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Estimatin of Social Entropy: The Dictum of NEO Modernism in Agricultural Knowledge Environment in India

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The history of Extension Education in India is inevitably flamboyant with a pro-adoption approach in transfer of technology mode. The much acclaimed Green Revolution in India had been instrumental so far and so on, as some might demand, with transfer of exotic technology, external supply of input and a supply driven knowledge concept. A plethora of extension programs may be bracketed with this so called '**Transfer of Technology**' mode.

When knowledge is imposed, motivation is imported and action is imitative, the social outcome is supposed to be an exposition of **disorderness/ chaos** despite of its quantum achievements. The present study is basically a concept paper on **Social Entropy**, an analogy of **Principle of Thermodynamics**, has been applied herewith.

In a closed system of energy flow, the gap between the work done and energy lost is widening to add to, what we think that, with the increase of **gap between motivation unleashed** and **accomplishment made**, the **Social Entropy** will be increasing.

The training and transfer of technology approach in science will be rendered classical and depletive since, it would be adding more exotic capacity without withdrawing systemic and **intrinsic disorders**. This would invite institutional conflict, organizational disorder and performance chaos.

1. Review and History

The etymology of the term ***social entropy*** is said to trace back to philosopher-historians Brooks Adams and Henry Adams who applied the concept of entropy to human affairs, viewing it as a tendency seen in the histories of whole nations or civilizations, a tendency characterized by a running-down of human energy, of a diminished capacity for meeting the problems set by that nation or civilization.

In the 1968, author Amitai Etzioni described "social entropy" as a state of society in which no social bonds are present.

In 1990, American sociologist Kenneth Bailey published ***Social Entropy Theory***, a non-equilibrium approach of societal analysis using a mix of Ludwig Bertalanffy's general systems theory, Claude Shannon's entropy, and Rudolf Clausius' entropy. Bailey defines an "**isomorphic complex system**" as being comprised of human individuals as the components, interaction of these components, and the national (political) border of the country, with the latter serving as a boundary for social interaction.

Bailey also included a section titled the "History of Social Entropy", in which he traces the use of thermodynamics and entropy in sociology from Pareto to Prigogine to Samuelson and others in the literature.

So, the paper is focusing on an alternative paradigm for managing human behavior and organizations, institutions and society through managing entropy by withdrawing disorderness from the system trembling with **chaos, conflict** and **non-performance**.

In the 2001 paper "Social Entropy", Peruvian engineering professor Alfredo Infante argued that social entropy is the quantity that measures the effects of the **second law of thermodynamics** in human social behavior and that the "state" of a human society as a "system" is described by the degree of dissatisfaction or satisfaction with the social, political, and economic rules. He states that in social systems, the **Gibbs free energy** is the total energy in the system less the energy that is unavailable and that this difference represents the 'state' of the social system.

2. Thermodynamic Entropy

The term "**entropy**" was coined by Clausius in nineteenth-century thermodynamics, and is the subject of the Second Law of Thermodynamics, which states that in an isolated thermodynamic system, entropy will either remain constant or increase toward its maximum, but cannot decrease. This means that in an isolated system, the system will gradually become more and more disordered, until it reaches maximum entropy. This is a complete state of rest or dissolution, with an absence of available energy for doing work.

The phenomenon of entropy was originally observed in thermodynamic systems such as heat baths. An isolated system is one that is closed to inputs of both matter and energy.

This means that since no new heat energy can be added, the system can never become hotter, but can only remain the same temperature, or become colder. As it loses heat over time, its entropy increases, until finally it reaches its maximum.

This state of maximum entropy is called thermodynamic equilibrium. This is sometimes described as the state of "system death." Such thermodynamic systems, as found in nature, are "irreversible systems," where heat cannot flow from colder to hotter parts of the system, but only from hotter to colder areas. Thermodynamic entropy is denoted by the symbol *S*, and the formula for change in entropy is:

$$dS > dQ / T \qquad \text{……..(1)}$$

where S is entropy, Q is heat, and T is the temperature of the system. The difference in two entropy states, S1 and S2 is:

$$S2 - S1 > \int_{1}^{2} dQ / T \text{ (irreversible process)} \quad \text{……..(2)}$$

Entropy (*S*) can only remain constant or increase, until it reaches a maximum. When the system is in thermodynamic equilibrium, then:

$$dS = 0 \quad \text{……(3)}$$

In physics, work and entropy are inversely related. The principal way to decrease entropy is to do work through the expenditure of free energy. If free energy is available, and is expended to do work, then the system becomes more orderly and entropy decreases. But if all available energy has been expended, then no more work can be done, and entropy will either remain constant or increase.

2.1 Entropy in General Systems Theory

The General **Systems Theory** (GST) movement in the 1950s defined a system broadly as a set of interrelated parts, generally within a system boundary. One of the goals of GST was to eliminate redundancy in science, and to search for similarities in concepts and procedures across disciplines, ultimately perhaps leading to an integrated science of systems. The term “system” had been in use for many years, both in disciplines dealing with nonliving systems such as physics and chemistry, and in those dealing with living systems such as biology and sociology. However, before GST there had never been a coordinated attempt to broadly integrate and connect the study of all systems including both nonliving and living systems (see *General **Systems Theory***).

3. Concept

Let's get it straight: 1) The energy of the universe remains constant; 2) **entropy in any system increases over time**. That means any closed or open system over time will tend to slow down, run down, get cooler, fall apart, *unless energy outside the system is applied.*

In scientific terms, "**social entropy**" reigns. Unless outside fuel is applied to a particular system (organization like a law firm or even an entire economy), the system will begin naturally to fail. In one iteration of the theory, increased dissatisfaction means increased entropy (failure).

Social entropy is a macro sociological systems theory. Social Entropy is a measure of the natural decay within a social system. It can refer to the decomposition of social structure or of the disappearance of social distinctions. Much of the energy consumed by a social organization is spent to maintain its structure, counteracting social entropy, e.g., through legal institutions, education and even the promotion of television viewing.

3.1 Anarchy is the maximum state of social entropy

Modern complex societies remain organized by large inputs of energy to mitigate the natural progression of increasing entropy (disorder), according to the **Second Law of Thermodynamics**, a fundamental law of physics. This effectively states that Entropy (disorder) increases with time. As the system becomes more complex, through access to energy, it becomes more susceptible to changes that may occur if one were to remove this source of energy. Think of our everyday kitchen. On any given day, it remains messy, unless work is performed on the system (kitchen). The same goes for societies at large. Take away the energy inputs (largely from fossil fuels) and organization (for instance, blueprints, databases, etc...) corrodes, thus society becomes less cohesive and trends toward **anarchy**. This is at the center of the Peak Oil debate. Once reliable, cheap supplies of energy are limited, social systems will begin to become more disorganized and disorderly. However, one can expect that regenerative energies will eventually take the place of fossil fuel, allowing societies to keep up energy spending to control entropy.

3.2 Social Entropy is the Manifestation of Entropy

- The amount of energy (motivation) unavailable for doing a work (performance) in a given process, in a given social system.
- Distinguished by models of negative behavior, alienation, anomie and deviance.
- That functions to instill a disordering effect in given social structure or order.
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- That functions to instill a disordering effect in given social structure or order.

4. Domain of Entropy

- Human being: The high end recipient and generator of Social Warming in the form of conflict, non-compliance, anomie, deviance etc.
- Interaction of institutions: Alienation, conflict, withdrawal, disagreement, domination.
- The surrounding of the entropy: The domain of social entropy in context of small and micro society delineations.
- The internal energy state: The enthalpy in context of social warming is related as internal energy state.
- Energy transfer process: The social kinetics and movement of information in random motion (Brownian motion is related).
- Movement from present to changed equilibrium: Present equilibrium, dis-equilibrium and neo- equilibrium.

4.1 Social Entropy

Entropy has been widely applied in sociology, but this was primarily a late twentieth-century development. Nineteenth- and early twentieth- century **social-systems** models generally utilized the companion concept of **social** equilibrium, rather than the concept of **social** entropy. In thermodynamics, equilibrium occurs when is maximized, so that change in entropy (entropy production) is reduced to zero, as in Equation (3).

Entropy is generally maximized as a result of all of the system's energy being dissipated, so that the system is now in a state of rest or stability, with no energy remaining for doing work. It is possible to have a condition of equilibrium when entropy is below the maximum. In thermodynamics, the extensive variables of an isolated thermodynamic system are energy, entropy, and volume, and the intensive variables are temperature and pressure. Equilibrium can be defined for non-maximum conditions of entropy if the values of the other variables are changed so that the system properties are mathematically equivalent to the condition of maximum entropy. For example, for a given (non-maximum) entropy value and a given volume, equilibrium exists when energy is at a minimum was no rigorous mathematical measurement of social equilibrium.

The criticisms were telling, and **social equilibrium theory**, after being dominant in macro-sociological thought for almost a hundred years, finally succumbed to negative pressures in the 1980s. Today, one rarely sees lengthy discussions of social equilibrium (although some sporadic mentions of equilibrium do still occur).

The adherents of social equilibrium social did not succumb willingly. They answered their critics as best they could. In response to critics who said that the notion of equilibrium was too static, equilibrium theorists presented the concept of "moving equilibrium." In response to those who contended that equilibrium applied only to thermodynamic systems, equilibrium theorists presented the concept of homeostasis, saying that it was the appropriate equilibrium analog for biological and **social systems**.

Later they applied the notion of a steady state for cybernetic systems. These modifications and others extended the debate, but in the end equilibrium theorists failed to convince the critics, with the result that extended models of social equilibrium are rarely presented today.

Recently emphasis has shifted within social science from equilibrium to non-equilibrium models. There are a variety of non-equilibrium models, among them the model of **Social Entropy Theory (SET).**

Macro sociological variPopulation (P)

- Information (ISpatial area (S)

Technology (T)

- Organization (O)
- Level of living (L)

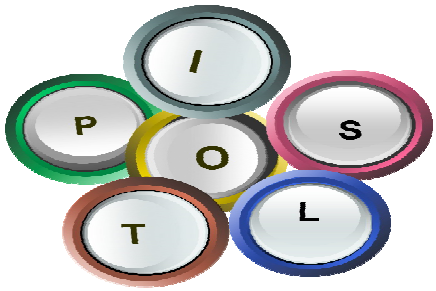

Fig. 1: PISTOL Model of Macro-sociological Variables.

5. The Social Chaos

- Entropy has been loosely associated with the amount of order, disorder and or chaos in a thermodynamic system.

Entropy is a measure of molecular disorder and the amount of wasted energy in a dynamical energy transformation from one state or form to another

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5.1 Thermodynamics and Social Entropy:

- In the 2001 paper "Social Entropy", Peruvian engineering professor Alfredo Infante argued that social entropy is the quantity that measures the effects of the second law of thermodynamics in human social behavior and that the "state" of a human society as a “system” is described by the degree of dissatisfaction or satisfaction with the social, political, and economic rules. He states that in social systems, the Gibbs free energy is the total energy in the system less the energy that is unavailable and that this difference represents the ‘state’ of the social system.

  dH = G + T.dS

  Or

  dS >= dH/T

  “=” stands for a reversible process and “ >” for irreversible process.

  dG = Gibbs free energy

  dS = Entropy

  dH= Enthalpy

  T = Absolute Temperature at which the process is occurring.

Measure of Entropy (Peter Landsberg, 1984)

It is a combination of thermodynamics and information theory arguments

Disorder=CD/C_I

Order =$1-CD/ C_I$

CD is the disorder capacity of the system. The entropy of the parts contained in the permitted ensemble.

CI is the information of the system.

Thermal Energy Entropy vs Social Entropy

Thermal Energy Entropy ΔS=Q̃/T	Social Entropy ΔS=M/A
ΔS: The change in entropy	ΔS: The change in social entropy
Q̃: The amount of heat absorbed by the system in an isothermal and reversible process in which the system goes from one state to another.	M: Motivation
T is the absolute temperature at which the process is occurring.	A: Total Accomplishment The amount of motivation absorbed by the system in an isomotivational and reversible process in which the social system goes from one state to another.
If the temperature of the system is not constant, then the relationship becomes a differential equation	A is the absolute accomplishment at which the process is occurring. If the motivation of the system is not constant, then the relationship becomes a differential equation
Ds=dq/T, Total change in entropy for a transformation is ΔS=dq/T	Ds=dM/A, Total change in entropy for a transformation is ΔS=dM/A

6. Modeling Social Entropy

Social Entropy can be clearly explained by some of the key models. These models are basically derived by correlating the key theories from the field of Social Science, Archaeological and Physical Science (i.e. Physics, Chemistry and Biological Sciences).

1. **Equilibrium Model:** This model describes how the Basic Factors of Social Entropy, responsible for increasing the same within a system, works.

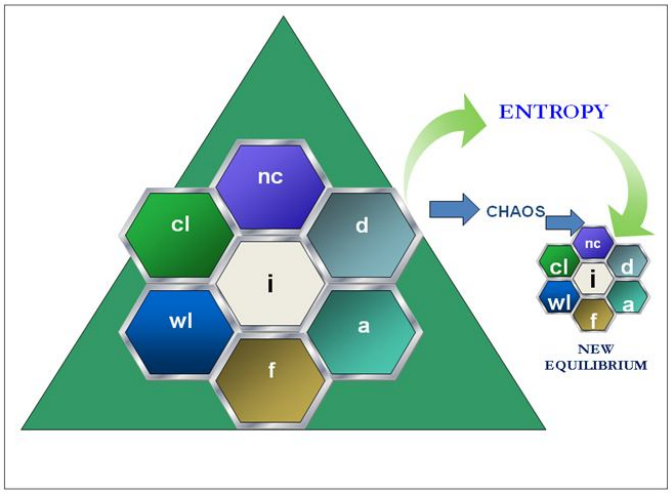

Fig. 2: Equilibrium Model.

Moreover, in any Social Structure, the complex changes brought down by the society brings about disorderness/chaos/dissatisfaction due to, may be, **negative behavior, anomie, alienation or deviance.** These all leads to a new equilibrium and the gap between the two equilibriums represents best the Social Entropy.

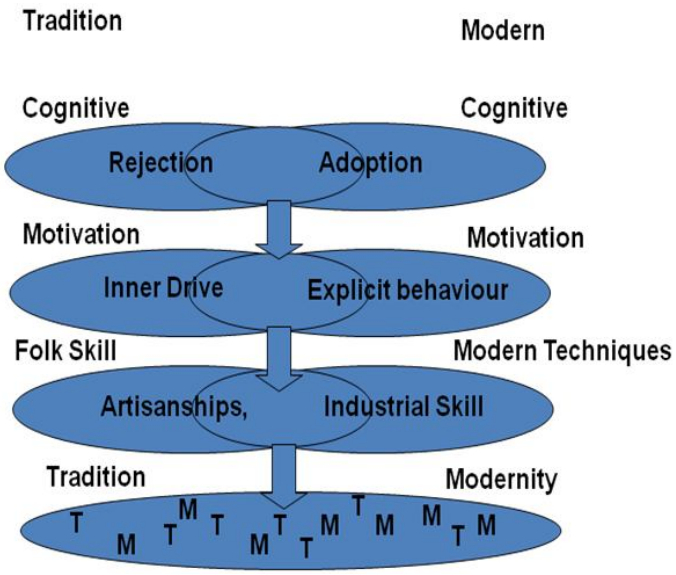

Fig. 8: Dialectical Process of Knowledge Synthesis.

7. Conclusion

- The whole approach of extension needs a comprehensive relook while working with the system, we have to respect both the concept of social physics (Auguste Conte) dialectial materialism, (Karl Marx). Technology is basically a character, the social desire and technical means, that goes inextricably.
- Every chaos and entropy has got a framework to act and make the system somehow operational.
- The concept of Social Entropy would help –
  a) Calculation of residual energy/motivation.
  b) Estimation of motivation flow mechanism to formulate better, scientific and effective training, motivation, leadership, project monitoring, teaching learning program, Organizational Behavior and Objective Evaluation Mechanism.
  c) Would help measure and adopt remedial measures to fight stress, morbidity, neuro-psychosis, psychosomatic disorder
  d) To combat and redress conflict, intra-group rivalry, leadership intimidation, shift stress etc.

In conclusion, contemporary **entropy theory** presents the concept of **entropy** not as merely a thermodynamic concept whose utility is primarily limited to the study of heat and temperature change, but rather as a generic concept that is inversely related to the amount of work done. Thus, it is potentially applicable to any system where energy exists in quantities sufficient to permit work.

8. Implications

- **Chaos/disorderness** is an integral part of system performance. In other way, making a system functioning means some amount of entropy shall be generating therewith.

But the question is 'what is the available space within the system confinement to accommodate that Residual Energy or EntropySo, a threshold level needs to be delineated and any entropy beyond that level has to be rendered manageable. The ventilation of entropy, getting emitted out of the system, is more important alongside the functioning of the system.

9. Glossary

Entropy: A measure of the degree of disorder or uncertainty in a system. Change in **entropy** is inversely related to change in free energy.

General Systems Theory: An interdisciplinary **systems** approach that seeks generalities across various disciplines.

GST: General **Systems Theory**.

Information-theory entropy: The statistical measure of **entropy** derived by Shannon in the field of information **theory**.

PILOTS or PISTOL: The six key macro-variables of SET, or Population, Information,
Level-of-Living, Organization, Technology, and Space.

SET: Social Entropy Theory.

Social entropy: Entropy in a social system, as exemplified by entropic behavior in any number of social variables such as wealth or residence location.

Social Entropy Theory: The comprehensive study of entropy in contemporary complex society.

Thermodynamic Entropy: The original entropy concept derived in thermodynamics by Clausppppppopppppppp