NIGERIAN JOURNAL OF
SOCIAL AND DEVELOPMENT ISSUES

Vol. 1 No. 1 June 2001

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A PUBLICATION OF THE FACULTY OF SOCIAL SCIENCES
UNIVERSITY OF CALABAR, CALABAR - NIGERIA

Nigerian Journal of Social and Development Issues, Vol. No. 1 June 2001

ECONOMICS OF THE ENVIRONMENT

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INTRODUCTION:

Development is aimed at the minimization and possible eradication of poverty. In the old development literature, the importance of environmental factors in the development calculus of any nation was never seriously considered. In recent times, scholars, policy-makers and others have come to realize that sustainable economic development is difficult to achieve if environmental issues are not adequately addressed.

Furthermore, it is useful to allow future generations to continue to enjoy and benefit from the fruits of environmentally sensitive and induced development. This paper examines vital environmental issues especially on how to abate the externalities of environmental pollution in the interest of society.

Following this introduction, section 2 of the paper discusses the environment and the macro economy. The environment and environmental problems arising from industrial activities are analysed in section 3. In section 4, we consider some issues in environmental economies. Section 5 presents some recommendations and concludes the paper.

THE ENVIRONMENT AND THE MACRO ECONOMY

The economy and the environment are interlinked. Hanley, Shogren and White (1997) maintain that these interlinkages, to an extent, are all embracing. In this case, every economic action could have some effect on the environment while every environmental change have impact on the economy. This dialectical relationship between the economy and the environment could better be appreciated by looking at the economy from the production and consumption perspectives while the environment is viewed first as a supplier of resources and then as a sink, or receptor for waste products.

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The environment is also a scarce resource, with many conflicting demands and alternative uses. The relative scarcity resulting from such conflicting demands could be solved in principle using a correct set of (shadow) prices. Absolute scarcity, according to Daly (1991), is such that all demands on environmental services are simultaneously increasing. Absolute scarcity in this case is mainly a result of economic growth through increasing demand for materials and energy, increase in waste outputs, as well as increased demands for environmental quality as an input to recreational, educational and scientific activities. It is therefore obvious that given the fixity of most environmental resources (i.e. limited assimilative capacity, limited supplies of minerals etc.), absolute scarcity increases as economic growth is enhanced.

Most texts in economic development and planning say very little or nothing about the environment. Yet, the inability to consider environmental issues can bias any economic analysis relating to development. In other words, absence of an environmental cost results in less optimum situations. The neglect of the environment in development economics has a human cost. This cost shows up as the deterioration of human capital via ill health and premature mortality resulting from environmental risks, as forgone GNP because of the failure to recognize the high economic rate of return to many environmental investments, and as the erosion of the natural capital base on which the development of many countries depend.

Let us address the role that environmental assets and natural capital should play in development analysis. Given the importance of savings and investment in economic theory, it is perhaps surprising that the effects of depleting natural resources and degrading the environment have not, until in recent times, been considered in the measurement of national savings. This omission may be explained both by the models economists' use and the fact that the UN system of National Accounts (SNA) ignores depletion and degradation of the natural environment.

"Enlarging the concept of net saving to include the depletion of natural resources is in many ways the most natural alternation of traditional savings concepts, because the depletion of a natural resource is, in effect, the liquidation of an asset and so should not appear in any measure of net national product or, by extension, net savings." These issues are well developed in Hamilton, (1994a) and Gandhi, (1995)

The methods of valuing the depletion, discovery and growth of commercial natural resources in the context of the System of National Accounts (SNA) remain problematic. More problematique is the valuation of environmental degradation. The UN guidelines for environmental accounting favour valuing degradation in terms of maintenance cost, that is, the cost of restoring the environment to its state at the beginning of the accounting period. The most recent approaches (Ghandi, 1995) suggest the marginal social costs of pollution are the correct basis for valuing waster emissions to the environment.

The above issues (otherwise known as green national accounting) can be formal-

ized thus

$$MEW = C + 1\text{-}n(R\text{-}g)\text{-}\sigma(e\text{-}d)+PB^{B} \quad (1)$$

Where:

MEW	=	economic welfare;
C	=	consumption;
I	=	investment
n	=	the next resource rental rate net of Emission taxes on production;
R	=	resource extraction;
g	=	resource growth;
σ	=	marginal social costs of pollution;
e	=	pollution emissions;
d	=	natural dissipation of pollution; and
P_B	=	the willingness of consumers to pay for Environmental services B.

For non-living natural resources the term in g is zero while d is zero for pollutants with cumulative effects. The measure of sustainable national income simply drops the last welfare term from equation (1). The intuition is that I-n(R-g) -σ(e-d) is the value of net investment when changes in natural resource stocks and stocks of pollutants, appropriately shadow priced, are included in addition to increments to the stock of produced assets. From equation (1), it is clear that environmental issues must be addressed if an economy is to maintain a sustainable level of national income. It is also possible to derive genuine national savings from the above expression. We do not intend to pursue it here, see Gandhi, 1995, pp. 85-88.

The basic conclusion is that environmental degradation gives rise to major economic costs in developing countries like Nigeria in terms of:

1. impairment of the human capital stock through premature mortality and morbidity.
2. loss of marketed GNP through health effect and degradation of assets such as soil and forests,
3. loss of non-marketed GNP that could be subject of capture through appropriately designed policies, domestic and international; and
4. reductions in genuine savings, which amount to the mining of the capital base on which many developing countries depend.

In assessing or determining an environmental project in a society, the Cost-Benefit methodology is recommended.

3.1 THE ENVIRONMENT

The ecosystems in their natural forms are viable because they are balanced and

stable and thus able to withstand shocks arising from natural and human actions. At the very initial stage of universal history, man himself was part of the said validity. Then, man's habitat demands were in a stable balance with the ecosystem of which he was part. Presently, there does not seem to exist natural ecosystem due to the influence of man's technological know-how and other innovations aimed at facilitating the process of development (Umoh, 1998).

The environment consists of land, water and air in which we operate and from which we tap the resources we need. And there exists a dialetical relationship between human beings, other living organisms and the environment in which they live. We influence the environment and it influences us in turn. Such influences may be beneficial or detrimental. It is therefore important to pay attention to the environmental resource-base. Environmental matters must be given its proper place in development economics as well as development planning. This is in line with the views of Dasgupta and Maler, (1995). The developing as well as less developed countries depend heavily on natural resources. These resources include the soil, water forests and forest products, animals and fisheries. If these environmental resource-base is mismanaged and allowed to continually deteriorate unabated, these poor economies deteriorate the more. The very fact that the rural sectors of these developing economies are biomass-based calls for care in the exploitation and devastation of natural resources.

3.2 ENVIRONMENTAL PROBLEMS

The industrial sector is mostly dominated by the following major forms: Steel works, Metal Fabrication and Finishing, Synthetic Fibres and Plastics, Oil Service, Oil Producing, Food Processing, Textiles, Petroleum Refineries and Petrochemical Facilities, Paint, Breweries, Fertilizer, Cement, Mining, Natural gas, Wood works, Hygienical Products, Glass, Electronics Utilities.

Jaffee et al (1975) distinguishes three categories of industrial pollution abatement costs.

The high pollution industries include:

(i.) Paper and allied products; (ii) Chemical and allied products;
(iii.) Petroleum and coal products; and (iv.) Primary metal industries.

The moderate pollution industries include. (i) Furniture and Fixtures;
(ii) Fabricated metal products; and (iv.) Electric and electronic equipment.

The low pollution industries are made up of the following:

(i) Printing and publishing; (ii) Rubber and plastic products; and (iii) machinery except electrical.

The problem relating to environmental abuse are many; some are direct while others are indirect. The World Bank (1992) identifies three main damaging effects of environmental degradation. These are harmful effects on human health, negative impact on economic productivity, and loss of various benefits enjoyed by people from the existence of

an undamaged environment. Examples of environmental degradation that harms human health include contaminated and unsafe water, air pollution and poor sanitation. Environmental damages that result in loss of economic productivity include overuse and/or pollution of renewable resources such as soils, forests and water, etc.

Table 1 below shows the details of specific impacts of industrial activities.

It is possible to broadly classify environmental degradation into domestic and global variants. The global type affect the "global commons", mainly the upper atmosphere change (greenhouse or global warming and ozone depletion). The domestic brand includes water contamination, air pollution, unsafe disposal of solid and hazardous wastes, soil degradation (erosion, loss of fertility, desertification, Salinization, flooding, etc) deforestation and biological diversity. In addition, there is acid rain and the dumping of toxic waste - these could have spill over effects on neighbouring countries.

The impact of environmental problems on the economy is presented in Table I below. It is clear that failure to address environmental issues in Nigeria will adversely affect economic growth and invariably poverty will accelerate. In Nigeria, the domestic varieties of environmental damage constitute enormous problems. Table 2 below indicates that less than 50% of the Nigerian population has access to health services, safe drinking water and good quality sanitation. Perhaps, the enormous environmental problems account for the worsening social conditions in Nigeria. High under-five mortality and low life-expectancy rates in Nigeria may be due to air pollution and water contamination.

Indonesia which was at the level of development like Nigeria can boast of higher standard of living (See Tables 2 and 3).

TABLE 1

Nigeria: Impact and Cost of Unsustainable Development

Priority Environmental Problems	Economic Growth Impact	Distributional Equity Impact	Resource Integrity Impact	U $ Million Per Year
Soil degradation	High	High	High	3,000
Water contamination	High	High	High	1,000
Deforestation	High	High	High	750
Coastal erosion	Moderate	Moderate	Moderate	150
Gully Erosion	Moderate	Moderate	High	100
Fishery Losses	Moderate	Moderate	High	100
Water Hyacinth	Moderate	Low	Low	50
Wildlife losses	Low	Low	High	10
Total:				5,110

Source: World Bank (1990), Towards the Development of an Environmental Action Plan for Nigeria.

Because of the problems of environmental activities on the economy, it is crucial that projects bordering on the environment be properly managed. This is important so that society can maximize its benefits from any environmental projects.

TABLE 2

SOCIAL INDICATORS

	Life at	Expectancy birth (Yrs.)	Under-Five Mortality rate		Daily Calorie Supply as %		Adult Literacy		Population with access to Health Sources	Safe Water	
Country	1960	1990	1960	1990	1965	1988	1970	1990	1987-89	1988 -	1990
Nigeria	39.5	51.5	316	167	95	85	25	51	46	48	
Indonesia	41.2	61.5	225	97	81	120	54	77	80	28	
All Developing Countries	46.2	62.8	223	112	90	109	46	64	64	68	
Sub-Saharan Africa	40.0	51.8	284	175	92	89	27	51	48	10	

Source: UNDP, Human Development Report, 1992, pp. 131, 135.

TABLE 3

SOME ENVIRONMENTAL INDICATORS

	Forest area as % of total Land area	Annual Rate of deforestation (%)	Annual % Change in fuel wood Production	Annual Rate of change in energy Consumption	Urban Population annual growth rate (%)
	1990	1980-90	1972-82	1980-89.	1960-90
Nigeria	17	2.7	4.1	5.5	6.3
Indonesia	65	0.8	2.2	3.9	4.7
All Developing Countries	28	1.1	2.3	4.9	4.0
Sub-Saharan Africa	33	0.5	3.3	2.8	5.2

Source: UNDP, Human Development Report, 1992, pp. 169-173.

4. ECONOMICS OF THE ENVIRONMENT - SOME ISSUES

4.1 UNCERTAINTY AND THE PRECAUTIONARY PRINCIPLE

In many environmentally related issues, there exist uncertainty over the effects of actions of economic agents on the environment and the impacts on these agents of subse-

quent environmental changes. For instance, while we know that carbon dioxide causes global warming, it is uncertain how much warming will occur if the Co_2 levels are doubled and it is even more uncertain the extent of the physical effect of such warming on human beings. On this note, therefore, society must take action before such uncertainty is resolved given the possibility of the costs of not taking action being greater than the costs of preventative or anticipatory action currently taken, especially when the absence of action today leads to irreversible undesirable environmental results. (Taylor, 1991).

4.2 ENVIRONMENTAL RESOURCE ALLOCATION

It has become clear that the market system works poorly in the allocation of environmental resources. This is generally due to imperfections of the price mechanism as a means of resource allocation. According to Hanley, Shogren and White (1997), markets, for environmental assets can fail if prices do not communicate society's desires and constraints accurately. Moreover, the price system often understate the full range of services provided by an asset. In other cases prices may not even exist to send appropriate signal to the market place about the value of the asset.

Market failure is said to occur when the market (price) mechanism ends up in inefficient allocation of resources. In which case private decisions based on market prices, or lack of them, fail to generate an efficient allocation of resources. In that state of affairs it follows that resources could still be reallocated such that at least one person is made better off without making anybody worse off. However, there is a dichotomy between private wants and societal wants. Unfortunately, the perfectly competitive market where private decisions lead to social optimum is non existent anywhere.

Most market failures with environmental assets can be linked to incompleteness of markets. Markets are incomplete due to the failure or inability of institutions to establish well-defined property rights. The absence of well-defined property rights form the rationale for governments to intervene as an advocate of proper environmental management.

4.2 SOCIALLY OPTIMAL LEVEL OF POLLUTION

Coase (1960) maintains that disputing parties over environmental degradation could work out a private agreement that is pareto efficient. This decision rule says that the marginal cost (MC) to one individual from the pollution and the marginal benefits (MB) to the polluter must equate to give the socially optimal level of pollution.

An externality exists if the consumption or production activities of one individual or firm affect another individual's or firm's production function in such a way that violates the pareto optimal resource allocation conditions. Such external effects, does not, however work through a market price, but rather through its impact on the production of utility or profit. Assume that the private optimum is q' and the social optimum is q^* levels of pollution given that the polluter selects a privately optimal level of pollution q, let his net

profits π^R be given by

$$\pi^R = \pi^r - C(q)$$

Where π^R is the profits before pollution abatement, and $C(q) \geq 0$ is the cost of abatement such that cost is a decreasing function of pollution, $C^1(q) \equiv dc/dq<o$, so that the marginal cost of abatement is zero, $c^1(q^1) = 0$, at a threshold level of pollution, q^1. Therefore the polluter's marginal benefit from increased pollution equals $- c^1(q)$.

Let the sufferer of pollution's net profit, π^0 be given by $\pi^0 = \pi^0 - B(q)$

Where π^0 is his profits given no pollution and B(q) is the monetary equivalent of the damage suffered given that damage is an increasing function of pollution, $B^1(q) \equiv dB/dq>0$. The sufferer's marginal cost of increased pollution is therefore equal to $B^1(q)$.

In this circumstance the socially optimal level of pollution is determined by taking account of the impact of the polluter on the sufferer of pollution. This social optimum requires that the marginal benefit of the polluter balance against the marginal cost of the sufferer of pollution.

i.e. $-C^1(q) = B^1(q) = q^*$

Other cases of market failure for environmental assets include non-exclusion, non-rival consumption, non-convexities and asymmetric information. These failures may be abated through collective action, privatisation etc.

4.3 INDUSTRIAL POLLUTION ABATEMENT: ASSESSING OPTIMAL INVESTMENT REQUIREMENT

The day-to-day operational decisions regarding the allocation of limited public investment funds on environmental relevant industrial projects are based on microeconomic techniques of analysis known as "project appraisal". The methodology of project appraisal rests on the theory and practice of "social" cost-benefit analysis. The basic idea of cost benefit analysis is straight forward. In order to decide on the worth of projects involving public expenditure, it is required to weigh up the advantages (benefits) and the disadvantages (costs) to the society as a whole. The need for social cost-benefit analysis arises because the normal yardstick of "commercial profitability" that guides the investment decisions of private investors may not be an appropriate guide for public investment decisions.

Private investors are interested in maximizing private profits and thus normally take into account only those variables that affect net profit: receipts and expenditures. Both receipts and expenditures are valued at prevailing market prices for inputs and outputs.

The take-off point for social cost-benefit analysis is that it does not accept that actual receipts are a true measure of social benefits nor actual expenditures a true measure of social costs. That is, where social costs and benefits diverge from private costs and

benefits, investment decisions based entirely on the criterion of commercial profitability may lead to a set of "wrong" decisions from the point of view of social welfare, which should be the government's major concern. Though social valuations may differ significantly from private valuations, the practice of cost-benefit analysis is based on the assumption that these divergence can be adjusted for by public policy so that the difference between; social benefit and cost will properly reflect 'social profitability' just as the difference between actual receipts and expenditures measures the private profitability of an (industrial) investment.

Invariably, social profit in any period can be defined as the difference between social benefits and social costs where these are measured both directly (the real costs of inputs and the real value of outputs) and indirectly (e.g. employment effects, distribution effects etc.). The calculation of the social profitability of an investment involves a three - step process:

(i.) We must first specify the objective function to be maximized normally "net" social benefit - with some measure of how different benefits (e.g. per capita consumption, income distribution) are to be calculated and what the trade off between them might be.

(ii.) In order to arrive at calculations of net social benefit, we need some social measure of the unit values of all project inputs and outputs. Such social measures are called "accounting" or "shadow" prices of inputs and outputs to distinguish them from actual market prices. That is, a shadow price reflects the true opportunity cost of a resource. In the techniques of linear programming, shadow prices are merely, the solution values of the "dual to a linear - programming output or profit - maximization problem". In general, the greater the divergence between shadow and market prices, the greater the need for social Cost-Benefit analysis in arriving at public investment decisions rules. The bedrock of social cost-benefit analysis is the calculation and/or estimation of the prices to be used to determine the true value of benefits and the real magnitude of costs. The reasons why in less developed countries, market prices of outputs and inputs do not give a true reflection of social benefits and costs include: (a) Inflation and currency overvaluation, (b) wage rates, capital costs and unemployment, (c) tariff, quotas and import substitution, (d) savings deficiency and (e) social rate of discount.

(iii) We need some decision criterion to reduce the stream of projected social benefits and cost flows to an index, the value of which can be used to select or reject a project or to rank it relative to alternative projects.

Choosing projects: Decision Rule

The "return" on an industrial project can be expressed in a number of ways. One of the most common is in the form of a benefit cost ratio:

$$\frac{B}{C} = \frac{(b_1-c_1)}{(1+i)} + \frac{(b_2-c_2)+}{(1+i)^2} \ldots\ldots \frac{+(b_n-c_n)}{(1+i)^n} \ldots\ldots (1)$$

pines illustrates the applicability of these techniques.

Through appropriate interventions, it was estimated that the total economic benefits associated with pollution reduction exceeded the costs. It is therefore necessary that high priority be placed on reducing water pollution in selected sectors with high benefit-cost ratios. These include particular industrial sectors such as mining, quarrying and manufacturing Delos Angeles et al (1994).

From the foregoing discussions it is evident that the processes of industrial production produce both benefits and costs to the society in terms of environmental impact. The negative impacts can be controlled, reduced or totally eliminated. The existing environmental regulations if thoroughly enforced could go a long way in ensuring that industrial concerns internalise their negative externalities. Otherwise industrial polluters of the environment must be made to pay for such actions.

5. RECOMMENDATIONS AND CONCLUSION

We have analysed issues hinging on the economics of environmental abatement. There is no doubt that sustainable development must tackle the problems of environmental degradation in the course of industrialization. In the light of these we put forth the following recommendations.

i. Public enlightenment campaign should be embarked upon to educate the citizens on issues of environment.
ii. Government must make adequate funding of environmental projects through its agencies;
iii. There is need for the co-ordination of environmental issues in the ECOWAS sub-region;
iv. There is need for a stricter enforcement of the existing environmental protection regulations, especially those pertaining to the production of hazardous wastes, Environmental Impact Assessment (EIA) and land use;
v. Industrial ventures must be regulated to internalise their negative externalities (waste products) which constitute cost to the society. This can be implemented by imposing tax per unit of waste produced;
vi. Our waste management should be commercialised at all tiers of government especially at the state and local government levels. Such commercialization could be done using the "Polluter-Pays-Principle" (PPP).
vii. There is need for revised accounting procedures to take care of environmental issues;
viii. There is need for more and better economic valuation of non-marketed resources; and
ix. A complete rethinking of mainstream development economics at the pedagogic level is necessary to reflect the rethinking that has already taken place at the level of research (See Ekpo and Umoh, 2000).

In assessing or determining an environmental project in a society, the cost-benefit methodology is recommended.

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