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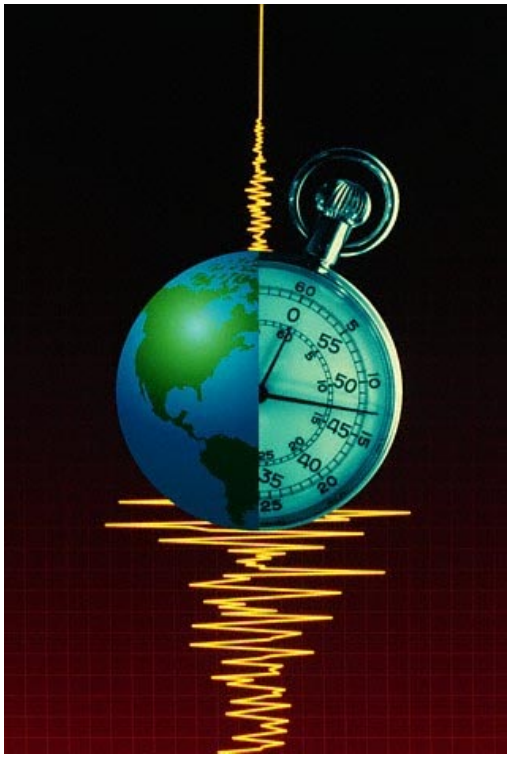

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Environmental Problems – What, Why and How?

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TABLE OF CONTENTS

"It is easy to call for interdisciplinary synthesis, but will anyone respond?"
(Hardin 1998, 682)

ABSTRACT

The purpose of this paper is to formulate a comprehensive qualitative model that can be used to analyse, why there are environmental problems, what are the characteristics of environmental problems, and which are the ways to mitigate environmental problems. First, the article represents a general model to outline the emergence of environmental problems. Then we use the model to classify measures that are used to solve environmental problems. Finally, a sub-model of individual and societal factors affecting human action is outlined. We hope to contribute a relevant way to outline an interdisciplinary wide picture of environmental problems and solutions.

TIIVISTELMÄ

Ympäristöongelmien olemus – mitä, miksi ja miten?

Artikkelin tarkoituksena on tuottaa kokonaisvaltainen laadullinen malli, jota voi käyttää seuraavien kysymysten tarkempaan teoreettiseen analysointiin: Miksi on ympäristöongelmia, millaisia ympäristöongelmat ovat ja miten ympäristöongelmia voi lieventää? Aluksi esitetään yleinen malli ympäristöongelmien synnystä ja luonteesta. Sitten tätä mallia käytetään ympäristönsuojelun keinojen jäsentämiseen. Lopuksi esitetään osamalli yksilöllisistä ja yhteiskunnallisista tekijöistä, jotka tuottavat sellaista ihmistoimintaa, josta seuraa ympäristöongelmia. Toivomme tarjoavamme olennaisen esimerkin tavasta, jolla voi hahmottaa ympäristöongelmien poikkitieteellistä luonnetta.

1. THE SCOPE OF THE PAPER

In other sciences than environmental sciences there usually is a well-established and well-documented theoretical basis and scholar history. But in environmental sciences you can hardly talk about common theories. If one thinks about the difference between, for example, the fields of entomology, non-organic chemical engineering and sociology of professions, this is no wonder. However, all these fields can contribute knowledge that is relevant for the protection of the environment. In addition to these specific disciplines, more general approaches are needed. The purpose of this paper is to formulate a comprehensive qualitative model that can be used to analyse, why are there environmental problems, what are the characteristics of environmental problems, and which are the ways to mitigate environmental problems.

First, the article represents a general model to outline the emergence of environmental problems in Chapter Two. Then we use the model to classify measures that are used to solve environmental problems in Chapter Three. Finally, a sub-model of individual and societal factors affecting human action is outlined in Chapter Four. We hope to contribute a relevant way to see the wide picture of environmental problems and solutions. The purpose of the models is to serve as schemes for orientation in the environmental issues, not as deeply grounded substantial theory.

The general model is constructed by Willamo (1997) and the sub-model of individual and societal factors affecting human action is constructed by Tapio (1997). Some aspects of the models are results of synergistic effort when trying to understand environmental problems and solutions.

2. GENERAL MODEL ON ENVIRONMENTAL PROBLEMS AND SOLUTIONS

The model presented in Figure One consists of two major systems, the *human environment* and the *ecological environment*. To overcome the unfruitful structural dichotomy of man and nature, we assume that both human beings and nature can be found in both systems. For example, a person eating strawberries from the ground can be better understood in ecological terms, like hunger, but a person eating strawberries in a five star hotel restaurant is more adequate to understand in human terms, like social status. A clear distinction is neither possible nor needed. It is more adequate to understand the total environment as a continuum, where the extremes are purely human and purely natural phenomena. Most phenomena are in between. (Hahtola 1990; Willamo 1992.)

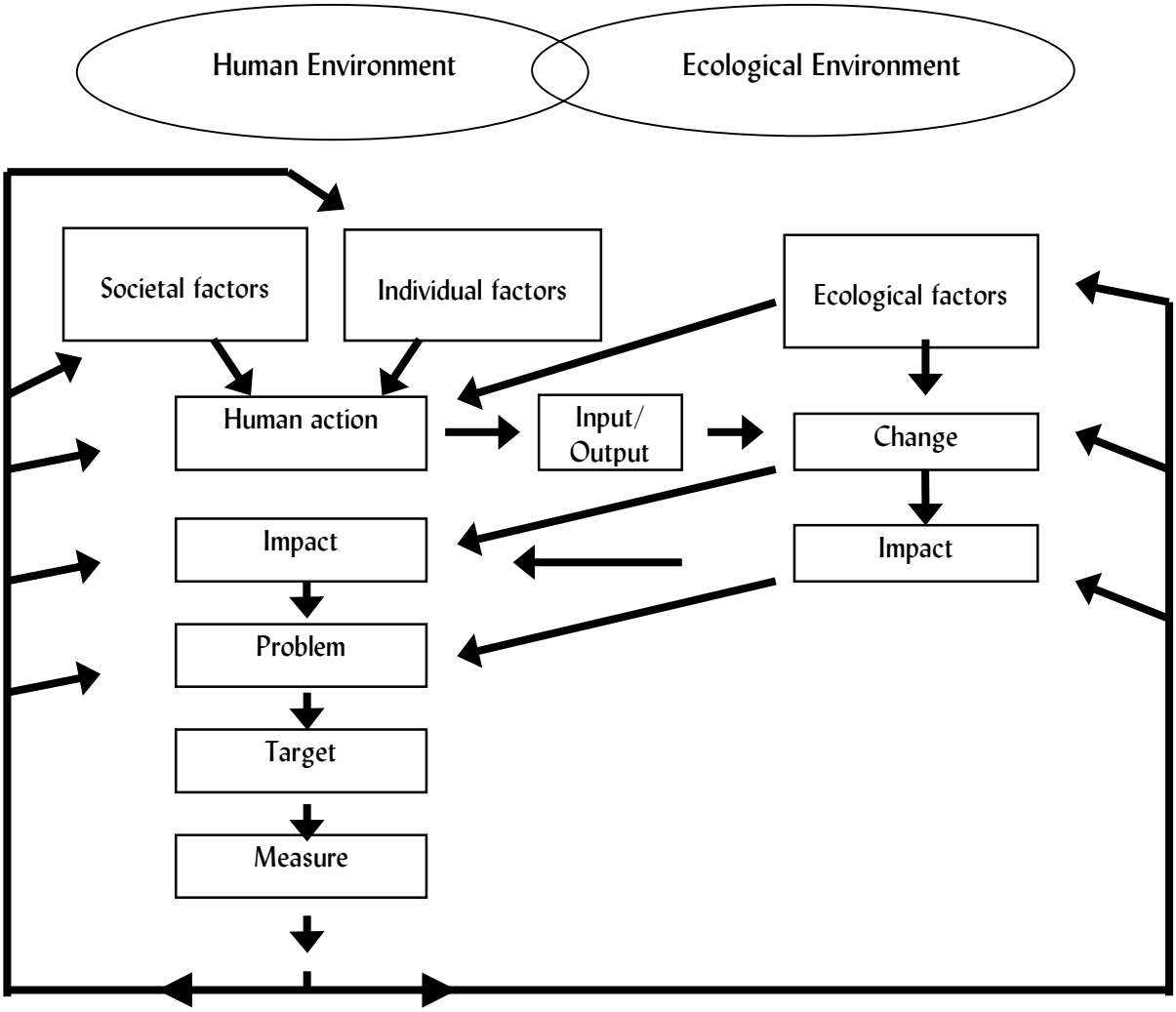

Figure 1. The comprehensive model of environmental problems and solutions (Willamo 1997)

Environmentalists often argue that human action is the cause for environmental problems. Less often is explained, why humans are acting the way they do. One way to divide factors affecting human action is the following:

1) individual factors,
2) societal factors, and
3) ecological factors.

Individual factors. The individual factors affecting human action include here knowledge, values, emotions, experiences and resources. Of course, the term 'individual' should be understood in relative terms, because individuals partly adopt their values by social learning. The subsystem of individual factors will be discussed in more detail in chapter 4.1.

Societal factors. The societal factors affecting human action include here politics, administration, legislation, science, religion, economy, mass media and social activism. The subsystem of societal factors will be discussed in more detail in chapter 4.2.

Ecological factors. Social scientists often forget that there are also ecological factors that affect human action. This neglect can be understood as an implication of fear of social Darwinism, which reduces human history to a simple explanation of evolution. Instead of social Darwinism, we are suggesting here that there are some complementary ecological factors that explain part of human behaviour. For example, traffic research has shown us that on aggregated level people have almost fixed "travel time budgets" that do not differ much according to culture or transportation technology (Mogridge 1997; Shaefer 1998). This fixation can be interpreted as a migration pattern.

Human action. Environmental problems are due to a variety of human action, which covers anything from agriculture to traffic, industrial production to household consumption, forestry to recreation. Actors that are considered here, are individuals as well as groups, organisations and whole societies. We should keep in mind that some action of human beings belong to the ecological environment, like breathing, or the part of eating which produces energy to us.

Input/output. Human action affects inputs from and/or outputs to the ecological environment. The inputs and outputs can be energy, substance, or living material. Typical examples of inputs are removing trees from a clear-cut area, hunting animals, and taking energy from the water in a waterfall for electricity. Typical examples of outputs are sulfur and carbon dioxide emissions to the air, planting fish in streams, changing the DNA structure of a genome and making waves with a ship. These inputs and outputs are often intentional and are usually expected to cause preferable changes in the ecological environment, such as increase in food production. But from an environmental point of view, they often include non-intentional aspects.

Change. The inputs and outputs mentioned above cause primary changes in the ecological environment. For example, there can be increase in sulfur and carbon dioxide concentration in the air, decrease of energy in a river flow, and clones of plants with modified DNA structure. Some of the changes can be interpreted as "good" changes, since human manipulation is essential for many biotopes and species. But often the changes will be later interpreted as environmental problems.

Impact. The primary changes cause secondary impacts on the ecological environment. For example emissions of sulfur dioxide affect human breathing outdoors, planting fish in streams may lead to the distinction of natural species and the increased carbon dioxide concentration may lead to climate change.

There are also impacts to the human environment. For example acid deposition degrades sculptures, climate change may make living in dry areas more difficult and the use of genetically manipulated organisms may effect the market shares between companies.

Problem. Environmentalists and some natural scientists seem to take for granted that most impacts caused by humans on the ecological environment are negative. However, there is a big philosophical difference between the description of what happens and the judgement of whether this is good or bad. One cannot derive from what has happened to what should have happened, as the Humean guillotine states. For example, in Finland most people regard eutrophication as a problem because it makes swimming less attractive, but in China people fertilise waters in order to catch more fish to eat. The reduction of outdoor air quality for breathing may not be regarded as a severe problem in places where people stay 90 per cent of the time indoors. Beck (1996) even suggests that the concept of 'environmental problem' should be changed to for example, concept like 'risk', because the former concept includes the idea, that problems really are in the ecological environment instead of in peoples' minds.

Target. If some impact is regarded as a problem, the next stage is to set a target. The range of proposed target levels in environmental issues are impressive. For example, the targets people would set on the appropriate carbon dioxide emissions, percentage of forest reservoirs and the use of genetically manipulated organisms vary a lot according to different people, different scholars and different countries. Another illustrative example of the wideness of targets, would be the discussion about the Limits to Growth reports, where even the core principles of Western societies were questioned (Meadows et al 1972; 1992).

Measure. When a target is set, one still needs measures to get there. Agreement on the target does not mean agreement on measures. For example, the Kyoto protocol to the United Nations Framework Convention on Climate Change (UNFCCC) has agreed targets but there are different views, which are the best means to achieve the targets (Kyoto Protocol…1997). For example, one could build more nuclear power, put emphasis on the renewable energy sources, or argue that the total consumption of energy should be reduced.

Risk. The idea of risk is thoroughly present in the model. People are not only discussing about existing human actions and existing environmental problems but also potential action and problems as can be observed in the discussion of climate change and genetic engineering. This fact makes reasonable discussion even harder, because the views about future events are even more theory-, uncertainty-, interest-, and value-laden than the views about the past and the present. Several references in the discipline of futures studies and environmental sociology emphasise this problem (e.g. Amara 1981; Beck 1988; Tapio 1996; Bell 1997.)

3. CLASSIFICATION OF MEASURES TO SOLVE ENVIRONMENTAL PROBLEMS

We now move on to a classification of the measures to protect the environment according to the comprehensive model of environmental problems and solutions. Similar classifications have been presented in environmental policy sciences by Jänicke (1988) and Sairinen (1996), continuing Jänicke's work in a more sociological direction. There is no need to limit the classification in policy making, since similar qualities can be found in environmental education, private enterprises, non-governmental organisations, and the everyday lives of individuals. We have used it ourselves in the structure of a university-level basic course textbook of environmental sciences (Berninger *et al.* 1997).

The basic idea is that one can try to affect all the phases described in the model. Moving backwards of the 'problem production process', more profound solutions will be presented. It seems that the more profound social measures are more efficient in the long run whereas the more technical measures are more efficient in the short run. (Willamo 1997.)

Measures neglecting problem. The first reaction to many environmental problems, such as the Minamata episode in the 1960's in Japan, is to deny or neglect it. From the humanistic psychological point of view, this is easy to understand, because people tend to keep their worldview, values and feelings in consistent harmony as long as they can. Although this strategy seems to be irrelevant in most cases, sometimes this can be justified, if a problem is overestimated. This seems to be the case in the debate of organochlorine substances of forest industry wastewater in Sweden and Finland in the late 1980's and early 1990's.

Measures affecting impact. The next phase is to aim the environmental measures at the impacts. Examples of this are inserting limestone into acidified lakes to neutralise them, putting in earplugs to avoid disturbing noise and raising flood control dams in case of raise of sea water surface affected by climate change. Some of this kind of measures, like restoring toxic land, are very expensive and inefficient in the long run. But if the quality of the environment is already regarded poor, any precautionary measure is already late and there are no alternatives.

Measures affecting change. The next phase is to aim the measures at the change in the ecological environment. Examples of this are building up taller chimneys to reduce the concentration of pollutants in an urban area, and building up noise walls in order to stop the spread of sound waves.

Measures affecting ecological factors. Also, measures can be aimed at ecological factors in order to avoid undesired impacts. For example, one can build a water pipe to get fresh water to urban areas instead of cleaning up the sewage water, or one can develop plant genotypes that are more resistant to ozone by genetic engineering.

Measures affecting output. There is also a possibility to affect the output to the ecological environment. Measures targeting to the outputs are usually referred to as "end-of-pipe" emission prevention (*e.g.* Jänicke 1988). Typical examples of them are catalytic converters in combustion engine cars, emission filters of coal power plants and restriction of genetic engineering into greenhouse facilities.

Measures affecting input. Measures aiming at the inputs are seldom discussed in environmental vocabulary. They include, for example, leaving old growth deciduous trees in a cut area for rare

insects to live on. These kind of measures are hard to separate from the measures targeting to human action, because according to the first law of thermodynamics substance and energy do not 'come from nowhere'. That is why the input is almost impossible to change without changing at least some production technology or human action.

Measures affecting human action. One step towards more profound measures are the ones targeting directly to human action. These can be divided further in *qualitative change* and *quantitative change* in human action. Measures targeting to qualitative change include, for example, travelling by electric train instead of private combustion engine car, sorting up one's waste to different categories for recycling, changing fuel from oil to natural gas in a power plant *etc*. Measures targeting to quantitative change include, for example, reducing travel kilometres, reducing shopping to reduce the production of waste and improving energy efficiency of a power plant.

Measures affecting individual factors. More profound is to aim measures at individual factors that affect human action. These include, for example, increasing information of energy saving capacity in everyday life, having educational campaigns that create emotional relation to trees, or emphasising environmental values by pictures of sympathetic animals, like pandas. A more detailed focus on these measures are discussed in chapter four.

Measures affecting societal factors. Also, profound measures can be aimed at the societal factors, which make human action produce environmental problems. The change can concern substantial issues or institutional rules. Examples of substantial changes are increased environmental taxes, restricting punishment of breaking environmental laws, and printing more success-stories about everyday environmental solutions in newspapers. Examples of institutional changes could be widening the range of participants in environmental policy decision-making, reducing the power of prosecutor in court, and reorganising an enterprise's way to act according to an environmental management and auditing system (EMAS).

Jänicke (1988) put forward a hypothesis that the historical development of environmental measures would have moved from the neglect of problems towards end-of-pipe solutions, changes in human action and then towards the factors affecting human action. After the examination of 24 empirical cases, the pattern was not found, however (Successful Environmental Policy 1995).

One could argue that the best long-term solutions would be found when targeting the measures on the origins of human action, especially individual and societal decisions. However, it seems, that a set of multiple measures will lead to most efficient solutions, because thus one can avoid bottlenecks (Successful Environmental Policy 1995; Willamo 1997).

It should be emphasised that all the measures presented here have strong theoretical assumptions behind them. The more profound one sees the origins of environmental problems the stronger is the theory-ladennes. That is probably one of the reasons why natural scientists and engineers feel uncomfortable with social sciences. It is easy and apparent to see that the pH value in an acidified lake increases when one inserts limestone to the lake. But to measure the effect, which an environmental education programme run in a local school has on the pH value in the nearby lake, is practically impossible.

The more profound measures also raise the ethical questions, do the actors using these measures have any legitimate ground in doing so? What right has an environmentalist to say to other people that they should ride a bike instead of driving a car? And what is the difference between useful environmental value education and distorted manipulation of young people? Of course, the environmentalist might argue that the car industry's environmental marketing is also done in very questionable way. All societies have certain values that are taught to young ones and these values change over time. But the history of ethical thought gives no easy solution to this problem.

4. A SUB-MODEL OF INDIVIDUAL AND SOCIETAL FACTORS AFFECTING HUMAN ACTION

The comprehensive model of environmental problems and solutions presented above provides a broad and rough view on the issue. In this chapter, the individual and societal factors affecting human action are examined more carefully in a sub-model (Figure two). We are not thinking of all human action and all factors affecting it but only the kind of human action that seems to produce environmental problems and/or solutions.

The sub-model has been constructed with the help of references from cognitive psychology (Etzioni 1988; Venkula 1988), environmental education (Hungerford and Volk 1991), environmental economy (Hahtola 1990), environmental sociology (Luhmann 1986) and environmental policy sciences (Paldanius 1992). The individual factors have been divided to knowledge, value, emotion, experience and resource subsystems. The societal factors have been divided to politics, administration, legislation, science, religion, economy, mass media and social activism subsystems. The concept of subsystems has been adopted in the loose humanistic spirit of soft systems approach (see Checkland 1989) instead the more formalised systems approach of the Talcott Parsons manner, which, for example, Luhmann (1986) uses.

In the next chapter, we will make an overview of the sub-systems. Any presentation of the dynamics between the subsystems includes so much theoretical interpretation, that a more static approach was adopted. The approach also highlights the model as a flexible tool to analyse different cases. All sub-systems are not significant factors in every case, but an overview is still relevant because usually problems of environmental analysis origin from a too narrow scope instead of a too wide scope (Söderbaum 1985).

4.1. Individual Factors

Knowledge. The subsystem of knowledge refers to the rational and logical part of human thinking. It consists of the knowledge of information about the environment as well as environmental measures, and also the schemes, or cognitive maps, about the interrelation of the facts. These schemes seem to be important. If one lacks a scheme, one can do lots of work in vain, for example sort one's organic wastes cautiously and then put them in a plastic sack. The general model presented in chapters 2 and 3 is an example of an explicit scheme of environmental problems and solutions.

Value. The subsystem of value refers to the goals of life, freedom, safety, equality *etc*. Values seem to be important factors affecting human action but a certain value does not determine a practical choice. For example, interviewing people who wanted to prevent cutting of old growth forest in Finland, Nykänen and Järvikoski (1994) found out that the activists had different values: some wanted to conserve the forest in order to respect the intrinsic value of nature, some expected conservation to make a monetary profit as a tourist attraction, and some wanted to prevail it as a landscape of national cultural heritage. It is an interesting task to ethical research to find out, how different values can lead to same conclusions. From the point of view of impacts in ecological environment, only the conclusions are relevant.

Emotion. The subsystem of emotion handles the feelings, or affections, that individual has on certain objects or situations. They can differ from the love for automobile to the animistic unity between oneself and nature. In the psychoanalytical and humanistic tradition of psychology, emotions are very important factors affecting human action.

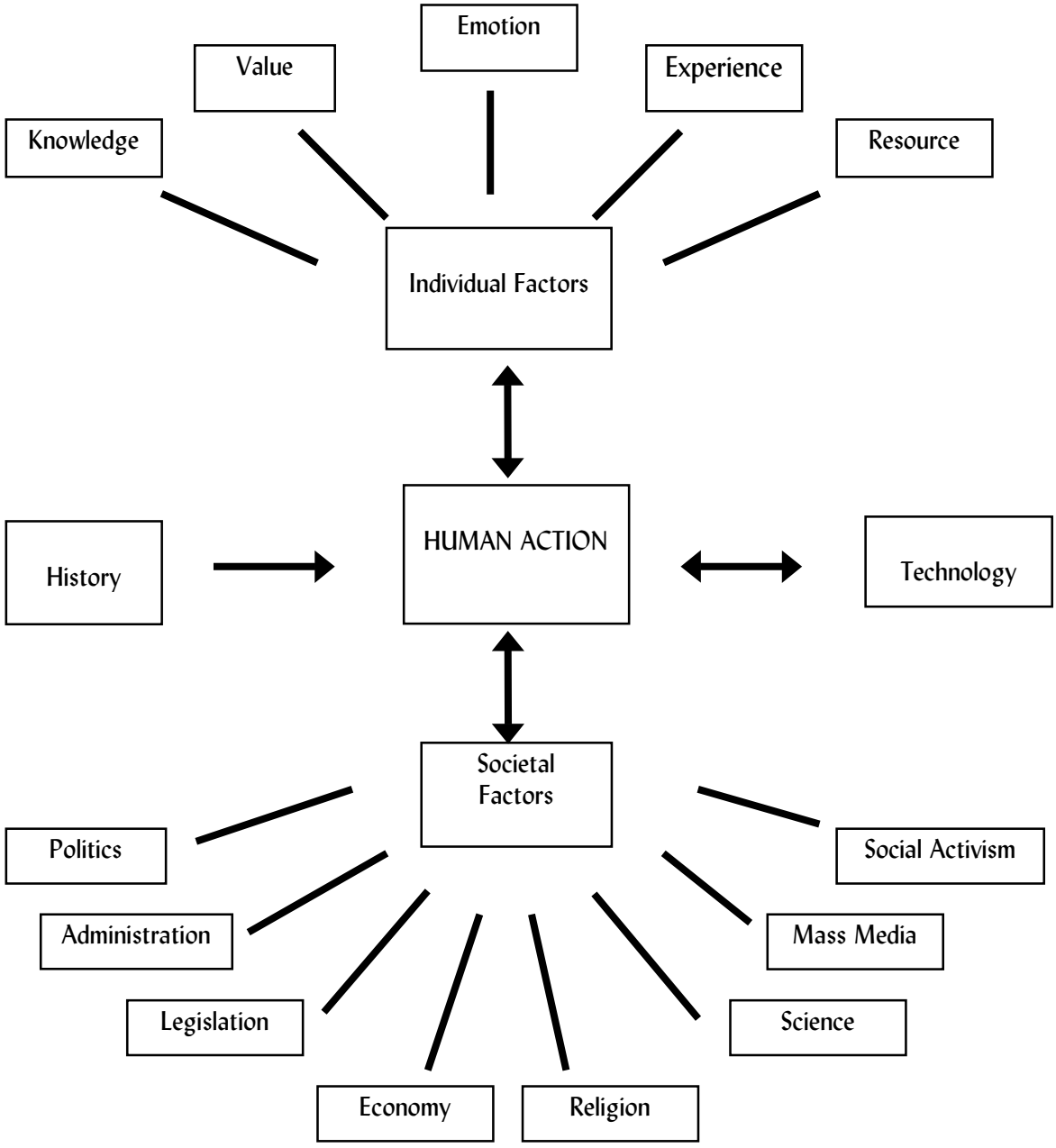

Figure 2. The sub-model of individual and societal factors affecting human action (Tapio 1997)

Experience. The subsystem of experience includes the individual habits of everyday life. In traffic behaviour research, habit has been found a significant explanation of choice of traffic mode (Steg *et al* 1997). Experience is a kind of secondary factor, since it is a product of learning of the social behaviour codes and individual decisions made in the past. Experience also affects a time lag, or 'friction', to all change in human action.

Resource. The subsystem of resource includes individual resources to act in a certain way, for example money and time. These are often found significant factors if they are asked (Hungerford and Volk 1991). For example in theoretical research on environmental education, they can be forgotten, although, for example, lack of time could be the main reason for teachers not to develop their teaching substance and methods towards a more environmentally sound way.

A scientist interested on structural explanations might claim that most of these individual factors are 'coming from somewhere', *i.e.* they origin from societal history (*e.g.* Haila & Levins 1992). On the contrary liberalist point of view, society is the aggregate entity of individuals. However, these two systems are complementary and cannot be reduced to each other. Interaction occurs to both ways via human action (Hahtola 1990).

For example, if an enterprise gives money to employees, that use public transport, instead of investing the money to new parking places (*economic* system), it gives motivation to employees (*emotion*) to use more car pools, public transport and bicycles in work related traffic (*action*), which may affect employees' *knowledge* about public transport timetables and also make them reconsider their *values* about the freedom to move individually (see Shoup 1997). Following the chain backwards from the individual system to the societal system, the change in values might also make people participate in public hearings (*social activism*) of the local land use plan and thus give information to road *administration* to build up more bicycle lanes, which again could affect other people's *action* to bicycle more, and so on.

4.2. Societal Factors

All human action cannot be understood as individual choices. For example, people cannot get on a train, if there is no railway station around. The existence of a railroad station depends on societal decision-making and other societal factors. In environmental attitude and behaviour studies there has been a tendency to put more emphasis on the possibilities offered by society to act in a certain way (Moisander 1996).

Politics. The subsystem of politics includes the policy-making procedures. It is of the very nature of politics to make common decisions about things that individual solutions cannot handle (Aristotle 1992). Political decisions produce plans, laws, budgets and taxes that have an effect to the environment.

Administration. The subsystem of administration includes the implementation of decisions and also the early stages producing material for decision-making. For example Luhmann (1986) sees administration and politics as one system, but according to Finnish energy and traffic policy research there are significant conflicts between the political system and administration and it even seems that the pre-decision phase dominates the actual formal decisions (Ruostetsaari 1989; 1995; Paldanius 1992; Tapio 1996).

Legislation. The subsystem of legislation includes the institutions of court and juridical procedures. The legislative subsystem is needed to have a control of political decisions and laws are an important environmental measure. But laws are often very abstract and leave a lot to interpret when deciding which kind and how big a change in the ecological environment is legal or illegal. In

some cases, like the well-known Exxon Valdez oil spill in 1989, these interpretations become key environmental policy decisions.

Science. The subsystem of science includes science as research results, science as a productive organisation, science as a social organisation and science as a discourse. From the system point of view, science as a discourse seems to be of especially important factor affecting human action. Generally, it can be said that science is more interested in what happens in the world than what should happen or what could happen. Problems occur, when this kind of 'objective' knowledge of the past is brought to the technical reasoning (*Zweckrationalität*) of administration and again in the value reasoning (*Wertrationalität*) of politics, that are more interested in the future. By projecting the past into the future and using the projection as a basis for planning and decision-making, a *status quo* policy will be the result of the circular reasoning. (Weber; Habermas 1966; von Wright 1986; Tapio 1996).

Religion. The subsystem of religion includes religion as a social institution and the dogma of religion. World-wide, religion plays a role in the ways that people and governments make their environmentally important decisions. A significant discussion has been gone on about the judeo-christian dogma, whether they produce environmental problems. To put it simply: god is superior to humans who are superior to nature. A hypothesis was put forward by White (1967) that this dogmatic power structure has legitimated the exploitation of natural resources. During the discussion, White (1974) too, neglected the hypothesis, because giving humans the power over nature also gives the responsibility to take care of it instead destroying it. If we come from metaphysics back to real world, there still remains the question, why this exploitation view has been more dominant than the responsibility view in the history.

Economy. The subsystem of economy includes here both the economical institutions, like markets and ways to organise enterprises, and also the economic actors like banks, productive enterprises and consumers. Trade unions are suggested to be in the subsystem of social activism. It has been argued that the institutionalised individual greediness of capitalistic economy is the fundamental cause of environmental problems (*e.g.* Haila and Levins 1992). When thinking about profit, enterprises try to externalise all possible costs and one of these costs is the degradation of the environment (Ibid.; Kapp 1983). Also, it has been argued that economic thought is colonising other systems (Haila and Levins 1992).

If this would be the case, there are two conclusions. The more incremental conclusion would be internalising the externalities into the prices of commodities (Ayres and Kneese 1977). This can be done in several ways including emission taxes, insurance, tradable emission quotas *etc*. These economic measures have been criticised because in them one always sets a monetary value on the environment, which is in nature, an ethical and political task (Kapp 1983; Söderbaum 1985). However, this criticism actually hits the arbitrary way the prices of environmental externalities are usually set and not pricing *per se*. A more radical conclusion would be to develop a new kind of economic principle. The market economy system has beaten the change economy system and the centrally planned economies, but could there be still another alternatives?

Mass media. The subsystem of mass media includes the ways to produce great publicity. Environmental issues belong to the age of mass media. The risk of climate change did not become an issue in 1827 when Fournier found out the greenhouse effect, nor in 1896 when Arrhenius discovered the possibility of global warming due to fossil fuel burning, but in the late 1980's when the mass media became interested about it. (Houghton 1994 *ref.* Wilenius and Tirkkonen 1997.)

Social activism. The subsystem of social activism includes the actions of non-governmental organisations and the less-organised social movements. One could argue that most environmental solutions have been provoked by social activism or at least, that these improvements would not have become real without social activism. It brings us the question, is the quality of the

environment better in the Western world than in the former socialist states because of market economy or was it really a question of more freedom to participate in public debate?

What then is the overall dynamics between all these subsystems? Some arguments have been stated that the economic system is colonising the other systems (Haila & Levins 1992). One can see the tendency of politicians and administrators talking more about money and less about ethics, cost-benefit analysis has become a standard procedure in policy making, mass media fills pages and programs more and more with advertisements, university is seen as a factory which produces research with a certain investment, and monetary value is even put on the ecological environment, for example carbon dioxide tonnes and bird species thus replacing our knowledge and direct evaluation of environmental quality.

There is a temptation for one overall theory that would explain the whole dynamics of all the systems. But we prefer keeping the model as a broad flexible framework, open for different kinds of theories and interpretations. There is hardly a common theory that could explain at the same time the international climate policy debate, lab techniques of genetic engineering, or even forestry in Canada and Thailand.

5. DISCUSSION

In this article, we have presented a comprehensive model of environmental problems and solutions. We argue, that problem oriented interdisciplinary research on the environment should be emphasised more (see also Kates *et al* 2001). Problem orientation gives at least some kind of help in drawing the line between interdisciplinary environmental research and any interdisciplinary research. Problem orientation also helps to maintain control of concentration instead of floating around different disciplines.

Environmental problems often originate from a too narrow scope in fragmented fields of science, administration, individuals etc. If only a narrow view is adopted, the measures taken in order to solve the problems are probably also too narrow. We hope that the model presented here could serve as a good example of what wide scope in environmental issues can mean.

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