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Interpretation of Balanced Act in Ecological Concept

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The destination of discussion was to consider the direction of application of the green technologies from ecological concept. Ecosystem maturity is the most important logical base to define ecosystem complexity. Boolean Algebra is used to formulate the general properties of ecological system. Plausibility of ecological sub-unit was assumed from potential capacity of strategic acts. The attenuation of the plausibility and divisibility condition of ecosystem, and then stratification of ecosystem of united niche structure were formulated. Then it was discussed that ecosystem complexity is function to such energy, and which functions as running force of material inflow. The ecosystem maturity increases the structural complexity improving system performance. However as unavoidable phenomena, the process result fragility of the system to the asymptotic perturbation. It was naturally resulted that if green technologies contribute the system complexity, negative human impact on environment will be improved, however inevitable fragility rise up. On the other hand, from the macroscopic point of view, young ecosystem such as suburban and rural ecosystem is more robust to the asymptotic perturbation. It was pointed out that the balance between young and matured ecosystem is important to manage Ecological robustness. Implementation strategy of green technologies should consider such a point.

Keywords: *Ecological Robustness, Green technology, macroscopic view, urban rural ecosystem complex*

Introduction

To propel implementation of the green technologies is enhancement of evolutional practices of evolving world. The background to enhance such acts is rising up the reality in the limitation of our global habitat (Meadows *et al*. 1972). It has been expressed wherever on the earth, any parson is already implicated chronic problem originated from historical human activities, then anyhow scientific information has rapidly accumulated as world wide issues since it was noticed (ICPP 2007). In this paper, a series of ecological logic is tried to conceptualize as a reference to consider the application of the green technologies. Accordingly, a series of simple mathematical models will be used to make clear image of the evolutional ecological system in this paper. Then, ecological meaning of application of the green technologies will be discussed.

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Methods & assumptions

We simply assume that each part of ecological system is differently organized, but is all composed of the same sort of more elementary entities (EE), which is the approach that has been followed in the study of molecules, atoms, and subatomic particles (Margaleff 1963). This EE are agent for evolutional try-and-error ecological process, which similar with consistent robot (Jaynes 2003). The "maturity" (Malgaleff 1963), which is defined as complexity of structural information, is the most important logical base of discussion in this paper. The terminologies mature and young are used to interpret ecological state. The complexity is a degree of organization of a system, which composed of the same sort of more EE, and is quantative property for ecological maturity. The complexity is conceptualized density of strategy in a ecosystem. Then, bounding hypothesis (Margaleff 1963) is considered, such as "When two systems of different maturity meet along a boundary that allows an exchange, energy (production) flows towards the more mature subsystem, and the boundary or surface of equal maturity shows a trend to move in an opposite direction to such energy flow" in conceptualizations of ecological systems.

To analyze ecological open system (Kikuchi 2010), notation of the usual symbolic logic (Boolean Algebra)

is used following Jaynes (2003), and his desiderata were respected. Fore example, when sub-ecosystem type A will, in general, depend on whether related factor B is true, we indicate this by the symbol $A|B$, which we may call "the conditional plausibility that A is true, given that B is true". It stands for some real number. Thus, fore example, $A|BC$ represents the plausibility that A is true, given that both B and C are true. Or $(A+B)|BC$ represent the plausibility that at least one of the propositions A and B is true, given that both B and C are true, and so on.

Conceptualizations

Potential capacity of strategic acts

When a cluster of EE plays strategy C_1, we call it ecological sub-unit C_1. Then if the ecological sub-unit C_1 has got updated to C_2, in the case, the plausibility for A is increased: $A|C_2 > A|C_1$. Then, a segregation of the ecosystem between C_1 and C_2 shows better plausibility, where these ecological sub-units coexist as components of the ecosystem $C_{(21)}$, respectively. Hence, it defined apparent equivalent between coexisting ecosystem types C_1 and C_2 for better A. Here, in reality, C_1 is giving a surplus energy and resource materials to C_2. Along this process, writing the number of EE of C_k as $[C_k]$, the $[C_1]$ is interacting to $[C_2]$, *i.e.* $[C_1]$ is continuously exploited, there fore, replaced by $[C_2]$. Here, if we assume potential number of positions of EE, which is sum of $[C_1]$ and $[C_2]$ before C_2 invade to C_1, and then it is multiple of $[C_1]$ and $[C_2]$ after C_2 invade, as follow.

$$f([C_1]) + f([C_2]) = f([C_1][C_2]) \qquad (1)$$

The surplus of C_1, which is C_2, is forgiven part of C_1 *i.e.* surplus energy of C_1 feed the C_2, and the potential sort of EE in $C_{(21)}$ is increased as synergy effect between coexisting C_1 and C_2. The increase of potential number of position is coursed of the established reflective structure of redundancy between C_1 and C_2. The conserved property is potential number of positioning (sort of position) among EE, and it is obvious the function $f(\ )$ is $log(\ )$. According to this conceptualization, plausibility A is potential number of positioning of EE or potential capacity of strategic acts (C_k) of an ecosystem.

Then, according to the attenuation of marginal A of $[C_k]$, when we assume tangential line $g([C_1])$ in that condition, $f([C_1+C_2])$ must smaller than extend line of $g([C_1])$, because $f'([C_k])>0$ and $f''([C_k])>0$ for all $[C_k]>0$. Then we get next formula,

$$f([C_1]) + f([C_2]) > f([C_1+C_2]) \qquad (2)$$

for all $[C_1]>0$, $[C_2]>0$. This is positive effect of divisibility of the potential number of positioning. It is natural consequence of ecological system. Hence, the combination condition of ecosystem types between $[C_1]$, and $[C_2]$, such as $[C_{(21)}] = f([C_2]|[C_1])$ is as follows (*c.f.* ESS: Thomas 1985),

$$f([C_2]; [C_2]) > f([C_2]; [C_1])$$
$$\text{and } f([C_2]; [C_1]) > f([C_1]; [C_1]) \qquad (3)$$

where, the first condition specifies that the strategy is a Nash equilibrium, and the second specifies that Maynard Smith's second condition. Here, stratification of the ecosystem by another ecosystem type *3*, such as $f([C_3]|[C_2])$ is also simply can be assumes as $f(([C_3]|([C_2])|[C_1])$ in the same way. In these cases, the surface of equal maturity between neighboring ecological sub-unit moves towards the less mature subsystem, then the potential complexity would be balanced each other performing same plausibility A.

Ecological system

Living system, from cell organelles to organisms or to ecosystems, are open dissipative systems in the sense of Prigogine (1961). In fact, each EE and its clusters $[C_k]$ are considered as the cannel to suck energy. On such an assumption, we write flux of energy as M, and $[C_{k=j}]$ are ecosystem sub-unit (k=1, 2, $\in$, j, $\in$), and $[C_i]$is one of these (j is not i), $F([C_k]|M)$ is supplement of energy to $[C_j]$, and $F(M|[C_j])$ is capture of energy by $[C_j]$. In this presumption, using Boolean algebra, the ecological channel of C_i of a ecosystem is simply written as follow,

$$F([C_i]|M)$$
$$= \{F([C_i])\, F(M|[\,C_i])\}|\Sigma_k\{F([C_j])\, F(M|[\,C_j])\} \qquad (4)$$

where, the property of allocation of energy among ecological sub-units $[C_k]$ are written as function of $\Sigma_k F([C_j]|M)$, which is core of complexity of ecological system of C_k. These are consequence of formula (1) as well as (2) and (3). In the dynamics, shown as formula (4), each C_k is countering to the others, respectively, and simultaneously, each C_k is trying to obtain the

highest yield of *A* against the other strategies. Under such a non-cooperative situation (Nash 1950, 1953), ecological boundaries are balanced, *i.e.* the ecosystem chose its optimized feature by itself. This is a definition of united ecological niches and basic process of ecosystem architecture. This is newly shape up concept of niche borrowing concepts from Nash (1950, 1953), Margaleff (1968) and Jaynes (2003), and it seems to be greatly at variance with usual notion, however it may not be refused to admit the idea.

Discussions

Ecological maturity as suction pomp and magnet

The asymmetric contact between ecological sub-units originates the sucking up surplus energy of mating unit. The relationship via such energy flow is entirely be defined as energy gate, and it perform entanglement between theses mating ecological sub-units. Then, the entangled relationship performs multiple functions as shown in formula (1). It is origin of synergy effect or non-linearity of ecological complexity. The mating asymmetric relationship among ecological subunits is origin of its complexity. Then it maintains more stable and high performance state together. Here, as shown in formula (2) and (3), the diversification is naturally advanced as self-progressive process. The internal diversity of ecological system is result of this system property. Accordingly, the energy has provided from out side toward the complex system, if we use terminology, mature and young, matured ecosystem function as a suction pump of energy from young ecosystem. This is what Prigogine (1961) called, that is, the living system, from cell organelles to organisms or to ecosystems are open dissipative systems. This is qualitative character of ecological system, which has mostly suggested by Margaleff (1968). Moreover, the transferred material is used to construct and increase its efficiency to make mature the ecosystem. In fact, complex system is not only suction pump of energy, but also it is magnet to gather every required resouces towered itself. Then as a real state of affairs, ecological complex system, such as shown in formula (4), has developed via self-organized processes.

Fragility of ecosystem

The character of higher complexity has been paid attention among ecologist. Because the biodiversity is believed to improve the ecological stability then a lot of ecological sub-units can enjoy higher efficiency, coexisting each other. However May (1972) point out a paradox of the assumption, i.e. diversified system also damaged because of the complexity.

In general, the ecosystem complexity increase along time, so called succession, and there is a trend toward increasing in primary productivity, biomass, stratification, complexity, and internal structural diversity (Margaleff 1963, 1968). However, systems that have evolved to in higher level of complexity are optimized for specific internal and external perturbations, at the same time, are also inevitably extremely fragile against unexpected perturbations (Carison and Doyle 1999, 2002, Kitano 2007). Hence, it simply can say that it needs to add a boundary condition to formula (3), concerning the fragility coincide with system maturity, that is as follow,

$$f[C_2; C_2] < f[C_1; C_1] \qquad (5)$$

which is for asymptotic perturbations. This condition means low adaptive system is robust to the asymptotic internal and external perturbations. Thus, $[C_{(321)}]$ is more robust than $[C_{(21)}]$ to asymptotic perturbation, and $[C_{(1)}]$ is the most robust in more serious situation. Accordingly, it may be concluded that young ecosystem sub-unit has ability to survive.

Ecological interpretation of application the green technologies

The destination of discussion in this paper is to consider the direction of ecological interpretation of application of the green technologies. The diversification of skills and jobs (diversity), or the relative flow of potential energy can be taken as proper criteria in our commonsense, and it is possible to map the maturity of states and continents in the ecological sense of organization (Margaleff 1968). According to such presumption, even the reality of EE is still unsure, we continue qualitative discussions of ecology for human impacted ecosystem, because of consistent with the commonsense. In this paper, to have macroscopic discussion, urban-rural complex is chosen as example as one of human impacted complex systems.

The function of urban area is always stable or being tried to keep the state, the performance of united elements has higher complexity than rural area, and the created performance request sufficient energy and material as the ecological suction pump.

Simultaneously, transferred energy and materials are used to full fill the demand. In addition, the efficiency of well complex ecosystem needs to be protected, so that energy and resources are also used for disaster prevention. In this process, if stability of urban system is enlarged, then the internal energy exchange would be enhanced with increasing complexity, there fore, more energy and resources will be consumed because of ecological character of the magnet. If green technologies will always be installed to enhance such urban-progressive process, the magnitude of complexity, performance, and energy and resource requirement increase, respectively. Then, as a consequence, many environmental negative impacts will be improved. However, concerning the ecological fragility, such eco-hightech system will have inevitable high fragility to asymptotic perturbation. In this point of fact, it may be difficult to separate the positive and negative contribution of green technology on urban function from microscopic point of view. As an example, the application of nuclear energy and its linkage between green technologies must be discussed with this context. As it has been mentioned above, anything that accelerates energy exchange and flow in an ecosystem causes a reduction in potential maturity, *i.e.* running force of ecological complexity, so that to reduce energy consumption par a EE (parson) is ecologically required condition for green technologies applications. In a viewpoint for landscape level discussions, the urban area (C_u) is complex system united with suburban (C_s) and rural (C_r) area. According to the complexity $C_{(usr)}$ should, there for, be the highest. However, the robustness is $C_{(usr)}<C_{(sr)}<C_{(r)}$, accordingly, as a consequence from the macroscopic point of view, to conserve countryside (r) is important to increase robustness of the urban-rural complex system. In general, good natural environment, and traditional ecosystem element are remained in rural and remote area with a small flow of energy, or consequence of heard environmental condition. It is considered that to conserve nature, traditional society, cultural landscapes are also essential in the context of green technologies and robustness of urban life style. The needs of equity, such as balanced acts, between urban and rural ecosystem may have important meaning in nature conservation and eco-tourism, and other environmentally sound acts for rural area. Because it makes sense in new discussion, how robustness of urban-rural complex can be increased.

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