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I = PBAT

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The familiar equation $I = PAT$ describes environmental impact (I) as a function of population size (P), affluence (A), and technology (T) (Daily and Ehrlich, 1992). Often referred to as the 'IPAT equation', its utility is clear from how frequently it appears in environmental studies texts and on-line syllabi. The equation is not intended as a formal mathematical model, but rather as a conceptual framework. It is this provision of a framework that accounts for its usefulness.

$I = PAT$ is an extension of Ehrlich and Holdren's (1971) $I = PF$, where F is defined as a function that describes per capita impact. Ehrlich and Holdren originally used $I = PF$ to highlight the role of per capita impact in determining a nation's environmental impact. Accordingly, $I = PAT$ is often described as the product of population size multiplied by per capita impact. Hardin (1993) elevates the IPAT equation to his Third Law of Human Ecology.

The IPAT equation is particularly useful as a starting point for disentangling the determinants of per capita impact, either of a group of people,

such as a nation, or of an individual, such as one's self. However, my colleagues and I have found that, after listening to an introduction to the equation, students are routinely puzzled. They know behavioral choices affect environmental impacts, but the role of behavioral choices is not intuitively clear from the IPAT equation. Strictly speaking, $I = PAT$ suggests that, aside from important choices about future birth rates, the only ways a rational individual can reduce her environmental impacts are by reducing her wealth or using more efficient technologies. But of course, per capita impacts also depend upon behavior (B).

Therefore, I propose modifying $I = PAT$ to write $I = PBAT$. This form more clearly captures the determinants of environmental impact, and has the added benefit of calling attention to the many behavioral choices that are immediately available to all individuals.

Ehrlich and his co-authors certainly recognize the obvious importance of behavior. For example, Daily and Ehrlich (1992) capture the role of behavior by defining A as '...affluence or per capita consumption', but this definition is counterintuitive and renders T superfluous. Because the equation's intuitive simplicity is largely responsible for

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its usefulness, it seems preferable to simply add B and use simple, intuitive definitions for the various terms.

Affluence, technology, and behavioral choices are interrelated, but affluence and technology do not dictate behavioral decisions. For example, an individual may be wealthy and use only the most efficient devices, but her environmental impact will still depend upon whether she is a profligate consumer or lives like Thoreau at Walden Pond. Moreover, behavioral decisions will also determine whether she invests in coal mines or contributes to ecological restoration efforts. In other words, affluence constrains potential environmental impacts and technology affects the efficiency of

resource consumption and waste production, but behavioral decisions largely determine the actual form and extent of one's impacts. Thus, while it might not roll off the tongue quite as well, $I = \text{PBAT}$ may provide an even more accessible conceptual framework than $I = \text{PAT}$.

References

- Daily, G.C., Ehrlich, P., 1992. Population, sustainability, and earth's carrying capacity. *Bioscience* 42, 761–771.
- Ehrlich, P.R., Holdren, J.P., 1971. The impact of population growth. *Science* 171, 1212–1217.
- Hardin, G., 1993. *Living within Limits*. Oxford University Press, New York, p. 339.