

# Soils and Society – an environmental history of challenge and response

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## Böden und Gesellschaft – eine Umweltgeschichte von Herausforderung und Reaktion

### 1 A worm's view

If history could be written from a soil perspective, from an earthworm's desk, so to say, how would the periods of history be identified and named? Which major driving forces, which revolutions would worms as soil historians notice? The textbook version of the worm history might start with the age of the bare foot (called pre-history by some), followed by the age of livestock herding, the age of the digging stick and the age of the hoe and the spade. The succeeding plough ages would begin with wooden implements in the fertile crescent in Eurasia but also in other centers around the world. Later, iron implements would become common, meriting a period

name of their own. The plough ages would be called the ages of the hoof by some worm historians. The social soil historians would point out that the age of the moldboard plow documents the increasing violence against soils, with all the upheaval of species caused by turning over the sod. Some historians would fight for another name for this age, arguing that ploughs are secondary to the means of draft power applied, and call the moldboard plough age the age of the horse instead. Some more sophisticated soil historians would argue that the age of the seed drill merits special mention, pointing out that a new type of operation unseen before, an operation which brings the seed into the soil in a controlled rather than a stochastic fashion, needs to be recognized as an

### Zusammenfassung

Die Arbeit gibt einen Überblick über Konzepte und Herangehensweisen zur Untersuchung der Beziehungen zwischen Boden und Gesellschaft. Die Einleitung (1) bietet eine nicht-anthropozentrische Sichtweise auf die Geschichte der Böden. Danach wird das DPSIR-Modell (2) vorgestellt und diskutiert: Die Rolle von Konzepten von Umweltschädlichkeit (2.1) wird ebenso beleuchtet wie die Rolle von Mythen über Natur in der Lebensgestaltung (2.2). Mit Hilfe des Interaktionsmodells der Sozialen Ökologie (3) können Umwelteinflüsse untersucht werden. Repräsentationen von Natur müssen auch unter dem Gesichtspunkt von Macht betrachtet werden (4). In historischer Betrachtung werden Veränderungen im Verhältnis von Böden und Gesellschaft erkennbar (5). Modelle sozialen Wandels werden vorgestellt (6). Forderungen für die sozialwissenschaftliche Bodenforschung werden abschließend entwickelt (7).

**Schlagnworte:** Autorität von Wissen, Cultural Theory, DPSIR, Umweltgeschichte, Bodenforschung.

### Summary

The paper gives an overview of concepts and approaches for the study of relationships between soil and society. The introduction (1) offers a non-anthropocentric view on the history of soils. The DPSIR-model is introduced and discussed thereafter (2): Concepts of environmental hazard (2.1) are elucidated as well as the role of myths about nature in livelihood strategies (2.2). Environmental impacts can be investigated with the interaction model of social ecology (3). Representations of nature have to be analyzed in terms of power relations (4). Changes in the relations between soils and societies become visible in historical reflection (5). Models of social change are introduced (6). Requirements for social soil research are developed in conclusion.

**Key words:** Authority of knowledge, cultural theory, DPSIR, environmental history, soil research.

age in its own right. Tractors and the steel implements they carry will give name to the last age, the present, and while worm historians might disagree with one another over the importance of the energy input into their world by means of fertilizers they might very well be aware that doomsday is near. The advent of soil upheaval in the forests would be seen as a particularly visible sign of the increasing danger by some worm historians, but heavy metal pollution of soils would be seen as much more dangerous by the majority of organisms in the soil parliament.

Some soil NGOs would publish lists of lost civilizations of soil organisms, whole worlds with their own distinct culture and tradition, lost recently due to catastrophes like those on Haiti, or lost to slow degradation and deprivation like those first to perish, those of Mesopotamia. As the worm NGOs have no forces to command they would lobby for the identification of sanctuaries, difficult-to-reach tracts of soil that could be used as a repository for some of the cultural diversity. Clever soil politicians would argue that one must not tell a decline story and urge committees to analyze the positive effects of high input-high output societies, with the fabulous population growth such a regime allows for certain members of the soil biota community. Their views would likely win a majority, because most of the species of the first soil civilizations are long extinct and the sad remains of some of them have no political power. They are mourned only by historians and the culturally conservative. Some worm or arthropod in defense of modernity would most certainly argue that life is better at the high energy end. The quicker turnover and the higher flexibility it demands are challenges soil organisms simply have to respond to, and soil cultural development will mediate its negative effects.

## **2 The starting point: the DPSIR model as a basis of soil – society interaction research**

Humans write the history of soil, and from a different perspective than the worms would. Only recently have they begun to see in a comprehensive way the challenges social developments mean for natural systems. An environmental history of soils is needed, which combines their natural and their cultural histories. The interaction between those two realms needs to be understood in order to being able to work for a sustainable future. Pedogenesis, the natural history of soils, was the only historical force at work in the age of the bare foot. Ever since the age of the hoe soils also have a his-

tory of cultivation, and hence, of culture. The similarity between the two words is not an accident, as the notion 'culture' derives from words for turning the plough. The cultural history of soils, while seldom at the center of interest of historians, has been implicitly the theme of agricultural history for a long time. Rather than their natural OR cultural histories, the history of the interaction, i.e. the environmental history of soils should be studied to develop a sound understanding of processes and phenomena from a non-anthropocentric but therefore nevertheless humane perspective. For an overview of the environmental history of the 20<sup>th</sup> century, see McNeill (MCNEILL, 2000). A very brief overview of the environmental history of soils can be found in McNeill and Winiwarter (MCNEILL and WINIWARTER, 2004).

During the development of a thematic strategy for soil research in Europe one of the current socio-ecological models of the interaction between culture and nature has been used, and the fact that it has been used in interdisciplinary context is, in itself, a major achievement (see Figure 1 for an overview).

The DPSIR model alone is not enough. The model suggests a causal chain, but does not detail the way in which responses derive from impacts, nor how these responses change driving forces. We need to look at these processes to develop a strategy for science-based soil conservation that works.

In order to do that, I suggest we ask which model(s) of nature lie behind the DPSIR-model. We need to understand their merits and limitations, we need to add context and develop an understanding of the processes between impacts, responses and pressures. One will also have to ask which model(s) of nature will be useful for soil research. Further, I suggest we ask if we can model the long-term interplay between nature and culture in some way, opening the 'black boxes' of the DPSIR model. By looking into them, our attention will again be drawn to the models of nature on which actions are based, and we will also have to ask about the role knowledge plays in this interaction. When dealing with knowledge, we need to understand how the authority of knowledge is determined. We might be able to create authority for soil scientists' knowledge based on such an understanding. What results from this investigation is a call for trans-disciplinary research strategies based on the environmental history of soils. Finally, I shall suggest an agenda and priorities for a soil thematic strategy. Not surprisingly, from my viewpoint as an expert of society, soil scientists, if they want to be effective in protecting soils, need to engage on a conceptual level with social sciences in order

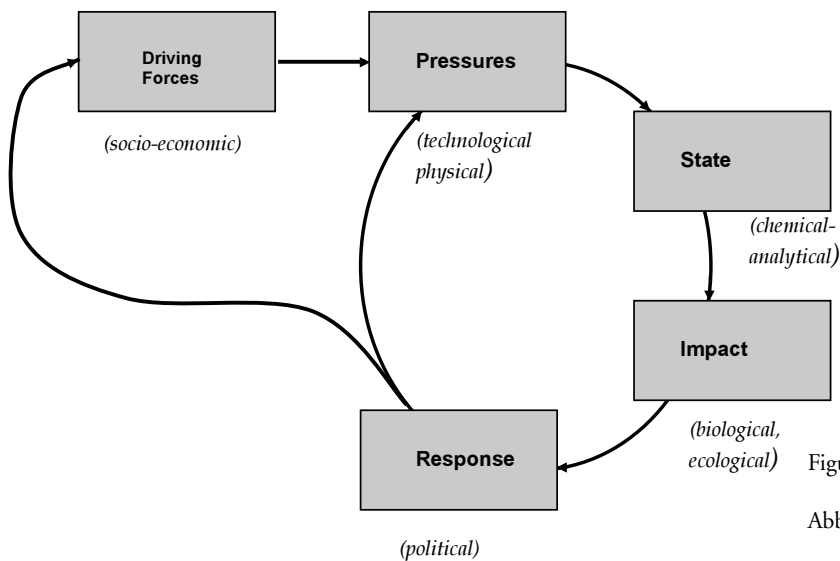


Figure 1: The DPSIR model as used by the European Environmental Agency  
 Abbildung 1: Das DPSIR-Modell, wie es von der Europäischen Umweltagentur benützt wird.

to understand their own role and thus be enabled to take part in rewriting the plot of the play in which they act.

## 2.1 Reflecting on the DPSIR model (1): concepts of environmental hazards

The soil organisms in the ‘worm history’ show different perceptions of what constitutes an environmental hazard. Some use a toxicological model, some a disturbance-oriented model that sees the balance of nature endangered. Some discuss energy and thus entropy as a problem, and the worm NGOs argue from a viewpoint of equality and morality. Taken together, these four models represent how environmental hazards are conceptualized today. Paradigm I, ‘toxicity – pollution’ asks: which substances are toxic. The main measures undertaken are the definition and enforcement of threshold values for toxic substances. Paradigm II, ‘natural equilibrium’ asks how a natural system works, and tries to protect such systems by means of conservation, restoration, and other means of protection. Measures are aimed at ecosystems, which are designated as valuable. Paradigm III, ‘resource economy, entropy’ asks which economic activities are entropic and devises measures to reduce material and energy use. Paradigm IV, ‘conviviality’, asks which human activities create suffering for other beings. The related measure is the reduction of dominance (KORAB, 1992; FISCHER-KOWALSKI et al., 1997).

It is notable that the Working Group on the Soil Thematic Strategy has identified threats to soils which comprise

more than one of these paradigms by discussing among others erosion, contamination, soil organic matter as well as loss of biodiversity and sealing.

While the DPSIR concept does not differentiate between these hazards, responses are based on either one of the perceptions of danger, and thus research strategies have to take into account their differences. Each of these paradigms results in a different political agenda – so in order to address Cluster 3 of the Soil Thematic Strategy, ‘Driving Forces’, we need to learn more about differences in conceptualizations of nature.

## 2.2 Reflecting on the DPSIR model (2): myths of nature and human livelihood strategies

‘Cultural Theory’ was developed by anthropologists in an effort to understand how risk is perceived by different actors in a given society. The theory is concerned with social constructions of nature, with the way humans think how nature works, not with nature per se. The authors call these constructions ‘myths’ to make clear that they are talking about social constructions, not about nature as such. Cultural theory offers a four-fold taxonomy of such ‘myths of nature’ (THOMPSON et al., 1990), suggesting we differentiate (for current societies) between four different concepts and patterns of behavior (or ‘management strategies’), called *individualist*, *egalitarian*, *hierarchist* and *fatalist*. The key argument is that myths of nature are inextricably bound to these strategies. Ideas about the nature of nature lie at the bottom

of management strategies, e.g. in terms of group solidarity, competition and social transactions. This means that these strategies, according to cultural theory, cannot be disentangled from myths of nature. What is called a 'management strategy' might be misleading for those who are used to economic theories of management. Cultural theory talks about the ways and means individuals devise to make their living, how they manage to cope with life, and might perhaps even be called livelihood strategies. The concept can be visualized in a rough sketch, Figure 2.

Figure 3 shows that for *individualists*, nature is benign and resilient, able to recover from any exploitation, and man is inherently self-seeking and atomistic<sup>1</sup>. Trial and error in self-organizing, and ego-focused networks (markets) are the way to go, with Adam Smith's invisible hand ensuring that people only do well when others also benefit. Individualists trust others until they give them reason not to and then retaliate in kind, and see it as only fair that those who put the most in get the most out. Managing institutions that work 'with the grain of the market' (getting rid of environmentally harmful subsidies, for instance) are what are needed. Emission certificates and eco-labeling for those products that are safe are typical individualist solutions. Well-informed consumers are conceived as regulators in the market-driven system, which if it is set free, will ultimately solve all problems.

Nature is almost the exact opposite for *egalitarians*: fragile, intricately interconnected and ephemeral, and man is

essentially caring and sharing (until corrupted by coercive and inegalitarian institutions such as markets and hierarchies). We must all tread lightly on the earth, and it is not enough that people start off equal; they must end up equal as well. Trust and levelling go hand in hand, and institutions that distribute unequally are distrusted. Voluntary simplicity is the only solution to our environmental problems, with the 'precautionary principle' being strictly enforced on those who are tempted not to share the simple life. Egalitarians believe that natural laws are rules that apply also to humans. Therefore, society needs to be changed in order to adapt better to nature. Sufficiency, abstinence from consumption, and minimizing interventions into nature are the rules that follow from the egalitarian world-view. Environmental problems such as waste are a result of the social disorientation of consumer society and these problems can only be solved by radically changing society.

The *hierarchist's* world is controllable. Nature is stable until pushed beyond discoverable limits, and man is malleable: deeply flawed, but redeemable by firm, long-lasting, and trustworthy institutions. Fair distribution is by rank and station or, in the modern context, by need (with the level of need being determined by the dispassionate authority of experts). Environmental problems are understood as a perturbation of social order mirrored in nature. Polluted natural objects have to be brought back to an orderly condition, and if this is not possible, nature has to be changed

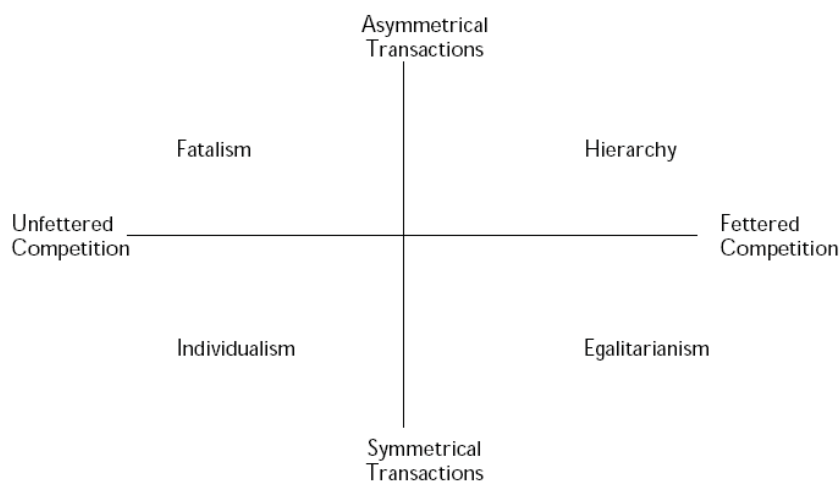


Figure 2: Cultural Theory suggests four types of behavior in relation to competition versus non-competitive actions on one hand and in terms of the symmetry of transactions on the other hand. Each type is linked to a specific myth of nature (see Figure 3). Taken from THOMPSON, 2002.

Abbildung 2: Der Ansatz der Cultural Theory unterscheidet vier Typen von Verhalten bezüglich Konkurrenz oder Kooperation einerseits, und hinsichtlich der Symmetrie der Transaktionen andererseits. Jeder Typus ist mit einer bestimmten Vorstellung von Natur verbunden. (siehe Abbildung 3). Aus THOMPSON, 2002.

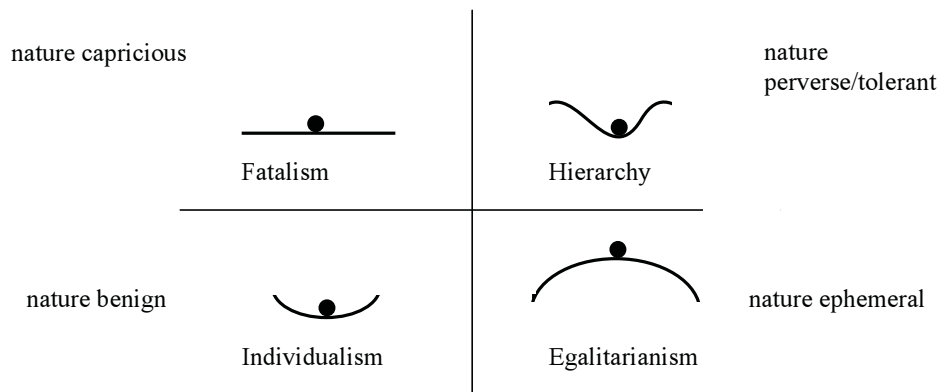


Figure 3: Concepts of nature as linked to the four types of livelihood strategies distinguished in Cultural Theory.  
 Abbildung 3: Konzepte von Natur und ihre Verbindung zu Strategien der Lebensgestaltung, wie sie in der Cultural Theory unterschieden werden.

to match the new social order. Environmental management requires certified experts to determine the precise locations of nature's limits and statutory regulation to ensure that all economic activity is then kept within those limits. The repair mentality trusts in cultural, i.e. technical fixes: If acid rain changes lakes into acid, one can add lime to repair the problem. To solve an environmental problem, a hierarchist will establish and assign criteria, e.g. assemble taxonomic lists of hazardous chemicals, detailing the correct handling, legal procedures and licensing of use.

The three approaches, different as they may appear, have something in common, nevertheless. They all suppose that individuals have an ability to learn, and they fundamentally believe in the feasibility of both change and order.

*Fatalists*, on the contrary, find neither rhyme nor reason in nature and know that man is fickle and untrustworthy. Fairness, in consequence, is not to be found in this life, and there is no possibility of effecting change for the better. With no way of ever being in harmony with nature or of building trust with others, the fatalist's world (unlike those of the other three types) is one in which learning is impossible. There are many things one simply has to cope with, without being able to change them. Fatalists accept risks as inevitable. In environmental conflicts, they do not protest but comply, which makes them just as relevant for environmental policies as the other groups.

Individuals can change their livelihood strategies, but what about nature? If we assume an interaction, it might well lead to different perceived properties of nature. Figure 4 depicts a chain of events in the metaphor of the landscape and ball that is used by Cultural Theory.

It has to be borne in mind that the perceived properties of nature are by no means static, and if humans interact

with it, they might well end up with natural properties, so unlike those on which their model of nature was based that they eventually change their view. With respect to the DPSIR-approach, Cultural Theory offers us a view into the relation between responses and driving forces, and explains how responses are not simple effects of impacts but mediated by myths of nature.

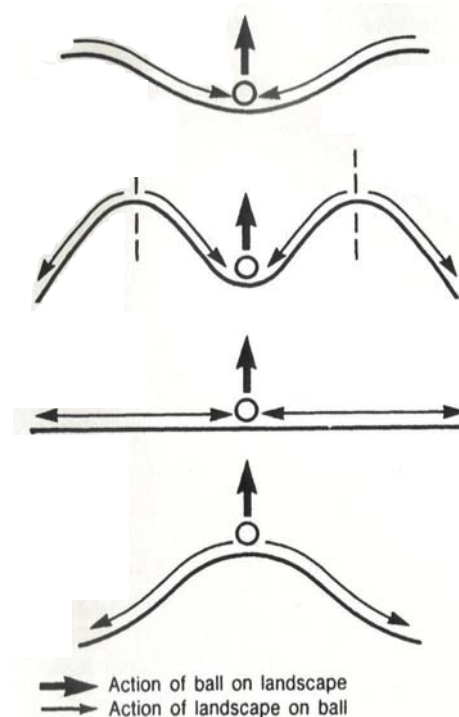


Figure 4: How nature can change in response to human action (THOMPSON, 1990)

Abbildung 4: Wie sich Natur in Reaktion auf menschliche Eingriffe verändern kann (THOMPSON, 1990).

### 3 Understanding impacts: how culture interacts with nature

In order to gain a deeper understanding of the other connections in the DPSIR concept, we need to turn to yet another model, this time one of the interaction between nature and culture. It offers yet another way to explain how humans' symbolic capacities translate into action. It allows us to relate concepts to impacts. Figure 5 shows the interaction model developed by the Institute of Social Ecology in Vienna. The model depicts very well that nature and culture overlap in us and in the biophysical structures we have developed or built. The model makes visible that action happens within the realm of nature and that the realm of culture is the symbolic system with which we make sense of our actions and their consequences. Someone has to really DO something, drive a tractor or apply fertilizer (1), has to know HOW to do that (2), and somehow, hopefully, learns from the reaction of the earth (3), which he measures by indicators, and then this experience translates into concepts again (4). One needs to take a closer look inside the realm of culture to fully understand what is happening. And here we need to apply cultural theory, depicted in Figure 5 as a filter through which information is passed. Filtering is the metaphor to describe how we represent our experiences with nature (in our case, soils). Representation itself is a very broad concept, it includes scientific models as well as art and common knowledge ('common sense'). The nature-culture-interaction model is needed to understand the DPSIR concept (Fig. 1). The nondescript arrows, connecting Driving Forces, Impacts, States and Responses in the DPSIR concept cannot be understood without an understanding of the different systemic properties of culture and nature, which are not as hierarchists would have it simply mirroring each other. States and Impacts as they exist in nature are brought to our attention by means of cultural devices (i.e. by the production of data). While one could draw arrows for impacts and driving forces between the spheres of the nature-culture-interaction model it is not easy to superimpose the rest of the DPSIR model and map it onto the interaction model. But we need to understand the nature of the interactions (the arrows) to develop a strategy for research that translates into policies.

What we find relevant to measure and create data about is determined by cultural factors, NOT by natural states or impacts. We can interpret as a soil threat only those things that we have integrated into our cultural concepts. And here the filter of cultural theory becomes predictive. Fatalists

would not measure anything, hierarchists would prescribe more measurements for a better setting of thresholds, individualists would be concerned with incentives for protection, but would tend to find the risks exaggerated, anyway. They would want to ensure cost-effective monitoring strategies. Egalitarians would ask why we measure what cannot be measured, the value of the whole, and call for ethics instead.

### 4 Looking into representation from a power perspective: the authority of knowledge

The main thrust of the argument I am making here is that the process called 'representation' in Figure 5 has to be understood by soil scientists to develop a soil thematic strategy. In addition to cultural theory as a 'filter' for perception, the process called representation comprises knowledge production and the ways in which the authority of such knowledge is defined. To understand this process a historical perspective is particularly helpful.

L. Iunius Moderatus Columella, a wealthy landowner who lived in the Roman Empire in the 1<sup>st</sup> century AD wrote one of the most comprehensive agricultural manuals of all times. Soil scientists might enjoy his second book, devoted entirely to soils, but in dealing with authority as a question of the interface between knowledge and politics his introduction is more telling.

'Again and again I hear the leading men of our state condemning now the unfruitfulness of the soil, now the inclemency of the climate for some seasons past, as harmful to crops; and some I hear reconciling the aforesaid complaints, as if on well-founded reasoning, on the ground that, in their opinion, the soil was worn out and exhausted by the over-production of earlier days and can no longer furnish sustenance to mortals with its old-time benevolence. Such reasons, Publius Silvinus, I am convinced are far from the truth; [...] And furthermore, I do not believe that such misfortunes come upon us as a result of the fury of the elements, but rather because of our own fault; for the matter of husbandry, which all the best of our ancestors had treated with the best of care, we have delivered over to all the worst of our slaves, as if to a hangman for punishment.' (Col. r.r. I, Prooem. 2–3)

Columella's complaints are partially a rhetorical strategy to explain why he has written an agricultural manual. But we can also learn that Columella was better off than soil scientists are today in one respect: Politicians DID talk about

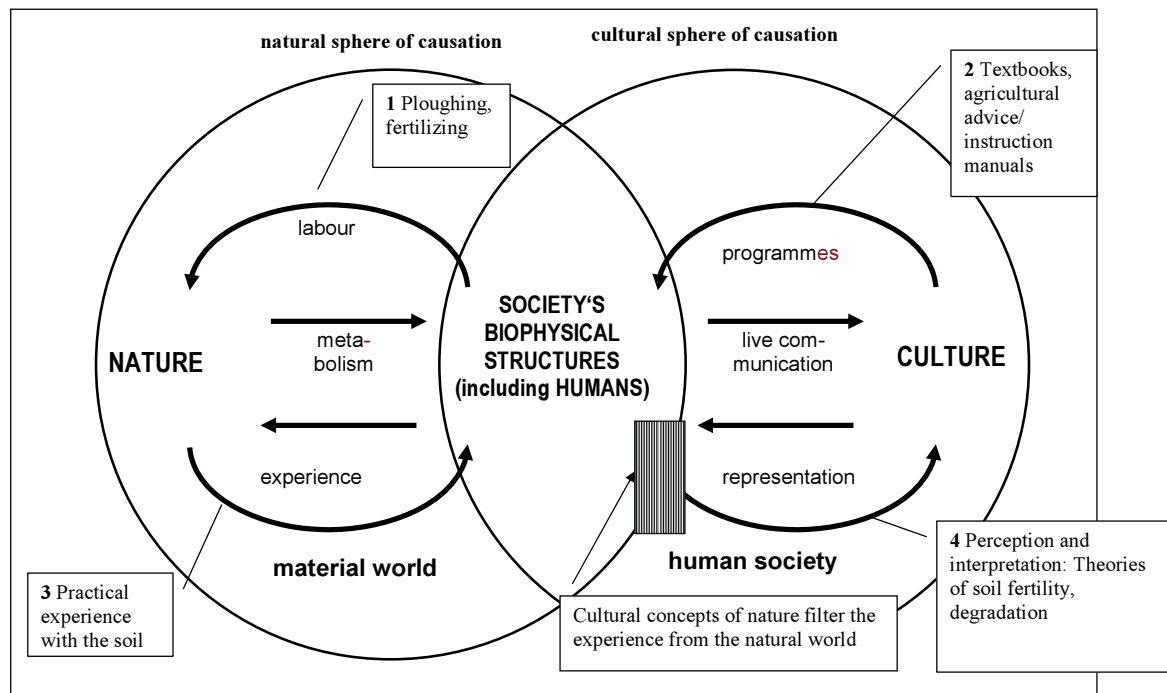


Figure 5: The interaction between nature and culture as conceptualized by the Institute for Social Ecology, Vienna. (FISCHER-KOWALSKI et al., 1997). Soil related examples and cultural theory filter added by the author.

Abbildung 5: Die Interaktion zwischen Natur und Kultur, wie sie vom Institut für soziale Ökologie in Wien konzeptualisiert wird. Bodenbezogene Beispiele und der Filter der Cultural Theory sind Hinzufügungen der Autorin.

the soil – even if their concepts did not please the expert. Today, we have to fight for being taken onto the agenda at all – environmental politics is a weak policy matter. The suggestions made by those of us close enough to politics to know how politicians can be approached make clear that the hope is mainly to cast conservation and sustainability issues and threats to soil ecosystems into the mould of economics – signaling gains and opportunities instead of cautioning in the face of danger.

As Columella's example shows, soil and soil degradation occasionally figured on the political agenda as long as all wealth ultimately depended on it, as long as societies were based on solar energy, converted into a useful form by plants, which can only grow on fertile soil. The politicians' concern then and now was and is the surplus (nowadays in addition tied to growth) on which they depended. Soil experts (agricultural experts) were granted authority because they worked right at the centre of the machinery of society, which is why experts on petrol are granted authority today. Their estimates on stocks of fossil energy are regarded as important and drive policies. Such policies do not always express themselves in a benign way, if we look at the history of the Middle East ever since it became clear that

much of the fossil fuel reserves of the world are to be found in this region (e.g. YERGIN, 1991). One might very well ask which kind of advice to the EU governments would result from a soil-based view of the world. It might well be to admit both Ukraine, and, if possible by any means, the 'European' part of Russia into the EU, because of the vast, mostly fertile land they contain.

## 5 Soils and Society: a broken link?

But let us get back to history and see what advice we can derive from it. Charles de Secondat, Baron de Montesquieu (1689-1755), wrote his seminal 'L'Esprit des lois' after having traveled widely through Europe. Book XVIII 'Of Laws in the Relation They Bear to the Nature of the Soil' commences with a historical analysis of the interaction between nature and society: '(1) *How the Nature of the Soil has an Influence on the Laws*. The goodness of the land, in any country, naturally establishes subjection and dependence. [...] Thus monarchy is more frequently found in fruitful countries, and a republican government in those which are not so; and this is sometimes a sufficient compensation for

the inconveniences they suffer by the sterility of the land. [...] (4) *New Effects of the Fertility and Barrenness of Countries*. The barrenness of the earth renders men industrious, sober, inured to hardship, courageous, and fit for war; they are obliged to procure by labour what the earth refuses to bestow spontaneously. The fertility of a country gives ease, effeminacy, and a certain fondness for the preservation of life. It has been remarked that the German troops raised in those places where the peasants are rich, as, for instance, in Saxony, are not so good as the others. Military laws may provide against this inconvenience by a more severe discipline.’ (MONTESQUIEU, 1748)

Today, such analysis is all too easily brushed aside as ‘environmental determinism’, which has gone out of fashion in favour of the progress narrative and later on in favour of a possibilist way of looking at our interaction with nature as niche construction (LALAND et al., 1999). But Montesquieu has something to tell us. He sees a strong connection between the make-up of a society and its natural resources, and in that he is principally right. In the solar-based society he analyzed, soils were indeed of paramount importance for society. Maurice Godelier has called changes in our relation to nature the most profound way of changing society (GODELIER, 1990). New forms of social systems are brought about through changing the ways we interact with nature. Montesquieu shows an understanding of this connection. While his determinism is of limited use, his basic idea is of paramount importance for the sustenance of soils.

## 6 How can change be understood?

All social theories want to explain change. Cultural Theory is one way to conceptualize change. If we distance ourselves from the concept for a moment, we must admit that there is some truth in all positions in the fourfold taxonomy. Nature is capricious, benign, perverse/tolerant and ephemeral. We can give examples for each kind of natural system. So each of the positions has some truth, but each is prone to surprises or contradictions, and thus, by means of experience and its interpretation, people do change their mentality over time. Figure 6 shows the theoretical possibilities of change. Figure 7 depicts several possible micro-changes, which result in the same overall change. The model does not need to postulate revolutionary behavior, a ‘macro-change’; micro changes happen all the time and thus majorities shift, which has an effect on the overall make-up of society.

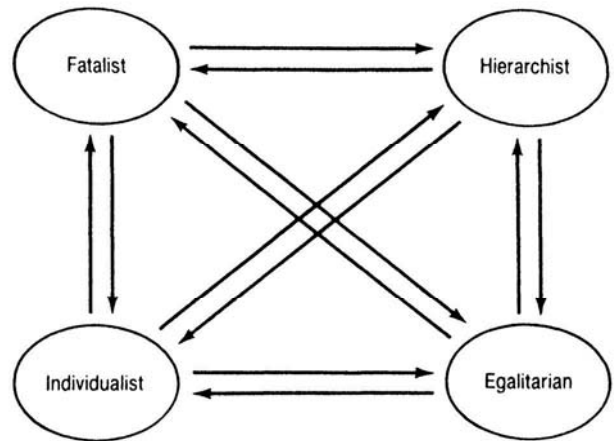


Figure 6: All the moves which are possible between the four mentalities. According to THOMPSON et al., all changes are indeed viable and plausible (THOMPSON, 1990).

Abbildung 6: Alle Bewegungen, die zwischen den vier Mentalitäten möglich sind. Nach THOMPSON et al. sind tatsächlich alle Veränderungen machbar und plausibel (THOMPSON, 1990).

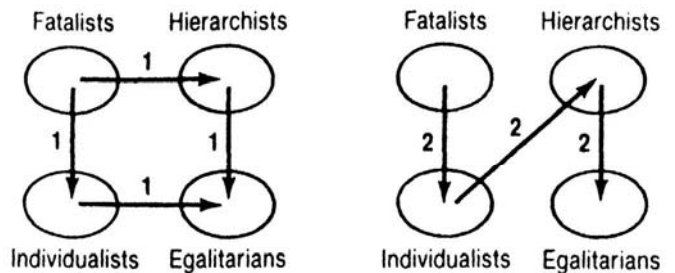
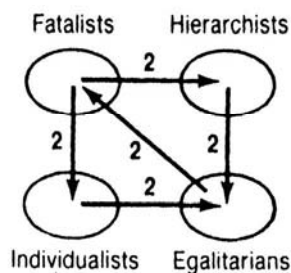


Figure 7: Three different ways in which society can gain two egalitarians, showing the workings of micro-changes, which need not be unidirectional to change majorities (THOMPSON, 1990).

Abbildung 7: Drei verschiedene Wege, auf denen eine Gesellschaft zwei egalitär denkende Personen hinzugewinnen kann. Die Abbildung zeigt die Mikro-Veränderungen, die nicht nur in eine Richtung verlaufen müssen, um die Mehrheitsverhältnisse zu verändern (THOMPSON, 1990).





Change, according to cultural theory, is both inevitable and stabilizing. Each of the mindsets is fraught with contradictions, so people adopt another if the contradictions become intolerable for them. A lot of micro-changes can lead to different people ending up in different places, but with the overall distribution essentially the same. So change and stability cannot be seen as contradictory, but both are possible outcomes of micro-changes.

## 7 How can a thematic strategy for soil science research benefit from social sciences?

Let us start with applying the theory to scientists and their role vis-a-vis politicians. We must ask ourselves which kind of filtering of information will lead to representations and thus to programs which serve the goals of the soil thematic strategy, if we want to fill the empty arrows in the DPSIR-model with meaning. We can do this in three steps. The first step is to identify which model the majority of soil scientists adhere to. We should then ask if this model is able to secure sustainable use of soils, and if not, we need to work on changing it. But we should also ask the question whether any of the models but the egalitarian one can provide us with a long-term sustainability perspective, that is, whether we believe that market mechanisms or laws and directives are sufficient or if we need to change the entire set of values in the society – independent from the consideration if we are able to do this or not. The third step is to devise strategies to move soil scientists from one model to the other.

Joop Vegter<sup>2</sup> has suggested that we should contextualize soil research within the framework of policies and politics, and to see opportunities instead of threats and problems. What he suggests, is to move from an egalitarian or a hierarchist worldview to an individualist one, which is the view of most politicians today. While this is certainly sound practical advice, we should be conscious about what we are doing here in terms of the models of nature underlying these positions, and ask if such a model of nature will lead to the type of changes we want to set in motion by means of our research.

Let me put this in a very simplified, but sharpened perspective: We might come to the conclusion that rather than doing soil science we should invest into Buddhist centres all around Europe to help them promote their egalitarian view of life on earth. This is, of course, not possible as such. But if we move projects into a trans-disciplinary direction, we

can include experts on Buddhism (i.e. exponents of the different mentalities) and engage in public discourse about our scientific project, so the message can get across. We might also come to the conclusion that action based on hierarchist thinking holds the largest promise. If so, our projects need to involve legal experts and health professionals, to name but a few. Again, we should involve stakeholders and offer them an insight into the rationale of the project design. Politicians are interested in voters, at least once in a few years, and thus voters' opinions need to be our concern in addition to providing direct expertise on the policy level. Only in the long run we will be able to evaluate which mode of action is more efficient.

The public, I am told, dislikes complexity. The message, actually, is simple: The use of natural resources in a society is tied to the basic working of this society. To illustrate this point we might turn Montesquieu upside down, noting that Eurasian totalitarian governments have proven more 'efficient' in soil destruction than democratic ones.

If one wants to reduce this relationship to one headline indicator, energy is the most useful. Societies with similar energy systems have remarkably similar features. To give one example: solar based societies cannot afford mass transport of goods over land, thus their spatial pattern follows river systems and cities far from rivers can only be either royal residences or be situated on highly profitable luxury trade routes.

Sustainability is impossible on the basis of fossil energy. It has to be based on solar energy. We have yet to devise a more efficient and practicable solar energy collector than plants. Soils are still the best (and in practical terms, the only large scale) medium to grow plants in, therefore soils and energy systems are closely related. Framing soil research this way, it suddenly connects to a much more central concern of politics, energy.

Fossil energy has allowed us to develop technology, unbelievably inefficient in energy use at first, but becoming more and more efficient. This detour from a sustainable path by means of fossil fuel based technological will enable us to build a techno-solar-based society, which will be markedly different in many respects from the agricultural solar-based society of the past. But it will be not only similar, but structurally identical in one respect: Soils will be the key resource again, productive land will be among the most valuable commodities, so e.g. sealing of prime quality land for building will cease to be a problem, for simple economic reasons. This transformation will be as profound as the one which led to the fossil fuel society,

which we call a 'revolution'. It will come with social upheaval, discontinuity and a fair amount of confusion (SIEFERLE, 1997).

Catastrophe theory is a good guide to the understanding of such transformations, which entail sudden changes unpredictable from the initial conditions and profoundly different from the 'normal' course of events. For a graphical representation, see Figure 8.

In contrast to experts for the future, historians are cautious in making predictions. What exactly the new technological society will look like, I have not the slightest idea. I am sure that soils will be among its central concerns.

The only laboratory we have for understanding the future is our past, the archive of trial and error and learning we should make available for the present. I have tried to show what kind of understanding can be gained from history, but have sacrificed detail in favour of conceptual explorations. A soil thematic research strategy should by all means be concerned with long-term-developments, because soils are long-term resources, slow in their development and regeneration in comparison with society. To understand the interaction patterns between society and nature, one usually has to use a time frame long enough to cover the natural resources' turnover time, e.g. 200–400 years for the study of temperate

woodlands. This means we need to study all of human history to make sense of (and to learn from) the long-term consequences of human interaction with soils.

Soils and society are so interwoven that one cannot be imagined without the other in the mind of the environmental historian. Interdisciplinarity is therefore an indispensable characteristic of future-oriented soil research.

Five top priorities can be suggested from this viewpoint:

- Assessment of the influence of long-term land-use histories on the resilience and productivity of soils – integrating the natural and cultural histories of soils into an environmental history. It will be crucial for best practice models for the future to have a positive yield factor in terms of energy. Scenario building to learn how such systems can be developed.
- Identification of best practice models not only in terms of techniques but in terms of the social organization of land-use and how it is embedded into value systems.
- Global Change related research to develop resilient land-use systems by using historical information, including that on the consequences changes of social structure have had on soils.
- Assessment of past agricultural techniques under the assumption that they might have been soil biota manage-

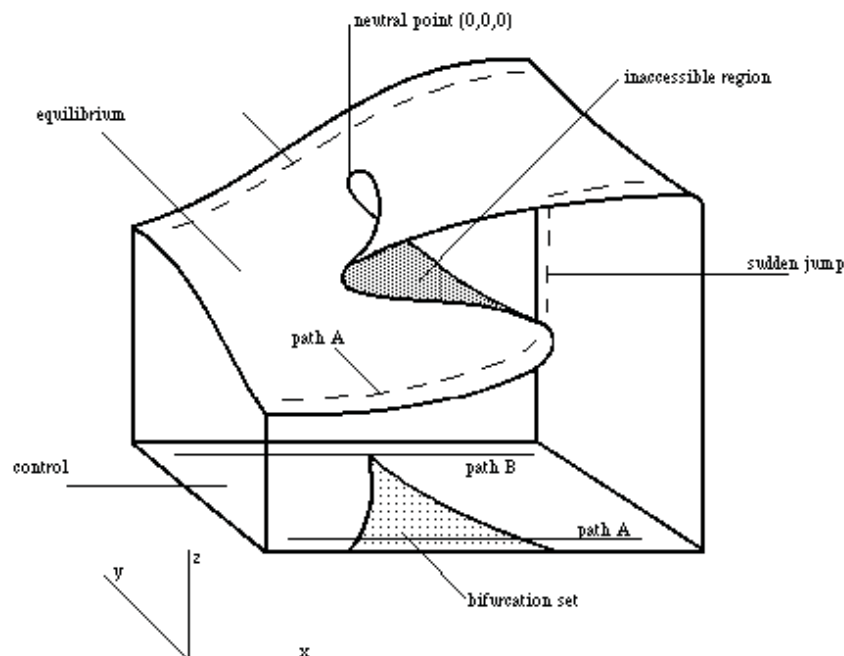


Figure 8: How catastrophe theory makes sudden social changes visible. Path A entails a catastrophe, and circumvents an inaccessible region of social development. ([http:// users.fmg.uva.nl/hvandermaas/cusp.GIF](http://users.fmg.uva.nl/hvandermaas/cusp.GIF), last viewed 29-03-2005)

Abbildung 8: Plötzlicher sozialer Wandel visualisiert nach der Katastrophentheorie. Pfad A enthält eine Katastrophe und umgeht eine nicht erreichbare Region sozialer Entwicklung <http://users.fmg.uva.nl/hvandermaas/cusp.GIF>, zuletzt besucht am 29.3.2005.

ment strategies rather than soil chemistry management-oriented. Learning from such best practice models.

- Reflexivity i.e. the question of how knowledge gains authority and therefore, how the research done by soil scientists can be made effective politically, should be built into all thematic projects.

These applied problems call for some basic research. The most prominent question we must ask concerns the indicators we now use to assess that the sustainability of agricultural systems are true sustainability indicators. Many of them, as intellectual children of the fossil fuel age, are inherently based on a system that in itself cannot be sustainable. This calls for basic research on indicators and a critique of how they are embedded into the fossil fuel system, which should lead to the development of new indicators for a sustainable use of soils.

Soil scientists, due to their object of study, have reached the limits of disciplinary world-views and have become pioneers of interdisciplinary work. They and their study object alike will benefit from long-term investigation of the interaction between soils and society.

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## Notes

- <sup>1</sup> This text is abridged and adapted from THOMPSON, 2002, and has been published in another context in WINIWARTER, 2004.
- <sup>2</sup> Personal communication, October 2004.

## References

- COLUMELLA, L. IUNIUS MODERATUS (1981–1983): *De Re Rustica*, lat.-dt./ ed. and transl. Will Richter (Vol. 1 Tusculum, München, 1981, Vol. 2 Tusculum, München, 1982, Vol. 3, Tusculum, München, 1983).
- FISCHER-KOWALSKI, M., H. HABERL, W. HÜTTLER, H. PAYER, H. SCHANDL, V. WINIWARTER und H. ZANGERL-WEISZ (1997): *Gesellschaftlicher Stoffwechsel und Kolonisierung von Natur. Ein Versuch in Sozialer Ökologie*. Gordon & Breach – facultas, Amsterdam.
- GODELIER, M. (1990): *Natur, Arbeit, Geschichte. Zu einer universalgeschichtlichen Theorie der Wirtschaftsformen.* (= Sozialgeschichtliche Bibliothek bei Junius 6) Junius, Hamburg.
- KORAB, R. (1992): *Zwischen Mechanismus und Management. Eine Indizienkette zur sozialen Verfassung des Naturbegriffs.* Aufrisse 1, 3–10.
- LALAND, K. N, F. J, ODLING-SMEE and M. W. FELDMAN (1999): *Niche construction, biological evolution and cultural change.* Behavioral and Brain Sciences 23 (1), 131–175.
- MCNEILL, J. R. (2000): *Something New Under the Sun. An Environmental History of the Twentieth-Century World.* Norton, London.
- MCNEILL, J. R. and V. WINIWARTER (2004): *Breaking the Sod. Humankind, History and Soil.* Science 304, 1627–1629.
- MONTESQUIEU, CHARLES DE SECONDAT (1748): *L'Esprit du Loi.* 2 vol. Genf. English translation 'The Spirit of Laws', translated by Thomas Nugent.
- SIEFERLE, R. P. (1997): *Rückblick auf die Natur. Eine Geschichte des Menschen und seiner Umwelt.* Luchterhand, München.
- THOMPSON, M., R. ELLIS and A. WILDAVSKY (1990): *Cultural Theory.* Westview Press, Boulder.
- THOMPSON, M. (2002): *Understanding Environmental Values, A Cultural Theory Approach,* Carnegie Council on Ethics and International Affairs, Presentation of October 12, 2002. [http://www.cceia.org/media/711\\_thompson.pdf](http://www.cceia.org/media/711_thompson.pdf).
- YERGIN, D. (1991). *The Prize: The Epic Quest for Oil, Money and Power.* Simon & Schuster, New York.
- WINIWARTER, V. (2005): *How to deal with 'Nature'. Concepts for an environmental history of woodlands.* In: BUNDESMINISTERIUM FÜR LAND- UND FORSTWIRTSCHAFT, UMWELT UND WASSERWIRTSCHAFT (Hg.): *Internationale IUFRO-Konferenz "Kulturerbe Wald" (International IUFRO-Conference "Woodlands- Cultural Heritage" = News of Forest History III(36/37)-1/2005, Part 1, 13–24.*

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