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THE NEW ENVIRONMENTAL ISSUE: SOIL POLLUTION

Soil pollution has become a new environmental issue. In this paper a case study on soil pollution as well as the causes of this pollution in the Federal Republic of Germany are presented. There are also given prespectives of a more active soil conservation in the future.

1. Soil Pollution: A World-Wide-Problem

In principle, the pollution of the soil in many developing countries stems from the same causes as that in the industrialized countries:

- inappropriate and overly intensive use of land for agriculture and forestry,
- use of land according to its economic value and not according to its environmental carrying capacity and,
- planned or uncontrolled introduction of noxious substances.

Another cause has to do with the soil's special function. Whereas pollution of the other environmental media, air and water, is, as a rule, immediately evident and largely apparent to our senses, the soil absorbs a good deal of pollution invisibly at first, acts as a buffer between man and the effects of that pollution, and permits damage to mount to a point that in other media would have long since triggered an SOS.

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Yet the fact that the soil has recently become the object of environmental policies in some countries should also lead to greater scientific reflection on the various cause-and-effect-relationships between the soil, environmental quality, and well-being.

2. Causes of Soil Pollution

The difficulty of describing soil pollution is, first of all, that land has no definitive state: it can only be defined as a changing entity. Describing the soil is not only a physical, chemical, or biological task. The characteristics of land and of the changes in it can be assessed meaningfully only in relation to the social relevance of the actual and potential uses to which it can be put. The concept of what constitutes soil pollution varies over time. To make it easier to grasp the problem of soil pollution, it thus appears necessary to categorize the various types of pollution.

The classification scheme below seems plausible for the problem as it is, for instance, known in the Federal Republic of Germany:

1) Pollution resulting from a change in the use of land: General changes in use stemming from the development of open spaces with industrial plants, housing units, and infrastructure. This process is also called the conversion of rural land to urban, industrial, and transportation uses (Landschaftsverbrauch). In addition to the obvious changes in use that can be described statistically with some degree of meaning, there are also those changes that result from an increase or decrease in the intensity of use (land being used for agriculture and forestry is a particular case in point).

2) Intentional pollution, primarily by substances used to fertilize the soil and control weeds and pests. Their subsequent side-effect is the lasting harm done to the soil itself, to microorganisms, ground water, or other uses of the soil, one result being poisons in food.

3) Discharge of noxious substances by third parties over which the land owner or user normally has no control (ambient pollution, acidification, heavy metals, and the like).

4) A fourth way to describe the harm done to the soil is to illustrate the individual impacts or pollutants and to show where damage by polluters has occured or can be expected to occur and how concentrated it is.

Just which of these types of pollution impairs the soil most is a question that can scarcely be answered in general terms. One reason is that most of the types of damage are clustered, although their individual impacts, when combined, affect different kinds of soil in different ways. Agricultural policy, the policy of "high smokestacks", or the goal of having the same living standards in all areas--to cite only three examples--contribute to making soil pollution all but inevitable.

In one single presentation it is not possible to go into detail about all the processes of soil pollution and to forecast what they will be like in the future; the following examples are thus intended only to give an idea of the destruction now taking place.

3. Federal Republic of Germany - A Case Study

In the Federal Republic of Germany, each day an average of 165 ha of open space are designated as--and converted to--housing and infrastructural development.

According to the last land-use planning report of 1982, the settlement areas increased by 120,922 ha between 1979 and 1981.

In North-Rhine Westphalia, some 7,425 ha of open country were used each year for buildings and industry between 1970 and 1978, another 2,275 ha for transportation facilities, and 1,363 ha per year for athletic grounds and military facilities.

The figures in Table 1 show the use of land in the Land of Baden-Wuerttemberg:

TABLE 1:

DEVELOPMENT OF ALL AREAS IN BADEN-WUERTTEMBERG, 1900-1982

Period	Total Settlement Area				Use of open Space Per Daily Average in ha
	Absolute Change		Percentage Change		
	Total in 1,000 ha	per year in 1,000 ha	During total period (in %)	in % per year	
1900-1913	18.8	1.45	15.8	1.21	4.0
1913-1927	11.3	0.81	8.2	0.58	2.2
1927-1938	37.9	3.44	25.4	2.31	9.4
1938-1950	25.2	2.52	13.4	1.12	6.9
1950-1955	20.1	4.02	9.5	1.90	11.0
1955-1960	16.6	3.32	7.1	1.42	9.1
1960-1962	9.4	4.70	3.8	1.90	12.8
1962-1964	9.7	4.85	3.8	1.88	13.3
1964-1966	10.1	5.05	3.7	1.88	13.8
1966-1968	12.8	6.40	4.6	2.30	17.5
1968-1970	19.6	9.80	6.7	3.37	26.8
1970-1972	21.8	10.90	7.0	3.51	29.9
1972-1974	1817	9.35	5.6	2.81	25.6
1974-1976	11.0	5.0	3.1	1.57	15.1
1976-1978	15.5	7.75	4.1	2.05	21.1
1978-1980	14.4	7.18	3.8	1.90	19.7
1980-1982	9.7	4.87	2.5	1.24	13.4
1900-1978	258.5	3.31	216.6	2.78	9.1
1950-1978	165.3	5.90	77.8	2.78	9.1
1960-1978	128.6	7.14	51.6	2.87	19.6
1970-1978	67.1	8.39	21.6	2.70	23.0
1978-1982	24.1	6.03	6.4	1.60	16.5

Source: I.C. Tesdorpf, Landschaftsverbrauch, Berlin 1984.

Recently, a number of forecasts about this subject have been made. For many reasons, one must assume--as things stand now--that the trend of changing the use made of land will continue.

Seeking the causes of this process of change (in many places, more area was developed within the last generation than in the preceding 800 or 1,000 years), one finds a variety of answers. A primary cause is the land owners' interest in enhancing the economic value of their land. Normally, it is more profitable to develop it than to protect it from building. Besides the owners, others interested in high prices for land include the banks, real estate agents, local governments, the

revenue service, the surveyor's office, the land registry bureau, for their income (or percentage of the fees involved) increase with the price of a piece of land.

In our economic system this mechanism of land use is presently considered legitimate. Planning law and building rights, the provisions of which have been on the books since the 1960s, have not reduced the proportion of land being converted--even though the population is decreasing almost everywhere in the country.

In his study on Baden-Wuerttemberg, Tesdorpf showed that the rezoning of land--particularly for the building of housing estates and commercial purposes--causes the massive conversion of rural land for urban, industrial, and infrastructure use. The increase of dwelling space per capita and the trend toward single-story production facilities partially explain this phenomenon. Other reasons stem from the lack of awareness in political bodies (such as local councils) responsible for the actual use of land.

The general protection of water, landscape, or monuments is largely unquestioned. But it is still a little known fact that protection of the soil is also required. The negative consequences have either received too little attention or have not been directly attributed to soil pollution.

The largest extent of the danger--it seems to me--stems less from controversial, large-scale projects than from the myriad discreet decisions made by agencies and individual citizens on such things as the expansion and rezoning of areas in which development is permitted, the laying of concrete for garage ramps and driveways, parking lots, and garden paths, the widening of local roads, the cementing of embankments, etc.

3.1. Intentional Pollution

According to a study conducted in 1983 approximately 8% of the land in the Federal Republic of Germany should to be foreclosed at once because of expected health hazards largely attributable to the type of agriculture practiced on it. In the foreseeable future, ap-

proximately 10% of the country's water processing plants must be shut down because the ground water being tapped has excessive levels of nitrate, which are primarily attributable to fertilization; animal and plant species continue to die out.

That the intensive uses of land for agriculture is at the root of this is scarcely a matter of debate any longer. But over-fertilization and the use of pesticides and herbicides are not the only factors harming the soil in various ways. Further intensification of land use is also involved (radical changes in green areas, large-scale cultivation of corn, utilization of big machinery, etc).

A large part of this damage is not only due to the individual polluter, the farmer, but also to the basic conditions governing agriculture and forestry--the marketing regulations of the European Community, and agricultural policies in general.

3.2. Third-party Pollution

In the Second National Report on the quality of the Environment, it was noted that the "wet deposition of sulfur dioxide results in the acidification of soil and water, in changes in the buffer and developmental capacity of the soil, the mobilization of heavy metals and phytotoxic elements (like aluminum)." To be sure, there are differences of opinion about the extensiveness of such soil damage caused by the introduction of noxious substances. However, the dimensions are no longer contested, as the discussion about forest damage shows.

Whereas in Canada and Scandinavia acid rain falls directly into water bodies, in central Europe acid rain's impact--slowed by the higher buffer capacity of the soil--also occurs through the chain linking soil and vegetation or soil and ground water. The damage done to the soil by SO_2 pollution appears to be increasingly serious in the Federal Republic of Germany. Signs of this are, for example, that the Kleiner Arbersee or the Rachelsee in the Bavarian Forest have pH values of 3.5--4.2, thereby approaching "Scandinavian levels".

It is well known that there are high levels of heavy metals in soil in the vicinity of plants with high emission levels, or directly along-

side roads. The list of places noted for this in the Federal Republic of Germany is long: Mechernich, Oker/Harlingerode, Stolberg, Nordenham, etc. It is unclear how many other areas there are whose contaminated soil we do not yet know about. This is what is known as the problem of past damage (or Altlasten), an issue with which local authorities and environmental groups are especially preoccupied.

Besides the air-borne pollutants from industrial production, transport, and domestic fuel, many substances polluting the soil enter the ground by other means:
- depositing sludge on the soil,
- dredging material from rivers and canals,
- strewing salt (chloride, for example) on streets in winter time,
- disposing of sewage, etc.

These pollutants constitute some of the hazards to the soil and contribute to its destruction. According to G. Bachmann (1983), approximately 7% of the area in the Federal Republic of Germany must be called contaminated.

Under normal conditions, soils can absorb and partially decompose a considerable amount of pollution. The use of the microbial metabolism to dispose of waste water in sewage farms shows that these features of the soil have been known and tapped for a long time. Heavy metals are taken up into the soil's natural components: the soil accumulates them. The capacity for enrichment, however, is limited. It varies depending on the type of soil concerned and can fluctuate greatly if the decisive characteristics of the soil--the pH value--change. For example, if the pH value decreases, the soil's accumulated heavy metals are remobilized and can then contaminate ground water.

The essential point is that soil "overloaded" with pollutants exceeding its buffer capacity cannot be restored to its natural state. This seems to be the crucial difference between pollution of the soil and pollution of water or air. The destruction of the soil is then irreversible.

To summarize, the amount of land that has been irreversibly destroyed in the Federal Republic of Germany can no longer be considered marginal. Whether this constitutes 5%, 7% or even 10% of the soil is moot;

in any case, the scale of the damage ist significant. The process of soil destruction is evidently accelerating for all three types of causes outlined above.

4. Why The Protection Of The Soil Has Been Discussed Only Recently?

It is surprising that the issue of soil pollution in the Federal Republic of Germany did not attract public and political attention until just the last few years. By contrast, water pollution control has a tradition stretching back more than a hundred years. There has been similar experience with ambient environmental quality control. This long tradition led to the establishment of institutions for scientific research, monitoring, and enforcement of protective measures for water and air. Not so with the third environmental medium, land. Like the environmental media of water and air, the soil's capacity to regenerate has been impaired by urban agglomeration and pollution since at least the start of industrialization, but the authorities did not consider it necessary to protect the soil effectively. There is a relatively simple economic and legal reason for this: Air and water were thought to be "free goods" in the market economy, and since the price-cost mechanism does not apply for such goods, the government was, so to speak, forced to serve as a trustee and regulate their use on behalf of all.

By contrast, land has been a private good for centuries, although about one-third of the area of the Federal Republic belongs to public bodies. In principle, damage to this good can be regulated in civil courts. If, in addition, the government were to create the necessary conditions--legal codes, for example--further interference through soil protection programs would be theoretically unnecessary, because the mechanisms of civil sanctions would be brought to bear when damage occurred.

Since the passage of the Federal Building Act (Bundesbaugesetz) of 1960, however, the legislature has made it clear that land, as part of the free-market system, is subject to conditions other than those of supply and demand. A number of regulations for the protection of the soil were codified in this law, but they were not implemented effecti-

vely, if at all. As early as 1963, one of the aspects of the soil pollution, Landschaftsverbrauch, (i.e. the conversion of rural land to urban, industrial, and transportation uses), was criticized in the first Regional Planning Report of the Federal Government.

Although the two major planning laws in the 1960s (the Federal Building Act of 1960 and the Regional Planning Act of 1965) proscribed the "improper use" of the soil, these regulations have had no long-term effect on the continued conversion of rural land, on the contrary.

The reformulated and more general call for soil protection in the Federal Government's environmental program of 1971 was to be a new start in conjunction with environmental policy. Land is referred to in that document as a prime target of environmental policy. Still, this formula for the protection of the soil was relatively abstract and empty, and was not strictly acted on.

Five main reasons for this deficiency:

1) As mentioned above, land is private property. Accordingly, the government and local authorities are supposed to refrain from interfering.

2) The urgency of the need to protect the soil was not considered to be as great as that of clean air and water quality control. Grassroots initiatives (Bürgerinitiativen) at that time had different priorities, such as energy conservation and noise abatement.

3) Political or administrative responsibility for protecting the soil was not, and is not, clearly assigned to the federal, state, or local government. Rather, responsibility is only indirectly distributed to a variety of public bodies. Thus, when the first environmental program was being prepared in 1971, there was no agent invested with the competence to formulate and press the demands for soil protection.

4) This non-decision about assigning primary competence and responsibility for soil protection resulted in the formulation of general statements only and the deferral of the issue. Moreover, the Federal Government has hardly any clear constitutional recourse for action; protecting the soil, however it is managed, comes essentially under the juridication of local and state governments.

5) Finally, the scientific community did not recognize the urgency of the issues surrounding land, or did not point them out clearly enough to the broader public. Even experts in soil science, working in a

field that is more than a hundred years old and that focuses on agriculture and soil productivity, were relatively late in addressing the problem.

The issues outlined above are reasons for the fact that soil conservation has not yet become an integral part of environmental policy. When this aberration became clear, two demands were discussed in the Federal Republic of Germany:
- The introduction of ecological principles into policy, thereby requiring that biological interdependencies be taken into consideration in all government interventions and that especially ecological parameters be integrated into environmental policy;
- The management of land as a special resource to be protected, meaning that conservation programs should be worked out and soil conservation laws be passed.

A great deal of thought, therefore, has been given to soil conservation throughout the country recently. In August 1984, a draft concept for soil conservation was presented to the Federal Ministry of the Interior for the first time. This is not yet a working soil conservation program, but a concept that at least contains a number of interesting proposals.

5. Perspectives in Active Soil Conservation

At the present stage of the discussion, the primary question is not whether the problems described above can be solved by a law mandating soil conservation or by a technical manual on land use (like that on air). For the time being, it is necessary instead to explore how the government intends to--or should--deal with land as a private good in the future.

Some of the questions thus far largely excluded from the debate about soil conservation may now be examinated:
1) Which specific objectives for soil conservation should be achieved? Should a total ban be imposed on conversion of rural land for urban, industrial, and transportation uses? Or should an annual increase of one or two percent be permitted? Only when a social consensus has been forged on this matter will it be effective discussing which instru-

ments are adequate for soil conservation.
2) Can the land owner's responsibility be expanded to include the protection of the natural environment? Does the objective of soil conservation make it permissible for the state to impose conditions that cause a loss of income for the land owner?
3) Soil conservation requires that legal competence and political responsibility be clearly assigned. Up to now, the actors are frustrating each other's "honorable" intentions.
4) For developing a code of law for land use, empirical findings about the conversion of rural land must be taken into consideration, as should the question of whether local government's planning authority for land use be restricted, and responsibility for these issues be assigned to other departments, such as regional planning offices.

A satisfactory answer to these, certainly not very easy, questions could make an important contribution to ending the practice of treating soil conservation as just another isolated, specialized area of environmental protection but to link it to the tasks of protecting the natural environment in general.

6. Concluding Remarks

When the time came at the beginning of the 1970s to formulate an environmental policy for the Federal Republic of Germany, it was done largely without the intellectual assistance of the scientific community. Either the questions of environmental policy considered relevant at that time were not of interest in the various scientific disciplines, or there were no appropriate target groups in the universities and research institutes to whom these questions could be addressed. Environmental policy was therefore formulated essentially in very pragmatic terms only.

The situation today, some fifteen years later, appears to have changed little. True, tremendous scientific potential has developed under the banner of environmental research. But in the process, the complex concept of "environment" has not been pieced together or interpreted as a coherent whole but rather dissected into ever more minute parts. The environmental medium of "land" is a prime example of this. The challenge to academics, then, lies in the creation of feedback systems (in

the organization of scientific work as well) that permit an holistic approach and genuine teamwork while at the same time allowing for the pursuit of individual research interests.

Although environmental research so far has been focused strongly on technical aspects, the analysis of the relationships between society and the environment (primarily of implementation and acceptance) should be seen as the central challenge. The issue of soil pollution aptly justifies this call. More than one hundred years of scientific and technical study of the soil have not helped us to act in time to prevent damage to our forests, nor has adequate knowledge been provided about how to fight soil pollution, and how to successfully apply knowledge in practice.

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NOWE ZAGADNIENIA W OCHRONIE ŚRODOWISKA: ZANIECZYSZCZENIE GLEBY

Zanieczyszczenie gleby stało się nowym problemem w ochronie środowiska. Przedstawiono badania zanieczyszczeń gleby i omówiono przypadki tego zanieczyszczenia występujące w RFN. Pokazano perspektywy aktywniejszej ochrony gleby.

НОВЫЕ ВОПРОСЫ В ОХРАНЕ СРЕДЫ: ЗАГРЯЗНЕНИЕ ПОЧВЫ

Загрязнение почвы стало новым вопросом в охране среды. Описаны исследования загрязнений почвы и обсуждены случаи этого загрязнения, встречаемого в ФРГ. Показаны перспективы более активной охраны почвы.