Interactions of Self-organizing Systems in Nature

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Abstract: Nature essentially consists of complex systems. The paper presents a conceptual framework to understand how complex systems interact with each other in nature. All natural systems are thermodynamically open and physically adaptive. The process of adaptation and continual self-organization cause these systems to interact continuously with the environment and compete against such similar systems for limited resources.

Keywords: complex systems, complexity, information, self-organization, network, hierarchy, natural process, human mind, cognitive process.

Introduction: A system is a collection of internally interacting elements and constraints. The systems that are found in nature are thermodynamically open and therefore, continuously exchange energy and entropy with the surrounding media. The systems found in nature are structurally complex. A system can also be defined as a connected network. Complexity increases not with the amount of connections between the nodes that are present in a system but due to the numerous combinations of possible connections. All natural systems have a tendency to organize with time. Processes that result towards greater organization are called natural processes[1]. Evolution is a cyclic process[1, 2]; therefore, the changes incurred by the system affect the system itself. Thus, the system evolves through a positive feedback loop. On reaching a certain level of organization (*node*), the system stores the information in its physical memory.

The theory and practice of sustainable environment - by which each level of

hierarchy (*physical*, *chemical*, *biological*, *social and cultural*) is supported by the previous one - has in theories of evolution of complex systems, a useful tool for designing, planning, monitoring and evaluating different strategies and interventions. At its own scale each species is unique; while at their scales, their parts differentiate increasingly as they recover from perturbations during development, becoming ever more intensively unique[3].

Interaction can be thought of as process of information exchange between the systems and nature.

Interaction as a process of information exchange

Complex systems interact with each other through exchange of energy and entropy. Entropy is a measure of the lack of information about a process[4]. Thus, entropy is a quantitative notion and it can be used to quantify the amount of information present within a system. The Shannon entropy is given by,

$$S = -\sum_i p_i ln p_i$$

It can also be used as a tool for measuring the information exchange between systems. Interactions between systems occur at all levels of hierarchy and even surpass metaphysical and philosophical levels. Metaphysical level of interaction is a form of social interaction between all self-organizing complex systems existing in society[5]. It is this form of interaction at meta-physical level that helps us to understand nature. Human thought process is affected by nature and various natural processes as the human mind is itself a complex self-organizing system.

Conclusion: The paper presents an idea to understand the interaction of complex systems at the social and philosophical levels. The idea presented in this paper can be applied to understand the human-self and the various conscious processes in more detail.

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