Environmental Problems and Economic Geography Theories

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1- Introduction:

The background to the discipline

Environmental economics has been succinctly defined as, " Economics concerned with issues relating to man's use and abuse of natural resources. The key phrase in this definition is 'Use and abuse' for although conventional economic theory deals with optimal use strategies for natural resource strategies little attention is paid to their abuse, since precisely what constituted 'Abuse' was unclear. The increasing awareness of the finite nature of our natural resource endowment has forced us to derive a practical definition of abuse which concerns negative externalities from sub-optimal rates of depletion. Progressively more economists are becoming aware of the urgency of the situation and the discipline of environmental economics is growing apace.

Exhaustible resources, pollution and other externalities have proved to be cause for concern for many economists for many decades and apolalytic writing is nothing new. In the late 18th century the reverend Malthus became famous for his assertion that, since population growth followed a geometric progression, and the improvement of means of supporting the population followed an arithmetic progression, sooner or later the world would reach starvation point. Malthus was not alone in his bleak views; Smith, Riccardo and other noted classical economists also believed the negative prognosas. However, they all failed to take account of technical progress in their models. The technical leaps of the 19th and 20th centuries not only raised agricultural productivity, but shifted the emphasis of the economy away from immobile, inflexible land-based agriculture to infinitely adaptable industry. Technology appeared to have saved the day.

1- New Penguin dictionary of economics 5th edition.

The Euphoria which surrounded the new technology should not be underestimated, at last it seemed as though man was no longer constrained by nature, but that he was in control of his natural environment. However, the dash for growth through technology was not without a price, and by the mid 20th century advances in science had facilitated the detection of various pollutants and their effect in the 1960's the connection was made between the pattern of economic growth and environmental degradation, the sphere of environmental economics had arrived.

The main principle behind environmental economics is the treatment of damage to the economy as an externality, and in this peripheral form the subject was mentioned by welfare-economist Alfred Pigou who observed in 'The economics of welfare' (1932) that: ".... in certain industries a wrong amount of resources is being invested because the value of the marginal social net product there differs from the value of marginal private net product, it was tacitly assumed that in the main body of industry these two were equal". (Palgrave)

As work on externalities became more sophisticated, so did the framework for analysis of environmental consequences augmented both by economic and scientific advances.

2- The Environmental Problem

As the economic subsystem grows larger the volume of environmental externality increases, and as technology improves different and perhaps

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1- Externality exists when the consumption of a good by consumer x affects the welfare of consumer y by a method external of the price mechanism. If consumer y's welfare is reduced the externality is negative, if consumer y's welfare is increased the externality is positive. Clearly, the case of environmental damage is a negative externality. (See Penguin Dictionary of Economics 3rd edition).

more harmful externalities are created. The earth itself is a complex and sophisticated system with a remarkable capacity for assimilation and self-regeneration. But it would seem as though we are nearing her limits. Goodland (1992) quotes a statistic that the human economy is using 40% of the net primary products of terrestrial photosynthesis. One only has to listen to news reports to learn of another famine, another flood, another marine disaster, nuclear leakage, air pollution incident. The world's population is currently 5.3 billion and there are estimates that his will have doubled by 2026. At that rate the human race will be using all the earth's terriestrial resources by around 2040. At that rate it cannot be long before things start to run out. These primitive calculations certainly do not take account of the damage we are inflicting onto our natural resource stock, which will almost certainly force the resource constraint to bite more quickly.

So we have seen that our capacity to take things from the earth is limited. But our capacity to use the earth as a disposal area is also limited. Though less is known about our planets assimilative structure it would seem certain to have a limit. The vast and overhelming evidence which exists for global warming could be seen to indicate that we are approaching that limit. Accumulation of PCBs, CFCs, DDT, Methane and other toxic chemicals in the ecosystem is also beginning to show conspicuous damage, yet as Goodland points out producers are allowed to use the earth as a dumping ground free of charge.

The correlation between economy and environment is obvious. It is the larger, wealthier economies of the developed world which demand high standards of living and therefore high consumption. The poorer areas are attempting to emulate their lifestyle, and it is vital that the approach to the earth as a resource alters before they proceed much further.

In 1983, the United Nations established a World Commission of Environment and Development and commisioned its leader, Norwegian Prime Minister Gro Harlem Brundtland to produce a report on the state of the environment-economy relationship. The final document, our common future, illustrated the need for its own existance with some stark facts:

Over the 900 days taken to write the report (October 1984 - April 1987):-

. " The drought triggered, environment development crisis in Africa reached its peak, putting 35 million people at risk, killing perhaps one million.

. A leak from a pesticides factory in Bhopal, India, killed more than 2,000 people and blinded and injured over 200,000 more.

. The Chernobyl nuclear reactor explosion sent nuclear fallout across Europe.

. Agricultural chemicals, solvents and mercury flowed into the Rhine river, killing millions of fish and threatening drinking water in the Federal Republic of Germany ".

3- The initial responses to the problem

Tietenberg (1993) useful divides the responses to environmental concerns into those made by the pessimists, and those made by the optomists.

a) The pessimist model

In 1972, the club of Rome commisioned a report investigating the environmental constraints on future economic activity, which was published as 'Limits to growth' (Meadows Et.Al): The report sought to

analyse the environmental externalities and incorporate them in a model through the use of 'Feedback Loops' to connect the initial activity with its consequence. It attempted to estimate the number of years until total exhaustion of a resource by using the equation:

Where

TE = Number of years to total exhaustion

Co = Current consumption rates (ie. at t = o)

k = Annual growth rate of demand

t = number of years (time)

s = stock of the resource

Some of their results included the following values for TE:

Aluminium	31 (55)	Molybdenum	34 (45)
Chromium	95 (154)	Natural gas	22 (49)
Coal	111 (150)	Nickel	53 (96)
Cobalt	60 (148)	Petroleum	20 (50)
Copper	21 (48)	Platinum	47 (85)
Gold	9 (29)	Silver	13 (42)
Iron	93 (173)	Tungsten	28 (72)
Lead	21 (64)	Tin	15 (61)
Magniz	46 (94)	Zinc	18 (5)

(Pearce & Turner 1990)

Figures in brackets represent adjust values for TE after consideration of technological improvements.

The 'Limits to Growth' team reached three conclusions: Firstly that unless there is major change in resource use patterns we will have exhausted our stock of non renewable resources within 100 years. This will result in a collapse of the economic system as we know it. Falling agricultural production, rising unemployment and an increasing death rate. Secondly, the team did not believe that anything short of total change would alleviate the situation. Piecemeal attempts at solutions

for specific problems would merely exacerbate the situation in other areas leading ultimately to the same apocalypse. Thirdly, as a follow on from the second point, the only potentially effective solution is an immediate constraint on population and pollution, not to mention ending economic growth (Tietenberg 1993).

However, there are reasons to doubt the conclusions of this model, not least because we are still enjoying the use of several of the resources which, according to their calculations, should be extinct. Pearce and Turner (1990) point out that, although Nickel reserves are at their predicted level, Copper, Lead and Zinc reserves have increased. Pearce and Turner go on to say that the exponential indexing technique used by the limits to growth team do not consider: Variations in forecast demand, the effect of rising real prices on demand, the effect of rising real prices of supply (Particularly with regard to recycling and exploration).

b) The Optomist Model

In 1976 Herman Kahn and his team published a heartening response to the bleak predictions contained in 'Limits to growth', in their block, " The Next 200 years: A scenario for America and the world " they presented the optomistic view.

Kahn's Model took a more qualititive, human approach to the situation, and their conclusions were grounded more in subjective assessments of plausibility than computer-generated prediction. Kahn's optimism is dependent largely on technology which, in the case of food production is expected to suggest improvements in production techniques and new potential foodstuffs. His arguments are counter-Malthusian in nature and take little account of feedback effect. However, on precedent (again, think back to Malthus) his position is justifyable.

The general conclusion of the model was simple: we cannot know what

leaps in technology will occur in the future, but gives the advances of the past. It would seem plausible that nature will cease to be a constraint on man's activities.

This may seem naive, but advances in recycling and recovery have already had an impact on estimates of resources depletion. Pearce & Turner (1990) quote the following table:

Material	Demand growth per annum (%)	Estimated identified reserves (Tonnes)	Depletion of estimated reserves by 2000 (%)	Depletion of estimated recoverable resources by 2100 (%)
Chromium	3.3	1.0 x 10	12	-
Cobalt	2.8	5.4 x 10	150	36
Manganese	2.7 - 3.3	2.8 x 10	120	18
Molybdenum	4.5	2.1 x 10	249	5
Nickel	4.0	2.1 x 10	152	35
Titanium	3.8	7.1 x 10	102	38
Tungsten	3.4	6.8 x 10	236	11
Zinc	2.0	3.3 x 10	581	37

Clearly, these two models represented extreme views, but at the time, and still today, environmentalists and economists failed to agree on the precise ingredients of any compromise.

So far, this paper has discussed mainly the 'Environmental' side of environmental economics. Given the environmental situation we now turn to the economic systems applied in its analysis.

4) The economic development of the discipline

a) Classical Theory

If one traces the origins of environmental economics back to Malthus writings in the late 18th century, then it is clear that the discipline must have been based upon classical economic theory, and the so called 'law' of diminishing returns is frequently invoked. Malthus theory stated that given our fixed quantity of cultivable land, and an expanding population, diminishing returns to labour would set in so that food production would increase at an arithmetic rate, while population would expand geometrically until one could no longer sustain the other. Ricardo took a similarly pessimistic view. He believed that, as population expanded, land of lower quality would be brought under cultivation and thus lead to diminishing returns. While Ricardo's model did not allow for technical progress increasing productivity, the population pressure would still eventually lead in cultivation of poorer land and therefore diminishing returns (Palgrave).

b) Marxist theory

In Marx's writing much weight is attached to the importance of the capacity of the production system to reproduce itself continually. In this sense, Marx would appear to be one of the earliest contributors to the sustainable development thesis. Pearce and Turner (1990) succintly express Marx's argument in terms of his usual emphasis on capitalist class-worker class relationships. The profit-maximizing capitalist seek to reduce labour costs by installing new technology. Short-run labour productivity and total producer surplus value rise, leading to greater profits and still more capital accumulation. In the long run, these new technologies have a high environmental cost, and the subsequent environmental damage reduces the health and life expectancy of the workers. In order to maintain worker productivity, firms face higher medical costs, reducing profits, according to Marx. The result is inevitable capitalist-worker conflict and this would probably inspire

an even greater shift to capital intensive product. Leading to more rapid exhaustion of environmental resources.

c) Neo-Classical theory

Neo-classical theory provided the most useful tools for environmental economic analysis, and it is the framework upon which most modern research is based. Neo-classical theory provided us with the theory of price based on scarcity, through supply and demand, and with the ability to draw inferences from the effect of incremental changes- marginal analysis. It also provided a more formal framework for analysis of externalities, the Pareto optimality criterion.(1)

However, as Redclift (1993) points out, the limitation of neo-classical theory pose particular problems for environmental economists. The interaction of rational, well-informed agents is a crucial assumption if the model is to provide efficient outcomes. In reality, rationality is a debatable quality for many individuals, and the problem of poor information is endemic. Neo-classical theory also assumes a given set of preferences for each individual, designed to maximize his utility. It is unclear as to whether these preferences could be altered to take account of wider social issues. Redclift goes on to emphasize the hazards of viewing human behaviour as homogenous saying that, " The subjectivity of human beings, which makes them "Subject Persons" rather than object persons, plays a very considerable role in the way they use the evironment".

1- A Pareto optimal outcome exists when it is not possible to make one member better off without reducing the welfare of others. A pareto non-optimal situation exists when it is possible to increase the welfare of one or more of the members at no welfare cost to the others. This would be a pareto improvement.

d) Humanist theory

Humanist theory essentially takes into consideration the criticisms touched upon by Redclift. The humanists reject the homogeneous approach to human behaviour and thus the existance of the 'Rational economic agent'. They draw heavily on psychological assessments of individual human needs, which are arranged in an order of priority, and they accept the change of these needs over time. Through this more pragmatic approach the humanists are able to conceive of motives other than pure self-interest. Though individuals still utility maximize, their utility may depend on far more than material possession, and could include satisfaction from altruistic deeds. A sense of communality is possibel in this paradigm, which might augur well for the environment.

It would be tempting to believe the humanist view of a more altruisic society. Since it seems to provide hope for a long term solution. However, most environmental economics does not incorporate the view in its analysis. This is perhaps a good thing, since it may lead to avoid complacency.

e) Institutionalist theory

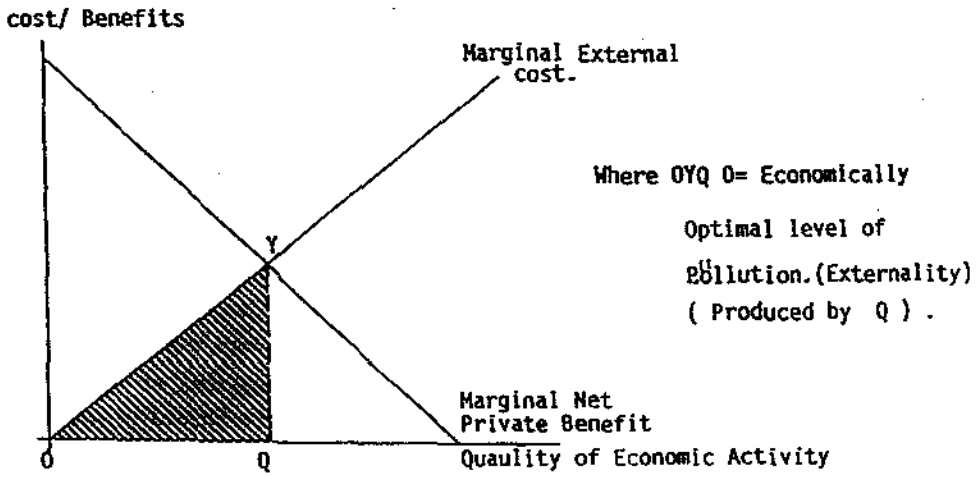
The institutionalists view the economy as essentially dynamic, with the impetus for change being mainly cultural. In their view 'culture' is responsible for the movements of the invisible hand, rather than the ubiquitous 'Rational Economic Agent'. The 'Cultural individual' has both private and public preferences. The former dominated by the self and the later incorporating some idea of the common good. The public preferences are therefore more desirable, and since they are embodied by public institutions, it is these institutions which should be allowed to dominate.

While the institutionalists have long recognized the importance of an ecologically sustainable economic system, they disagree on exactly how much and what type of institutions would best create it, some believing

that an authoritarian system would be the only answer (Pearce & Turner 1990).

5- Environmental economics today

Present day, mainstream environmental economics leans heavily on neo classical theory. Most conventional discussion appears to be centred around the holy grail of 'sustainable development', and the use of resources according to their marginal opportunity cost. The concept of the 'optimal level of pollution' also derives from neo-classical marginal analysis.

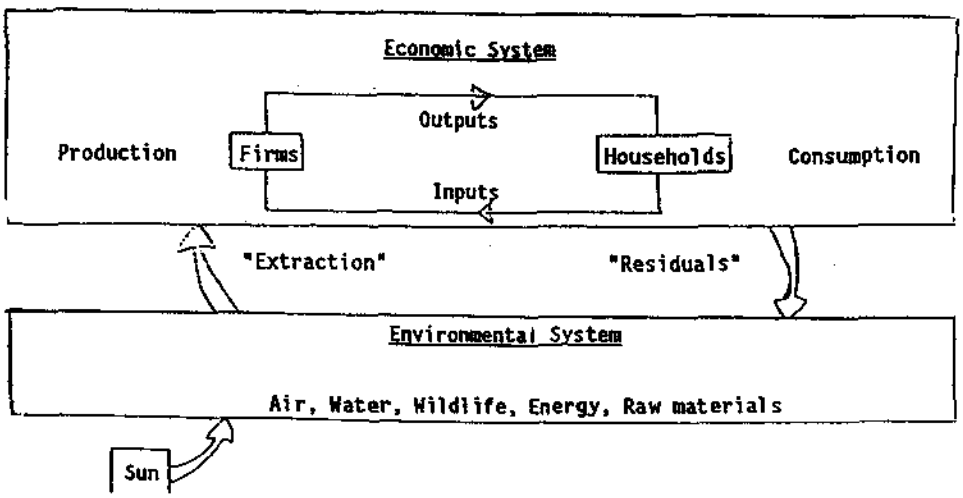


From this common analysis of the problem come differnt approaches to its solution.

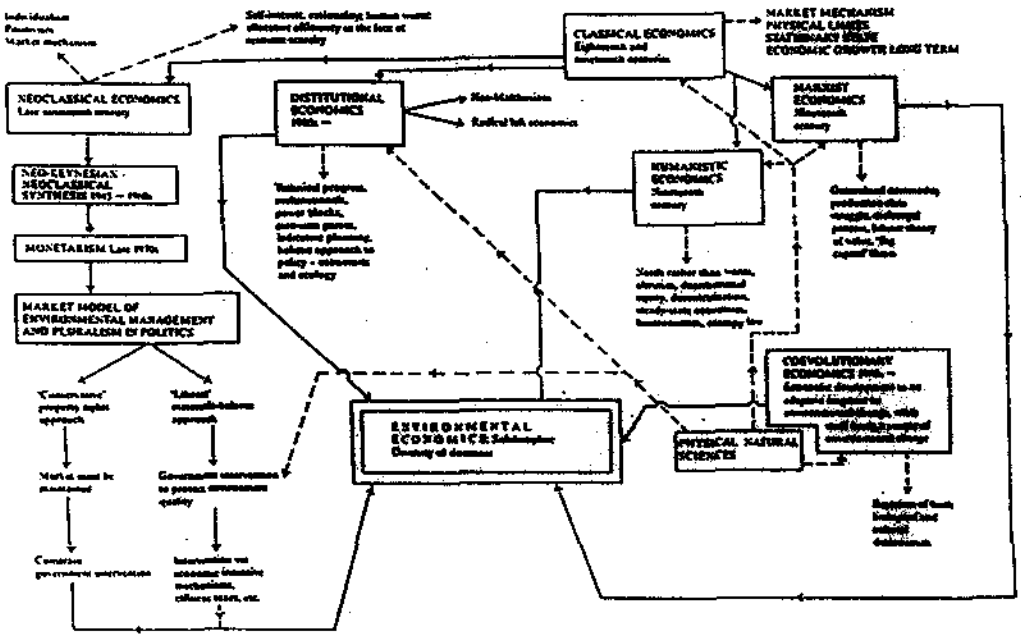
Those who lean more heavily towards the standard neo-classical assumptions of rational economic man and the efficiency of the perfect market see the answer as the reduction of imperfections through the allocation of property rights. Coase theorem is perhaps the best known exemplar of the approach. Coase believed that the solution to a pollution problem may best be achieved by the efficient bargain between the creator of the pollution and the sufferer-essentially a buyer meets seller situation. This could be reached through the distribution of property rights so that polluter and victim are easily indentifiable. Those who advocate this approach also tend to favour minimum government intervention in the problem. They assume public motivation to be based on the same self interest as private motivation, and so the use of any institutional framework is unlikely to benefit anyone other than the members of the institution.

Others, while they still view pollution as evidence of market failure, see it as a scientific inevitability. This group of economists believe in the difference between private and public motivation to some extent. And view government regulation and incentives as a feasible solution. While not entirely based on institutional theory, its influence is obvious. Authorities research optimal levels of pollution and take action to ensure they are not exceeded (Common 1992).

Tietenberg (1993) usefully demonstrates the interaction of environment and economy using the diagram below.



It has taken man and his economy many years to understand the nature of this interdependence and the reaction to the problem of sustaining a workable relationship is summarized diagrammatically by Pearce & Turner (1990)



Economic paradigms and the environment. Some caveats are in order. The figure is meant to be descriptive rath than analytical. It is probably not correct to view changing economic doctrines over time in terms of Kuhnian "scientific revolutior. Rather it is more fruitful to think of clustersof interconnected theories or "scientific research programmes" which compete agair each other .

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