

Working paper

**COMMUNITY ADAPTATION AND  
SUSTAINABLE LIVELIHOODS:  
BASIC ISSUES AND PRINCIPLES**

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### **References**

## **CHAPTER 1: Introduction**

Community adaptation can provide the basis for sustainable livelihoods in a context in which human society is co-evolving with the ecozone in which it is located; under the influence of external forces of policy, technology, trade, etc. Put simply, human society takes its raw materials from the environment to produce useful services and products for consumption, and the wastes are returned to the environment to be acted upon by natural processes. We use the term socio-economic subsystem to describe the social and economic actors and processes and the complex interactions among them. The social aspects include the political, cultural, emotional and spiritual dimensions and the related institutions and rules by which human society is organized and functions. The economic aspects include those actors and processes primarily involved in the production and distribution of goods and services to satisfy some need or demand. In many instances, the actors and processes in the social and economic spheres are the same, there is an intimate relationship between them and hence the term socio-economic.

The ecological system refers to the earth's natural systems either as single ecosystems such as a coral reef, a mangrove swamp, a stand of Douglas fir, one of the Great Lakes; or planetary systems such as the ocean-atmosphere coupling. An ecological system is comprised of various interactive groups of species, genera, families and communities of organisms. In certain regions ecological features are present which define the region as a bioregion. We use the term ecozone to describe these planetary subregions which include coastal zones, arid and semi-arid lands (including the prairies), mountains, forests, large agricultural plantations, and towns and cities.

The search for sustainable development or sustainable livelihoods is a search for harmony between the activities and inherent evolutionary processes and tendencies of the linked socio-economic and ecological systems.

This linked socio-economic and ecological construct is what we refer to as the socio-ecological system. This could equally well be called a socio-natural system. In this arrangement, the socio-economic subsystem is embedded in and dependent on the natural or ecological system.

Because of this dynamic interactive process, we need to consider the community in this environment as a single system which can be described as a socio-ecological system. An understanding of the attributes of a socio-ecological system then becomes a fundamental pre-requisite to a region's perception of community adaptation and how such adaptation can provide a basis which can result in sustainable livelihoods as a desirable outcome.

Recent fieldwork by the IISD in the use of Adaptive Strategies as tools for Sustainable Livelihoods in the Arid and Semi-Arid areas of Africa examined ecological, policy and institutional factors and their relationship with sustainable livelihoods. The community and policy reports from this work provide detailed explanations of adaptive strategies as local responses to stresses and change in the communities environment. However, it was the general conclusion that socio-ecological systems are little understood and this has resulted in the legislation of inappropriate policies which often disrupted local adaptive strategies and destroyed sustainable livelihood options.

This document attempts to describe attributes which are intrinsic to most socio-ecological systems. Eight attributes are defined and explained in the context of their ecological, socio-economic and socio-ecological features in which the ecological and socio-economic are subsets of the socio-ecological system. Because these terms are rather unwieldy we will use "human" to replace "socio-economic" and "natural" to replace "ecological". By outlining the interactions between the human and natural system it will be shown that: ***sustainable livelihoods are the outcome of a complex "web of functional inter-relationships in which every member of the system is needed and participates."*** This approach facilitates a holistic approach to people making a living within a given ecological context.

In addition, operational principles for action and their implications for policy making will be addressed in the final sections. Although these attributes have been drawn from research conducted mainly in rural communities, the principles are generic enough to be applied to any socio-ecological system. Using the operational definitions of sustainable livelihoods and adaptive strategies (Singh and Titi. 1994), these attributes can directly assist future researchers, policy makers and communities in understanding possible options for achieving sustainable livelihoods.

The human economic system is one of the many complementary and contributing parts of the over-all socio-ecological system. This aspect is governed by politics, economics, social and cultural policies, consensual

agreements and human institutions. This becomes interlinked with how societies are connected to, and function within the diversity of the eco-system. Diversity within the human system interacts with the diversity of the ecological system, which results in immense complexity and in conflicting approaches to systems analysis.

There are many reasons for bringing together these generic attributes or theoretical principles as they may variously be described. They are necessary in order to:

- help understand the reality of the community with its vast array of beliefs, knowledge, strategies and practices situated in a dynamic and interlocking social and ecological system from which livelihoods are derived.
- establish an epistemological basis for policy making in the face of uncertainty, constant change and complexity.
- develop an approach to identifying entry points and interventions, which when made at these leverage points lead to massive amplification and self-organization within the system to significantly increase the sustainable livelihood options.
- help transform intuitions and anecdotes into a deeper understanding of the complexity of socio-ecological systems.
- develop a framework in which global community action can be networked and synergised into a potent countervailing force to globalisation.
- separate fundamental characteristics from fascinating idiosyncrasies and incidental features.
- guide action and behaviour so that they become consistent with vision (sustainable livelihoods for all).
- identify tools which are more effective in analysing and drawing conclusions in today's world (compared to the badly blunted tools in current use, such as trend analysis, determination of equilibria sample means etc. in the face of non-linearities of complex adaptive systems).

Sustainable Livelihoods have been defined by Singh and Titi (1994) as people's capacities to:

*"generate and maintain their means of living, enhance their well-being and that of future generations. These capacities are contingent upon the availability of and accessibility to options which are ecological, socio-cultural, economic and political and are predicated on equity, ownership of resources and participatory decision-making."*

The notion of sustainable livelihoods incorporates the idea of change and uncertainty and locates it analytically in the concept of a socio-ecological system. The latter can be defined as the space in which political, cultural, religious, social, economic, biological and geo-physical factors of an

environment simultaneously interact with and in combination with each other to produce a variety of functions, processes and products, which shape the way a community makes its living in a given ecozone.

To acquire a deeper understanding of the interactive processes of learning, knowledge collection and adaptation within a given ecosystem, it is necessary to take a holistic and evolutionary approach.

In Chapter 2, we describe in some detail those attributes which seem to be the characteristic of all socio-ecological systems. Interestingly, these characteristics also define systems which are now called complex adaptive systems and this links our work to a growing body of knowledge and theory. We have drawn a lot from this body in what follows (see especially Holland, 1995). Such a system is characterized by diversity, categories, measures of association, non-linearity, resilience, co-evolution, learning capacity and community participation. These attributes will be defined in the context of their operational significance so as to illustrate their universality throughout other socio-ecological systems.

Each concept is first defined and their relevance to the human and ecological sub-systems is then discussed. This is followed by an examination of the concept in the integrated socio-ecological system.

In Chapter 3, we present some principles to guide study and interventions related to community adaptation and the quest for sustainable livelihoods. This Chapter essentially consists of two quoted extracts. The first extract is from Ludwig, et.,al (1993) in *Science* (Vol. 260) and relate to the "principles of effective management" for the system with the attributes we have described. The second extract entitled "Principles of Sustainable Livelihoods" is taken from a 1996 report published by the Society for International Development and the Center for the Respect of Life and the Environment based on 1995 workshop in which IISD participated.

## **CHAPTER 2: Attributes of Socio-Ecological Systems**

### ***Attribute 1. Diversity***

## 1.0 Concept

Diversity is the variety and range of forms, features, functions and opportunities in nature and human society. It can be measured in ecological terms at the level of the individual, the species, the family, the community, the ecosystem or in political terms at the individual, household, community, provincial, national or international levels. The existence of species within a system is dependent on not only the climatic and geo-physical state of the area; but also, on the functions and interactions with other present organisms and species in the ecozone; where, *"each new species opens still newer possibilities for interaction and specialization, with still further increases in diversity."* (Holland, 1995) Diversity in the context of socio-economic structures include policies, private and public actions, different social groups, institutional structures, etc.

### 1.1. Diversity in the ecological subsystem

Diversity, within an ecological system, is measured by the number of interacting organisms within the given area, which in turn, determines the complexity of the system. The complexity of an ecological system is also measured by the degree of specialization. Within a specialized system, such as the arid and semi-arid ecozone, there are few species and many individuals. In a generalized system, such as a tropical forest ecozone, the number of species is high but there are comparatively fewer individuals. This environment is therefore marked with a larger biomass, an increased number of alternative energy and nutrient pathways and, a greater number of regulatory mechanisms.

At the same time, neither specialization nor generalization generates stability within the system. As one species is eliminated from the system, the processes of substitution, adaptation and complementation occurs concurrently. The subsection below discusses how communities maintain their livelihoods by utilization of resources found within the environment. It addresses the human potential to modify, adapt and respond to situations and changes within the ecosystem, hence increasing the community's chances of survival.

### 1.2. Diversity in the social subsystem



A socio-economic system is marked by people made rules, institutions and structures, to either protect or facilitate the functions and efficiency of the various sectors of society. Distinctive features of diversity within a socio-economic system include race, religions, cultures, foods, languages, employment opportunities, products and services for consumption and ways of life. This measure of social diversity may be disrupted by religious or socio-economic impositions. For instance, a religious fundamentalist state may cater for only one religious group or culture in a country. The contribution of other religions are thus neglected and the versatility of the human system is undermined. Similarly, the uniform imposition of structural adjustment programs across different socio-economic community types can be disruptive of local livelihood systems.

Skills, knowledge, background, culture and age stratification all contribute to the diversity of the socio-economic system in the forms of employment or occupation. In turn, this determines the type of society or community in the given area, such as, an agropastoralist society, consumer society, agricultural, industrial, or fishing community.

In most communities, culture and religious ideologies directly influence the manner in which livelihoods are built and maintained. During the 13th century, capitalist societies throughout Europe were built upon doctrines, which called for expansion of land, prosperity, power and wealth. This resulted in increased and continual environmental and human exploitation for economic growth. On the other hand, some cultures believe that their livelihoods are determined by nature. Consequently, their livelihoods would maintain more conservationist or sustainable practices.

Political, economic, educational, religious and cultural institutions are in themselves, measurements of diversity within a socio-economic system. It demonstrates a community's ability to accept various views, opinions and livelihoods within the 'whole'. Interactions are maintained mainly through the media, local gatherings or meetings and constant exchange of information.

### 1.3. Diversity in the socio-ecological system

The socio-ecological system is comprised of interactions between the human and the ecological subsystems. These interactions are usually the result of the human use of the natural system for survival and livelihoods. Ecosystems are considered to be 'productive' when they support human populations. A livelihood is built upon the wealth of the ecosystem by the choices that are available for the community's use. Diets, building materials for houses, farming practices and crops grown, mode of dress and overall activities are all influenced by the diversity of the environment, in addition to external factors such as trade, communications, etc. A community's habits and traditions are influenced by what is available for use and consumption in their immediate

environment. Changes to their environment, such as depletion of a resource, will lead to search for a substitute. Compensation for change, loss or destruction is determined by the options available. It is important to note, however, that the over-all socio-ecological system behaviour is not merely the result of the interaction of the two subsystems mentioned, but is also the results of factors external to system which impact on it. These factors are typically driven by policy directives and technological innovations.

Diversity increases options and alternatives. Options are the number of pathways which are made available to people and other species seeking survival. This information helps to ascertain whether or not a community can adapt to certain changes within their system and maintain their livelihood base. Options allow for risk reduction and facilitates the process of adaptation in situations where survival is at stake. For instance, mixed cropping can contribute to a nutritionally well-balanced diet for the farming households; it can guard against the loss of an entire field in times of drought; and such farming can be beneficial to pest control and soil fertility.

Diversity, offers communities a variety of choices. Choices are the deliberate responses of communities to the challenges of situations in the socio-ecological environment around them. Economic, social, cultural, religious, political and managerial paradigms will affect adaptive strategies of a community. Human institutions determine the value or worth of the crop, production, accessibility to resources, taboos and beliefs, legality of actions, and gender roles in the community.

The rich and dynamic diversity of socio-ecological systems which is the basis for both new opportunity and resilience can be overwhelming to both researchers and policy makers. Fortunately, some categories or groups with similar characteristics are found in both social and natural systems. However, there is a tendency here to over generalize similarities with categories and this leads to serious error both in research and in policy making.

## ***Attribute 2. Categories***

### 2.0 Concept

Natural categories such as species, families, communities, etc., can be found in the midst of diversity. Categorizing, as a human activity, involves planning and grouping according to commonalities of distinctive features of an object or organism. It is the agglomeration of common properties which allow common definition. The utility of categories can be illustrated by the 'jigsaw effect' whereby the pieces are meaningless and confusing until grouped according to common features. Upon linking the various pieces and placing them into

groups, patterns eventually begin to surface and a clearer descriptions can be made of the system.

## 2.1. Categorizing within the ecological subsystem:

Although this process limits the diversity of characteristics of individual species, categorization can prove to be useful in simplifying and creating order in the system. For example, species congregate naturally into herds, schools, populations and habitats based upon internal behavioural traits and habits and the need to adapt to the surroundings.

Kauffman (1995) describes natural categories as due to: "*the exquisite power of self-organization .... which may well be the ultimate wellspring of dynamical order.*" What accounts for this behaviour of the organisms within the ecological systems is perhaps the need for self-regulation of their intricate environment. Categories help researchers by enabling overview and synthesis of the interactive processes in the socio-ecological system. Of course, each hierarchy and category will have its own 'organized' feedback regulations and basic governing features which further facilitates predictions of similarities in behavioural patterns, actions and relationships with other factors in the environment.

## 2.2. Categorizing in the social subsystem

A community separates resources for food, trading or income earning potential; shelter, fuelwood, landmarks, etc.; and in so doing, provide its members with an easier means of keeping inventory of the available resources. Many ecosystems are categorized according to order of importance. When emphasis is placed upon the preference of one category over another, the value of the latter depreciates. Loss of worth results in greater potential for destruction of the species. The resulting repercussions are only experienced by the ecosystem long after the damage.

Socialization amongst members of a community result in categories according to status and position. This creates levels and ranks in business and community organizations, religious and other institutions. For instance, the community might be organized according to occupation, e.g., councilors, lawyers, doctors, farmers or fisherfolk; social categories, e.g., children, adults, men, women,

etc. and on cultural features, e.g., language, religious belief and race. Categories can prove useful to decision makers in that they provide effective means of establishing which groups interact with each other and for what purposes. They are also the sources of conflict as well as creative tension.

### 2.3. Categorizing in the socio-ecological system.

The existence of multiple categories in each subsystem interacting with each other creates multiple levels of complexity. The existence of categories provide useful entry points for study and action, but the emergent patterns of livelihood systems are not usually the simple aggregate sum of the individual contributors of each category. To fully understand how socio-ecological systems evolve and adapt to change, interactions can be examined in light of patterns and commonalities of the over-all system.

In complex socio-ecological systems, patterns evolve from similarities of behaviour, shapes, colours, size and so forth. In this context, patterns are dynamic and embodied in all relationships within the system. At the same time, patterns might create the illusion of distinctive features and boundaries within the ecozone. Many communities have recognized these "patterns of nature" and have been able to distinguish for example, climatic changes and seasonal changes throughout the year and migration of species to specific areas- based upon rainfall, water and food availability. These patterns are emergent properties resulting from the complexity of the system and not from the properties of the individual components. Such patterns might provide useful basis for integrated indicator systems.

The community's observation of their immediate environmental dynamics have enabled them to predict (to a certain extent), some changes which can directly affect their livelihood. In South Africa, good rains are predicted on "the presence of mopane worms, a ring of clouds around the moon and winds from a northerly or northwest direction". Poor rains can be predicted by "winds from a south, south west direction, silence of frogs and millipedes, arrival of first rains after late September and the presence of large number of locusts".

To work in a holistic manner with categories and patterns, an appropriate unit of analysis is required. Such a unit must be small enough to be manageable but at the same time include a minimum core of the social, economic and ecological variables.

#### 2.3 1. Analytical Units

Analytical units provide the frameworks for recognition and measurement of the complex and varied inter-action of social, economic, political, cultural and ecological variables. Decision and policy makers, as well as researchers, use these units as building blocks for describing and collecting information about the human and natural systems. A bad choice of analytical units will result in difficulties, for example, in integrated decision-making at the end of a study or investigation.

To be useful in understanding adaptive strategies and sustainable livelihoods, we propose that the smallest unit of analysis must include both the socio-economic and the ecological and not one or the other and hence our proposal to use the socio-ecological unit for study and action in community adaptation and sustainable livelihoods.

Until we are able to see and use the socio-ecological unit as the smallest or indivisible unit for thought and action, our efforts at holistic approaches will remain mired in a sea of reductionism.

### ***Attribute 3. Tagging***

#### 3.0 Concept

Tagging is a mechanism that facilitates the formation of aggregates and boundaries in complex adaptive systems. Tagging helps us to discern the mechanisms that enable simple agents to form highly adaptive aggregates and the kind of boundaries that demarcate these adaptive aggregates. Further, it assists in understanding how agent interactions within these boundaries are directed and co-ordinated; and how the contained interactions generate behaviours that transcend the behaviours of component agents.

#### 3.1 Tagging in the ecosystem

Tagging mechanisms are widespread in ecosystems and include for example the queen in an anthill or a beehive around which a whole system of activities and interactions take place or a mating pheromone in an insect population. Others could include a feeding site or a site for egg laying in a swarm of fish, living in a coral reef.

#### 3.2 Tagging in the social system

The most familiar example is a banner or flag that is used to rally members of an army, or people of similar political persuasion. (Holland, 1995) Other examples could include cultural or religious symbols or leaders or even the culture or religion itself. Chiefs or political leaders are also examples. Vested interest and/or collective self-interest of a social system is perhaps the most pervasive in today's world.

### 3.3 Tagging in the socio-ecological subsystem

Tagging in the socio-ecological system may eventually evolve into what is now called traditional ecological knowledge and expressed as a cultural or art form. Because of the combination of processes and interactions with and within the ecosystem, the information is internalized and becomes characteristic of the community. Communities are then able to describe and even predict behavioural patterns of species or groups within the ecosystem upon which their survival depends. When ecological degradation is high on the social agenda, it serves as an excellent tagging mechanism to mobilize people and resources for action. Tagging may result in labels which are highly informative of the complex adaptive system from which it emerged.

### ***Attribute 4. Non-linearity***

#### 4.0 Concept

The concept of linearity, which assumes that the sum of the parts will add up to the whole and which is the basis of much of our deterministic and predictive tools in reductionist science, does not produce results consistent with observations when applied to living and constantly evolving systems such as the socio-economic system or the ecological system. In each of these there are positive and negative feedback loops which constantly generate uncertainties and surprises. In other words, the future of these systems is inherently unpredictable in any great detail. Nonlinearity is the term used to express the relationships which seem to result in multiples rather than sums of the unpredictable overall behaviour of complex adaptive systems results from the interaction among the parts rather than the properties of the individual parts.

Positive and negative feedback loops are the mechanisms which drive the non-linear behaviour of complex adaptive systems whether they be human society, the economic system, a given ecosystem or the global ecosystem. These

mechanisms are illustrated in the context of the socio-economic and ecological sub-systems below.

#### 4.1 Non-linearity in the ecological subsystem

Examples of non-linear behaviour in and of ecosystems are common place and constantly observed when studying natural phenomena. Populations of species may suddenly die of or they may suddenly proliferate beyond prediction. Such events maybe triggered by common place, agents of change such as wind, fire, diseases, intense pulses of grazing or application of a pesticide, etc. or a combination of these.

On the other hand, we have experienced the spectacular recovery of river ecosystems such as the Cuyahoga (the burning river which was once on fire because of its heavy pollution) and from which edible fish can now be caught, or the recovery of the Rhine after the massive chemical spill.

The putative effects of clouds and vegetation on the global greenhouse mechanism and their ultimate contribution to human induced climate change are interesting examples of positive or negative feedback systems - coupling the global circulation system with natural ecosystems.

Holling (1986, 1995) has proposed four primary stages in an ecosystem cycle to explain such observations. The stages are exploitation in which rapid colonization of recently disturbed areas is emphasized; conservation in which slow accumulation and storage of energy and material take place; release or creative destruction in which tightly bound accumulation of biomass and nutrients becomes increasingly fragile, until it is suddenly released by change agents; and finally reorganization in which processes of mobilization and immobilization minimize nutrient loss and reorganize nutrients to become available for the next phase of exploitation.

In the event of gaps or loss of part of the cycle, there are always substitutions and adaptations. Substitutions may alter a cycle and trigger off a series of events or reactions within the system. These reactions may ultimately lead to new products, processes and mutations.

Any shock or stress to system may therefore result in severe damage to ecosystem health or it may bring increased resilience or vitality.

## 4.2 Non-linearity in the social subsystem

Current economic analysis does not provide any direct insight into how the behaviour of micro-economic agents affects the macro-economic context. It argues that aggregate growth depends on aggregate investment especially in goods such as machines that would improve productivity; and further postulates that possibilities for growth are ultimately limited by diminishing returns such that each successive round of investment becomes less and less productive and stagnation eventually ensues. The almost perpetual growth in twentieth century led to the conclusion that growth depended mainly on non-economic factors which led to the postulate of a "coefficient of ignorance" which describes the incapacity of economic analysis to explain growth.

Joseph Schumpeter's work in the first half of the 20<sup>th</sup> century explained economic growth as due to innovation - new products, new processes, new markets, new resources and new organizational forms. According to Schumpeter, it was the entrepreneur who was the creative force driving the economic system on to greater heights of achievement. In other words the macro was constantly evolving out of the micro.

Brian Arthur (1996) has argued that increasing returns are the dominant mechanism behind the most modern part of the economy, the knowledge based part. He describes the hallmarks of increasing returns as market instability where the market tilts to favor a product that gets ahead, multiple potential outcomes, unpredictability and lock-in. He lists the characteristics of high tech markets which encourage increasing returns as: upfront costs, network effects and customer groove-in. He concludes that the bulk processing world (metals, textiles, agricultural commodities) allows constant improvement, constant optimization and favors hierarchy, planning and controls. On the other hand, in the knowledge based part of the economy "the rewards go to the players that are first to make sense out of the new games booming out of the technological fog, to see their shape, to recognize them". This demands flat hierarchies, mission orientation and a sense of direction rather than 5 year plans. It requires adaptation in the proactive sense, watching for the next wave that is coming, figuring out how it will work and setting the company up to take advantage of it. *"Adaptation drives increasing returns not optimization."*

## 4.3. Non-linearity in the socio-ecological system

Because of non-linear processes in the socio-economic and ecological subsystems, many of the problems within the socio-ecological system cannot be solved by use of linear mathematical equations and reductionist scientific



rationale. The reality being, how do we live with constant change and unpredictability today and at the same time allow for the livelihoods of the future generations? Adaptive strategies of households and communities as a series of processes and reactions within the socio-ecological system, provide clear examples of constant interaction, inputs, adjustments and regulation of the system's activities. Macro-economic policies (such as The World Bank/IMF structural adjustment programs) impacting through the livelihoods equation can intensify resource extraction to the point of ecosystem destruction. It is through non-linear mechanisms as well that the poverty-population-environment downward spiral can be induced by shocks to the system.

### ***Attribute 5. Resilience***

#### 5.0 Concept

Resilience measures a socio-ecological system's ability to recover from shocks and stresses. At the same time, it determines the efficiency and strength of adaptive and coping strategies of the community within the system.

#### 5.1 Resilience in the ecological subsystem

Stability of a system measures the ability of that system to withstand shocks and stresses over time. A system with many interactions and functions simultaneously occurring, shows higher order and stability. Ecosystems are protected by fall-back mechanisms, such as diversity of species and functions, which protect the entire system. Ecosystems exhibit strength and resilience when they function efficiently as single system making optimal use of all its parts, properties and inter-relationships.

Resilience in other words is the ability of a system to bounce back to a single or to multiple states while maintaining its health and essential integrity.

Closely related and sometimes confused are the terms fragile and marginal. A fragile ecosystem is non-resilient, but might be highly productive. A marginal one is not highly productive but might be resilient.

#### 5.2 Resilience in the social subsystem

Resilience of the social system is the capacity of people and institutions to self-organise, maintain order and to function normally in the face of multiple shocks, such as war, famines, changes in the availability of jobs, resource depletion, economic downturns and social distress. Social structures and institutions which do not learn, adapt and evolve overtime reduces the resilience of societies and communities. Inflexible institutions make for a brittle society. A well educated not necessarily well schooled) and constantly learning community enhances resilience.

### 5.3 Resilience in the socio-ecological system

Resilience in the socio-ecological system is a result of synergistic interactions among its social, economic and ecological spheres. These can be cemented together by cultural traditions, respect for people and nature, spirituality, and an openness to learn and adapt. On the other hand, fragmentation can occur as a result of ethnic strife, resource scarcity and the absence of hope.

Resilience is the bedrock of sustainability and is predicated on subsets such as social equity, economic efficiency and ecological integrity. However, competitive and divisive forces among these must be carefully addressed with a focus on building on their creative potential rather than seeking to nullify them.

### ***Attribute 6. Co- Evolutionary Dynamics***

Evolution is the emergence of a species or system through which process that species or system achieves an enhanced capability of dealing with its environment. The process may be the result of Darwinian natural selection, or of a self-organizing system or of spontaneous natural order. Co-evolution is the process whereby the evolving organism or institution changes the environment in which it is evolving. In other words, the evolutionary changes in one part of the system induces evolutionary changes in other linked parts of the system, so that multiple evolutionary pathways evolve at the same time. The metaphor of fitness of evolutionary landscapes has been used to describe how populations would evolve in tandem with their ability to climb the hills representing high performance. Evolution was shown to select for populations with the ability to learn rather than for populations with optimal behavior so that the performance hills and the population co-evolve.

The terminology and concept of equilibrium when applied to a socio-ecological system is likely to be misleading at best. Similarly, the traditional systems approach which utilizes a mechanical representation of a system isolated (or frozen) for the purposes of study, while representing an improvement over piece-meal approaches is inherently inadequate for dealing with socio-ecological systems and consequently with sustainable development. Models which embrace the realities of complexity and co-evolutionary dynamics are now feasible and likely to give better approximations on which more realistic policy making can be based. (Clark et, al. 1995) Our instruments of research and analysis have been and continue to be so woefully blunt that ironical and perverse outcomes of well intentioned policies should come as no surprise.

## ***Attribute 7. Learning***

### 7.0 Concept

In the previous section, we argued that evolution selected populations with the ability to learn, rather than populations with optimal behaviour. Further co-evolution implied that the advantage to be gained from a particular behaviour depends on other behaviours present at that time. In other words, it is the capacity to learn, i.e., assimilate, process and act on new information; rather than the knowledge content of a population, community or individual, that leads to success. Equally important is that the worldview, paradigm, conceptual framework (call it what you will), that is used consciously or unconsciously in the interpretation of new information be allowed to evolve in tandem with evolutionary landscape to which it will be applied. While our information and knowledge society is busy acquiring and communicating new information, the need to use a dynamic and evolving analytical framework for decision and policy making is not often recognized. The problem with change is not so much the lack of new ideas or information, but getting rid of the old ways of doing things. The basic reason for this might in fact be our obsession with new information in the face of, or disregard for, correspondingly new paradigms for analysis and action.

### 7.1. Learning in and of ecosystems

Species exhibit learning abilities through adaptive traits and habits. Many species survive in an ecosystem due to climate, soil type, food supply and

habitat. The ability to select what one needs from an environment is an internally acquired trait which stems from trial and error. Senses play an important role in survival in the environment. Species are constantly relying on their sense of smell, touch, taste and hearing to gather food, mate or migrate.

Successful species are able to rapidly learn the rules of success in an environment in which the rules are constantly changing. Such changes occur in populations of a given species and others as well as in food and habitat availability, colonization by other species including man as well as natural fluctuations in environmental conditions. People's knowledge of nature will therefore at best be imperfect. The internal mental models we use will always colour our knowledge and understanding of ecosystem behaviour, and the more removed the environment in which these mental models evolved from the environment being studied, the less chances we have of understanding. Hence, the colossal danger we face from the increasing dominance of western Newtonian paradigm of the world and rapid rate of western globalisation.

We have shown earlier that the behaviour of natural systems is inherently uncertain and unpredictable and therefore our approach to learning and making decisions about these systems must be by cautious experimentation and adaptive management.

Knowledge is often context dependent and the most knowledgeable people about a problem are very probably those immediately connected to it. Approaches to harnessing and mobilising such knowledge productively, include community participation, multi-stakeholder processes, participatory learning and action, and participatory action research. These approaches must therefore become the rule rather than the exception in resource and ecosystems based inquiries and the conduct and formulation of related policy.

## 7.2. Learning in human society

The common cliché "we are in the information age" does not readily answer the question "so what?" So what does that mean for sustainable development policy making? For the way people behave, for sustainable livelihoods, etc.? But clearly the implications are significant.

Firstly, we need to acknowledge that the world is not uniformly in the information age or indeed any country, community or even household. For purposes of practicality, we will assume that some communities are uniformly in the information age, implying that the majority of its members have about the same level of computer and related communication skills or lack of skills, access to information, etc.

In most countries, we will then find a range of community types varying from hunter-gatherer types through agricultural, industrial, service based, post industrial, knowledge and information based to post capitalist types. In each of these community types the capacity to learn or handle large amounts of information will vary (typically increase) from left to right of the spectrum. However, the knowledge base and knowledge systems of each community type is equally valid. To understand issues related to community adaptation and sustainable livelihoods, we must therefore develop and use approaches which accept the validity of different knowledge systems and seek the synergy among them.

The bases for accepting such validity are not just mutual respect and goodwill but they are rooted in the fundamental questions of the philosophy of science such as: Can science know what it does not know? and in conclusion's such as those reached by Einstein that we can only test the relationships between our concepts and our observations and never the relationship between these and the "real world".

The biggest challenge to increasing the rate of learning in human society is institutional change from rigid, permanent hierarchical bureaucracies designed to follow rules established on the premise of a deterministic world; to more flexible non-hierarchical, interdisciplinary institutions capable of adapting to constantly changing challenges and information sets. The recent literature in organizational development on "teams" and "the learning organization" is a step in the right direction while the literature on re-engineering the corporation is unhelpful being more of the same mechanistic approach to management.

Parson and Clark (1995) have concluded that generally lacking are theories of social dynamics that can complement the emerging theories of ecosystem dynamics to produce real understanding of the long term, large scale interactions of environment and development. They further posit that learning as a manifestly dynamic process provides a theoretical counterpart to social theory based on power and interest which characteristically yields a static formulation.

In today's world of increasing uncertainty change and complexity, there can be no experts in fields as broad as sustainable development or sustainable livelihoods. This is so not because of the scope and interdisciplinary nature of these subjects but because of the inherent uncertainty and co-evolutionary nature of systems involved. The concept of co-learning in which people with different mental models learn from each other and improve their capacity to learn and adapt to changing circumstances and to change circumstances is likely to be much more useful and relevant than that of "an expert". This concept leads naturally to processes such as participatory action research (PAR), participatory learning and action or community participation which is

well documented in the literature (see for example, Pretty et al. 1995; Rennie and Singh, 1996).

When we consider that communities or human society in general is a living evolving system much as natural ecosystems are, the possibility of an integrative dynamic framework for planning and policy-making becomes real. Both the significance of the community and the reasons for its actions are embedded in the web of finely inter-related factors. Adaptation as applied to ecosystems and ecological structures is a: "process by which and whereby an organism or a community of organisms fits itself to the environment... {and where} experience guides change in the organism's structure so that as time passes the organism makes better use of its environment for its own needs." (Holland, 1995)

The parallel with community adaptation is striking. Communities in a given habitat possess extensive learning capabilities and diverse strategies of absorbing information, interpretation and reactions to circumstances. People intuitively or deliberately draw from this entire repertoire in their search for livelihoods. It is therefore an appropriate starting point and premise from which to design interventions which have sustainable livelihoods as their desired outcome.

Michael (1995) concludes that there are two kinds of learning: "one for a stable world and one for a world of uncertainty and change. Learning appropriate for the former world has to do with learning the rights answers and learning how to adapt and settle into another mode of being and doing. Learning appropriate for our world has to do with learning what are the useful questions to ask and learning how to keep on learning since the questions keep changing."

### **CHAPTER 3: Guidelines and Principles**

In the introduction to this paper, we answered the question "*why is a theoretical understanding of socio-natural systems helpful?*".

In this Chapter, we attempt to answer: "*how and to whom is an understanding of the attributes of socio-natural systems helpful?*"

Let us take the latter part of this question first, i.e., who might benefit from this work. The first group that comes to mind comprises researchers, practitioners and teachers of sustainable community work or those in the more traditional but related fields of community economic development and integrated rural development. The group that we expect will most benefit however, is the mixed group of people working either at the grassroots level, in policy making or in research who would like to help facilitate a process of community self-empowerment especially for those communities facing a range of impoverishment processes and the consequent loss of livelihoods.

Resource and ecosystem managers, especially those involved in developing approaches to sustainable utilization of renewable resources or in maintenance of ecosystem health, should find here some useful ideas.

Whichever of the foregoing groups the reader might belong to, he or she will be faced with the dilemma of creating change in established ways of doing things whether in research, policy making or grass-roots advocacy work. For example, the traditional structure of the "project" with fixed goals, objectives, timelines, activities, outputs and beneficiaries will be frustrating at best. Yet to work in today's institutions, we must find some approach to planning, management and policy making which will be more consistent with reality than we have been able to achieve so far. To do this effectively, we will need to use a mix of "top-down" and "bottom-up" approaches as well a mix of reductionist and holistic or complex adaptive systems approaches. We can no longer remain slaves to goals that we might have agreed to, but must be prepared to embrace uncertainty, change and surprise as our natural allies. We can and must stop making assumptions which assume away the complexity of real world situations because more and more, we are learning how to deal with complexity.

To start the transition, we need a vision of sustainable livelihoods bounded by principles which make it realizable. We suggest the Principles articulated by the Society for International Development and the Centre for the Respect of Life and the Environment as a starting point (See Appendix 2 to this Chapter). We also need some management guidelines to start doing differently what we do know. Some suggestions are presented in Appendix 1 to this Chapter.

### ***Appendix 1. Some Principles of Effective Management***

(Extracted from: "Uncertainty, Resource Exploitation and Conservation Lessons from History" - Ludwig, D.; Hilborn, R. and Walter, C. in Science Vol 260, pgs. 17 & 36)

Our lack of understanding and inability to predict mandate a much more cautious approach to resource exploitation than is the norm. Here are some suggestions for management:

1. Include human motivation and responses as part of the system to be studied and managed. The shortsightedness and greed of humans underlie difficulties in management of resources, although the difficulties may manifest themselves as biological problems of the stock under exploitation.(1)
2. Act before scientific consensus is achieved. We do not require any additional scientific studies before taking action to curb human activities that effect global warming, ozone depletion, pollution, and depletion of fossil fuels. Calls for additional research may be mere delaying tactics.(2)
3. Rely on scientists to recognize problems, but not to remedy them. The judgment of scientists is often heavily influenced by their training in their respective disciplines, but the most important issues involving resources and the environment involve interactions whose understanding must involve many disciplines. Scientists and their judgments are subject to political pressure.(3)
4. Distrust claims of sustainability. Because past resource exploitation has seldom been sustainable, any new plan that involves claims of sustainability should be suspect. One should inquire how the difficulties that have been encountered in past resource exploitation are to be overcome. The work of the Brundland Commission (4) suffers from continual references to sustainability that is to be achieved in an unspecified way. Recently some of the world's leading ecologists have claimed that the key to a sustainable biosphere is research on a long list of standard research topics in ecology (5). Such a claim that basic research will (in an unspecified way) lead to sustainable use of resources in the face of a growing human population may lead to a false complacency: instead of addressing the problems of population growth and excessive use of resources, we may avoid such difficult issues by spending money on basic ecological research.
5. Confront uncertainty. Once we free ourselves from the illusion that science or technology (if lavishly funded) can provide a solution to resource or conservation problems, appropriate action becomes possible. Effective policies are possible under conditions of uncertainty, but they



must take uncertainty into account. There is a well-developed theory of decision-making under uncertainty (6). In the present context, theoretical niceties are not required. Most principles of decision-making under uncertainty are simply common sense. We must consider a variety of plausible hypotheses about the world; consider a variety of possible strategies; favor actions that are robust to uncertainties; hedge; favor actions that are informative; probe and experiment; monitor results; update assessments and modify policy accordingly; and favor actions that are reversible.

Political leaders at levels ranging from world summits to local communities base their policies upon a misguided view of the dynamics of resource exploitation. Scientists have been active in pointing out environmental degradation and consequent hazards to human life, and possibly to life as we know it on Earth. But by and large the scientific community has helped to perpetuate the illusions of sustainable development through scientific and technological progress. Resource problems are not really environmental problems. They are human problems that we have created at many times and in many places, under a variety of political, social, and economic systems.(7)

Appendix 1

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## ***Appendix 2: Principles of Sustainable Livelihoods***

Statement of North America Pre Conference Workshop

On Civil Society, and Sustainable Livelihoods

Washington, D.C., USA, January 13-15, 1995

### **PRINCIPLES OF SUSTAINABLE LIVELIHOODS**

In an era of global social crisis characterized by increasing unemployment, jobless growth, and ecological destruction, we need a broader vision of how people can meet their needs in a sustainable way. Attempting to solve the world's employment crisis using conventional job creation through sustained economic growth cannot work.

The concept of livelihood - defined as "***means of living or of supporting life and meeting individual and community needs***" - provides new perspectives on developing healthy sustainable societies that provide people with secure and

satisfying livelihoods. Sustainable livelihoods provide meaningful work that fulfills the social, economic, cultural, and spiritual needs of all members of a community - human, non-human, present, and future and safeguard cultural and biological diversity. The following is not an exhaustive listing of the components of sustainable livelihoods but an attempt to identify the key determinants.

#### *Sustainable Livelihoods:*

- Promote equity between and among generations, races, genders and ethnic groups;
- Nurture a sense of place and connection to the local community, and adapt to and restore regional ecosystem;
- Stimulate local investment and help to keep capital within the local communities;
- Base production on renewable energy and on regenerating local resource endowments while reducing intensity of energy use eliminating over-consumption of local and global resources and assuring no net loss of biodiversity;
- Utilize appropriate technology that is ecologically appropriate, socially just and humane, and that enhances rather than displaces community knowledge and skills;
- Strengthen the social economy and value non-monetized work as well as paid work;
- Provide secure access to opportunity and meaningful activity for all in community life.

These principles encompass a holistic set of values that are non-exploitative, promote participation in decision-making, emphasize the quality and creative nature of work, place needs over wants and foster healthy, mutually beneficial relationships among people and between people and their environment (especially domesticated animals). It is hoped that these principles and their underlying values can stimulate further discussion.

#### *Public Policy*

Sustainable livelihoods are supported by political, economic and social policies that enable mutually beneficial relationships to develop among people and the whole community of life. Economic globalization, on the other hand, primarily advances supranational corporate interest, and is often inimical to human and environmental well-being. Current policies externalize social and environmental costs, destroy ecosystems, pit localities into competition with one another, and lower standards. Current measures ignore many of the crucial social functions on which all economies depend, in particular women's tremendous productive and reproductive roles. Policies are now geared toward economic growth based on over-consumption by the few while the needs of the

many go unmet. Instead, socio-economic security and equity, meeting the needs of all and promoting authentic human development should be the overall goals of policy formulation.

Policy formulation should begin by visioning processes that involve all sectors of community, as decisions made by all stakeholders better ensure equity, human rights and effective implementation. Central to a broad policy framework that supports sustainable livelihoods are:

- An investment in people and the environment as well as in physical capital;
- Explicit recognition that women's empowerment is central to the achievement of broad-based socio-economic goals;
- Broad public participation in the establishment of research priorities and the assessment and selection of technologies consistent with needs of sustainable communities; and
- New resource accounting and institutional mechanisms for resource allocation and debt management and relief.

### *Political Priorities*

Sustainable livelihoods require public participation and involvement in policy making at all levels to keep government agencies and officials responsive and accountable for their decisions and actions. Political reforms should both limit and make transparent the influence of corporate lobbies and campaign contributions. Corporations should be held accountable to a code of conduct based on principles of social and environmental responsibility. Multilateral trade agreements, treaties, and conventions should not supersede local, state, and national sovereignty. Subsidiarity should be an organizing principle of government, supporting the local rootedness of livelihoods.

### *Economic Priorities*

To promote sustainable livelihoods, power must be rooted in the localized economies. Economic policy should be based on full-cost accounting which incorporates social and environmental costs and benefits. Trade agreements and tax policies should favor local need over export marketing; encourage sustainable production and consumption, and support renewable resource technologies. Such policies will support worker rights, debt relief, and local control over resources within a framework of broader responsibility to share and protect resources.

### *Socio-Cultural Aspects*

Socio-cultural policies should support principles of sustainable livelihoods in education, health, arts and the media, drawing on the wealth of cultural diversity and encouraging exchange of indigenous and modern knowledge,

wisdom and skills. Special attention must be given to transforming structures that perpetuate inequity, injustice and intolerance, including those that perpetuate inequality and injustice toward women.

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