Letter to the Editor

Gerson, S. 2004. Letter to the editor regarding S. Levine's (Spring 2003) "Comparing Products and Production in Ecological and Industrial Systems," *Journal of Industrial Ecology* 7(2): 33–42.

It is certainly essential to acknowledge inherent differences between ecological and industrial systems in order in order to develop successful IE applications, and the distinction you make between the products of both systems is an important one. However, I feel that in your comparison, ecological systems are considered in discrete industrial terms, representative of the current industrial paradigm, instead considered systemically and ecologically. I find this somewhat detrimental to the comparison as a whole, and to our ability to understand and mimic ecological systems.

You claim that "as material flow systems, ecological systems are supply, or input driven. In contrast, industrial systems are largely demand, or output, driven, where that output is products" (p. 36). However, I would posit that viewing ecological systems as either supply or demand driven is somewhat of a misinterpretation. Although I understand and agree with your reference to trophic levels, and, referring to your example, that the number of antelopes determine the number of lions (or, at least, more so than the other way around), applying the supply-demand model to ecological systems perhaps misses the essential dynamic equilibrium between the two. Supply-and-demand implies cause-and-effect, whereas ecological systems are inherently autopoietic, involving feedback loops and self-regulation. In other words, it is not that ecological systems are purely supply-driven, but that supply and demand in ecological systems are bound in perpetual circular causality – both create and are created by each other. The demand itself is somewhat determined by the supply in that organisms are nourished by what is available in their local ecosystem (or they would have never co-evolved in that particular ecosystem), and if they are not nourished by supply, due to some fluctuation, they move elsewhere, ore are replaced by others which can be nourished by what is available. Thus, when the ecosystem is considered as a whole, supply and demand remain in dynamic equilibrium.

More importantly, the supply is often an indicator of adequate demand. The supply of food in an ecosystem indicates to the resident organisms both how much (quantity) and what kind of (quality) food they ought to eat in order to sustain themselves and the ecosystem. Supply fluctuates through time, continuously offering foods which will allow resident organisms to remain adapted throughout the seasons, for example. In ecological systems, accordingly, supply and demand are not so distinct, but are necessarily intertwined. In industrial systems, on the other hand, supply and demand are somewhat divorced, demand driven by habit or propaganda and not by production capacity. And although the supply of a good certainly influences its consumer demand, supply's influence upon demand is perverse in this case – it is not directly related to production capacity, as it is in ecological systems, but actually increases with scarcity.

This mutual influence of supply and demand, versus a divorce, is certainly something to be mimicked in industrial systems. Instead of being determined by extraneous variables, referring to your other example, perhaps demand for cattle should be match how many cattle can be sustainably raised in the given amount of space with the given amount of resources. And this is not to say that consumers ought to be deprived of the beef they demand because of supply quotas – I genuinely believe that if people were consuming exactly what they needed to consume (we are the only organism which overeats and must be taught how to "eat right," versus all other organisms who achieve perfectly balanced diets intuitively), we would demand exactly what could be produced in our local bio-region. What our local food systems can produce sustainably matches with our needs for living in the local geography (or will indicate the local geography's non-viability for human habitation). I understand that this is a precarious argument, but perhaps if we could once again intuit our biological needs and if we achieved sustainability in industrial systems, consumer demand might match supply as it does in ecological systems. Ultimately, before applying the supply-demand model to ecological systems, I would examine whether this model truly reflects the nature of these systems, and glean valuable lessons from any discrepancies.

I find similarly problematic your discussion of interaction types in industrial versus ecological systems. You employ a (symbol/symbol) model, in which each symbol represents one party, and therefore considers only two parties at a time. However, ecological systems are more complex than what is implied by this model. Although we may discuss interactions between two parties in discrete terms, to aid our own understanding, these interactions are embedded within a larger web of interactions, involving all organisms within an ecosystem. If only 2 organisms are considered, an interaction may seem to be (+/-). However, when considered within the context of the entire ecosystem, this interaction may be understood as simply (+) – for the collective health of all species involved (both within the ecosystem itself, and perhaps, within the larger systems in which the ecosystem is nested). Thinking of ecological systems in terms of (symbol/symbol) interactions between 2 individual parties is perhaps too democratic, considering that ecological systems are "webs of life," networks of co-dependant organisms (and in my opinion, the qualitative stability you referred to implies true democracy).

Industrial systems similarly represent networks of co-dependant organisms. Instead of designing industrial systems according to a tit-for-tat model, such that all interactions between 2 parties are fair and just, it might be fruitful to consider the larger system as a coherent entity, understanding that (+/-) relationships may be observable when viewed discretely, yet play a part in the sustainability of the whole. And in allowing (+/-) relationships to exist in industrial systems, I am not implying predatory-prey relations. Instead, I am recognizing that not all industrial systems need to have a fair and equal share of resources, but that resources may be in dynamic flux depending on differences in need, parallel to polycultures and succession planting (same plant at different stages of development, and therefore with different needs). Once again, I am merely questioning the applicability of the (symbol/symbol) model to ecological systems, and wondering if a more meaningful model would better describe ecological systems, and allow us to better design industrial systems in their image.

Finally, I find your definition of products, as "goods and services exchanged for something of value," to be interpreted too narrowly in the context of ecological systems. According to

this definition, everything within an ecosystem appears to be a product – every breath, every feces, etc. – as all contribute to the health of the ecosystem overall. As mentioned above, instead of simple exchanges between two products, ecosystems involve complex webs of exchanges, parallel to immature versus mature economies. Therefore, discrete products may be difficult to identify, in a sense, because they are not exchanged in 1-to-1 interactions, but flow through integrated networks. And it would certainly be beneficial to understand industrial systems in this manner, cultivating rich web-like product exchanges instead of simple and more linear product exchanges.

In sum, I recognize the need to distinguish between ecological and industrial systems in order to successfully pursue industrial ecology. However, if we are to design ecologically, we must think ecologically as well – and instead of subordinating ecological systems to industrial paradigms, understand ecological systems holistically, and apply their systemic paradigm to industrial systems. Thinking of ecological systems in an ecological manner, I believe, will allow us to more successfully employ them as models for the design of industrial systems, and to better develop the necessary consciousness in order to do so.

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