MARKETABLE POLLUTION RISK : A POTENTIAL POLICY FOR AGRICULTURE[1]

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Pollution reduces society's welfare, and efforts to minimise it may be costly. The "polluter pays" principle can be used to determine optimum levels where marginal gains of abatement equal marginal cost. It is possible to involve insurance for this purpose; there are reasons to expect pollution insurance to be more efficient than most other proposals. However, compulsion is needed for such a market to develop, and to forestall non-insurance and default by polluters.

BEMARKBARE BESOEDELINGSRISIKO : 'N POTENSIËLE BELEID VIR DIE LANDBOU
Besoedeling verlaag die welvaart van die gemaanskap, en pogings om dit te minimeer mag duur wees. Die "besoedelaar betaal" prinsiep kan gebruik word ter bepaling van optimum peile waar marginale voordele uit opklaring gelyk is aan marginale koste. Dit moontlik om versekering vir hierdie doel te betrek; daar is rede om te verwag dat besoedelingsversekering meer doeltreffend mag wees as die meeste ander voorstelle. Afdwinging is egter nodig vir so 'n mark om te ontwikkel en om nie versekering en verstek deur besoedelaars te voorkom.

1.   Introduction

The idea of protecting society (as the third-party) and the environment through mandatory pollution insurance for all producers is an intuitive reaction to the escalating havoc of environmental degradation. It has the potential of being economically the most efficient solution to environmental degradation because it will rely on the market to arrive at the socially optimal level of environmental degradation. It will simultaneously protect society, the environment, producers and the treasury. As governments are forced by reality to make polluters pay for the cleanup of polluting emissions, astronomic environmental liabilities (in monetary terms) emerge which threaten the continuation of productive activities, unless producers can spread this pollution risk through insurance agencies.

This paper involves two issues: how the socially optimal level of environmental degradation can be attained through compulsory pollution insurance and how such insurance can maximise producer profit as constrained by limits on the use of pollutants such as fertilizer (cf. Moxey & White, 1994).

2.   Optimum environmental degradation

Environmental studies soon established that both zero pollution (because the very life processes of living organisms and most production activities involve the emission of pollutants), and zero environmental degradation are impossible in the immediate future. It is therefore important to determine the optimal level of environmental degradation in terms of social welfare.

Figure 1 measures marginal gain and loss along the vertical axis and the polluting scale of industrial and farming activity along the horizontal axis. Losers (the public) suffer from pollution and gainers are profit takers and wage earners who benefit from production. The gainers like to push production to B at which the marginal gain is zero. The losers prefer zero pollution, i.e. the origin, where the loss is zero.

If gainers do not have to compensate losers they would expand their activities until they are at B. The benefits and costs of that situation will be:

Benefit (to gainers)	=	OAB
Cost (to losers)	=	ODB
Overall gain (to community)	=	OAD^1B^1
	=	OAB - ODB

If however, it is imperative for gainers to reduce the activity from B to E, the gain to society increases as follows:

Benefit (to gainers)	=	OACE
Cost (to losers)	=	OCE
Overall gain (to community)	=	OAC

OAC exceeds OAD^1B^1 by B^1D^1C. Thus E, is the socially optimum level of production (Kula, 1992).

However, should regulation coerce producers to install expensive devices (abatement technology) to control pollution, or if farmers are made to abandon some inputs (eg, fertilizer) without a suitable substitute, the situation in figure 2 arises.

The gainer's function shrinks to A^1B^1 and the scale of activity is reduced to OB^1. The loss function disappears due to absence of externality and the net gain to society becomes OA^1B^1. Society is now clearly worse off with the zero externality which is achieved with a costly change in technology (Kula, 1992).

Conversely, a situation can be envisaged where the loser's function OL^1 has a steeper slope than OL (see Figure 3), because the unit cost to losers is larger than the unit benefit to gainers, i.e. a situation of high marginal loss per unit activity. This possibility is real when one considers toxic wastes, nuclear accidents, the loss of biodiversity or irreversible environmental degradation (eg. loss of the ozone layer or loss of the integrity of the global climate). The gain to society decreases, as the angle ß between the loser's function and the horizontal axis increases (i.e. increase in marginal loss per unit activity), i.e. OAC diminishes to OAC^1, the socially optimum level of activity decreases from E to E^1. Environmental effects with high marginal loss per unit activity deserve special attention by policy makers and analysts. Such activities could be banned by legislation; as the slope of L gets steeper, a point may be reached when all the social gain from the activity will be lost.
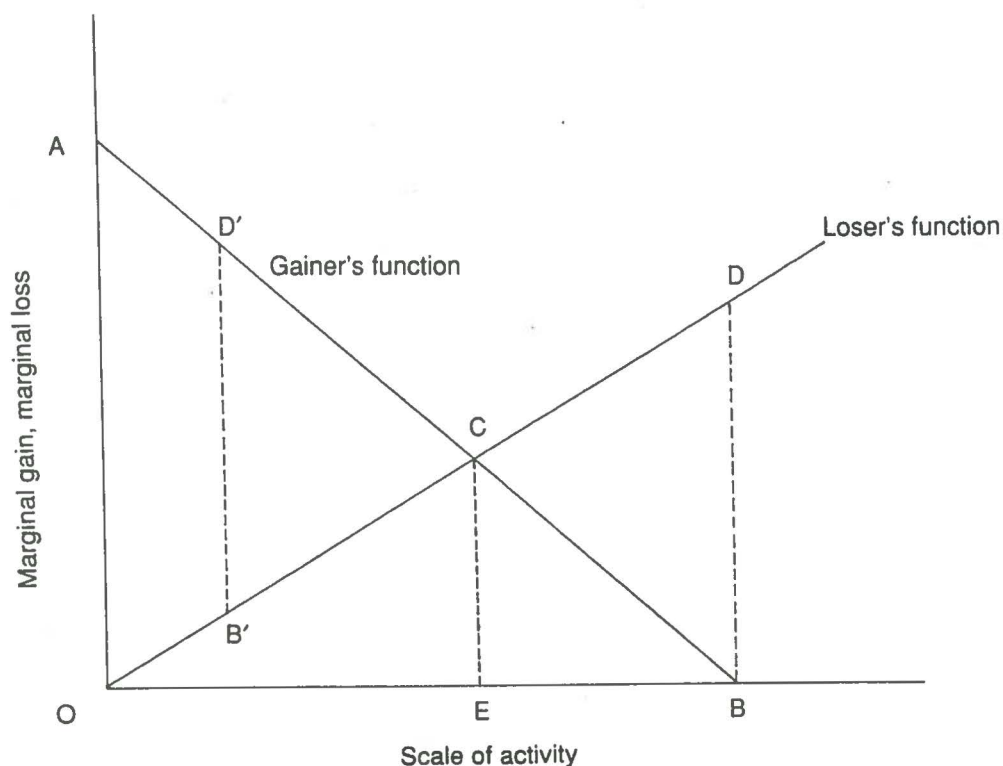
Figure 1:   **Socially optimal level of environmental degradation**

Source: Kula (1992)
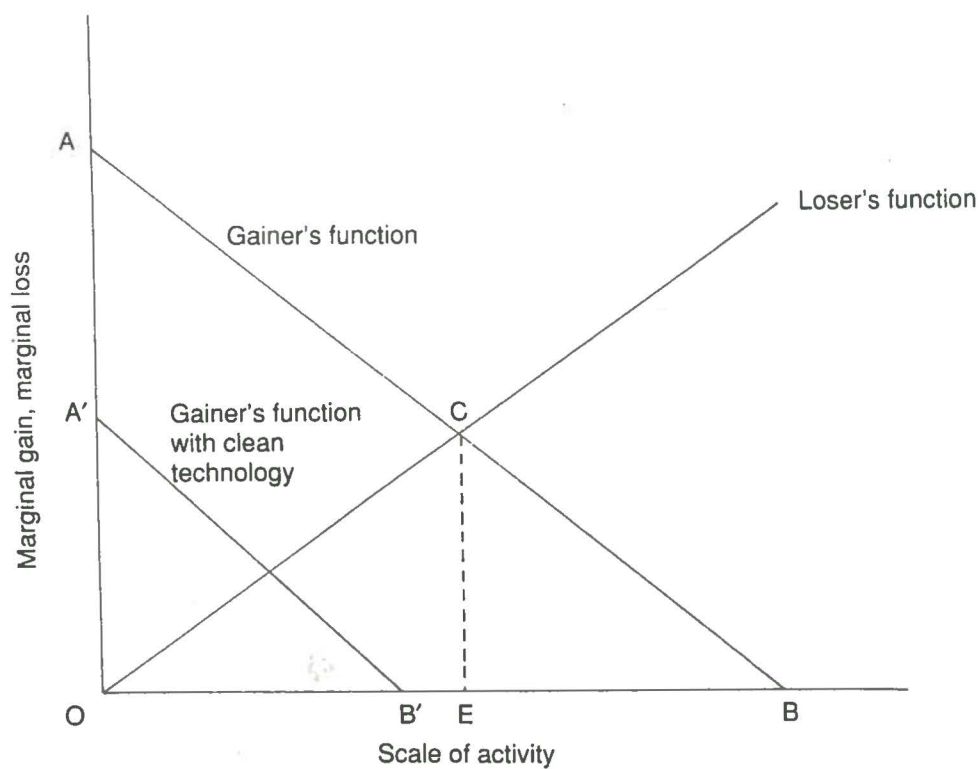

Figure 2:   **Socially optimum level of activity with a costly pollution-free technology**
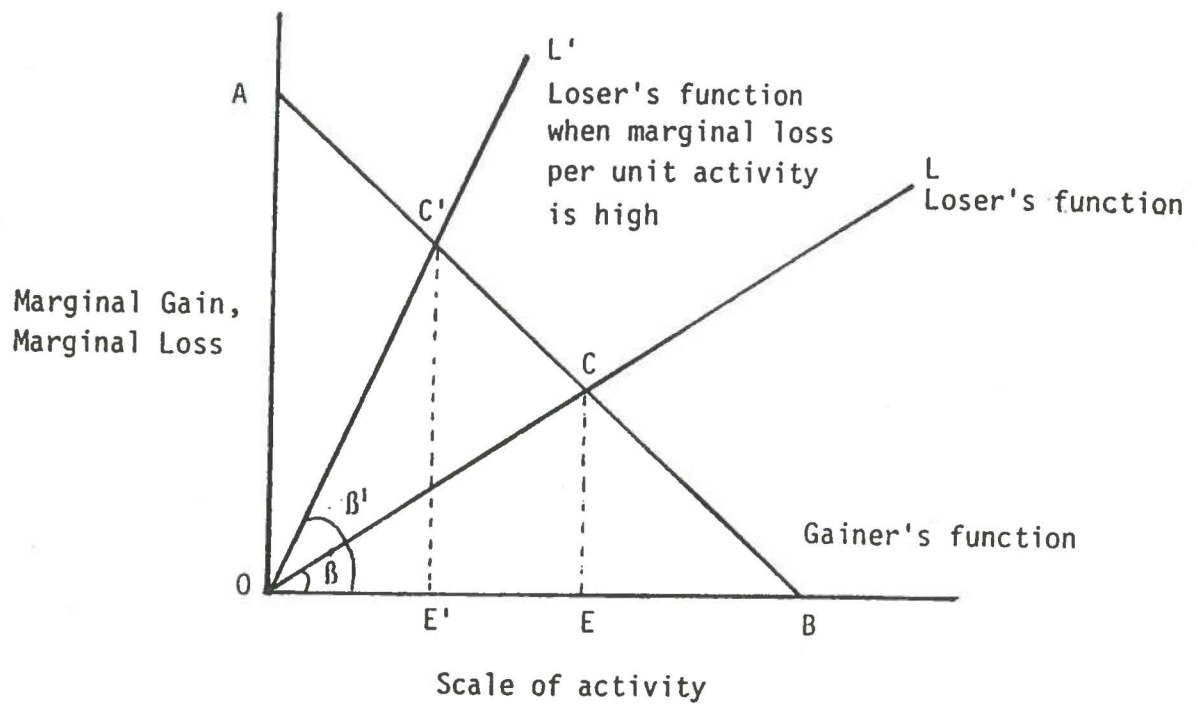
Source: Kula (1992)

Figure 3:   **Socially optimum levels of activity with changes in the loss function**
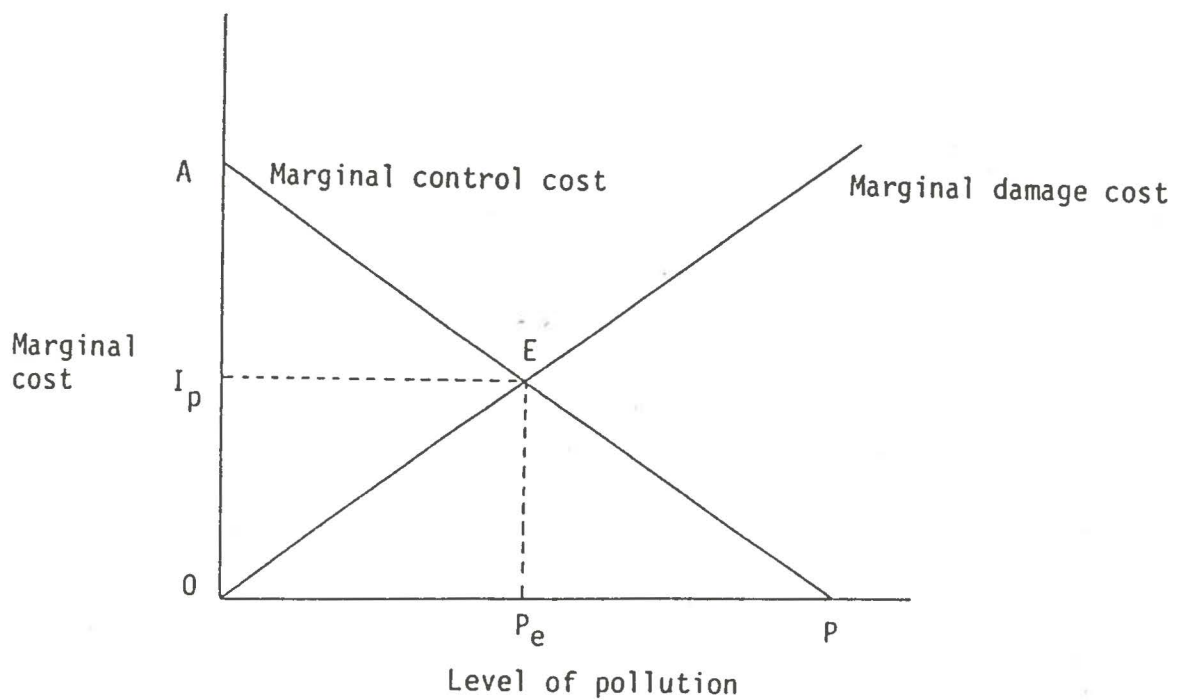
Figure 4:   **Insurance and the optimum level of environmental damage**

3.   Pollution insurance as a market for pollution risk

Government intervention can assist the creation of a formal market for pollution risks. Implementation of the polluter pays principle and enforcement of environmental liability will result in pollution risk that producers cannot handle in the absence of insurance. Insurance agencies could be authorised to offer this service. The market mechanism created could be legitimised and protected with the necessary environmental legislature, involving enforceable standards for pollutants and environmental control agencies to monitor and control the system. The control agents should be able to bring cases in court against the insurers when the client (the potential polluter) polluted the environment beyond the level allowed by the standard.

Alternatively, the authorities may require producers to pay a deposit which will be used to clean up after pollution. This option will be more expensive for a few reasons:

a) Each producer's deposit will have to be large enough to pay full damages in case of a pollution mishap. Insurance basically involves the pooling of risk; and premiums are considerably lower than would be such deposits.

b) A deposit scheme will involve large amounts of potentially productive capital, being kept idle.

c) A deposit scheme will most probably be run by the state or parastatals, which do not internationally have a good reputation in terms of efficiency.

At its inception the pollution insurance scheme could exist side-by-side with existing environmental policy instruments and gradually replace these afterwards. Mandatory insurance for losses to third-parties is not a new idea as shown by compulsory third party insurance for automobile owners, for example.

4.   The dynamics of the pollution risk market

In Figure 4, the marginal control cost (MCC) is attributed to the control of pollution by the polluter. This cost will be zero at point P where no abatement takes place, and maximum at point A where abatement cost born by the industry is also maximum and equal to OA. At the maximum abatement cost pollution is completely under control, i.e. point O. The level of pollution is negatively correlated to MCC. The marginal damage cost (MDC) represents the pollution burden on society, and rises with the level of pollution.

Let us assume that the regulations of a society make it mandatory for all producers to insure their enterprises against all potential pollution risks. Agencies that offer insurance cover will have to fix premium rates in relation to the cost of potential damage (which relates to MDC) and the probability of damage. These two factors are the main determinants of the cost of insurance. The abatement cost (the cost of abatement technology) a producer will be ready to incur will be in relation to the price of insurance (premiums). The higher the premiums, more will the producer spend on abatement; since better abatement technology reduces the probability of damage. Better abatement technology should lead to lower premiums.

Two markets with their individual but interacting forces will be set in motion, and these determine the nature, shape and situation of the MCC and MDC curves. All the forces in the two markets acting simultaneously will determine the point where MDC and MCC intersect, and therefore E. At E the insurance premium to be paid is Ip and the level of pollution Pe.

The degree of competition in these two markets will determine the slopes of MCC and MDC and hence, their intersection point, E. Competition should give rise to research, growth and advancement in the abatement technology and pollution insurance industries. Over time, competition and efficiency of the two markets should cause E to move to the left, leading to reduction in pollution levels, lower pollution insurance premiums and lower abatement technology costs.

This solution to environmental degradation is similar to pollution tax, though there is a significant difference. The market forces called into play here allows society, through the elaborate markets created, to determine prices for the products and services required to control pollution. Pollution tax, on the other hand depends entirely on public regulation and enforcement.

5.   Applicability in agriculture

Agriculture has been both a polluting agent and a loser from pollution. The effect of industrial, residential and other agricultural pollutant emissions on agricultural water is well known, as is the effect of industrial air pollution. However, agriculture has also contributed to environmental pollution through the emission of the residues of fertilizers, animal manure, pesticides, etc. It is particularly intensive agriculture that pollutes and also loses most from pollution. In South Africa, agriculture is one of the main agents of river salinization (Aihoon, 1994; Department of Environment Affairs (DEA), 1992); soil acidification (Du Plessis, 1986; Giliomee, 1992; DEA, 1992); over fertilization (Du Toit, 1986) and phosphorus contamination of the soil (Laker, 1990); pesticide contamination (Barlin-Brinck, 1991; Giliomee & Glavovic, 1992; De Kock & Boshoff, 1987); soil degradation including erosion (Laker, 1990; Verster et al, 1992; Du Plessis, 1987); etc. In certain parts of Europe (eg Western Flanders), intensive pig and poultry farming is causing air pollution from excessive emissions of methane, and soil and water pollution from manure (De Vries, 1990; Goeteyn, 1989)

The principle of "polluter pays" is now internationally entrenched in pollution thought and legislation, however polluters are unwilling to incur costs for abatement, clean-up, or compensation, unless they are compelled to do so or are compensated by other water users (Dockel, 1971). Compensation by other users is clearly unfair and inequitable, and therefore regulation appears to be necessary.

Within this framework, certain types of action such as tort can obviously act as deterrent, But will hardly be able to restrict pollution sufficiently to socially optimum levels. Another approach could be regulation in terms of quantities of certain inputs (such as fertilizers, breed sows or farrowing pigs). Besides problems of control,

such measures will in cases have to be accompanied by drastic changes in farm organization with reductions in the revenues of farmers, particularly in intensive farming ventures (Lauwers, 1992, 1994). Other measures proposed include direct charges on drainage water and collecting funds for pollution control through increased charges on irrigation water (Dinar *et al*, 1989). However, these would hardly encourage the individual farmer to reduce pollution, since such procedures could assume the nature of the tragedy of the commons. South Africa has in any case had a tradition of subsidized water, rather than cost recoupment. Neither will such proposals lead to solutions for non-irrigation pollution. They cannot be expected to improve efficiency either.

Application of the "polluter pays" principle will inevitably, in the absence of insurance, lead to costly litigation and often to consequent default through insolvency. This increases the attraction of insurance of the third-party type.

6.   Conclusion

It appears that compulsory insurance offers the potential for more efficient pollution reduction than many other instruments. The relative benefits of different instruments ought to be established by research. One study in South Africa (Aihoon, 1994) quantified the relevant aspects of river basin salinization control (for the Olifants in Eastern Transvaal), and found pollution insurance in this case to be very feasible. One should, however, not over-generalize at this stage. More research is urgently needed.

Note:

1. Based on an MSc (Agric)-thesis by J. Kojo Aihoon at the University of Pretoria.

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