CHAPTER - 2

Theoretical Orientation

This Chapter mainly deals with the conceptual framework used in this study in order to provide a theoretical base for the empirical investigation and guidance for the selection of relevant predictor variables as well as to envisage a set of hypothesis for testing.

Authors are working on "industrial metabolism" (Ayres, 1989) or "social metabolism" (Fischer-Kowalski, 1998, Haberl, 2001) look at the economy in terms of flows of energy and materials.

Marx had shown much interest in the relations between the economy and the environment, particularly as regards capitalist agriculture. This was expressed in the use in his own drafts after 1857-58 and in **Capital**, of the notion of **"metabolism"** (Stoffwechsel) between the economy and Nature. The first volume of Capital was published in 1867. About One hundred years later, in the 1970s, the study of the human society and economy from

a physical point of view (flows of materials and energy) started to be practiced by coherent research groups.

Marx had used the word "metabolism" to describe the relations between nature and human society but Marxist authors still did not count energy and materials flows, and paid no attention to the unequal exosomatic use of energy and materials.

However, Marx and Engels did not consider the relations between their analytical concepts (productive forces, surplus value, exploitation) and the language of energy as they could have done in their mature work after the 1850s. For instance, they never said that the productivity of labour in agriculture and in industry would depend on the energy subsidy to the economic process.

Marx explained that the metabolic flow of materials between human society and Nature was mobilized by human labour except in primitive gathering societies. Tool development by humans was essential for the metabolism. The difference between bio-metabolism and techno-metabolism is crucial for the understanding of human ecology. Humans have genetic instructions on bio-metabolism but not on techno-metabolism, which is very different between rich and poor, and is explained by history, politics, economics, technology, culture.

Recently Social Metabolism has been defined as "the particular form of societies establishes and maintains their material input from and output to nature environment". It was one concrete in which society was embedded in cosmic evolution, which simultaneously offered models to help understand

how the social system functioned; for others it was a way of describing the exchange of energy and matter between society and nature. Social metabolism is a process of flow of motivational energy from one Social Ecology to another Social Ecology that is from technology generation ecology to technology adaptation ecology. The present study depicted that the social metabolism vis-à-vis social entropy can be estimated through a series of ecological variables. The increasing unrest in society as well as chaotic behavior of agro-ecosystem can call for demand in realistic study.

Socio-economic systems depend on a continuous throughput of materials and energy for their reproduction and maintenance. This dependency can be seen as a functional equivalent of Biological Metabolism, the organism's dependency on material and energy flows and we therefore employ the concept of "social metabolism". Contrary to the biological notion, however, the socio-ecological paradigm links material and energy flows to Social Organisation, recognizing that the quantity of economic resource use, the material composition and the sources and sinks of the output flows are a function of socio-economic production and consumption systems. These systems are highly variable across time and space. We describe social systems according to their metabolic profiles in relation to their economic and technological structures, as well as their demographic governance and information patterns.

Men were part of Nature, men used Nature's materials, we could increase its produce by the development of the so-called productive forces but we could also undermine the natural conditions of production.\

System

A system is a complex whole comprising a component having integration and interaction towards achieving a system goal.

Types of System Based On Purpose

There are four basic types of system depending on whether the parts and the whole can display choice, and therefore be purposeful.

Types of System based on Purpose.

Types of System Model	Parts	Whole	Example
Mechanistic	No choice	No choice	Machines
Animate	No choice	No choice	Persons
Social	Choice	Choice	Corporation
Ecological	Choice	No Choice	Nature

These types form a hierarchy with ecological systems the highest type. All but mechanistic systems can incorporate as parts other system of the same or a lower type, but not a higher type; for example, social system (e.g., Society) may incorporate animate systems (People) and mechanistic system (Machines), but a mechanistic system cannot incorporate either an animate or social system. Ecological system can incorporate system of all other types. Only animate and social systems can be said to be purposeful.

Systems or their parts are purposeful if, by their choices, they can produce (a) the same outcome in different ways in the same environment and (b) different outcomes in the same and different environments.

Mechanistic System:

Mechanistic systems and their parts have no purposes of their own, but their essential parts make possible the functioning of the whole. All mechanisms are mechanistic system. Plants are also. Clocks are common examples of such system; they operate with a regularity dictated by their internal structure and the causal laws of nature. Neither the whole nor the parts of a clock display choice, but they have functions. Similarly, an automobile is a mechanical system that has no purpose of its own but serves its driver's and passengers' purpose. In addition, an automobile's fuel pump (a mechanical system) has the function of supplying its fuel injector or carburetor with fuel, without which the automobile could not carry out its defining functions.

Mechanistic systems are either open or closed, closed if their behavior is unaffected by any external conditions or events; open if they are so affected. The universe was conceptualized by Newton as a closed (Self contained) mechanical system, with no environments like a harmonically sealed clock. On the other had, the planet earth is seen as an open system one whose motion is influenced by other bodies in the solar system.

Animate System:

These are conceptualized as purposeful systems whose parts have no purposes of their own. The principal purpose of such systems is survival. A person's lungs have no purpose of their own; but they function to enable a person to extract oxygen from the environments in order to survive. Understandings these interactions are essential for understanding their

properties and behaviour. Animate systems are living systems "life", has been defined in many different ways. The definition has most widely accepted by biologists involves the ways concept autopoiesis; the maintenance of units and wholeness, while components themselves are being continuously or periodically disassembled and rebuilt, created and decimated, produced and consumed. (Zeleny, 1981, P. 5)

These definitions, it follows that social and ecological system are also alive. (Many biologists are unhappy about these consequences of their definition of 'life.')

Social System:

These are systems that (1) have purpose of their own, (2) consists of parts at least some of which are animate, hence have purposes of their own, and (3) are a part of one or more larger (Containing) system that may have purposes of their own, and that may contain other social system. This, in turn, is part of or national government social system can be and usually are nested.

Ecological System:

Such system contains mechanistic, animate, and social systems as parts, and therefore, containing some parts that have purposes of their own. However, these systems as a whole (3) are conceptualized as having no purpose of their own. Nature, of course, is commonly taken to be an ecological system as in our environment.

Ecological systems serve the purpose of their animate and social parts and provide necessary inputs to these and open deterministic systems. They also provide receptacles of their waste as well as their useful products. Such

service and support is their function. Ecology can be affected mechanistically by the mechanical or purposeful behavior of its parts. For example, the purposeful use by people of fluoro-carbon as propellant and emissions of power plants affect the ozone layer mechanistically.

Animate and social systems are frequently confronted with situations in which their choices can affect their effectiveness, either positively or negatively. Such situations are problematic. In other words, problems are situations in which a system's choice can make a significant difference to that system.

Entropy versus Negativity

Entropy: The natural tendency of system to dissipate.

Negentropy: Requires change (addition of energy to system) to occur in order for the system to continue to exist.

Conflict Theory

Inequality principle: Inequality in resources distribution creates conflict.

Resources are almost never equality distributed.

Struggle and synthesis principle; Families struggle with distribution of resources

Families that are best able to distribution of resources; Families that are best able to distribute resources are best able to achieve synthesis (i.e. combine elements into a coherent whole.)

Symbolic Interaction Theory

Perception as reality; that which is perceived as real is real in its effect.

Role stain; this occurs when feeling one roles causes conflict with another role.

Thermodynamic system

Energy transfer is studied in three types of system.

Open System: Open systems can exchange both matter and energy with an outside system. They are portion of larger systems and in intimate contact with the larger system our body is an open system.

Closed System: Closed system exchange energy but not matter with an outside system. Though they are typically portion of larger system, they are not in complete contact. The earth is essentially a closed system; it obtains lots of energy from the sun but the exchange of matter with the outside in almost zero. A green house is an example of a closed system exchanging heat but not work with its environment.

Isolated System: Isolated system can exchange neither energy nor matter with an outside system. While they may be portions of larger system, they do not communicate with outside in any way. The physical universe is an isolated system; a closed thermos bottle is essentially an isolated system (though it's insulation is not perfect).

Heat can be transferred between open system and between closed systems, but not between isolated systems. Whether a system exchanges heat, work or both is usually thought of as a property of its boundary. A boundary allowing matter exchange is called permeable.

System Components and Properties

Boundary: A system boundary is a real or imaginary two-dimensional closed surface that encloses or demarcates the volume or region that a thermodynamic system occupies, across which quantities such as heat, mass or work can flow, In short a thermodynamic boundary is a geometrical division between a system and its surroundings. Topologically, it is usually considered to be nearly a piecewise smoothly homeomorphic with a two-sphere, because a system is usually considered to be simply connected.

Boundary can also be fixed (e.g. a constant volume reactor) or moveable (eg a piston). For example, in a reciprocating engine, a fixed boundary mean the piston is locked at its positions; such, a constant volume process occurs. In that same engine, a moveable boundary allows the piston to move in and out. Boundaries may be real or imagery. For closed system, boundaries are real while for open system boundaries are often imaginary. For theoretical purposes, a boundary may be declared to be adiabatic, isothermal, diathermal, insulating, permeable, or semi-permeable, but actually physical materials that provide such idealized properties are not always readily available.

Anything that passes across the boundary that effects a change in the internal energy needs to be accounted for in the energy balance equation. The volume can be the region surrounding a single atom resonating energy, such as Max Plank defined in 1900; it can be a body of steam or air in a steam engine, such as Sadi Carnot defined in 1824; it can be the body of a tropical cyclone, such as Kerry Emanuel theorized in 1986 in the field of

atmospheric thermodynamics; it could also be just one nuclide (i.e. a system of quasks) as hypothesized in quantum thermodynamics.

Surrounding: The system is the part of the universe being studied while the surroundings are the remainder of the universe that lies outside the boundaries of the system. It is also known as environment, and the reservoir. Depending on the type of system, it may interact with the system by exchanging mass energy (including heat and work), momentum, electric charge, or other conserved properties. The environment is ignored in analysis of the system, except in regards to these interactions.

Open system:

During steady, continuous operation, an energy balance applied to an open system equates shaft work performed by the system to heat added plus not enthalpy added.

In open system, matter may flow in and out of the system boundaries. The first law of thermodynamics for open systems states: the increase in the internal energy of a system is equal to the amount of energy added to the system by matter flowing in and by heatings minus the amount lost by matter flowing out in the form of work done by the system. The first law of system is given by

$$\mathrm{d}U = \mathrm{d}U_{in} + \delta Q - \mathrm{d}U_{out} - \delta W$$

Where, U_{in} is the average internal energy entering the system out and U_{out} is the average energy leaving the system.

The region of space enclosed by open system boundaries is usually called a control volume, and it may or may not correspond to physical walls. If we choose the shape of the control volume such as all flow in or out occurs perpendicular to its surface, then the flow of matter into the system perform work as it were a piston of fluid pushing mass into the system, and the system perform work on the flow of matter out as if it were driving a piston a fluid. There are then two types of work performed; flow work described above which is performed on the fluid (this is also often called PV work) and shaft work which may be performed on some mechanical drive. Thus two types of work are expressed in the equation:

$$\delta W = \mathrm{d}(P_{out}V_{out}) - \mathrm{d}(P_{in}V_{in}) + \delta W_{shaft}$$

Substitution into the equation above for the control volume 'cv' yields;

$$\mathrm{d}U_{cv} = \mathrm{d}U_{in} + \mathrm{d}(P_{in}V_{in}) - \mathrm{d}U_{out} - \mathrm{d}(P_{out}V_{out}) + \delta Q - \delta W_{shaft}$$

The definition of enthalpy, H, permits as to sue this thermodynamic potential to account for both internal energy and PV work in fluids of open system:

$$\mathrm{d}U_{cv} = \mathrm{d}H_{in} - \mathrm{d}H_{out} + \delta Q - \delta W_{shaft}$$

During steady state operation of a device (*e.g.* in Fig 3.1 above turbine, pump and engine), any system property within the control volume is independent of time. Therefore, the internal energy of the system enclosed by the control volume remains constant, which implies that dUcv in the expression above, may be set equal to zero. This yields a useful expression

for the power generation or requirements for these devices in the absence of chemical reactions.

$$\frac{\delta W_{shaft}}{\mathrm{d}t} = \frac{\mathrm{d}H_{in}}{\mathrm{d}t} - \frac{\mathrm{d}H_{out}}{\mathrm{d}t} + \frac{\delta Q}{\mathrm{d}t}$$

The expression is described by the diagram above.

Closed System:

In a closed system, no mass may be transformed in or out of the system boundaries. The system will always contain the same amount of matter, but heat and work can be exchanged across the boundary of the system, whether a system can exchange heat, work or both in dependent on the property of its boundary.

Adiabatic boundary – not allowing any heat exchange

Rigid boundary – Not allowing exchange of work

One example is fluid being compressed by a piston in a cylinder. Another example of closed system is a bomb calorimeter, a type of constant – volume calorimeter used in measuring the heat of combustion of a particular reaction. Electrical energy travels across the boundary to produce a spark between the electrodes and initiates combustion. Heat transfer occurs across the boundary after combustion but no mass transfer takes place either way.

Beginning with the first law of thermodynamics for an open system, this is expressed as:

$$\Delta U = Q - W + m_i(h + \frac{1}{2}v^2 + gz)_i - m_e(h + \frac{1}{2}v^2 + gz)_e$$

Where U is internal energy, Q is the heat added to the system, W is the work done by the system, and since no mass is transferred in or out of the system, both expressions involving mass flow are zero and the first law of thermodynamics for a closed system is derived. The first law of thermodynamics for a closed system is derived. The first law of thermodynamics for a closed system states that the increase of internal energy of the system minus the work done by the system. For infinitesimal changes the first law for closed system is stated by:

$\delta U = \delta Q - \delta W$

If the work is due to a volume expansion by dv at a pressure P then:

$\delta W = Pdv.$

For a homogeneous system, in which only reversible processes can take place, the second law of thermodynamics reads:

$\delta Q = TdS$

Where, T is the absolute temperature, and S is the entropy of the system. With these relations the fundamental thermodynamic relationships used to compute changes in interval energy, is expressed as:

$\delta U = TdS - Pdv$

For a simple system, with only one type of particle (atom or molecule), a closed system amounts to a constant number of particles, however, for systems which are undergoing a chemical reactions process. In this case, the fact that the system is closed and is expressed by stating that the total number of each elemental atom is conserved, no matter what kind of molecule it may be a part of Mathematically:

$$\sum_{j=1}^{m} a_{ij} N_j = b_i^0$$

Where, N_j is the number of j – type molecule, a_{ij} is the number of atoms of element i in molecule j and b_i^0 is the total number of atoms of element i in the system, which remain constant since the system is closed. There will be one such equation for each different element in the system.

Isolated System:

An isolated system is more restrictive than a closed system as it does not interact with its surroundings in any way. Mass and energy remains constant within the system, and no energy or mass transfer takes place across the boundary. As time passes in and isolated system internal differences in the system tend to even out and pressure and temperatures tend to equalize, as do density differences. A system in which, all equalizing processes have gone practically to completion in considered being in a state of thermodynamic equilibrium.

Truly, isolated physical system do not exists in reality (except perhaps for the universe as a whole), because, for example, there is always gravity between a systems with mass and masses elsewhere. However, real system may behave nearly as an isolated system for finite (possibly very long) times. The concept of an isolated system can serve as a useful model approximating many real- world situations. It is an acceptable idealization used in constructing mathematical models of certain natural phenomena.

In the attempt to justify the postulate of entropy increase in the second law of thermodynamics, Boltzman's H-theorem used equations which assumed

a system (for example, a gas) were isolated. That is all the mechanical degrees of freedom could be specified treating the walls simply as mirron boundary conditions. This inevitably led to Loschmedl's pardox. However, if the stochastic behaviour of molecules in actual wall is considered, along with the randomizing effect of the ambient, background thermal radiations, Boltzman's assumptions of molecular chaos can be justified.

The second law of thermodynamics for isolated system states that the entropy of an isolated system not in equilibrium tends to increase over time, approaching maximum value at equilibrium. Over all, in an isolated system, the internal energy is constant and the entropy can never decrease. A closed system's entropy can decrease e.g. when heat is extracted from the system.

It is important to note that isolated systems are not equivalent to closed system. Closed system cannot exchange matter with the surroundings but can exchange energy. Isolated systems can exchange neither matter nor energy with their surroundings, and as such are only theoretical and do not exists in reality (except, possibly, the entire universe).

It is worth noting that cloud system is often used in thermodynamics discussion when isolated systems would be correct i.e. there is an assumption that energy does not enter or leave the system.

Systems in Equilibrium:

At thermodynamic equilibrium, a system's properties are by definition unchanging in time. Systems in equilibrium are much simpler and easier to understand than systems which are not in equilibrium. Often, when analyzing a thermodynamic process, it can be assumed that each

intermediate state in the process is at equilibrium. This will also considerably simplify the analysis.

In isolated system it is consistently observed that a time goes on interval rearrangements diminish and stable conditions are approached. Pressures and temperatures tend to equalize, and matter arrays itself into one or a few relatively homogeneous phases. A system in which all processes of change have gone practically to completion is considered to be in a state of thermodynamics equilibrium. The thermodynamic properties of a system in equilibrium are unchanging in times equilibrium systems state are much easier to describe in a deterministic manner than non-equilibrium states.

In thermodynamic processes, large departures from equilibrium during intermediate steps are associated with increase in entropy and increase in the production of heat rather than useful work. It can be shown that for a process to be reversible. For a system must be in equilibrium throughout the step. That ideal cannot be accomplished in practice because no step can be taken without perturbing the system from equilibrium, but the ideal can be approached by making changes slowly.

Complex and Simple System:

One way to illustrate what a complex system is to first describe, what it is not. A destination has to be made between simple systems (capable of creating a different kind of complex dynamics e.g. Chaos), complicated system and complex systems. Simple systems have a small number of components acting according to linear laws, e.g. a perfect pendulum. Simple systems can generate “Complex” dynamics like chaos, e.g. a forced

pendulum. The system has no emerging properties and adaptability. Complex systems (typically have a large number of components. The components interact with each other and the environment) based on rules, which may change over time and usually are not well understood. These results in two typical features of complex system: Emergent properties and adaptive change.

"A complex system is a system with a large number of elements, building blocks or agents, capable of interacting with each other and with their environment. The interaction between elements may occur only with immediate neighbours or with distant ones; the agents can be all identical or different; they may move in space or occupy fixed positions, and can be in one of two states or of multiple states. (Complex systems are typically far from equilibrium. For example living organisms are in a permanent struggle with their environment to remain in a particular out of equilibrium state, namely alive.) The common characteristics of all complex systems are that they display organization without any external organization principle being applied. The whole is much more than the sum of its parts." (Amaral *et. al.,* 2004)

Consequences of using system dynamics concepts for ecosystems/sustainability science are an emphasis on uncertainty, recognition that the organization of a system at different scales matters, and that there emergent properties exists. Some of the authors cited in this work (Giampietro 2003, Gunderson 2002) have stated that the negation of just

these features in the part was the main reason for the error-proneness often observed in many sustainable development projects.

Ecosystems are often exemplified as the example for complex adaptive systems. Modern ecosystems approaches therefore, often utilize the concepts and terminology of complex system theory. A mutual use of these terms and concepts in different scientific discipline could also help bridge some problems of interdisciplinary research.

Social System

A social system is defined as a set of interrelated units that are engaged in joint problem solving to accomplish a common goal. The members or units can be individuals, informal groups, organizations or sub systems. The sharing of common objective binds the system together. Diffusion occurs within a social system. The social structure of the system influence how and what information is disseminated. Knowledge of social structure is important to consider while studying diffusion. A village as social system is made up of variety of individuals and groups with distinctive statuses, roles, norms and goals all of which, at least in ideal terms, functionally relate to each other to attain its major goals and objectives. The structure of a social system constitutes a set of boundaries within which innovation diffuse. The differences in the adoption of agricultural innovations at the village level can often to explain in terms of their differences in structural characteristics. The degree to which a village is structurally homogeneous or heterogeneous, unitary or highly stratified, it affects the rate of diffusion of agricultural innovation within the boundary. The information can be

distributed through formal (Government) and informal communication structures (peers, groups etc.). For example in a village 'A' the rate of adoption of an innovation was 57 per cent and only 26 per cent in village 'B'. This indicates that social and communication structures of these two villages are quite different regarding the diffusion of innovation, even though these innovations had promoted equally in both villages by Government agency. We can predict that in village 'A' the friends, neighbors are more likely to encourage other farmers to adopt since they themselves have adopted, and the village leaders in village 'A' are specially committed to adoption of an innovation, while in village 'B' they are not. This example shows how a system's structure can affect the diffusion and adoption of innovations, over and above the affect of such variables as the individual characteristics of the members of the system. Individual innovativeness is affected by individuals' characteristics and by the nature of the social system in which individuals are matters.

Social System Theory: The New Age Extension Science

Systems Theory is interdisciplinary theory about the nature of complex system in nature, society and science. System theory originated in 1920's to explain the interrelatedness of organisms in ecosystem, more specifically, it is a framework by which one can investigate and describe any group of objects that work in concurrency to produce some result. This could be a single organism, any organization or society or any electromechanical or information artefact.

"Social system theory was developed by Neklas Luhman. This theory is an option for the theoretical foundation of Human resource management".

i. Social system theory determines system as machines and takes open system approach. It addresses non linear system theory.

ii. This theory also defines social system as autopoietically closed system. As a closed system human resource management can be founded;

a) Conceptualization of organizing and managing human resources as a social process. It overcomes an individualistic angle.

b) The new importance of individual an essential element in the systems environment.

c) The abstention from far reaching or highly unrealistic assumption about the nature of human beings.

d) The interaction between various level and units of analysis built into the theory which is essential for comprehensive and in depth analysis of HR phenomena.

e) The openness for additional theories for which social system theory provides the overall framework.

Needs of this grand theory:

a) Critics frequently diagnose a lack of comprehensive theoretical frameworks for human resources management (eg. Drumm 1995).

b) In this effect a number of grand as well as less grand theories like behavioral theory (Schanj 2000, Martin 2001) or economic theory (Backs Gellnu 2001) and as basic prospective for HRM.

Advantages:

a) It enriches the HRM discussion. It will establish concepts from a different scientific field and is applied to HRM.

b) It contributes into the organizational theory discussion.

c) This not only helps HR theory but also strengthens the theoretical link to the general organizational theory thus emphasizing the vital rate HR plays in an overall view of organizations.

d) It is a unified theoretical perspective and allows to discuss the great variety of HR aspects with a single theoretical language.

e) Categories of framework can be used to reconstruct organization readily.

f) It establishes similarities and differences between framework and actors that otherwise are conceptually socially dispose (Kanpik 1978).

Social Entropy: Thermodynamics In Extension Science

In sociological thermodynamics, Social Entropy are manifestation of entropy, defined as the amount of energy unavailable for doing work in a given process, in a given social system, distinguished by modes of negative behaviors, specially alienation, anomie and deviance, that function to instill a disordering effect in a given social structure or order (Nisbet, Robert A, 1970). These anomalous behaviors are seen as withholdings or cross uses of the deviant manifestation of the human energies that normally go into support or fulfillment of the norms, role and statuses that make up a social order. American communication professor, Klaus Krependroff defines

social entropy as a measure of the natural decay of the structure or of the disappearance or destinations within a social system (Social Entropy Klaus Kripendroff's). He reasons that much of the energy consumed by social organization is spirit to maintain its structure, counteracting social entropy, e.g. through legal institutions, educations the normative consequences that 'anomie' is the maximum state of social entropy.

Social Entropy Theory Model:

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 Social Science, Archaeological and Physical Science (i.e. Physics, Chemistry and Biological Sciences).

PISTOL Model of Social Entropy:

Recently there is a shift within social science from equilibrium to non equilibrium models. Social Entropy Theory (SET) is not strictly speaking a non-equilibrium model. But it can incorporate the notion of equilibrium. SET recognizes that whether a given society is actually in equilibrium or not is a matter to be empirically determined at any given point of time. If the extreme of equilibrium can be documented, the SET can accommodate this, and can study the society in its current state of equilibrium continue. However, if the existence of equilibrium cannot be supported with data, SET can still study the society in its non-equilibrium state. Thus, SET can effectively formulate the equilibrium theory and also subsumes equilibrium as one of the many state of entropy, maximum entropy.

According to Kenneth D. Bailey (1994), Social Entropy Theory defines a society as a population (P) situated within a given bounded spatial area (S), and technology (T), level of living (L), and organization (O). Together, these comprise a set of six interrelated umbrellas concept that represents alternatively by the acronyms of PILOTS or PISTOL. The classic definition of society is that of a population within boundaries that posses a certain culture (beliefs, values, language and so forth).

PISTOL model of Social entropy

The basic definition of society is P, S, I and T, Information is an important component as it includes not only information (communication theory), but also cultural elements such as beliefs, values, religion and other cultural components. These six macro components are all interrelated so that no single one of them is the independent variable all the time. Rather it can represent as a set of equations such that each variable serves alternatively as the independent variable in one equation and as a dependent variable in all of the other five equations.

$$\boldsymbol{P = f(I, L, O, T, S)} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots..\mathbf{(1)}$$

$$\boldsymbol{I = f(P, L, O, T, S)} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots.\mathbf{(2)}$$

$$\boldsymbol{L = f(P, I, O, T, S)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. \boldsymbol{(3)}$$
$$\boldsymbol{O = f(P, I, L, T, S)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. \boldsymbol{(4)}$$
$$\boldsymbol{T = f(P, I, L, O, S)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. \boldsymbol{(5)}$$
$$\boldsymbol{S = f(P, I, L, O, T)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. \boldsymbol{(6)}$$

These six variables are “global,” or macro-sociological properties of society that can define and measures of minimal knowledge of individual members of the society except of population which is simply the sum of existence of all individual members of the society.

Apart from these global properties of societies, two additional levels of properties exist, mutable and immutable. The mutable properties are distribution that are formed by distributing the population P (one of the six global properties) across the range of values of the remaining five global (I, L,O, T, and S) to create five mutable distribution. These distributions are macro-properties of the whole society, but are not global. Rather, these remain as aggregate macro-properties and are the sum of respective values of all individuals in the society. The mutable are dual macro/micro properties. In addition to being societal properties, the mutable are also micro properties of individuals in as much as each individual is linked to each of the five mutable distributions.

As for example, a society has an absolute amount of wealth within its boundaries and this is global value of level of living (L). In addition a distinct mutable distribution of wealth is the wealth of each individual (a micro or individual property) and then this value determines the individual’s position in the wealth class distribution. This wealth

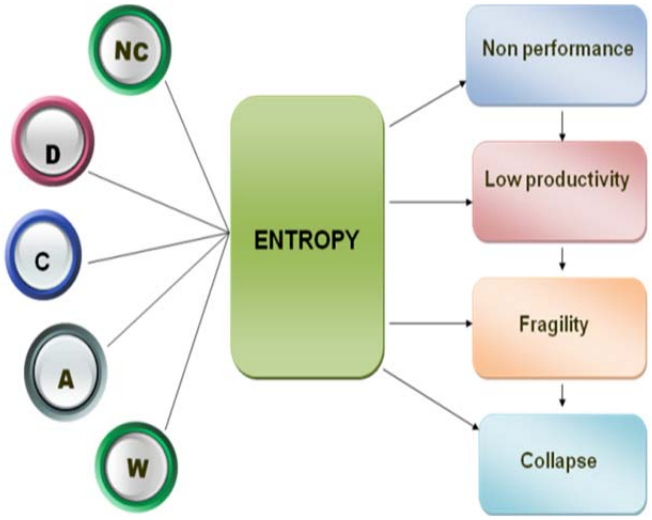
distribution can yield five classes for example, (Lower class, Lower middle class, Middle class, Upper middle class, and Upper class.). This is also a given amount of wealth possessed by the individual, which identifies his or her position in the mutable distribution. For example, the wealth variable is an indicator of the level of living (L) component. It can be measure at three levels. First the global level, as an absolute macro-property of society (for example, the society possess wealth of a certain amount). Second, the mutable level (the distribution of wealth into five classes). The third one is society (macro level).

There are effectively two measures of each mutable, one macro and one micro. The macro measure of wealth is the class system and the micro measure of wealth is the individual position in that class system. Thus the mutable distribution serves as a micro/macro link between the individual (micro level) and the society (macro level).

Therefore, each society has two macro measures a global and a mutable. In addition, each individual within the society has two micro measure (one mutable and one immutable). The mutable micro properties are "achieved" variable such as education, income, occupation, area of residence and so forth. There is another kind of micro property in SET known as an "immutable" property. This is some property that generally is not altered during the course of the individual's lifetime. Examples of immutable include race, sex, and age (birth date). Although the immutable are not strictly speaking a part of the mutable distribution, they can be correlated

with the mutable, and thus can help determine an individuals' position in the mutable structure of the society.

Distortion Model of Social Entropy:



Distortion model of social entropy:

When, in a system (Organizations), due to anomie, negative behavior, alienation or deviance, there is Disagreement (D), Non-Compliance (NC), Conflict (C), Aggression (A) and Withdrawal (W). The inherent Entropy level rises to a level, such that it is rendered unmanageable. In such situation the level of non-performance is visible in the system (Organizations) leading to low productivity (which is, anyway, the ultimate goal of any organization) which ultimately leads to fragility and collapse

Equilibrium Model of Social Entropy:

This model describes how the Basic Factors of Social entropy, responsible for increasing the same within a system, works. Moreover, in any Social

structure, the complex changes brought down by society brings about disorder/chaos/dissatisfaction due to, may be, negative behavior, anomie, alienation or deviance. These all leads to new equilibrium and the gap between the two equilibriums represent best the Social Entropy.

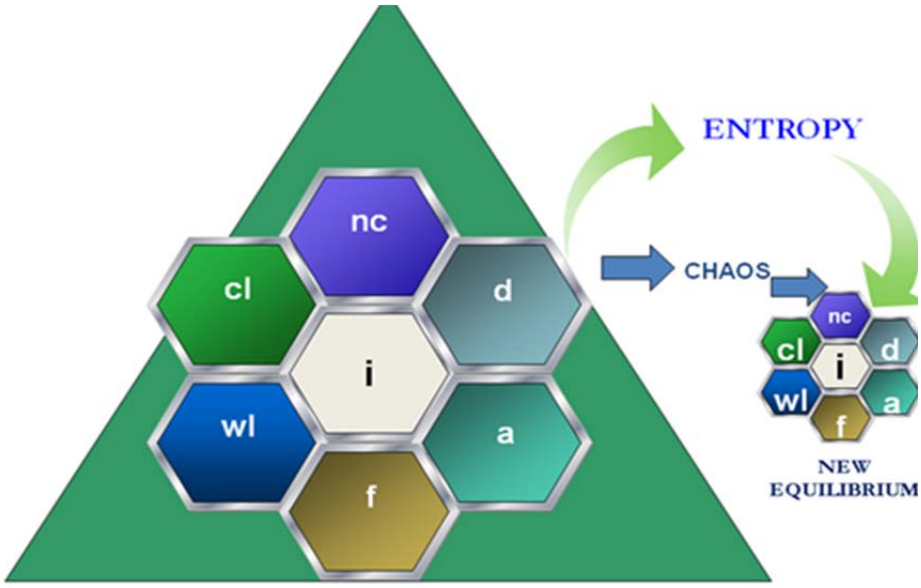


Fig. 1: Equilibrium model of social entropy

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 behaviour 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 system, the Gibbs free energy that is unavailable and that this difference represents the 'state' of the social system.

$\delta H = \delta G + T.\ \delta S$ or,

$\delta S >= \delta H/T$

Where,

'=' stands for a reversible process and '>' for irreversible process.

δS = Entropy

δG = Gibbs free energy

δH = Enthalpy

T = Absolute Temperature at which the process is occurring.

Domain of Social entropy:

a) Human being: The high end recipient and generator of social warming in the form of conflict, non-compliance, anomie, deviance etc.

b) Interaction of institutions: Alienation, conflict, withdrawal, disagreement, domination.

c) The surrounding of the Entropy: The domain of social entropy in context of small and micro society delineation.

d) The eternal energy state: The enthalpy in context of social warming is related as internal energy state.

e) Energy transfer process: The social kinetics and movement of information in random motion (Brownian motion is related).

f) Movement from present to changed equilibrium: Present equilibrium, disequilibrium and neo-equilibrium.

Social Bond

Social Entropy is said to be one of the element or components of the social bond which according to American sociologist (Robert Nisbet) mediates a

part of the force that enables biologically desired human beings to stick together in the social molecules (Human Molecular aggregates) in which we actually find them from the moment, quite literally of their conception.

The etymology of Social Entropy is said to trace back to philosopher-historians Brook Adam and Henery Adam who applied the concept of entropy of human affairs, viewing it a tendency sun in the histories of whole nation or civilization a tendency characterized by running down of human energy of diminished capacity for meeting the problems set by that nation or civilization.

In 1968 Ametai 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 system 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 Kenneth, D. (1990). Bailey also included a section titled the History of "Social Entropy" in which he traces the use of thermodynamics and entropy in sociology from (Pregogine to Samuelson) and other in literature. (Bailey 1990).

In 2001, Peruvian Engineer Alfredo Infante wrote short article entitled "Social Entropy" as determined by the second law mandates the

spontaneous direction of all processes of nature and society and the generation of greater complexity and disorder (Waller, Thomas P. 2009).

Social Free Energy

In sociological thermodynamics, social free energy is the quantification of the free energy (or more accurately Gibbes Free Energy) of a social system or verbal description of it.

The first it seems to have used the term "Social Free Energy" is Croatian mechanical Engineer, Josip Stepanic in as early as 2004. In 2006 for instance, he reasoned that a part of socio-economic activity is expressible and measurable by way of social free energy as a measure of resources which can be transferred for a given purpose within a social system without changing its structure. (Stepanic Josip, 2004).

Social Energy

In sociological thermodynamics social energy is a general term referring to any of a number of types of energies in a social system modeled as a thermodynamic system, connecting or driving people. A famous demarcation on the topic of social energy is the 1910 argument by American historian (Henery Adams) on the applicability of the second law to human history, who commented on the lack of physical rigor in the thermodynamically understanding of social energy in contrast to the adamant adherence to entropy in the social context (e.g. psychic entropy or social entropy). In a noted humorous statement Adams tells us;

"Although the physicist are far from clear in defining the term vital energy, and are exceedingly timid in treating of social energy they are positive that

the law of entropy applies to all vital process even more than to mechanical".

Social Ecology and Social Ecological Systems

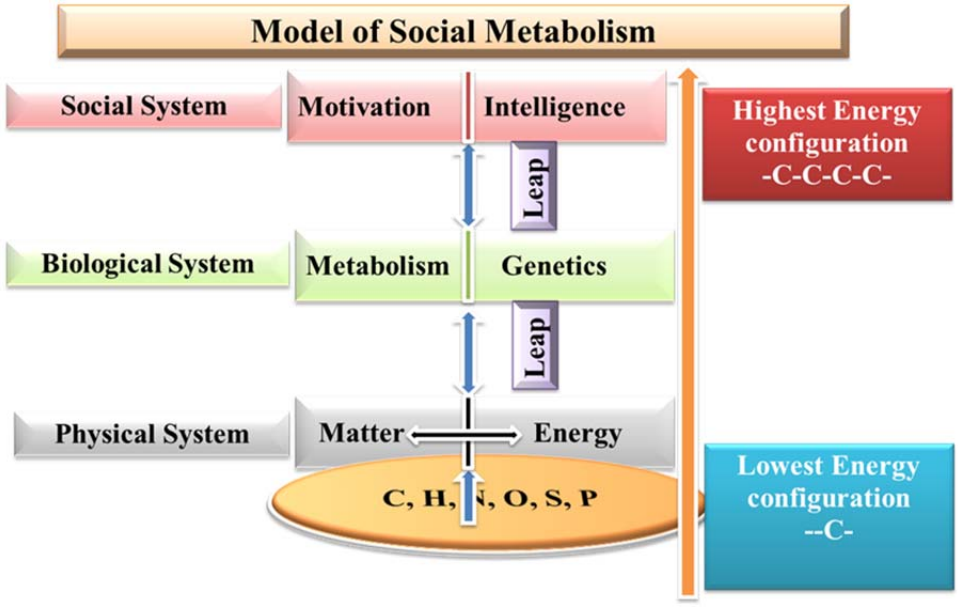
The concept of social-ecological system as a multidimensional system where natural and social spaces do not have a sharp and immobile border can be illustrated in the fig: 3.8 below. We use the framework proposed by Berks *et.al.* (1998). In this flow diagram ecosystem, People and Technology, Local Knowledge and Property right has been shown to have bidirectional relationship with pattern of interactions, sustainable society and knowledge and entitled dynamics.

The Social ecology as a system is supported by three basic things: Physical complex, Biological complex, Social complex. While the physical complex is functionally attuned to two basic components, the matter and energy, biological complex is being characterized with basic characters *viz*. the genetics and metabolism. Social complex has epitomized over two complexes mentioned earlier and has been unique by two basic characters one is intelligence and other is motivations.

Social Metabolism: Energy Equivalence In Social Ecology

Fisher-Kowalsky and Haberle 1994, described Social metabolism as "the particular form in which societies establish and maintain their input from and output to nature; the mode in which they organize the exchange of matter and energy with their natural environment". However, among early sociologist the concept of social metabolism was widely adopted. At that time it was used to describe the same process: the exchange and the

transformation of matter, energy, labour and knowledge carried out between the social system and the environmental system. But it did have various different meanings. For some authors it was one concrete way in which society was embedded in cosmic evolution, which simultaneously offered models to help understand how the social system functioned; for others it was a way of describing the exchange of energy and matter between society and nature, that which permitted the reproduction of the social system and of the social environment needed for human advancement; for others again, social metabolism was one way in which society could renew its *elite*. It was assumed that this concept was the product of sociological organicism and when sociology became more rationalist and individualist, it lost this perspective which linked society with its environment.



Model of Social Metabolism (Acharya and Sharma)

Analogical Thought:

The theoretical system of the early sociologist were influenced by contemporary interpretations of nature, both because they thought the sciences of nature and of the biological body, such as biology and medicine, were becoming more and more accurate and scientifically objective, and because these early sociologist thought that nature of society itself dependent, in many ways on relations with nature that surrounded it, with the environment.

Auguste Comte 1975, had conviction that there was an indisputable interdependence between social evolution and evolution within nature been due to the analogical cognitive structures which predominated. Analogical knowledge had dominated rational forms of western scientific thought for many centuries. Writing by Plato, Aristotal, Hobbes and Rousseau, who compared society to living organisms, are valid example of the analogical method.

Some argued that analogy was, and in some ways still is a tool for scientific learning, an indispensable and inevitable means for scientific progress, an epistemological bridge between social sciences and biological sciences to be more precise, it is not only metaphor, allegory and similarity that shape scientific knowledge, rather it is a special kind of similarity in structure and form between two sets of structures and of particulars, that are manifestly very different but which, structurally, are parallel. Generalising, the physicist and mathematician Robert Oppenheimer 1956, wrote, “every analogy presupposes two ontological conditions; one, a plurality of real

beings and thus among them an essential diversity. Monism is born enemy of analogy and two at the very heart of this multiplicity, of this inequality, a certain unity"

Organicist sociologist like Spencer, Worms, Lillienfeld, Schaffle or zoologist like Haeckel and Huxley, based their works mainly on this investigate the nature of animals and of human beings contemporaneously, by assuming that all these phenomena were regulated by the same laws of behaviour and of evolution. As the sociologist Jacques Novicow argued, "The laws of Biology can equally be applied to single cells, to clumps of cells, to plants or animals and to groups of humans organised in society".

The analogical method was not without its critics even among sociologist themselves. The most tenacious adversaries of organicism were the followers of Durkheim, in France; Weber and the sociologist of the Archiv fur Sozialwissenschaft und Sozialplitik, in Germany; and the sociologist of the crowd and the elite in Italy. Francois Simiand attacked sociological organicism arguing that "analogy is not, strictly speaking, a scientific method, in itself it proves nothing"; Celestine Bougle said that "analogy can, without doubt, be a starting point for explanations by suggesting research hypothesis, but it cannot be a substitute for the explanation itself"; Gabriel Tarde wrote that "Organicism is not only superfluous, it is also dangerous", Oppenheimer, 1956.

However, organicist analogy does make it possible to somehow keep society and nature together during analysis. Indeed, the end of organicism marked the complete breakdown of any connection between types of

phenomena which now appear as completely separate and which are identified by radically different laws and regularities. As Alfred Espinas recognised, "It was possible to recognise the rule of entirely new phenomena within society". But in this way, the centrality of thinking about the ways in which society uses, copies, follows and imitates nature were also lost.

Natural and Social Metaphors:

During the nineteenth century, the prevalent idea was that the social link that cements society is created within the natural conditions in which living beings exist, developing out of the complex of basic needs and of the tools to satisfy them. Both the genesis and evolution of all societies are ruled by constant and natural laws. These laws embody the origin, characters and evolution of "social facts" and they originate in the biological and cosmological conditions of human existence.

Ernst Haeckle 1866, who invented the term 'ecology', introduced a new field into the biological sciences, one where the relationships between living beings and environment in which they live are pre-eminent. Haeckel expressed the idea that a causality relation exists between the ontogenesis and the phylogenesis of organisms. The former, ontogenesis, studies the individual development of organisms, which is fast and is completed before our very eyes; the latter, phylogenesis, studies the genealogical evolution of organisms, which is very slow and must be calculated in terms of centuries. For Haeckel, the scientific link between ontogenesis and phylogenesis made it possible to physiologically link inheritance and reproduction, adaptation

and nourishment. Thus, in his view, this approach established a mechanical conception and a physic-chemical explanation of these two biological functions of organisms. In this way he also denied every teleological, spiritual and vitalist interpretation of organic life. Haeckel's ideas spread throughout all areas of the natural and social sciences. For these sciences, Nature was a unique complex system of parts which affect each other. In this system different partial systems produce, apply and spread the living force in different forms that obey universal laws which maintain the unity of the whole. Everywhere, systems of parts in vital communion appear: not only the social body is an "association", but the natural one is too, Schaffle, 1881.

Haeckel's use of metaphors to explain the organic management of living beings is very important. Building on the work of Rudolph Virchow, Haeckel stated that a higher organism is like a managed social unity, like a State, whose citizens are individual cells. In all civilised States, citizens are, to certain degree, independent individuals; but they are also mutually dependent, because the social division of labour increases the need to subject them to public laws. In the same way, Haeckel argued, the cells of plant and animal bodies are happy about their individual independence up to a certain point; indeed, following the biological division of labour, they fall into a condition of mutual dependence in which they are then subjected to central power of the community.

In Haeckel's opinion, this comparison could be taken further. The animal body, with its strong centralization, could be considered to be a cellular

monarchy; the plant body, less centralized, could be conceived of as a cellular republic. Haeckel turned the analogy that we will meet with among sociologists, upside down. The fact that zoologists and biologists like Haeckel used social and political patterns to explain the biological dimensions of the bodies, and sociologists used the biological viewpoint to justify certain social organisations is, in itself.

Haeckel felt the need to explain natural and biological evolution through social evolution in the organicist sense was, and is much more visible in human social groups than in the realm of organic nature. It was too difficult to show the natural and genealogical history of living species. Only the individual and social ontogenetic processes of differentiation and integration can really be seen, indeed, our knowledge of phylogenesis rests solely upon inference. In short, the history of human social groups, where historical records describe numerous cases of a transition from the simple to complex, could also explain the evolution of poly-cellular organisms.

For Haeckel, just as comparative political science described a long series of progressive improvements in the field of the forms of political organization, so too, did the comparative anatomy of plants and animals revealed a long series of progressive improvements in the field of cellular states. Arguing from this perspective, Haeckel stated that the organization of the cellular field lack “telos” a precise aim, but it is the manifestation of the historical evolution of the cells and of the mutual and reciprocal action of the cells upon each other. This evolutionary process had also taken place in society;

therefore the history of human civilization could explain the history of the organization of poly-cellular organisms to us, Heackel, 1880.

Schaffle, 1874, Torino, 1881, interpreted organicism founded its theoretical structure on it. According to organicism, the first social law that provided the basic logic to sociology at that time is that society is an organism, a true living body. This was the main difference between the old and the positivistic organicist conceptions of the social organism. The old idea that society seems to be an organism was simply an analogy; the positivist ideas of Spencer, Schaffle, Jager and Espinas, all said that society is true living system, a homology, an experimental truth.

Fitting And Evolution:

Organicism stated that evolution is a permanent process of averaging and of the adaption of the organism to the environment. The organism's life depends on this equilibrium being maintained. If the environment changes, or is changed suddenly, the organism dies; but alterations take place slowly and gradually, the organism will find a new equilibrium. Thus, organism should also be perceived as being within a dynamic process, one in which they undergo incessant differentiation and integration of both structures and functions. Bio-Organicist thinkers argued that the same happens in human society. Improvements could only take place when the adjustment process was both incessant and dynamic. If the transformation process stopped or too fast, such as during a revolution, society would die. Human society, like any organism, adapts to ceaseless variations of the environment. It harmonises not only with natural environmental modification such as

climate, food and vegetation, but also to the new conditions produced by psychological activity and by economic actions. Organicist said that these activities would create an artificial environment, different but still linked to the natural environment. This mechanism, analogous to the natural one, was termed “Social Metabolism”. In Paul Lilienfeld’s opinion, human society, like natural organisms, is a real entity. It is nothing but a continuation of nature, a higher manifestation of the same forces that underlie all natural phenomena. It like all living organisms, is characterized by the differentiation of parts and the integration of wholes, the development, perfection, multiplication, specialisation and refinement of structures, the storing of energy. Biological and social organisms are similar in this, rather, they are homologous, Society is only the highest form of an organism and, just like an organism and it too is a living unity, absorbing the ingredients of its environment and with a metabolic process. Its individuals are as dependent on the whole society as any cell is within any organism and, like a cell; society too has its nervous system and its reflexes.

Drawing a parallel with Spencer, Lilienfeld argued that the principal difference between a social and a biological organism is that society is somewhat less integrated than an organism. But in this respect there are three degrees of organisms; plants which have an ability to move as a whole; and social organisms, which can move in their whole as well as in their parts (individuals). Thus, this difference means only that the social organism is the highest class of organism, and nothing more. Lilienfeld came up against some objections; in a society, unlike in an organism, the

parts move, are asymmetrical and each individual has a "self" and a specific integrated consciousness while a society does not.

Lilienfeld countered these objections by declaring that in an organism parts move from one individual to another like spermatozoa, that social hierarchy is a specific kind of a symmetry in a social body, and that the individual "self", formed by changing, mosaic process, is similar to the public mind and to government activity in a society. Basically sociology should be based on biology and must apply all its laws to the scientific interpretation of social phenomena.

In this stage of bio-organicist thinking, society is not separated from nature. In the eyes of positivist sociology, society was almost completely immersed (or as Specner said, embedded) in natural and cosmic evolution of things even when some phenomena could be seen. This could have led one to think that there was increasing differentiation between the "natural" and the "social" or, as Spencer would have said, between the organic and super organic. Man as well as society is a part of nature and they are, mechanistically, subject to the same rules that govern natural evolution. At most, society is more complex Durkheim did social thinking become aware that the modern social organism was very different from both ancient society and animal or natural organisms.

The Organism and the Environment:

This circular interpretation of nature and society was widely accepted and organicism based on it. Society appeared as a true living body, the highest manifestation of the process of organic evolution. The way in which

biological and social lives are reflected in nature highlights the fundamental relationship between the organism and its environment. This relation was first described by Auguste Comte. When discussing the concept of "life", a concept that reflects the daily life of a living system, Comte argued, quite rightly, that the individual organism cannot live independently of the environment that surrounds it. "Life" was not a property of a particular type of substance, as the metaphysicists would have argued; rather it was the combination of, or the fairly harmonious co-operation between, two inseparable elements: the organism and the environment or *milieu.* Both the living and inert find themselves in a situation of mutual collaboration and dependence; the more complex the organism is, the more complex will the environment which surrounds it be. This maxim is particularly true in the case of human society where things and events were usually distant both in terms of space and of time.

Comte thought that organisms were, in some or another, not only able to adapt passively to the environment, but also to interact freely with the environment, thus modifying it. "If everything that surrounds living bodies really tends to destroy them" argued Comte "then the fact that they exist would be radically incomprehensible" (Auguste Comte, 1975). Thus he rejected both the idea of total interdependence between the organism and the environment, and the idea of an organism that could be passively deformed by the pressures of the surrounding environment, something which would deny the living being any individual spontaneity.

By posting the concepts of organism and of environment in relation to the physical conditions of life and inert matter he, in some way, mirrored Cartesian dualism between extension and thought. This dualism was the necessary condition that rendered universal progress, biological and social, possible. And this progress was none other than the enslavement and the control of inert matter by all life, in the light of an innate social subjectivity which rejected the idea of behaviourism as being derived from the environment. Life had to reproduce and rise by means of an exhaustive struggle against inorganic matter, against nonliving nature death. In his final works, Comte maintained that humanity's prime task, or duty, towards life was "to increasingly unite all living nature for an immense struggle against the whole inorganic world". Thus, positive politics should "direct all living nature (in the struggle) against non living nature, in order to exploit its dominion over the Earth." This was the ontological type of path through which Comte asserted the right of sociology to play a leading role in explaining human progress, but in this very way, he established a principle of natural subordination which was to underpin aggressive industrial Positivism, (J. H. Bridges, 1881).

Material And Symbolic Metabolism:

Analogical thought, and early reflections on the relation between living organisms (Biological and Social) and the environment laid the foundations for the discovery of the phenomenon termed "Social Metabolism". For the sociologists of the time, the fact that a living organism depended on its environment posited a problem of the way in which the exchange of matter

and energy between the organism and its environment took place. Obviously, in their explanations, they drew heavily on both biology and anatomy both of which, as we have seen, had for some time been trying to discern the nature of the relation between living things and their environment. However, once they began to consider the social organism, not only did the scale of the phenomena being studied" change, but also the quality. Above a certain size threshold, quantity took on an entirely different, often inexplicable, qualitative meaning.

Spencer's work based on close analogies between natural and social organisms, offers an important demonstration of the way in which society and nature are related. A society, Spencer argued, lives by appropriating matter from the Earth. It appropriates the mineral matter transformed from vegetal matter raised on its surface for food and clothing and the animal matter transformed from vegetal matter. The very process of social metabolism became clear when Spencer said that the lowest social stratum is the one through which such matter are taken up and delivered to agents who pass them into the general current of commodities" (Spencer, 1876). The process of exchange and transformation reveals the true nature of "Social Metabolism".

But in Spencer there was other unusual kind of metabolism: when nature becomes a mirror of society. The functional rationality of Spencer had glimpsed within the natural organization of biological organisms, and which had burst forth freely from the evolutionary dynamic of such organisms,

was soon applied to the analysis of society as a system. Thus, we can speak of cultural or symbolic metabolism.

Unlike Comte, Spencer did not really consider nature and living organisms as the counterpart of society rather, he saw them as a reflection of social organization. Thus the social construction of the image of nature was fundamental. For Spencer, society had to go through the same evolutionary process; society would have reached a new level, unlike the animal level wherein the integration of the whole was subordinated to the autonomy and freedom of the parts. Thus society would become a super-organism.

For Spencer, the key concept was that of *evolution.* Evolution corresponded to the process of increasing differentiation (that is of functional specialization) and to integration (or rather, of the mutual) interdependence of the structurally differentiated parts and the co-ordination of their functions). Furthermore, within a group, evolution was linked to the distribution of quantities of materials and movement; "evolution under its simplest and most general aspect is the integration of matter and the concomitant disintegration of matter" (Spencer, 1900). The tension between evolution and dissolution was, in Spencer's view, Visible everywhere and even as one process triumphed, so would the other triumph in its turn. In ecological terms one could say that Spencer had already identified the process that cybernetics has called "the increase and decrease of negative entropy", the dialectical relation between order and chaos.

Lastly, the process of evolution is linked to another curious phenomenon that Spencer identified quite clearly; he argued that *heterogeneity* was, in

Spencer's view, an almost universal fact. At the time when the *Principles of Biology* was published, this conviction was still without any empirical foundations but, curiously enough, it fits perfectly with what ecologists have recently discovered: ecological communities that contain a large number of interdependent species are very stable, while those with only a few species are subject to violent fluctuations and the population itself may even become extinct.

In Spencer's view society mirrored living organisms in organizational and functional aspects. He argued that social and biological organisms are similar in terms of the system by means of which they are sustained (metabolism): the system of distribution (the vascular and circular system in an organism is similar to the arteries, paths, taken by trade and commerce in a society) and also, the system which regulates the organism (the nervous system of an organism) is analogous to the system with which a society is governed.

Thus Spencer, if he is read carefully offers a mine of observation, concepts, theories and explanations concerning the relation between society and nature and the way in which society and nature can reciprocally influence each other.

Social Metabolism as Exchange of matter and Labour:

Organicism thought that evolution was the permanent process of an organism's adaptation to an environment. The organism's life is dependent on maintaining this equilibrium. If the environment were to change suddenly, the organism risked death, if changes took place slowly and

gradually, the organism would find its place in a new and well balanced state. Thus organisms should be seen as being part of a dynamic process, within which they show phenomena of unceasing differentiation and integration of both structures and functions.

The same happens within human society. This can only improve if the process of adjustment is both unceasing and dynamic. If the process of transformation is blocked, or goes too fast, as for example during a revolution, there is a risk that society will collapse. Human society, like any other organism cannot adapt to incessant variations in the environment. It must adapt not only to natural environmental changes in climate, food and vegetation, but also to the new conditions produced by economic and social activities. Activities of social nature create an artificial environment, different from but linked to the natural environment. This mechanism of differentiation of the environment outside of society was, like for the natural environment, called social metabolism.

A fairly clear description of social metabolism was offered by the German sociologist Adam Schaffle. He sociologist was one of the best at interpreting the process which allowed society to reproduce itself. In Schaffle's opinion, the pre-condition for every activity, from those of the smallest, least important parts, to the activities of the largest parts of the social body too requires an exchange of materials, which simultaneously penetrates every part of the social body: production, circulation, distribution, intermediary exchanges, use and elimination of the materials necessary for maintaining both the person and institutions of the social unit.

Indeed, continued Schaffle, every day an immense mass of the materials and the energy of nature are, through work activity, appropriated by the social body, only to be adapted to its needs, through production activity and then distributed to the various parts through circulation; transformed into the social fabric by means of absorption of goods and bodily forces. Thus Schaffle clearly outlined the mechanism of that social metabolism by means of which the energy and the matter existing in nature enables the social body to maintain itself.

Furthermore, the exchange of materials does not only serve as a means of conserving the bio-organic substratum of society, that is conserves biological bodies, it is also indispensable for maintaining the extra-organic parts of the social body: the functions of social life, the spiritual, religious ideas, culture and symbolic aspects which cannot exists without an exchange of materials. Even though it is still elementary, Schaffle recognised and described, very clearly, the ecological interdependence of society and nature.

The economic and physiological exchange of material does not entail the destruction of the material and energy but, rather, it entails their re-organization into sources of energy and into institutions which make their social use possible. Basically, Schaffle applied thermodynamic principles to social exchanges. According to these principles energy and matter are not destroyed but are only transformed, disorganized and then reorganised for other uses. An efficient mechanism of social metabolism can neither allow

any energy to be lost not permit increasing entropy, the result would be crisis within the social organism itself.

Schaffle distinguished between a progressive and a regressive exchange of materials or matter. The former corresponds to production and manipulation of raw materials; the second to the consumption and elimination of used materials (waste/rubbish/garbage). This distinction renders the social exchange of material that is carried out by the human community unique, different from that of animals and plants. Even though the organic process of transformation of materials is similar in humans and in other animals at the bodily level, Schaffle quite rightly argued, that the social economics of the exchange of materials was very different from the natural economy of exchange as practiced by other organisms.

Economic regulation of social metabolism depended on the conscious needs and reasons developed by society. According to Schaffle, socially manipulated goods, other than raw materials, contained a quid of uniqueness, spiritually, rationality, work and social techniques that made them completely different from the goods required for animal life. Traces of Marxian thought seem to hover around these words. Work makes the social exchange of materials possible and this work is, at a high level, conscious, spiritual, guided by rationality. The rational activity of intelligence, feeling, will makes the energy and the matter in nature available to humans, modifying, dis-organising and re-organising both energy and matter in order to meet humanity's specific needs. Thanks to agriculture and animal husbandry, the same process for the production of food rationality

dominates the whole organic kingdom of nature: nutrition becomes both rational agriculture and culinary art.

Concepts Of Schaffle's Social Metabolism:

First concept is *nature*, which meant as a "font or spring" and as the "place of dejection or evacuation" for the exchange of matter. Nature was one of three factors of production identified by Schaffle, which could be associated to labour and capital (the influence of Marx). Nature demonstrated two contrasting aspects in its relation with society without this help having to be group of "free goods", (*res communes*) which have recently been defined as being "service supplied free of charge by the ecological systems of society" for the good functioning of the support system for life on Earth" (Costanza, 1997).

Second concept was that of *scarcity.* For Schaffle quantitative scarcity and the qualitative lack of natural resources was the basis of all need, hence of the social economy of exchange which was effectively a complex of means for satisfying needs. Here he seems to be reasoning along the lines of the classical economists, except, one should remember, he was writing in 1874.

Third concept was that of labour, in the broadest physical maning of the word: every effort made by living forces, every use of this living force. According to Schaffle, both the labour of every person and every service (utility) supplied by a thing, every service and every personal use was labour. This definition is quite close to Lilienfeld, for whom labour is the combination of the physiological forces of natural organism with the forces

of human bodies or, to use other formula, the combination of matter and force.

Technology Socialization: A Paradigm Shift In Agriculture

Acharya *et. al*, (2012) considered as a complete level of technology socialization when it gives freedom to the farming community in respect of adoption, non-adoption, rejection and discontinuance and also as per there level of suitability they cope with or decide to select.

Socialization is a process to provide an individual with skill and habits necessary for participating within their own society; a society itself is formed through a plurality of shared norms, customs, values, tradition, social roles and languages.

The socialization has been christened as an alternative social process to purvey the transfer process in multi way channel and to a multi-dimensional projection. In the same study, the adoption, discontinuance, rejection and reinvention have been conceived as socio-psychological polymers against a single stimulus i.e. technology exposure.

Socialization is thus, the means by which social and cultural continuity are attained (Clasusen, John A. 1968).

Many a time we make mistake in understanding the differences between concept and commodity, need and devices to meet the need. A bag of fertilizer thus presents some inputs, not the concept of nutrient management for getting desired yield, a tractor, on the other way, is just a machine to harrow the land, not exactly in the concept to get the drudgery eliminated substantially and done the work with less of error.

Then, what is left is the socialization process that would combine the concept with commodity, techniques with tools, technology with culture. After having a technology socialized we can expect a complete social process in place. So, technology socialization process can be conceptualized a comprehensive process though with a technology, the combined concept and commodity, has to undergo accommodation, assimilation and accultural process and ultimately it would be transformed into a social character e.g. a TV set in an electronic shop is just a commodity, after being purchased and placed in a drawing room of any home, has become an ingredient of family process. The family member now start socializing with this TV set by ascribing family status, taking it as marriage negotiation item, getting informed and entertained, deriving pride and galore by possessing it and so on. This kind of commodity inflow into a social system through acculturation is called creatization.

Acculturation has been happening to every farm families with any exotic technology has been attempted to be diffused in a social system. Once a technology is being introjected, on may adopt, reject or reform it and in the passage of its subsequent adaptation, one may discontinue or reinvent it. This whole lot of process undergoes, again, a social osmosis process.

A social osmosis is basically acculturated screening process for desired assimilation and also a decided rejection over a proposed technology. It is just like a socialization process that a new born baby undergoes, some he/she undergoes an experiential learning process.

It is our cliché and conventions, we seldom take the logic of rejection and go happy to brand the rejecter a ‘laggard’ a category of non-adopter to be branded as an ‘offender’ for not adopting anything prescribed by ‘experts’.

A technology socialization process logically includes all possible outcome or responses to technology prescription, i.e. adoption, rejection, discontinuance, reinvention, elimination and alienation too. These all being done by a farmer (or by any individual in this world) to get his existence adapted to the change process through a perfect thought process and concluding in the most intelligent manner as well. In most case we are not enough ready to catch up with this thought process happening in the mind set of a farmer in congruence with the change process in market, climate, social echelons, group dynamics, leaderships, policies and politics in all levels *viz.* micro, meso and mega.