Understanding the role of Economic models that underlie Environmental Impacts and their Assessments (EIA)

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Abstract

This paper x-rays the role of economic models, specifically the Circular Flow Model and Materials Balance Model, with supporting Laws of Thermodynamics, in understanding the perspectives and dynamics of development and the environment, environmental impacts and environmental impact assessment (EIA). The ultimate goal of EIA is to achieve a level of environmental protection, enhancement, management and sustainability. Unless there is a political will to achieve these objectives, EIA will be a pro-forma exercise of little practical utility. This is therefore the conscious need for purposeful environmental governance in the processes, procedures and enforcement of EIA.

Keywords: Development, Environment, Environmental Impact Assessment, Circular Flow Model, Materials Balance Model, Sustainable Development

Introduction:

The rights to development and to the environment are found in most countries' constitutions. These rights are usually aimed at improving the living standards of the people. Also, the government on her own part has environmental objectives, enshrined in the constitutions that aim at protecting the environment to ensure a healthy and clean environment for the people.

To achieve the aims of these rights and objectives involve some form of development. According to Markandya and Richardson (1992), in the early 50s, economists mainly focused their attention on economic growth, with little attention to limited supply of environmental resources and increasing population. Together with this motion, a new environmental awareness germinated. As people became richer, their preferences for clean living environment, for natural goods and future environmental services increased. The wrong perception that environmental issues are the concerns of rich countries, as well as tackling the increasing poverty problem in developing countries, dominated the mindset for much of the 1960s and 70s. The change came about in the 80s when the key role of the environmental resource base in which the very process of development rests, led some economists to emphasize the need for the protection of environmental resources in countries' development plans. Although the desirability of development is universally acceptable, there has been a rising concern about whether development will cause serious environmental damage, thereby in turn impair the quality of life of this and future generations.

The environmental is integral to the overall process of development. Development at whatever level it takes place affects the environment. Also, many forms of development make demands upon the environmental as

they use natural resources (which are sometimes limited in supply) and generate by-products of pollution and waste.

One of the 21st century challenges is the understanding, reconciling and accepting the task of protecting and preserving the environment and its resources on one hand, and pursuing economic development on the other. It was in 1972 that the first official mainstream recognition of a link between development and the environment took place at the United Nations Conference on the Human Environment in Stockholm, Sweden. However, with the 2020 hindsight, there is the need to understand the critical relationship between development and/or economic activity and the environment, and how this can help us make better and wiser decisions. This therefore calls for a trade-off between economic growth and environmental quality. This is in response to Lawrence's (1997) call for more coherent Environmental Impact Assessment (EIA) theory-building, arguing that EIA theory is essential for further understanding of human activity, the environment and critical interactions between the two. Theoreticians, notably economists, have responded by advancing theoretical underpinnings of the nexus between development and the environment.

Economic Models and Environmental Issues

Economics provide analytical tools that help to explain the interaction of markets and the environment, the implication of that relationship, and the opportunities for effective solution. Economic models serve as powerful models that illustrate the link between economic activity and the environment. The analysis of this underlying relationship motivates economic analysis of environmental issues (Scott and Janet, 2013). According to Weaver (no date), most development models use economic information as basis to propose development, and include comparative advantage, Rostow, Harrod-Domar, dependency theory, and unbalanced growth theory. While these models/theories are helpful in the development process, they do not tell the whole picture regarding the nexus between development and the environment, especially the social, economic and environmental implications of development. Scott and Janet (2013) are one of those who advanced theoretical underpinnings of the nexus between development and the environment, notably the Circular Flow Model and the Materials Balance Model.

Environmental problems occur mainly from the fundamental perspective of decisions made by households and firms through consumption and production respectively. Activities in the households and firms draw on the natural resources of the environment. This process generates by-products of production and waste that negatively impact on environment. It therefore means that the fundamental decisions that involve economic activity are directly connected to environmental problems. According to Scott and Janet (2013), economists illustrate this relationship with a basic model of economic activity, called circular flow model. They gave an explicit description of the model thus:

The Circular Flow Model

The Circular Flow Model underlies the basis for modelling the relationship between economic activity and the environment, as shown in Fig. 1:

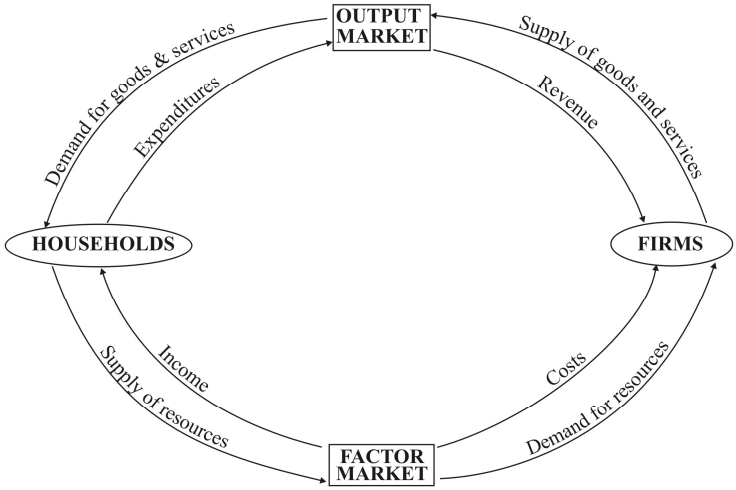

Fig. 1: Circular Flow Model (Adopted from Scott and Janet 2013)

In this figure, the two market sectors are households or consumers and firms or producers. The real flow consists of the non-monetary flow that runs anti-clockwise, while the non-real flow consists of the monetary flow that runs clockwise. Households supply resources or factors of production to the factor market, where they are demanded by firms to produce goods and services. These commodities are then supplied to the output market, where they are demanded by households. The exchange of inputs in the factor market generates an income flow to households, and that flow represents costs incurred by firms. Analogously, the money flow through the output market shows how households' expenditure on goods and services are revenues to firms. The volume of economic activity and the size of the flow are influenced by population growth, technological change, labour productivity, capital accumulation and natural phenomena such as environmental disasters (which includes flood, drought and earthquake).

This model exposes us to the basic functioning of an economic system and the market relationships between households and firms through the analysis and operation of the flows and how the size of an economy can change. However, the model fails to explicitly show the nexus between economic activity and the environment. To show this interdependence, Scott and Janet (2013) expanded the model to show the relationship, which they called Materials Balance Model.

Materials Balance Model

The Materials Balance Model in Fig. 2 shows how the real flow of the circular flow model is positioned within a larger schematic to show the connections between economic decision-making and the environment.

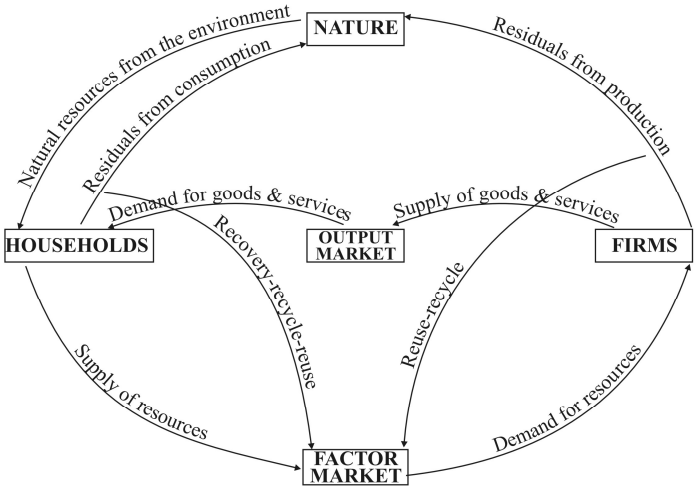

Fig. 2: Materials Balance Model

Source: Based on Kneese, Ayres and D'arge (1970)

This model can be seen in two perspectives – flow of resources and flow of residuals. One way in which an economic system is linked to nature is through a flow of materials or natural resources that runs from the environment to the economy, specifically through the household sector. This flow describes how economic activity draws on the earth's stock of natural resources, such as soil, minerals and water. This is the primary focus of natural resource economics, a field of study concerned with the flow of resources from nature to economic activity.

A second set of linkages runs in the opposite direction, from the economy to the environment. This flow illustrates how raw materials entering the system eventually are released back to nature as by-products or residuals. Most gases are released into the atmosphere, most are harmful, and some are absorbed naturally. However, other released gases are not easily assimilated and may cause harm, even in the short term. In addition, there are also liquid residuals such as industrial wastewaters; and solid residuals such as municipal solid waste (from consumption), and certain hazardous wastes, which are potential threats to the environment. This set of flows is the concern of Environmental Economics, which Munasinghe (1993) sees as the essential bridge between the traditional techniques of decision-making and modern environmental analysis.

In Figure 2, the flow of residuals back to the environment can be delayed through recovery, recycling and re-use. The inner flows from the residual outflows show that some residuals can be recovered from the stream and either recycled into another usable form or re-used in their existing form.

Although recycled and re-used products later become residuals, they are returned to the environment eventually. It therefore means that in the materials balance model, all resources drawn from the environment eventually are returned there in the form of residuals. This is scientifically supported by the first and second Laws of Thermodynamics. Applying the first law to the model means that in the long run,

the flow of materials and energy drawn from the environment into consumption and production must equal the flow of residuals that run from these activities back into the environment. This therefore means that when raw materials are used in economic activities, they are converted into other forms of matter and energy, without loss in the process. Overtime, all these materials become residuals that are returned to the environment.

The second Law of Thermodynamics states that the environment's capacity to convert matter and energy is not unlimited. During energy conversion, some of the energy becomes unusable. Though it exists, it is no longer available for use in another process.

There are two implications of the understanding of these two laws that support the Materials Balance Model. First, the residuals that result from environmental resources injected into economic activities impact negatively on the environment. The process can be delayed through the 3Rs (Recycle, Re-use and Recover) but not stopped. Second, the environment's ability to convert resources to other forms of matter and energy is limited.

Materials Balance Model and Environmental Impacts and Assessment

The implications of the laws of thermodynamics that support the materials balance model provide a comprehensive perspective of the important nexus between economic activity (development) and the environment as well as environmental impacts and their assessment. Achieving an appropriate balance between economic growth and the preservation of natural resources is the essence of sustainable development, which calls for managing the earth's resources to ensure their long term quality and abundance (Council of Environmental Quality, 1993). This means that successful economic development depends on the rational use of natural resources and on reducing, as far as possible, the adverse environmental impacts of development projects, proposals and plans (John and Stefano, 1998). Effectively assessing environmental impacts requires an understanding of the concept of the multiplex and dynamic relationship between development and the environment. According to ADB (1996), environmental impacts can be defined as the good or bad biophysical consequences in a receptor (people, plants and materials) after a change in exposure to a stressor (chemical, physical, and/or biophysical agents; types and levels of pollutant emission or habitat alteration). Impacts are generally characterized in terms of human health, human welfare, environmental resources and global systems impacts, and exhibit the following attributes, type, nature, magnitude, extent, timing, duration, uncertainty, reversibility and significance. There are a number of reasons that account for the assessment of environmental impacts of development projects on the environment. According to Maureen (2010), there are needs to:

i. Demonstrate success (to donors, ourselves, and the public) both t justify funds received to solicit for funding.
ii. Learn to understand how our efforts impact on local communities in order to improve the effectiveness of our interventions.
iii. Be accountable to the people (stakeholders) for whom we are working and
iv. Use the findings from impact assessment to advocate for changes in behavior, attitudes, policies and legislation at all levels.

The most useful tool for understanding and managing the impacts of a particular project is the Environmental Impact Assessment (EIA). Philip (2014) describes EIA as a procedure that must be followed for certain types of projects before they can be given development consent. It is a procedure that identifies, predicts and evaluates potential impacts of a proposed project or activity on the environment as well as describing the means of mitigating significant impacts prior to major decisions or commitments being made (UNEP 2008).

EIA is globally recognized as a principal tool in environmental management, entrenched in domestic and international laws (Bowd, Quinn and Kotze, 2015). The Rio Declaration marks an international consensus on the value of EIA as a mechanism for identifying and addressing the environmental impacts of development proposals and actions (REC, 2001). The Rio Declaration outlines 27 principles to serve as guidelines for global environmental protection and economic development. Principle 17 states that EIA, as a national instrument shall be undertaken for proposed activities that are likely to have significant adverse impact on the environment and are subject to a decision of a competent national authority, (UN 1992). EIA takes place within the legal and/or policy frameworks established by individual countries and international agencies. Its practice can be improved through a better understanding of the different arrangements that are made for EIA provision and procedure, and how these can contribute to successful EIA.

EIA is viewed as both science and art, reflecting the concern both with the technical aspects of appraisal and the effects of EIA on the decision-making process. The introduction of EIA may be seen as part of the reconstruction agenda and as an instrument that can help to ensure that other activities are consistent with the principles of sustainable development (REC, 2001). EIA is adopted in many countries with different degrees of enthusiasm since its inception in the early 1970s in USA.

Peter (1990) gives a run-down of the major issues of the EIA process, stating that the design of effective EIA procedures requires technical matters such as impact identification and prediction. EIA implies a special type of analysis involving a careful, thorough and detailed analysis of the likely implications of a development. This indicates the need for some threshold of significance being exceeded in order to trigger the full EIA process, a procedure commonly referred to as screening.

Several countries have developed lists of project which should be subjected to EIA, using some categorizations or considerations such as project type, size, location and significance of likely impacts. Initial Environmental Evaluation (IEE) or Preliminary Assessment (PA) is a detailed study that is carried out for projects with uncertainties. The outcome of this determines if a full EIA may be required. Baseline data collection follows, and is the collection of the background information on the biophysical, social and economic settings of proposed project areas. According to Nwafor (2006), this serves to provide a description of the current status and trends of the environmental factors of the host area, as well as provide a means of detecting actual change by monitoring once a project has been initiated.

The next stage is scoping, which is the process of determining which issues are likely to be significant. Impact analysis is the technical heart of the EIA process, with various activities, including impact identification, prediction, interpretation, communication and in devising monitoring schemes.

The structure of an EIA process is detailed primarily by the need to accommodate each of the key issues in the EIA phases. According to Peter (1990), EIA, from a technical perspective, is thought of as a data management process with three components. First, the appropriate information necessary for a particular decision to be taken must be identified and collected. Secondly, changes in environmental parameters resulting from implementation must be determined and compared with the situation likely to accrue without the proposal. Finally, actual change must be recorded and analyzed.

Conclusion and Recommendation

Development and the environment are inextricably linked. The environment is integral to the overall process of development. Development, at whatever level it takes place, affects the environment. Reconciling the aspirations to achieve development on one hand, and the protection of the environment on the other hand is at the heart of sustainable development. To achieve this requires a model that would further the understanding of human activity, the environment and the critical interactions between them. The Materials Balance Model, with the supporting Laws of Thermodynamics, provides a comprehensive perspective of the nexus between development and the environment, as well as environmental impacts and their assessment (EIA). The immediate aim of EIA is to facilitate sound decision-making by ensuring that environmental considerations are addressed in development proposals. For the ultimate goal of EIA to achieve a level of environmental protection that supports sustainable development and environmental sustainability, there should be a conscious political will to strengthen environmental governance by utilizing the potentials of EIA to achieve the objectives of environmental protection, enhancement and management.

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