sales in the neighborhood. This approach approximately triples the assessed value of land, as compared to current Milwaukee practice (Gaffney, 1970).

3. Renewal-oriented spending and service policy. One guide to this is "tiered" zoning and planning, firm and consistent. Attorney Robert Freilich, the "father of growth control", has shown how to make this work in Ramapo, New

Jersey, San Diego; and elsewhere. When Dan Hoan (1936, Chaps. 2, 8) was Mayor of Milwaukee from 1916 to 1936, he oriented spending this way reflexively, to serve the existing city rather than to expand it. Milwaukee was a city that worked -- then.

One may prefer other measures. More should be said about constraining the space demands of cars and trucks. But the point is that whatever measures one wants, they will have to cut much deeper than taxing pesticides and fertilizers. We are talking about major, radical readjustments of urban, tax and utility policies.

The Case of Agriculture

Farming manifests the same problem as forests and cities. Public policy suppresses full use of the best lands while subsidizing use and abuse of marginal lands. As we said of urban sprawl, the more land in use, the more runoff. Here are some elements that cause "agricultural sprawl".

1. Urban sprawl takes the best land out of farming. Cities deserve the best land and get it, but urban sprawl inflates urban demand several times over. In the best light, the demand is premature. Much of it is just wrong, now and forever. Shock waves from exploding cities fan out through the entire hierarchy of farm land uses. At each margin of supersession there is a transfer of chaos plus an increment. Citrus invades deciduous, deciduous sprawls out among vines and vegetables, these move into cotton, cotton pushes on alfalfa which displaces small grains which take over pasture which invades the forests and, at each margin, there is a new contribution of sprawl, chaos or entropy, a loss of concentration and focus and good economic spatial organization of farm activities.

2. Land retirement programs, under whatever label (there's been a new variation on the theme every few years since 1933) put good land on ice to support prices. Under the resulting "price umbrella", marginal land enters production. This is classic cartel behavior: a classic not of genius but of folly.

3. Surpluses are destroyed at home, or dumped (sold below cost) abroad, under Federal subsidy.

4. Some crops associated with high erosion receive strong support or protection: wheat, corn, cotton and sugarbeets, for example.

5. SCS funds are not allocated by need, but per Senator. Aldo Leopold (1949, p. 210) observed of SCS, "In our attempt to make conservation easy, we have made it trivial". It is worse: we have made it a pork barrel, like rivers and harbors. So instead of cover-cropping problem lands, we use SCS funds on lands that scarcely need them, reducing their output and increasing the pressure to till marginal lands.

6. We raise a farmer's property tax assessment for installing a truly conserving device like a Harvestore which turns hay into silage. The other farmer who stores corn silage in an open bunker pays few taxes while losing 1/3 to 1/2 of the product of an erosive culture. Corn also leads all crops by far in dependence on pesticides (Gianessi, 1987, p. 3). Six of the seven leading active ingredients used in farm pesticides are devoted mainly to field corn, these being alachlor, atrazine, butylate, metolachlor, trifluralin, and cyanazine.

Meantime we subsidize new and submarginal lands in dozens of ways. But on the farm as in the city, the more land, the more runoff. I have already cited the federal government's responsibility for the Westlands Water District draining into Kesterson Refuge, and the Wellton-Mohawk Project draining into the Colorado River. The State of California is as bad. The whole arid southwest quarter of the Great Central Valley is being brought into cultivation using subsidized water from the California Water Project's Westside Canal. Promoters there have discovered another treadmill effect, the "groundwater treadmill" of local-depletion-and-state-rescue. But salt runoff has reached such a level that the next rescue requirement will be a "brine line" to the sea, if a receptive coast county can be found for the outfall.

South of the Tehachapis, the Metropolitan Water District of Southern California (MWD) frightened city voters with drought forecasts (Kahr, 1982), secured entitlements to excess water, and dumped it on surrounding deserts, enriching land speculators who, while waiting for urban sprawl to reach them, farm with the mindset of short-term tenants, caring nothing for soil conservation or permanent farm improvements. MWD is now watering an "avocado crescent" 200 miles north-south, with groves on slopes up to 45 degrees.

Will pesticide taxation control those problem? It would certainly help. What inflates farm acreage also inflates demand for chemicals; and agricultural chemo-therapy is less rewarding to buyer and seller, both, when chemicals pay more tax. But in the whole picture, toxic runoff is just one of several reasons why we must face up to radical review of our political-economic treadmills, driven as they are by what *Time Magazine* has called "The Great American System of Public Works for Private Profit."

The Common Theme from Forest, City and Farm

Market failure, public programs, and perverse incentives in the land market create a gross bias towards spreading out too much. This aggravates otherwise fairly tractable runoff problems. The more denuded land, the more runoff.

This perversion does not occur by accident. Spread and sprawl in forestry, cities and agriculture are common results of the dominant force driving American politics, the quest for unearned increments to land value. Thorstein Veblen (1923, pp. 138-40) in his final testament, *Absentee Ownership*, noted that American farmers:

... have always, ... wanted something more than their ... share of the soil; not because they were driven by a felt need of doing more than their fair share of work ... , but with a view to ... getting a little something for nothing in allowing their holdings to be turned to account.

Rising population is one factor pushing up land values, but not the strongest. Increased demand per capita is the main factor. These demands include all the spurious demands described above, like the demand of government for land to "bank" and hold idle, and the demand of speculators "with a view to getting a little something for nothing".

Veblen went on to say that farm technology adapts to the Procrustean bed of absentee ownership. Rather than leading, technology lags changes in land-holdings wrought by rural speculative investors. Thus it is not "society" or "efficiency" alone that mandate monocultural chemical farming, but also the peculiar needs of absentee speculators holding more land than they can work themselves or with their families. Logic of, by, and for this minority is set up as logic for all.

Solutions

The solution is land stewardship, a new-old ethic to supplant the cowboy ethic in which western man has wallowed over several centuries of territorial expansion. To reprise from the section on forestry, we must synthesize two concepts of land stewardship. Concept A says "save for the future"; Concept B says put land to full use right now, to serve and employ people. Concept AB says do both, but each in the right place. Use the good land, use it well and fully, employ the workers, serve everyone's needs. Congregate and cooperate on

central, low, flat, fertile ground, as efficient markets and efficient public policies would dictate anyway. Leave the marginal land in peace.

Effective stewardship is not easy or trivial. Excise taxes have their place, true, but the problems at hand are much vaster and deeper than little measures reach. Solutions call for basic reconstruction and reorientation more drastic than most of us usually contemplate. But let's try; it might even be fun. Dan Hoan had fun making Milwaukee work; he is as good a model as we need.

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