The IPAT Formula

A simple, yet powerful, formula postulated and applied by environmentalist (and former presidential candidate) Barry Commoner during the early 1970s has widely become known as the IPAT Formula (although this practitioner prefers to call it the "IMPACT" formula as a descriptive term). The formula was originally intended to examine the root causes of the massive environmental pollution problem which was plaguing the United States at that time and now could be similarly used to examine root causes of the epidemic environmental pollution problems in the developing world such as China. In addition, with respect to other aspects of sustainability, the formula can also be used to analyze the factors causing increasing demand for natural resources. As originally developed, the IPAT Formula states:

Pollution Impact	=	Population	x	Economic Goods/Population	x	Pollution/Economic Good
		(population) factor		(affluence factor)		(technology factor)

Commoner stated that the second term, per capita consumption of economic goods, was due to the affluence in a society and that the third term, pollution production per unit output of an economic good, was dependent upon the state of technology. He then went on to analyze various economic sectors and products in the post-war economy to determine the relative importance of these factors.

I have provided elsewhere on this website a chapter which includes detailed analysis of this approach and illustrates a couple of Commoner's examples, so I won't go into detail here except to make two points. [1]

First, Commoner's interpretation of the second and third terms on the right-hand side of the formula was probably fairly accurate at the time, but now other factors such as education and lifestyle awareness also affect the per capita economic consumption; and economic costs, recycling and regulation also affect the pollution produced per unit output.

Second, and very important with respect to sustainability, as noted above the IPAT Formula can be used in sustainability analysis to examine development "what if" scenarios for their potential impact upon natural resource demand inputs for the whole economy or specific economic sectors. (Note: The third term is the same as the "resource intensity factor" discussed under "Sustainability Concepts".) For example, one might speculate how the global demand for natural resources will increase in the future based upon changes in population and consumption patterns in different parts of the world over the next few decades. Or, we could examine shifts in demand for steel in China's automobile sector compared to the U.S. auto sector over the next several decades.

Through this kind of analysis, it is relatively easy to demonstrate that the future demands for natural resources will increase many times over the present demands and, therefore, that it is vital to effect sustainable policies. Surprisingly, the IPAT Formula has not yet been widely adopted for these kinds of applications, but some examples related to natural resources are also presented in the reference below.

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[1] F. Douglas Muschett, "An Integrated Approach to Sustainable Development," Chapter 1 in *Principles of Sustainable Development*, F. Douglas Muschett, Editor, St. Lucie Press, Delray Beach, Fl., 1997