Developing Sustainable Strategies through Entropy-Based Resource Management

By John Milne, Design Engineer with Clark County Public Works

During the development of their mid 1990's watershed plans, Clark County was challenged by the environmental community to move beyond the construction of highly-engineered detention ponds in favor of developing "holistic, watershed-based solutions that mimic natural systems". This article outlines how the county met this challenge, and invigorated its Stormwater Capital Improvement Program, through the use of "Entropy-based Resource Management", an Organizing Principle for the development of sustainability strategies. The article briefly introduces this concept, and asks the reader to consider for a moment how this organizing principle might be applicable in your own particular field of study to help advance the cause of sustainability.

"Mr. Malthus – meet Mr. Smuts"

An essay concerning sustainability and the restoration of natural systems.

The popular modern concept of sustainability appears closely linked with Thomas Malthus's old observation that population is limited by its means of subsistence. To sustain ourselves as best we can, to maximize the population that any particular portion of the earth can hold, it is necessary that we manage our natural resources as efficiently as possible. The question to ask is "how best can this be accomplished?"

An answer may be found in the concept of "holism" put forward by Jan Smuts. Smuts recognized that natural systems appear to operate under conditions where "the whole is greater than the sum of its parts". This implies the possibility of achieving a degree of management efficiency that cannot be realized if we focus our attention on any one single resource, as our individual agencies and organizations so often tend to do. Perhaps not even by a collection of resource managers working diligently and efficiently on their particular resource of interest and then pooling those outcomes.

Working holistically on all resources at the same

On the left, Thomas Malthus (1766-1834). On the right, Jan Smuts (1870-1950)

time is needed. In matters related to the environment you have to consider the whole environment. John Muir seemed to acknowledge this in noting that "when you try to pick out anything by itself you find it hitched to everything else in the universe".

The concept of "entropy-based resource management" is offered here as a physical depiction of how we can manage our natural resources holistically and sustainably. The underlying premise is that natural processes always act to minimize energy loss at all times and so leave all resources in a state of minimum entropy after each and every process has been completed. By doing that, the resource is always maintained in its highest, most ordered state, at the highest energy level possible. Entropy-based resource management emulates that "natural resource management" by trying to find simple, effective ways to maintain or create order, that is to "create negative entropy", in all our resource management activities.

It is essential that *all r*esource management strategizing be holistic; you must consider all things, in all places, at all times. And, beyond that, you must try to develop strategies that realize that extra benefit that Jan Smuts identified when he noted that "the whole is greater than the sum of its parts".

Since natural systems already operate that way, the logical first step in any entropy based resource management strategy is to *use* those natural processes as much as possible. That is, to simply let natural processes continue to function un-interrupted to the maximum extent possible. Preservation of natural areas is an obvious policy to promote. But, using natural systems as much as possible, for as long as possible, is the key concept for us to focus on.

Natural systems effortlessly accommodate movement across physical, chemical and biological boundaries. To try to find means of moving across those same boundaries with that same facility is an important next step for us to take. Though we cannot hope to develop resource management strategies that approach the near-perfect efficiency of natural systems, a sound management option might be to try to "mimic" those natural systems in some way. Basically, this is what entropy-based resource management strategies, beyond simple conservation and the use of natural pathways, attempt to do.

Minimizing the entropy of a complex, interactive system is a daunting computational exercise. However, where absolute understanding and perfect quantification is not achievable, we should not be deterred. It has been said that "intuitive perception rather than mathematical calculation is the source of the truth of effective theories". This recognition leads us to apply entropy-based resource management in the form of a simple "organizing principle" that allows us to use logic and simple methods of analysis, rather than highly-detailed, single-issue calculations, when we are developing sustainability strategies. For example, a simple watershed management *game plan* such as "pump up the groundwater as high as possible, then plant everything" can be highly effective, by assuring, as it does when followed diligently, that the annual rainfall falling on a watershed is retained in the watershed for as long as possible and photosynthesis within that same watershed is

maximized. Entropy-based resource management is simple, but not simplistic.

Good progress can be made by developing entropy-based strategies for whatever area of resource management that you are working on at any one time, then seeking out like-minded practitioners in other fields that are doing the same. However, truly holistic strategies that achieve that "whole is greater than the sum of its parts" level of efficiency and success can only be fully realized by a group of dedicated professionals (biologists, engineers, planners, architects and others) working together as a team to address all aspects of resource management at the same time. The resultant strategies can then provide a truly holistic response to a sustainability question or need.

Sustainability, and further, the restoration of natural systems and functions, *can* be achieved. Use Jan Smuts' approach to meet the resource management needs identified by Thomas Malthus. The entropy-based resource management organizing principle can help you organize your thoughts and develop strategies. Consider all things in all places at all times. Work closely with others. Use all the tools at your disposal (science, mathematics, engineering, even philosophy and literature) to the best possible effect. The quest for sustainability will become clearer and within your reach.

"The ultimate purpose of life, mind, and human striving: to deploy energy and information to fight back the tide of entropy and carve out refuges of beneficial order" – Steven Pinker

An introduction to entropy-based resource management can be found at:

https://www.ipwea.org/newzealand/viewdocument/life-liberty-and-the-pursuit-of-ne

Tags: entropy-based resource management, holism, management efficiency, resource management, restoration, sustainability, sustainable strategies

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