The economic functions of the environment*

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Samenvatting

In dit artikel wordt het begrip 'extern effect' onder de loep genomen met het oog op toepassing in milieu-economisch onderzoek. Geconcludeerd wordt dat het begrip 'milieufuncties', omschreven als huidige en toekomstige gebruiksmogelijkheden van het milieu, een beter uitgangspunt vormt. Ingegaan wordt op de mogelijkheden om voor milieufuncties schaduwprijzen te construeren ten behoeve van kosten-baten analyses en het samenstellen van milieu-indicatoren.

Externalities

The growing severity of the problem of environmental deterioration, including depletion of resources, has caused a great increase in interest in the concept of external effect. This concept was introduced amongst others by Marshall [1969: 221 ff], Pigou [1962: 131-5, 183-96] and Scitovsky [1954: 143 ff] at a time when the environmental issue did not play a major role. Mishan [1971] reviews the more recent and extensive literature on external effects. According to Hennipman, in modern welfare theory the term 'external effect' is generally defined as 'the positive or negative influence operating outside the market which, as a side-effect of economic actions, is exerted on the condition of production or the level of satisfaction of other households' [Hennipman 1968: 250]. These side-effects are considered to be 'unintended or unintentional'.

From the descriptions and the examples given it appears that externalities cover a much wider field than the impacts on the environment by human activities. They also include a whole range of other effects such as the interdependence of consumer satisfaction, for example envy when others have more goods to consume; productivity-increasing inventions becoming available without charge to producers; advantages and disadvantages accruing to a producer as a result of activities of other producers, for example economic obsolescence of machines, the availability of well-trained labour, supplies of raw and auxiliary materials and of specialized semi-finished products at lower prices.

On the other hand, according to the definitions given in economic literature, the concept of external effect or external economies and diseconomies does not cover all impacts on the environment. Thus the description of an external effect as an influence operating outside the market implies that this effect can occur only if a market does in fact exist. These are evidently effects on 'outsiders' who do not belong to the parties constituting the market, the buyers and sellers of goods and services. Since government services are not performed by way of the market mechanism, no external effect can occur here. Moreover the government is assumed to take into account the interest of all citizens when making its decisions. Thit implies that all parties are represented in a government decision. Consequently there can be no question of influence on 'other households' which remain outside the considerations in the decision, as in the case of decisions made by individual firms or citizens, and nothing is external. Naturally the government is also supposed to express in its decisions both the wants of the citizens and its own preferences for a livable environment for generations to come. Particularly for this reason, which is of more fundamental importance than the absence of a market, there can be no questions of influence on 'outsiders' for whom no allowance is made in the decisions. However, effects on the environment can most certainly be caused by the government.

Thus, when a road is built through a nature area or a sewer is laid to discharge into a river, sea or estuary, important effects on the environment are caused, however accurately the government has weighed the various interests. Moreover, in such a case it does not matter whether others than the users of the road or the sewer suffer the damage through the effect. Even if every citizen makes equal use of the road or sewer, a number of functions of the environment is nevertheless lost wholly or partially for the same citizens.

In a somewhat different form the same thing occurs with goods and services produced by the market: the government decides about circumstances in which goods and services are produced and consumed, and whether or not effects on the environment are internalized in the price of the products whose production and consumption burden the environment. In the final instance the statutory framework determines the degree of burdening of our environment. The conflict between the quantity of goods and services produced and the quality of the environment is therefore not confined to the 'market economy' but continues to apply fully if production is collectivized partially or even wholly. The heart of the conflict lies in the finite carrying capacity of the environment.

The environment defined as a collection of scarce goods

On account of the reasons mentioned above, among other things, the present author has introduced the concept of 'function' [Hueting 1980, 1970]. The reasoning is briefly as follows. For an economic approach the environment can best be defined as humanity's physical surroundings, on which people depend for all their activities, such as producing, consuming, leisure, breathing, travelling. In everything people do, they use their environment in one way or the other. Consequently, as a first step towards systematization, possible uses of the environmental components water, air and

soil are distinguished. These possible uses are called 'environmental functions' or, in short, 'functions'.
As a result of more activities being undertaken by more and more people, the possible uses of the environment are increasingly falling short of meeting the existing demands. This situation is manifested when the use of an environmental function by a given activity is at the expense of the use of another (or the same) function by another activity, or threatens to do so in the future. We call this competition between functions.
When competition of functions occurs, the environment acquires an economic aspect. Economics boils down to the problem of choice with regard to the use of scarce alternatively applicable means for the satisfaction of classifiable wants. A good is scarce if the demand for it exceeds its availability, or, which amounts to the same, when something else we would like to have (an alternative) has to be sacrificed to acquire it. Environmental functions meet this definition fully as soon as they compete. Competing functions are scarce goods. Losses of function form costs, irrespective of whether or not they are expressed in monetary terms.
Economics deals with the problem of choice among scarce goods; the terms 'money' and 'market' do not occur in the definition of its subjects matter. From this it follows that when no such competition occurs, functions are free goods, without an economic aspect: they can be used without sacrifice.
A distinction is made between three kinds of competition of functions: spatial, quantitative and qualitative. When spatial and quantitative competition of function occurs, the amount of space and the amount of matter respectively are deficient in respect of the existing or future needs for them. This kind of competition is absolute. Withdrawal of matter or attachment of space on behalf of a certain function excludes the use of other functions. Thus in cities there is not enough space for walking *and* private cars *and* cycling *and* public transport *and* children playing. Ouside the cities competition prevails in the use of space for roads, suburbanization, recreation, farming and the survival of plant and animal species. An example of quantitative competition is the insufficiency of the amount of ground water for the growing requirements of industrial water, water for agriculture and water for domestic use. The same holds true for many other resources; their amount falls short in respect of existing demand, or threatens to do so in the future.

In qualitative competition the function 'dumping ground for waste' (or 'addition or withdrawal of species and matter') of the environmental components water, air or soil is in competition with other possible uses, such as 'water as a raw material for the drinking water supply', 'air for physiological functioning', 'water or soil allowing the existence of natural ecosystems' (plant and animal species of the aquatic and terrestrial ecosystems). An agent is introduced into or withdrawn from the environment by an activity as a result of which the quality of an environmental component changes; this may disturb other use or render it impossible. An agent is defined as a constituent or amount of energy (in any form whathever) which may cause loss of function by its addition or by its withdrawal from the environment by people. Agents could be chemical substances, physical phenomena (e.g. heating, noise, radiation) and the addition or withdrawal of plants or animals.
Tracing the competition between functions exposes the conflicts. This can be done with the aid of matrices, for elaboration of which see Hueting [1980].
With the concept of environmental function the environment acquires a central place in economics, as the basis of man's existance, and environmental losses are no longer considered as externalities or unintentional side effects of economic activities. Losses of function are often deliberately allowed for in decisions, notably decisions by the government, the only body than can influence the degree of availability of competing functions.

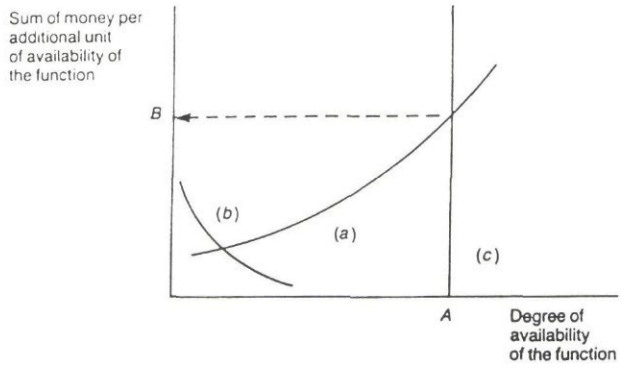
When competition occurs between environmental functions, the functions are always used at each other's expense. In this process it is not possible in analogy with external effects, to distinguish between 'main functions' and 'secondary functions'. Such a distinction would be pointless, because it cannot be established *a priori* which use is the most important one, economically speaking.
The concepts of function and loss of function are on the one hand connected with the matter of the environment and on the other are determined by the demand for the function, which makes possible measurement in physical units (see below). Thus the function 'drinking water' is coupled to the matter of the water and its quality and also to the need for drinking; the quality of the water is determined by biological processes. In this way the link between ecology and economics is made.
Competition between functions may occur in all kinds of forms. But in by far the majority of cases one can speak of the use of the environment by current producing and consuming activities which is at the expense of other desired uses or (with a certain degree of probability) of future possible uses. Roughly speaking, we have now reached a situation in which the use of an environmental function is always at the expense of one or more other functions (now or in the future). Of course our environment is material, as are the things that we produce and consume with the aid of it, whether these are wheat, music (vibrations of the air), medical aid, or books. In this situation the subject matter of economics can be described as the study of the problems of choice that occur when arranging the dead and living matter of our surroundings in accordance with people's wishes. Such a definition does justice to the fact that the environment is the basis of our existence, the foundation of our production and consumption and, in view of the competition of functions, finite.

The problem of shadow prices of environmental functions

On account of the obvious conflict between use of the environment for stepping up production and conservation of the environment for other use and for the future, calculations of shadow prices for environmental functions that are directly comparable with the market prices of goods and services would be most welcome. However, only in a few cases can such shadow prices be calculated. To find them, supply and demand curves have to be constructed.
The supply curve can, in principle, always be constructed. It consists of estimates of the costs of measures for various degrees of eliminating the causes of the loss of function, as a result of which the function is partly or wholly restored. The measures will often be a mix of technical provisions, such as add-on technology (treatment plants and the like and changes in process, and reducing or halting the burdening activities (which also can be expressed in monetary terms). The supply curve is called an elimination cost curve.
Constructing a demand curve is much more difficult. The reason for this is that only in exceptional cases the intensity of the individual preferences for environmental functions can be entirely expressed in market behaviour or other behaviour that can be translated into market terms (money). Loss of function can sometimes partly be compensated by provisions which act as a substitute for the original function. In some other cases it

causes financial damage. When, for instance, water is polluted by chemicals, compensation of the function 'drinking water' or 'water for agriculture' is possible to a certain degree and during a certain period by purifying the intake of the polluted ground or surface water. In the long run, however, elimination of the pollution is necessary, because of the cumulative effect. An example of financial damage is the damage by floods to crops and properties resulting from loss of the function 'regulation of the water management' of a forest.
Both compensation and financial damage can be interpreted as revealed preferences for a given function. As regards compensation, this will be immediately clear: after all, provisions are made to replace the function originally present. However, amounts of damage can also be conceived as revealed preferences, since they are losses suffered as a result of the disappearance of the function. In practice one can often choose between accepting damage and taking compensatory measures. Thus in the case of corrosion of steel by air pollution there is a choice between accepting the additional damage from corrosion and better production of the material.
Opposite the costs of elimination we naturally have the benefits of restoration of the function. The decrease of compensation costs and financial damage constitute the part of the benefits resulting from restoration of the function by elimination measures which can be manifested via the market. As stated above, preferences can seldom be manifested entirely via the market. It is clear that only a very small proportion of the losses of environmental functions are compensated, while in addition they are not always reflected in financial damage. Often, too, the possibility of compensation does not exist. Thus double-glazing may reduce the nuisance of traffic noise inside the house, but not outside; it continues to be impossible to open windows in fine weather without being disturbed by noise. Stench is practically inescapable. A compensatory measure like moving to a clean area is feasible only for the happy few. Moreover it evokes new traffic streams causing new losses of function. Financial damage through noise nuisance and air pollution is very incompletely reflected in the fall in value of the house, as a result of the tightness of the housing market and the immobilization caused by ties to work and the neighbourhood [Jansen and Opschoor 1972]. The construction of new forests and lakes is pointless as long as the process of acidification is not halted by elimination measures. The loss of soil by erosion cannot be compensated. Most important of all, much of the damage caused by losses of function will occur in the future, such as the damage caused by loss of the stability of the climate, by loss of the functions of tropical forests('gene reserve', 'regulator of the water flow', 'preventer of erosion', 'supplier of wood', 'buffer for CO_2 and heat', 'regulator of the climate' and the like), and by the disruption of ecosystems resulting from the extinction of species. Calculating the next present value (NPV) of future damages, the current extent of which can be established via the market (e.g. damage by flooding resulting from loss of the function 'regulator of the water flow'), breaks down on the unsolvable problem of the level of the discount rate in environmental costs and benefits [Hueting 1991]. Also, the risks of future damage and the resulting poor prospects for the future cannot manifest themselves via the market of today. Yet there is obviously a great need for unvitiated nature and a save future.

Because of the limited possibilities for preferences for environmental functions to be manifested in markt behaviour, efforts have been made to trace these preferences by asking people how much they would be prepared to pay to wholly or partially restore functions and to conserve them. Quite a lot of research is going on in the field of willingness to pay for the environment and willingness to accept environmental losses [Johansson 1987; Kneese 1984; Pearce *et al.* 1989]. It is questionable, however, whether this method can provide reliable figures for a number of reasons (argued in detail in [Hueting 1989]). Five of the most important reasons are, in brief:
1. Information on the significance of environmental functions is deficient in many cases. This is expecally true for the functions which determine the future quality of the environment. With respect to these (life-support) functions it is often a question of the risks of interrupting complicated processes versus the chances that technologies, that have not yet been invented, may cope with those risks. Many people may not be able to weigh these risks and chances. In all cases in which individuals are not aware of the importance of an environmental function, the questioning method is pointless. These cases constitute the most important part of the environmental problem.
2. In many cases the only sustainable solution is a shift towards environmentally non-burdening activities. This mostly saves rather than costs money. Thus



The degree of availability is measured as the value of one or more parameters, such as the concentration of harmful substances or oxygen in water or the degree of erosion or fragmentation of the countryside. About a unit of availability one can only say that the costs of its acquisition change along with the parameter, generally progressively.

Key:
(a) Supply curve of the function, or elimination cost curve.
(b) Demand curve of the function based on individual preferences derived from market behaviour such as compensation costs. As these preferences can manifest themselves only very partially in market behaviour, the intersection of curve (a) and curve (b) does mostly not reflect the shadow price of the function.
(c) Demand curve of the function based on preferences for a sustainable use of the function, voiced by society.
A *Standard for sustainable use of the function.*
B Shadow price of the function based on the standard for its sustainable use.

Figure 1 - Supply and demand curves for environmental functions.

cycling is cheaper than driving. People who realize this may refuse to answer because the question is not relevant.
3. A number of people will probably have their doubts about the participation of others (the Prisoner's Dilemma from game theory) or prefer to wait and see (the Free Rider Principle from the theory of collective goods). Thus in developing countries, where the tropical forests are, the view is widespread, for a number of good reasons, that people from the rich countries should pay for their conservation.
4. In cases where the whole community is involved, the willingness-to-accept approach is pointless. For who is paying whom to accept the loss?
5. There is a considerable difference between saying that one is willing to spend money on something and actually paying for it.
The willingness to pay (or to accept) approaches might be justified insofar as people are directly affected by environmental losses. Many such losses, however, constitute part of a process which may lead to the disruption of the life-support functions of our planet and endanger the living conditions of generations to come, and therefore cannot be considered separately. In all these cases the approach is pointless.

A practical solution: shadow prices based on standards for sustainable use of functions

Environmental functions are connected with specific human wants: environmental components (water, air, soil) derive their functions from the possibilities to meet these wants. The functions are also coupled to the specific demands made on the matter of the environment for the fulfilment of the function. Consequently the availability of the function and the occurence of losses of function can be established objectively. For instance, the degree of availability of a function such as drinking water can be established by measuring the concentrations of matters which determine the fulfilment of this function. This opens up the possibility of providing information in physical units on behalf of economic choices regarding the use of the environment, even when information in monetary terms cannot be given. The data in physical units constitute economic information because they can be used for choices among scarce goods. However, as the choice is mostly between the use of functions for the production and consumption of goods and other possible uses, the need for information in monetary terms remains urgent.
Therefore the present author has made the obvious proposal to base the shadow prices on the sustainable use of the functions [Hueting 1986, 1989].
With regard to the concept of sustainability points of application can be found in ecological literature. Thus Odum states that through human activities a development is increasingly taking place which results in mature, stable ecosystems being replaced by more recent, less stable stages [Odum 1971]. As fewer stable stages remain, restoration of impaired systems becomes increasingly difficult and of ever-longer duration, and the number of potential and actual possible uses falls steadily. An irreversible situation can come into being when harm is done on a large scale to predators, substantial numbers of species are lost or general biological activity is suppressed. This is a disruption of food chains that may lead *inter alia* to disruption of the life-support functions of our Earth. The process of the decline and disapperance of species can be seen as an indicator of the extent to which we are already on the way to disruption of the life-support functions. The chance of severe disruption can be minimized if human activities, through the use of recycling processes, (again) become part of the biological cycle, whereby te height of the level of activities is limited by the condition that the degree of stability of this cycle does not decrease. A sustainable activity pattern will amount to recycling of natural resources, changing to non-polluting sources of flow energy and a use of land that leaves sufficient room for natural ecosystems to function.
In any case the emission to the environment of accumulating chemicals, such as heavy metals, PCB's, CFC's, CO_2, nitrates and phoshates, is incompatible with sustainability. Depletion of non-renewable resources is not sustainable and has to be compensated by developing renewable substitutes, and bringing them into practice. One discussion of such compensation is given by El Serafy [1989]. As for erosion, only an erosion rate equal to the natural rate of increment of the top soil is sustainable.
For over ten years politicians and all kinds of organizations all over the world have been expressing their preference for a sustainable use of the environment. Especially since the publication of the Brundtland Report sustainable use of the economic functions of the environment is generally accepted as one of the main goals of the development of world society [WCED 1987]. Therefore standards for sustainable use of functions can be conceived as preferences for the degree of availability of the economic functions of the environment, voiced by society. In 1993 the demand curve for functions founded on individual preferences, which mostly remains unknown because of the

impossibility of knowing these preferences, can be replaced by a demand curve based on preferences voiced by society. Because demand by society is defined as being completely inelastic (namely, as a standard) this curve is a perpendicular straight line. This 'degenerate' demand curve can be viewed as the limit of curves which become more and more perpendicular as the demand becomes more and more inelastic.
In conclusion the above can be illustrated with the aid of Figure 1 (given more completely and with a mathematical derivation in [Hueting 1980: 118 ff]). Elsewhere this approach is developed further for the purpose of supplementing the national income statistics [Hueting *et al*, 1992].

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References

El Sefary, S. (1989). The proper Calculation of Income from Depletable Natural Resources. In: Y. J. Ahmad, S. El Serafy, E. Lutz. *Environmental Accounting for Sustainable Development.* The World Bank, Washington D.C.
Hennipman, P. (1968). De externe effecten in de hedendaagse welvaartstheorie (External Effects in Present Welfare Theory). *Economisch-Statistische Berichten,* 20 March 1968.
Hueting, R. (1970). Moet de natuur worden gekwantificeerd? (Should Nature Be Quantified?). *Economisch-Statistische Berichten,* 21 January 1970.
Hueting, R. (1980). *New Scarcity and Economic Growth.* Amsterdam, New York, Oxford. (First Edition, 1974).
Hueting, R. (1986). *A Note on the Construction of an Environmental Indicator in Monetary Terms as a Supplement to National Income.* Jakarta.
Hueting, R. (1989). Correcting National Income for Environmental Losses: Toward a Practical Solution. In: Y. Ahmad, S. El Serafy and E. Lutz (ed.). *Environmental Accounting for Sustainable Development.* The World Bank, Washington, D.C.
Hueting, R. (1991). The use of the discount rate in a cost-benefit analysis for different uses of a humid tropical forest Area. *Ecological Economics* 3 (1991) 43-57.
Hueting, R., Bosch, P. and Boer, B. de (1992). *Methodology for the calculation of Sustainable National Income.* Netherlands central Bureau of statistics. Statistical Essays M44. Voorburg.
Jansen, H. M. A. and Opschoor, J. B. (1972). *De invloed van Geluidshinder op de Prijzen van Woningen – Verslag van een Enquête onder Makelaars in en rond de Haarlemmermeer.* (The Influence of Noise-nuisance on the Prices of Houses – Report of an Inquiry at (under, of) House-Agents in and around the Haarlemmermeer.) Instituut voor Milieuvraagstukken van de Vrije Universiteit. Werknota No. 15. Amsterdam.
Johansson, P-O (1987). *The Economic Theory and Measurement of Environmental Benefits.* Cambridge University Press, Cambridge.
Kneese, A. V. (1984). *Measuring the Benefits of Clean Air and Water.* Resources for the Future, Inc., Washington, D.C.
Marshall, A. (1969). *Principles of Economics.* Eight Edition. London, (First Edition, 1890).
Mishan, E. J. (1971). The Postwar Literature on Externalities: an Interpretative Essay. *Journal of Economic Literature* IX (1971) 1.
Odum, E. P. (1971). *Fundamentals of Ecology,* 3rd Edition, Philadelphia.
Pearce, D., Markandya, A. and Barbier, E. B. (1989). *Blueprint for a Green Economy.* Earthscan Publications Limited, London.
Pigou, A. P. (1962). *The Economics of Welfare.* New York, (First Edition, 1920).
Scitovski, T. (1954). Two concepts of External Economics. *Journal of Political Economy* 62 (1954) 143.
WCED (1987). *Our Common Future.* The World Commission on Environment and Development. Oxford, New York, 1987.

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Kroos onder controle?

• *Slot van pagina 15.*

verwezenlijken. Uit veldonderzoek van de provincie Zuid-Holland [1990] blijkt overigens dat dergelijke lage gehaltes in de praktijk waarschijnlijk niet nodig zijn. In die studie werd namelijk gevonden dat kroos niet meer dominant is bij concentraties ammonium lager dan 0,1 mg N/l en fosfaatgehaltes lager dan 0,15 mg P/l. Het verwijderen van kroos zorgt slechts voor een tijdelijke oplossing van de problemen. Het moet gezien worden als een maatregel ter overbrugging van de periode waarin de nutriënten nog niet voldoende limiterend zijn om kroosdekvorming sterk te verminderen. Voor de verwijdering van kroosdekken wordt tot dusver geen speciale apparatuur gebruikt, maar enigszins aangepaste werktuigen uit de bouwwereld (met name grijpers). Overige maatregelen, die onderdeel vormen van slootbeheer of gericht zijn op kiemen en migratie, kunnen alleen in combinatie met sterke vermindering van de nutriënten de vorming van kroosdekken verminderen.

Beheersstrategie

Op basis van de verrichte studie is een beslisdiagram opgesteld om te komen tot een beheersstrategie voor het voorkomen en bestrijden van kroosdekken (afb. 3). Hierin worden de criteria gegeven waarmee een keuze voor beheersmaatregelen kan worden gemaakt.
In eerste instantie is het belangrijk om te weten of kroosdekken voorkomen op de sloten. Is dit niet het geval, dan zorgt de ophoping van kroos uit de sloten, via migratie, alleen voor dekken op hoofdwatergang of boezem en dienen aldaar maatregelen te worden getroffen.
Voor maatregelen in de sloten is het belangrijk om de mate van groeilimitatie in het veld te kennen. Deze kan bijvoorbeeld gemeten worden met behulp van een veldtoets, waarbij in kleine, afgesloten sloottrajecten regelmatig de kroosbiomassa gemeten wordt. Door de isolatie van trajecten heeft de – grootschalige – migratie geen invloed op de ontwikkeling van het kroos.

Aanbevelingen

Aanbevolen wordt om het beslisdiagram voor beheersstrategie in praktijk toe te passen en de mogelijke maatregelen verder uit te werken. Dit houdt in dat studie moet worden verricht naar haalbaarheid van nutriëntenlimitatie voor kroos in (polder)sloten en de wijze waarop dit gebiedsgericht kan worden aangepakt. De techniek voor kroosverwijdering moet verder worden ontwikkeld omdat dit op de korte termijn waarschijnlijk de enige maatregel is waarmee de problemen bestreden kunnen worden. In verband met maatregelen op de lange termijn moet onderzoek worden gedaan naar de praktische uitwerking van de kiemenverwijdering, slootverdieping, verschuiving van schoningstijdstip en kunstmatige beïnvloeding van de migratie. Als conclusie van dit verhaal kan worden gesteld dat er nog veel moet gebeuren voordat de waterkwaliteitsbeheerders in Nederland kunnen zeggen: 'kroos onder controle!'.

Verantwoording

De studie voor de STOWA werd begeleid door een begeleidingscommissie, die ook inhoudelijk een belangrijke bijdrage heeft geleverd. De leden van deze commissie waren: de heer drs. J. van der Does (voorzitter), de heer drs. J. H. Boeyen, mevrouw drs. G. Bolier, de heer drs. M. Schreijer en de heer ir. P. C. Stamperius.

Literatuur

BKH (1992a). *Ontstaan en bestrijden van deklagen van kroos. 1. Literatuur.* STOWA, rapportnr. 92-9.
BKH (1992b). *Ontstaan en bestrijden van deklagen van kroos. 2. Modelmatige benadering van de kroosontwikkeling en beoordeling van beheersbaarheid.* STOWA, rapportnr. 92-10.
Boeyen, H., Beljaars, C. N. en Gerve, R. van (1992). *Vergroten van de waterdiepte heeft een positief effect op de waterkwaliteit.* H_2O (25) nr. 16, 432-437.
Provincie Zuid-Holland (1990). *Ecologische beoordeling van kleine wateren in Zuid-Holland.*

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Cursus Gemeentelijk Riolerings Plan

Geoplan organiseert een driedaagse cursus over 'Het Gemeentelijk Riolerings Plan (GRP)'. De cursus vindt plaats op 17, 23 en 24 februari 1994 in Utrecht. Nadere inlichtingen: Geoplan, Emmastraat 28, 1075 HV Amsterdam, telefoon 020 - 67 16 121.