2. A New Platform For Planning

2.1 The Case for Resource-Based Planning in Developing Countries

INDUSTRIAL ECOLOGY appears to have captured the imagination of many sections of society in the developed world and is today increasingly practiced in the USA, Canada, Japan and Europe. In addition, considerable research work is being conducted and courses in Industrial Ecology are being taught in academic centers such as Yale and Carnegie Mellon University (in the USA), and the Swiss Federal Institutes of Technology, Leiden University, University of Vienna, and University of Trondheim, among many others (in Europe).

At the level of organized business, many large companies have realized that reduced waste means greater profits. They have made resource optimization part of their mainline corporate activity. Dow Chemical (Louisiana division, USA) was one of the early ones to understand this and had launched a program called WRAP (Waste Reduction Always Pays) as early as 1981.

Methodologies such as Life Cycle Analysis (LCA) to track the life of materials (and pollutants) from cradle-to-grave, and thereby understand the interaction of the materials with the environment, are being routinely undertaken by companies in many developed countries. This again helps the companies to make better assessments of the total impact on the environment by their products or processes and thereby helps make better assessments of any possible present or future liabilities.

Companies are also looking at options like Ecodesign or Design For Environment (DFE) for their products, processes and services. This way products are so designed that they possess environmentally sustainable properties. Some of these properties could be: they are dematerialized (offer the same or better service with lower

material input), they are easy to break down and recycle, they are biodegradable, they use less energy in the process of production and in their use, etc.

In North America and in Europe, the idea of Eco-Industrial Parks (EIPs)—or, on a wider geographical scale, Eco-Industrial Networks (EINs)—began to be explored in the early 1990s [1]. In Canada, the first systematic effort to initiate exchange of wastes for mutual benefit and build by-product synergies was undertaken by Ray Côté and his colleagues in a large industrial estate near Halifax [2]. In the USA, a special Task Force was set up by the President's Council for Sustainable Development to document and stimulate EIPs initiatives across the country; one of the well-documented projects being the metropolitan industrial ecosystem in North Carolina [3]. At around the same time, similar experiments were conducted across Europe, in the Netherlands (Rotterdam harbour), Germany, France, among others [4]. Large organizations like Electricité de France (EDF) have engaged in methodic research to develop the knowledge and know-how in order to implement synergies between various companies across different sectors [5]. More recently, in a few developing countries, there have been efforts to develop by-product synergies and eco-industrial networks in existing industrial estates, particularly in Asia [6].

In parallel, since the 1980s, the methodology of industrial metabolism was being developed in the USA and in Europe by pioneers like Robert Ayres, Peter Baccini, Stefan Bringezu and others [7]. The metabolism of societies can be studied in many different ways, some of them being quite sophisticated for scientific and academic objectives. Material and energy flow studies can be done for substances, products, processes, individual companies, municipalities, regions, depending on the issues at stake and the purpose of the study. The first large-scale study was initiated in the early 1990s at the request of the Dutch Government, in order to understand the pattern of pollution by certain toxic substances in the Rhine River Basin, followed by a similar effort in Central Europe [8]. A specific methodology for material flow analysis at the regional level has been designed by Paul Baccini and his colleagues at the Swiss Federal Institute of Technology (Zurich), an approach which is receiving growing attention from planners and policy makers in Europe [9]. Like the Eco-Industrial Parks experiments, industrial metabolism studies have been so far mainly performed in industrialized countries [10].

In the developing countries in general, such concepts are yet to take serious root and it may be useful to ponder on how they can be applied. Typically (though not always) many of the processes and products used in these countries have been designed in the industrialized world. Secondly, the scales of production in developing countries are often relatively small: there would be very few entities that can effectively use elaborate methodologies like Design for Environment (DFE) or Life Cycle Analysis (LCA). Therefore, many concepts related to the Industrial Ecology framework may not at first sight appear to be of immediate relevance in such contexts.

However, the issue of resources is critically important in the developing countries. Although some of them are considered to be rich in natural resources, their availability to the local society is often extremely limited. Any effort to improve the productivity of resources would greatly enhance their economies, quality of life, and sustainability. The principles of Industrial Ecology, which aim to maximize resource productivity, should be central to the economic and development planning process, taking into account that issues are many and complex in these countries. See page 22, *Characteristics of Developing Countries*.

2.1.1 Focus on developing countries

There are three significant reasons why it is important to focus on developing countries:

1. In developing countries, resources are often very scarce and the population density is high. A large population would feel the impact of unplanned activity, which has not taken into account the availability or use of resources in the region, in the immediate and the long term.
2. A great deal of manufacturing for the global market is increasingly occurring in developing countries, and it is now a crucial time to influence their choice of the industrial development path. For example, the analysis of resource flows at an early stage of development can lead to a resource-based development plan for a region or country that will create an industrial system that uses its resources more effectively.
3. A larger proportion of the world's population lives in the developing world!

Characteristics of Developing Countries

Obviously, the Industrial Ecology conceptual framework, which was originally formulated in the USA, does not directly apply to the vastly different context of the developing world. In contrast to industrialized nations, characteristics of developing countries may include:

Infrastructure

Poor transport network
Poor telecom links
Non-availability of reliable data due to the existence of a huge informal sector
Accelerated obsolescence of infrastructure due to climatic conditions and population pressure

Land-related issues

High population density, which makes land a very vital resource
Low per capita availability of arable land
Low agricultural yields

Water-related issues

Low per capita availability of fresh water (either surface or ground water)
Lack of treated drinking water
Lack of an adequate sewerage system
High cost of central water treatment and disposal systems
Widespread dependence on untreated groundwater

Labor

High levels of unemployment
Low labor cost
Low labor productivity
Poor work ethic
High level of daily wage earners with no job guarantees
Low level of skills
Poor working conditions and inadequate social security

Economy

Restricted availability of raw materials caused by limited financial resources
Low levels of technology
Smaller scales of manufacturing
Existence of millions of informal businesses
High inflation
Higher cost of capital
Restrictions on import
Volatile foreign exchange rates
High need to export and earn hard currency
Low brand equity with many small units doing job work for large domestic or foreign companies
Perverse subsidies which often encourage wastage of resources

Social

Low levels of education and consequently, poor awareness of health hazards from pollution or industrial accidents
Sometimes less concern for social issues (as jobs are often more important than whether a long-term environmental problem is caused)
Low concern for global issues that do not have an immediate bearing on the society
Lower "social cost" of law breaking
Often high levels of corruption among law-keepers
Very poor social security

Legal

Laxity in laws governing environment and worker safety, and hence low costs of disposal of wastes
Lax enforcement of laws
Ineffective or slow legal system

However, the approach to the application of Industrial Ecology concepts needs to be slightly different from that in the developed world. The developing countries are characterized by a huge informal sector and, even in the organized manufacturing units, the scales of production are often very small. There is considerable recycling of material resources (mainly dictated by poverty), but as it is often carried out in the small/tiny scale sector, the lack of safety of the recycling process makes the exercise dangerous. Hence, while discussing Industrial Ecology in the context of developing countries, a regional perspective is required.

2.2 A Regional Perspective

The example of an industrial symbiosis as in Kalundborg is simple to understand. A few entities share their resources to increase their net gain from their commercial activity. In effect, a handful of entities have a limited number of transactions with one another (Figure 2.1). It is easy for them to identify and quantify the waste or unused resource, and predict the normal availability of the resource, which is essential to planning. However, the matter becomes extremely complex, when the same exercise is attempted at a regional level where there are hundreds or thousands of entities having multiple transactions with one another (Figure 2.2). The availability, collection and analysis of data necessary to plan such resource exchanges become considerably more difficult. This requires a new perspective and new methods for collecting, presenting, analyzing and using the available data for planning.

2.3 A New Platform for Planning

As mentioned earlier, Industrial Ecology goes far beyond issues concerning environmental issues, as the term is generally understood. Industrial Ecology is a possible new platform for planning strategies for the sustainable development of societies.

The long-term economic well-being of societies can only be ensured if, at the level of the local community, the state, the country, they acquire a good understanding of the resources available. This understanding alone will enable them to make an objective assessment of their relative strengths and weaknesses. Based on that assessment, they will have to leverage their strengths to develop economically strong and sustainable entities.

FIGURE 2.1

Few Entities, Limited Transactions

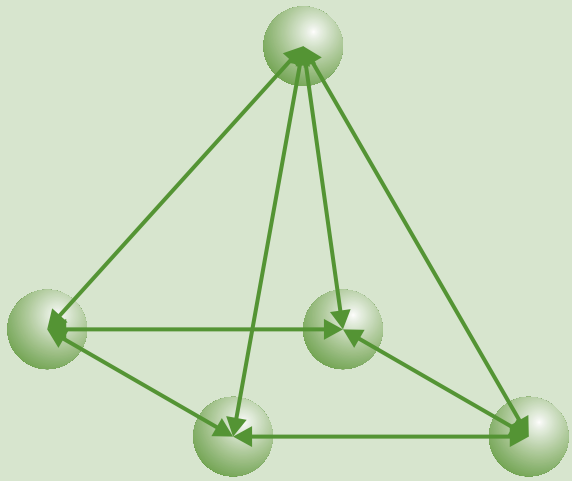
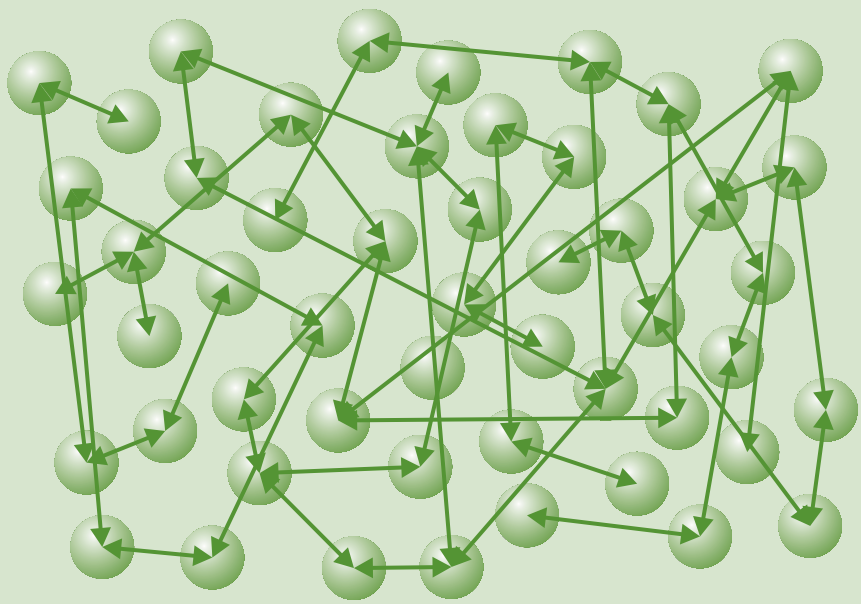


FIGURE 2.2

Numerous Entities, Multiple Transactions



For long it was considered adequate to understand the flow of money through the economic system, as ordained by conventional financial logic. Development objectives were set in monetary terms; for example, to increase the foreign exchange earnings, often without a rider on resource availability. This often gave rise to the growth of unsustainable economic activities requiring resources that the local community could ill afford. This is clearly not enough.

Industrial Ecology offers a new platform for developing strategies that leverage the resources of different societies in various contexts, and ensure long-term well-being and prosperity. This platform facilitates an understanding of the flow of resources through the system (material, energy, land and manpower). Such an understanding could help societies to assess the opportunities available to them, which maximize the productivity of the limited resources available to them, and to more fully assess the threats from their use (or misuse).

This is, of course, of much greater significance in developing countries, where resources are often scarce, and where the nominal value of resources is fixed on the basis of the affordability to the local population rather than on their intrinsic value to the local community.

The following two cases, detailed later in this book, strengthen the argument against traditional planning systems, where issues of monetary economics blind the planner to many other equally critical elements that should be part of the development process.

- First is the case of the leather industry in Tamil Nadu, a state in the south of India. The state was a major center for the export of raw hides and skins. In the 1970s India's economic planners banned the export of raw hides and skins to encourage the industry to tan the leather and finish it before export, to increase the value addition for a gain in foreign exchange, which the country needed desperately at the time. The enormous problem of pollution resulted, greatly endangering freshwater availability in a very dry region.
- The second case is that of the textile industry in Tirupur (also in Tamil Nadu). Till about the 1980s, for decades, Tirupur was only manufacturing white undershirts called "banians", which are commonly worn in India. The industry then discovered the lucrative international market for colored T-shirts, which led to a boom in exports. The government welcomed this growth and encouraged it in every way. The result again is a total destruction of the groundwater resources of the region (and, of course, all agricultural activity) to the extent that water has to be brought in tankers from as far away as fifty kilometers!

If the planning process had included a review of the resource availability in the region as an essential element, the industrial policy might have been differently framed and the activity would have been planned in a more sustainable manner.

These two cases, among many others, show that there is a very strong argument for a resource-based planning process in developing countries.

2.4 Resource-Based Planning

The two examples given above may give the impression that the constraints posed by paucity of resources in a region alone should be factored into the planning process. In fact, resource availability could be the basis on which plans could be formulated, with the objective of optimizing the use of the resources that are limited, and by leveraging the economic value of those that are plentiful. In effect, this exercise could become the basis of Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis for a region, a practice normally followed in management of commercial enterprises.

From this new perspective, the approaches to development planning in any defined socio-economic system (may be a city, state, country or a clearly defined region) could involve:

- Analyzing and estimating the present and likely future flow of resources through the system
- Redefining issues and problems in the context of resources
- Setting priorities for action and identifying resources, the uses of which are of immediate concern
- Doing a detailed analysis of the utilization of identified critical resources
- Preparing a strategic plan for optimizing the use of the scarce resources and leveraging the value of plentiful resources

For such a planning process to be successful, issues will have to be redefined, new priorities have to be determined and a new set of resource-based objectives must be identified. These need to be locale specific.

2.4.1 Redefining Issues

It may be necessary to redefine issues from the perspective of resource utilization. For example, an economic activity could be not just polluting but it could be overusing/wasting a resource. The critical importance of this redefinition, and the new strategy options that it throws up, is illustrated in the case of the leather industry detailed later in this book (Chapter 7).

2.4.2 Setting Priorities and Objectives for Planning

Planning priorities should be based on the availability and use of resources, or should at least include use of resources as an important element. As said earlier, a new set of resource-based objectives for economic activity should be developed, which may have to be locale specific. Such objectives may either put limits on utilization of certain resources, or could include specific resource-based productivity norms. For instance, the aim could be to generate x amount of foreign exchange (or employment) in the region per kiloliter of water consumed.

The questions often asked are: Even if such resource-based plans are developed, how can they be implemented? What kind of strategy options could be available? While it is easy enough to plan future economic activity on the basis of a resource flow understanding, the question of managing the present activity in a region could be fraught with problems. The following are some strategy options that may be available in the context of Industrial Ecology:

- Augmenting the availability of the resource, if possible, (e.g. water harvesting)
- Eliminating the use of critical resources by changing technology, or, possibly, by relocating activities using them
- Reducing use of such resources using lighter materials which perform the same function, with at least the same performance parameters
- Recycling the wastes so that the same quantity of resources is made to perform their function many times before being discarded into the environment, thereby increasing the productivity of the resources
- Substituting with a resource whose efficiency is better and hence its use and the consequent flow of wastes to the environment is minimal
- Substituting the use of such a resource with one whose availability is “interminable” (at least by human standards), such as solar or wind energy

Any of these steps at a regional level concerns hundreds or thousands of entities. These changes may involve not only the way people live and work but also where they work. The process of any changeover cannot be immediate and the transition will have to be carefully planned. However, this perspective will help the planner to set clear short- or long-term objectives towards a more sustainable system.

Notes

[1] For an introduction to EIPS and EINs, see Fritz Balkau: 'Industrial estates as model ecosystems', in Robert U. Ayres and Leslie W. Ayres (eds), *A Handbook of Industrial Ecology*, Cheltenham, UK, Edward Elgar, 2002, pp. 488–496 ; Raymond P. Côté and Ed Cohen-Rosenthal: 'Designing eco-industrial parks: A synthesis of some experiences', *Journal of Cleaner Production*, Vol. 6, No. 3/4, 1998, pp. 181–188. Additional references on EIPs and EINs are given in the bibliography at the end of the book.

[2] Raymond P. Côté, Robert Ellison, Jill Grant, Jeremy Hall, Peter Klynstra, Michael Martin, Peter Wade: *Designing and Operating Industrial Parks as Ecosystems*, report of the project "The Industrial Park as an Ecosystem", Dalhousie University, School for Resource and Environmental Studies, August 1994, ~300 pages. (http://www.mgmt.dal.ca/sres/research/ and http://www.mgmt.dal.ca/sres/eco-burnside/index.htm).

[3] For a synthesis of EIPs projects in the USA in the 1990s, see President's Council On Sustainable Development (PCSD): *Eco-Industrial Park Workshop Proceedings*, October 17–18, 1996, Cape Charles, VA, PCSD, Washington, DC, February 1997 (Proceedings available at: http://clinton2.nara.gov/PCSD/Publications/Eco_Workshop.html). The EIP project in Triangle Park, North Carolina, has been coordinated and documented by Judy Kincaid: 'Metropolitan industrial ecosystem development', in Dominique Bourg and Suren Erkman (eds), *Perspectives on Industrial Ecology*, Sheffield, UK, Greenleaf Publishing, 2003, pp. 95–100.

[4] For a case study in Germany, see Thomas Sterr: 'Inter-industrial Materials Flow Management – the Rhine-Neckar-Experience (South Germany)', in *Proceedings of the Helsinki Symposium on Industrial Ecology and Material Flows, August 30th-September 3rd, 2000*, CD-ROM, Jyväskylä University, School of Business and Economics, Jyväskylä, Finland, 2000 (ISBN: 951-39-0783-X). (http://www.jyu.fi/economics/research/)

For France, see Jean-François Vallès: 'Eco-industrial sites and networks', in Dominique Bourg and Suren Erkman (eds), *Perspectives on Industrial Ecology*, Sheffield, UK, Greenleaf Publishing, 2003, pp. 91–94.

[5] For an overview of the methodology developed by Electricité de France (EDF) for industrial cross-sectoral synergies, see: Cyril Adoue, Arnaud Ansart, Frédérique Vincent: 'Recherche de synergies matières/énergie entre secteurs industriels. Réflexions et perspectives', *Déchets Sciences & Techniques, Revue francophone d'Ecologie Industrielle*, No. 28, 2002, pp. 3–7. (http://www.pro-environnement.com)

[6] Anthony Chiu: 'Eco-Industrial Development Rapidly Implemented In Asia Pacific... How Far to Real Success?', *The Eco-Industrial Advantage*, Newsletter of the Canadian Eco-Industrial Network, Vol. 3, No. 1, March 2003, pp. 11–12 (http://www.cein.ca); see also Ernest Lowe: *Eco-Industrial Park Handbook for Asian Developing Countries*, prepared for Asian Development Bank, 2001. (http://www.indigodev.com/ADBHBdownloads.html)

[7] For an introduction to the concept of industrial metabolism, see Robert U. Ayres: 'Industrial Metabolism', in Jesse H. Ausubel and Hedy E. Sladovich (eds), *Technology and Environment*, National Academy of Engineering, National Academy Press, Washington, DC, 1989, pp. 23–49, and Stefan Bringezu: 'Industrial Ecology and Material Flow analysis. Basic concepts, policy relevance and some case studies', in Dominique Bourg and Suren Erkman (eds), *Perspectives on Industrial Ecology*, Sheffield, UK, Greenleaf Publishing, 2003, pp. 20–34.

[8] An overview of the Rhine Basin study is presented in William Stigliani and Stefan Anderberg: *Industrial metabolism at the regional level: The Rhine Basin*, in R. U. Ayres and U. E. Simonis (eds), *Industrial metabolism: Restructuring for sustainable development*, Tokyo, United Nations University Press, 1994, pp. 119–162. The study in Central Europe is described in a book: Stefan Anderberg, Sylvia Prieler, Krzysztof Olendrzynski, and Sander de Bruyn: *Old Sins. Industrial Metabolism, Heavy Metal Pollution, and Environmental Transition in Central Europe*, Tokyo, UNU and IIASA, United Nations University Press, 2000.

[9] The regional approach is summarized in Paul H. Brunner, Hans Daxbeck, and Peter Baccini: 'Industrial Metabolism at the regional and local level: A case study on a Swiss region', in Robert U. Ayres and Udo E. Simonis (eds), *Industrial Metabolism. Restructuring for Sustainable Development*, Tokyo, New York, United Nations University Press, 1994, pp. 163–193.

[10] The first PhD research on the relevance of material flow analysis (MFA) in the context of developing countries, by Claudia Binder, happened to be done in parallel to the field studies presented in this book, but on another continent (South America)! See Claudia Binder: *The Early Recognition of Environmental Impacts of Human Activities in Developing Countries*, Ph.D. Thesis, Diss. ETH Nr. 11748, Federal Institute of Technology Zurich (ETHZ), Switzerland, 1996. (http://www.uns.umnw.ethz.ch/pers/binder)