Building Knowledge and Facilitating Learning through Adaptive Community Forest Management

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Abstract

The theme of the paper is a set of conceptual frameworks that discusses how conservation and management knowledge develops, and how this knowledge is acquired by the local resource management systems through a continuous process of adaptation. It also examines the process of knowledge building as an integral part of adaptive co-management. Through analysis of certain bases of adaptive Community Forest Management (CFM) and various modes through which the process of adaptation occurs, the paper argues with examples that the entire process of adaptation is actually synonymous to creation and acquisition of knowledge by the Community Based Resource Conservation and Management (CBRCM) systems. It emphasizes that the management systems learn through their actions in an evolutionary manner and that this learning is a conscious process. New or modified knowledge and learning make adaptation a creative response to developments in the micro-macro environment and a part of their coping approach to deal with uncertainties. The discussions in the paper primarily revolve around both social-institutional and ecological processes in collaborative and participatory forest management with specific reference to India.

Keywords: Adaptive co-management, Community Forest Management, Conservation Knowledge, Social-Institutional and Ecological Systems, Community Based Resource Conservation and Management.

Adaptive Community Forest Management

Amidst growing complexities and uncertainties concerning the conservation of natural resources, the phenomena of Community Based Resource Conservation and Management (CBRCM) has gained a unique position in the world. In this larger context, there have been several instances of local communities taking up the responsibility of protecting and conserving forests in India today (Sarin 1996, Sarin and others 1997, Conroy and others 2001, Nayak and others 2003, Singh and Nayak 2003). Here many forest neighbouring communities have responded to the process of forest degradation by evolving local arrangements that seek to regulate access and control over neighbouring forest patches and in effect brought open access forests under CPR regime. As they evolve these local arrangements also start adapting to the changing complexities in the micro as well as macro policy environment and, today in India, thousands of such community efforts have laid the foundation of an alternate forest management system, commonly known as "adaptive community forest management" (Nayak 2003, Singh and Nayak 2003).

Based on the diversity of contexts within which adaptive management operates, theorists as well as practitioners of CPR have used it differently such as adaptive co-management, joint management, co-management, collective management, collaborative management, local management, and community management to denote various conditions of community based resource conservation and management.

Issues surrounding forest management are ecologically, socially, and economically complex. This complexity, together with limited understanding of the forest ecosystems and the unpredictable nature of many natural events, contributes to uncertainty about outcomes of management decisions. Changing social values, economic conditions and goals further increase uncertainty and contribute to controversy. Adaptive management is an approach to management that explicitly acknowledges uncertainty about the outcomes of management policies, and deals with this uncertainty by treating management activities as opportunities for learning to improve. Management activities are not just modified as a result of new information; they are deliberately designed to increase understanding about the system being managed (Taylor, B., Kremsater, L. and Ellis, R. 1997).

Adaptive management is often seen as a cyclic, learning-oriented approach to the management of complex environmental systems that are characterized by high levels of uncertainty about system processes and the potential ecological, social and economic impacts of different management options (Jacobson, C. 2003). Folke and others (2002 p. 20) define adaptive co-management as a process by which institutional arrangements and ecological knowledge are tested and revised in a dynamic, ongoing, self-organised process of learning-by-doing. Adaptive co-management systems are flexible community based systems of resource management tailored to specific places and situations and supported by, and working with, various organizations at different levels (Olsson and others 2003).

Ruitenbeek and Cartier (2001) emphasized that the adaptive co-management regimes must implicitly or explicitly cover an adequately long timeframe to deal with the long time-scales of their bio-economic production systems. They also mention that the degree of 'cooperation in management' can vary between all responsibilities being local to the other extreme of all responsibility being centralized. Conscious participation seems to be another important attribute of adaptive co-management; CIFOR's definition of adaptive co-management (2002) explicitly proposes that *conscious adaptiveness* is critical. Singh, N. M. and Nayak, P. K. (2003) mention, "in our use of the term adaptive co-management, we emphasize on the adaptive part which implies that the stakeholders or managers *learn* through their actions in an evolutionary manner and that this learning is a *conscious* process. Adaptation is a creative response to their environment and is part of their coping processes to deal with change".

Based on field studies on self-initiated CFM groups and review of existing literature, Nayak 2003 has used the definition of adaptive co-management as a management approach that is *dynamic, conscious, context specific, evolutionary, and responsive* to the changes in

- the needs of different elements within the community
- uncertainty about the socio-institutional and ecological processes
- the capacity of the resource
- pressures on the resource both from within and from outside the community
- the managerial experience and abilities of the community
- conflicts at intra as well as inter community level
- state policies on natural resources

Adaptive management is a flexible and learning oriented process that creates and maintains an environment conducive for the knowledge building process within the community based resource conservation and management systems. It is in this context that I would discuss a few conceptual frameworks to examine the processes of knowledge building and methods through which this knowledge is acquired and used by the local communities. However, before I proceed to elaborate on the conceptual frames there is a need to put in place certain working definitions that would support a common vocabulary and understanding. While developing concrete definitions is not within the scope or is a focus of this paper, these working definitions are more oriented towards facilitating discussion on the conceptual frames.

Conservation knowledge

Local knowledge concerning the conservation and management of natural resources has been interchangeably termed as traditional ecological knowledge, local ecosystem knowledge, traditional knowledge, indigenous knowledge, and ecological knowledge.

Traditional ecological knowledge is an attribute of societies with historical continuity in resource use practice (Dei 1993, Williams and Baines 1993) and is defined as a cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment (Berkes 1999).

Local ecosystem knowledge and practice is an attribute of more recently evolved resource management systems and refers to a cumulative body of knowledge applied and developed by actors in a local context. It consists of externally and internally generated knowledge about resource and ecosystem dynamics (Olsson and Folke 2001).

Traditional knowledge refers to the knowledge, innovations and practices of indigenous and local communities around the world. Developed from experience gained over the centuries and adapted to the local culture and environment, traditional knowledge is transmitted orally from generation to generation. It tends to be collectively owned and takes the form of stories, songs, folklore, proverbs, cultural values, beliefs, rituals, community

laws, local language, and agricultural practices, including the development of plant species and animal breeds (Article 8 J: Traditional Knowledge, Innovations and Practices, Convention on Biological Diversity).

Indigenous knowledge may be used as a generic term to refer to knowledge systems of indigenous peoples (Berkes 1999). The term indigenous knowledge is used to mean local knowledge held by indigenous people, or local knowledge unique to a given culture or society (Warren, Slikkerveer and Brokensha, 1995).

It is increasingly proposed that knowledge generation of ecosystems should be explicitly integrated with management practice and evolve with the institutional and organizational aspects of management (Dale and others 2000, Walker and others 2002) in what is referred to as adaptive co-management systems (Berkes and others 2003).

I would use 'conservation knowledge' as an overarching terminology to denote local knowledge and practices concerning the conservation and management of natural resources. The manner in which the term 'conservation knowledge' has been used in the discussion of this paper, it would include knowledge of both the social-institutional and ecological systems. Consolidation of experiences and learning from the social-institutional and ecological systems, either in their respective fields or both combined together, constitutes conservation knowledge in the context of CBRCM systems. Conservation knowledge thus includes elements of both institutional evolution as well as ecological progression, and thereby remains relevant to both social-institutional and ecological processes.

Community Based Resource Conservation and Management

While the discussions in the paper are more focused on the examples from community forest management systems, there is a general reference to community-based conservation and management involving all natural resources. I would use the term 'Community Based Resource Conservation and Management (CBRCM)' systems in this paper to include all community efforts involving restoration, management and conservation of local natural resources. By terming them as CBRCM systems my intention is to combine both the conservation as well as management aspects of the resource, while keeping their separate identities unaltered.

Why call them both conservation and management? Depending on their level and stages of evolution there would be varying degrees of conservation and management elements in the CBRCM systems. In all the studied adaptive CFM systems I have invariably found that they contain a combination of both elements of conservation and elements of management at all stages of their evolution. We have already recorded that most CFM groups start with a simple protection arrangement like 'Thengapalli' or paid watch person or social watch in the initial years. Gradually, with the unfolding of complexities and dynamics at both the resource as well as institutional front, elements of management such as how many watch persons and at what frequency of time, who is included and who is not, what would determine the exact forest boundary, what species to be allowed to grow and what not, etc. take precedence. A continued phase of successful protection and management creates the required context for long-term conservation of forest resources. Here issues such as what to cut and what not, how much to use, when and how, what rules and norms would facilitate better forest growth, etc. become prominent.

Studies aimed at recording the evolution of adaptive CFM systems have sufficiently indicated that in older and experienced resource management systems the elements of conservation tend to dominate while the elements of management remain subservient to them (Singh and Nayak 2001, Rai and others 2002). However, the point that I would like to stress is that the presence of both conservation and management elements in resource management systems is a much desirable phenomena, which, if avoided, may lead to an uneven growth of social-institutional and ecological processes within the resource management systems. Successful adaptation actually leads to an increase in the elements of conservation in the CBRCM systems and brings in a greater conservation orientation into these systems.

Social-Institutional and Ecological Systems

Several literatures on CPR have used the terminology 'social-ecological systems' to connote any description pertaining to social oganisations as well as resource conditions. I would use 'social-institutional systems' in place of social systems in this paper.

'Social' refers to the prevalent social conditions, hierarchies and dynamics. 'Institutional' includes the more specific aspects of a community that is rooted in norms and

regulations within the societal context to regulate human behaviour and actions. Terming it only as social may keep the inherent complexities pertaining to social regulations in a community hidden. While institutional processes are intertwined with the social systems, a distinct focus on separating these two would surely help in keeping their identities free from any eminent confusion.

In this context, the paper would make a deviation from the prevalent use of terminologies in CPR writings so far as it uses the terminology as 'social-institutional systems'. While the social-institutional processes deal with the prevailing societal dynamics and complexities, institutional issues at the structural, functional and normative plane, the processes in the ecological system manifest in the resource condition and the corresponding community action pertaining to its conservation.

CONCEPTUAL FRAMEWORKS

In this section I would present three conceptual frameworks to discuss how conservation knowledge develops and how the CBRCM Systems acquire this through the process of adaptation? The frameworks are largely based on the experiences of adaptive community forest management in India, but they would find relevance to most other resource situations involving community conservation and management.

1. Adaptive Management Framework

In a paper titled "Adaptive Community Forest Management: An Alternate Paradigm"[2] Nayak 2003 discussed a conceptual framework to illustrate how ACFM systems evolve through a continuous process of adaptation and how the various elements and means of adaptation operate to push for required changes in the local forest management systems. Nayak termed this model as "Adaptive Community Forest Management Framework" that portrayed a conceptual understanding of the environment and means of adaptation in community forest management. He discussed six elements (resource conditions, local context, issues of institutional evolution, livelihood conditions, policy change and influence of external environment) that often create an environment within which community forest

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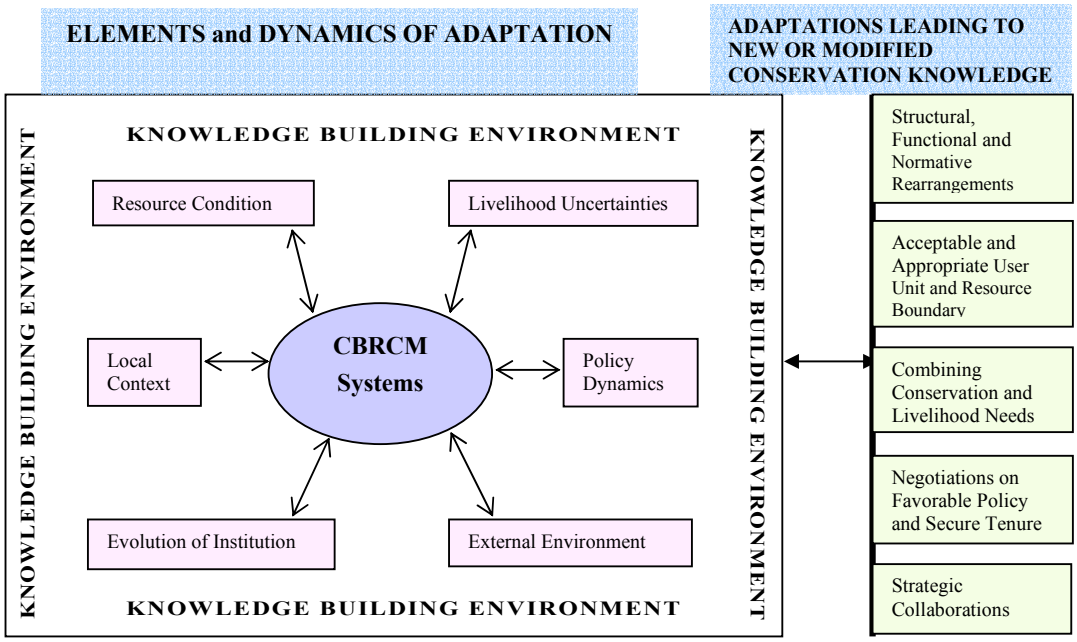
management systems respond to change in the micro and macro situations, and adapt over time. These adaptations, either individually or in combinations, result in responses of the community forest management systems to the influences of the micro and macro environment.

Based on the conceptual understanding presented in my previous paper, I would attempt here to refine and elaborate on the ACFM framework to include how the entire process of adaptation is in effect a process of building conservation knowledge in the CBRCM systems. I would term this new framework as "Adaptive Management Framework" that focuses on the interface between the processes of adaptation and building of conservation knowledge in CBRCM systems.



ADAPTIVE MANAGEMENT FRAMEWORK
(Building Conservation Knowledge through the Processes of Adaptation)

The Adaptive Management Framework depicts adaptation as a process of building and renewing conservation knowledge which not only makes it a conscious and informed process but also significantly contributes to the evolution of social-institutional and ecological processes within the CBRCM systems. How does this process function? The elements of adaptation create a much required context or an enabling environment within which new conservation knowledge develops and the existing ones achieve renewal or extinction thereby supporting the social-institutional and ecological processes.

The six elements, representing social and institutional dynamics, economic and ecological conditions, policy and external challenges, determine the evolution of the adaptive CBRCM systems. These elements, either singularly or in varying combinations, influence the course of adaptation. Adaptive Management Framework explains that these various sets of interactions between the elements of adaptation as well as between these elements and the CBRCM system, apart from facilitating adaptations, creates an enabling environment for the development of conservation knowledge. I term this setting as "Knowledge Building Environment" which remains decisive to the creation and modification of conservation knowledge and to the entire sequence of adaptations as well.

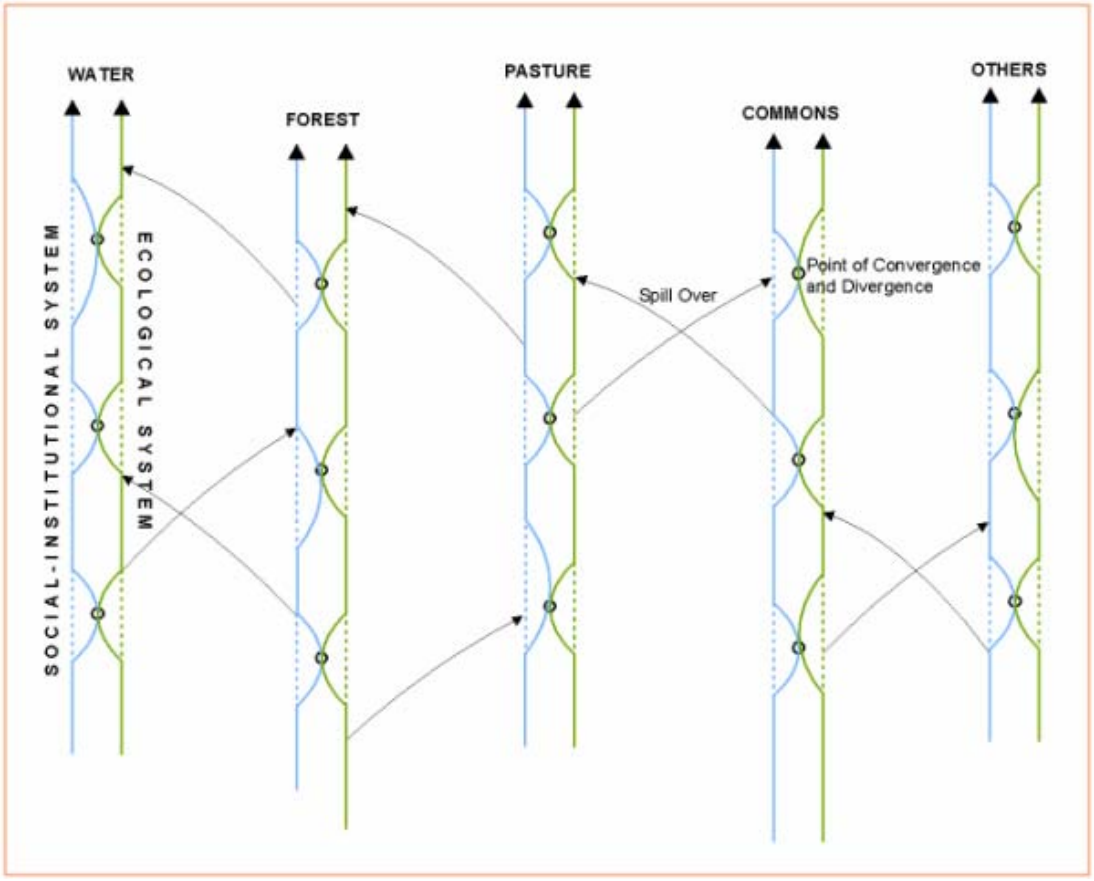
Each element of adaptation contributes to the building of conservation knowledge in its corresponding area, and supplements the knowledge building in the spear of other elements as well. The manifestation of new or modified conservation knowledge is seen as adaptations of various types achieved at the end of the process.

The progression in knowledge building and adaptive management is a two way process where the existing conservation knowledge facilitates the process of adaptation and, which in turn leads to either creation of new conservation knowledge or modification in the existing knowledge. Once a set of conservation knowledge gets established, as a result of adaptations, it continuously supports the elements of adaptation within the knowledge building environment thereby making it easy for the process of adaptation to keep going, so also the knowledge building process.

2. Convergence – Divergence Equilibrium Model

Two dominant processes broadly govern the evolution of a CBRCM system. These processes pertain to the social-institutional systems and ecological systems that combine to provide a definition to the local conservation unit. While the social-institutional processes deal with the prevailing societal dynamics and complexities, institutional issues at the structural, functional and normative plane, the processes in the ecological system manifest in the resource condition and the corresponding community action pertaining to its conservation. The convergence – divergence model looks at these two processes as critical factors in the success of community based conservation and management systems. It further maintains that the social-institutional and ecological systems and interactions between them

are responsible for the origin and development of new conservation knowledge as well as refurbishment of the existing conservation knowledge.



CONVERGENCE – DIVERGENCE EQUILIBRIUM MODEL
(Building conservation knowledge through the interaction of social-institutional and ecological systems)

The convergence – divergence model defines that in the evolution of resource conservation and management systems the social-institutional and ecological systems manifest themselves as independent but parallel processes. While they follow their own independent paths, there is convergence of these two systems at different stages of their evolution. Once converged for a period of time, they again diverge to follow their own singular independent courses. This process of convergence and divergence between the social-institutional and ecological systems repeats itself at regular intervals during the full course of evolution of the CBRCM systems. This continued interaction between the two systems over a period of time creates several points of convergence and divergence as important landmarks in the evolution of local conservation systems. What is important to note is that these points of convergence and divergence facilitate building of conservation

knowledge and remain critical to the understanding of social-institutional and ecological systems.

In the course of following their independent movements the social-institutional and ecological systems accumulate a lot of experience and learning in their respective spheres. This could be a result of using the existing conservation knowledge which facilitates the course of their evolution and at the same time necessitates acquisition of new conservation knowledge in order to deal with emerging uncertainties, thereby pushing these two independent systems towards convergence. The framework construe that the points of convergence are actually points where consolidation of social-institutional and ecological experiences and learnings take place to give rise to new conservation knowledge and also provides scope for renewal of prevailing conservation knowledge. It also maintains that the processes of divergence in the socio-institutional and ecological systems are movements towards gaining new learning and experiences in their respective spears, so that they can converge at another point to consolidate a fresh set of conservation knowledge. The singular processes which the social-institutional and ecological systems follow in their own spears, after diverging from the point of convergence, is backed and influenced by the new conservation knowledge developed at the immediate previous point of convergence where consolidation of social-institutional and ecological learning and experience had taken place.

Even when these two processes are converging, they actually retain their individual identities and keep running parallel through the entire phase of convergence, which is shown in the diagram as dotted lines in both the social-institutional and ecological systems. This makes evident that there are specific elements in these two systems, which go through the process of convergence and divergence, and not the whole system. These elements are actually those which are facing uncertainties at certain stage of their evolution and require modified or new conservation knowledge to firmly move in the process of evolution. Conservation knowledge guides this process in a manner that a complete breakdown either of the institutional arrangement or the resource base could be avoided and leads it towards improving conditions for the specific elements facing uncertainties at the point of time. Carpenter and Gunderson (2001) stress the need for continuously testing, learning and developing knowledge and understanding for coping with change and uncertainty in complex adaptive systems. Other scholars have also illustrated that many community-based management systems seem to have so-evolved with resource and ecosystem dynamics and

have developed knowledge and practice for how to live with change and uncertainty (Gadgil and others 1993, Berkes and Folke 1998, Berkes and others 2003).

Nayak et al 2003 have recorded this phenomenon in their study of conflict situations in community forest management systems in India. In the analysis of the causes and consequences of conflicts, we have observed that conflicts do not necessarily result in a complete breakdown of the management system or total destruction of the forest resource. Rather, CFM conflicts are inherently inclined towards negotiations on contested elements in the management environment which creates scope for elimination of uncertainties. While conflicts threaten to breakdown institutions and institutional arrangements relating to resource management, they also provide an opportunity for improving management systems and overcoming the problems that led to these conflicts. Community Forestry can play a significant role in conflict management with its orientation of community based management. It considers local preferences, recognises multisectoral objectives and brings together the different interests through an integrated approach. Cultural factors, including indigenous knowledge, are always considered (Nayak and others 2003).

There could also be spill over effects from these two systems during the process of their evolution, which may happen at any stage – either when they are moving independently or converging with one another or diverging from each other – thereby either creating separate independent systems and processes in their respective spheres or assimilate with similar existing systems. These spill over effects (socio-institutional and ecological systems and processes created by the spill over method) normally align with opposite systems and processes, i.e., social-institutional systems aligning with ecological systems and vice versa, to develop new conservation knowledge through the process of convergence and divergence. It is observed that older the CBRCM system greater the occurrence of spill over effect creating a complex web of several convergence – divergence models of social-institutional and ecological systems. This multiplicity in convergence – divergence models in social-institutional and ecological systems is a method of intensifying the process of building conservation knowledge in order to cope with increasing complexities and uncertainties in the local conservation systems as well as expanding and diversifying the conservation knowledge base by including management and conservation issues of corresponding resources. This multiplicity sufficiently denotes that the evolution of community based conservation and management systems is not only a linear process but also spreads horizontally over time.

In his discussions on the elements of adaptive CFM, Nayak 2003 has made the following observations which adequately clarifies the construct of spill over effect. He observed that institutional mechanisms that evolve out of collective action over forests also spin off into domains other than those originally envisaged. While it could be counter-productive to unduly stretch the domain of an institution, it could be advantageous to build upon the strengths of effective mechanisms accepted and functioning in the villages. Though the CFM systems originate with the specific task of protecting forest areas; their purpose does not remain limited to forests only. These institutions grow into taking responsibilities of managing other related CPRs such as grazing lands, village ponds, fisheries, grain banks, village funds, etc. in an integrated manner. In certain cases, the CFM institutions may also be assimilated into larger institutions, like the Village Council, Village Panchayats or similar bodies and function as sub-institutions with sole responsibility for forest related matters. I term the former as 'diverse adaptation' and the later as 'uniform or singular adaptation'.

Ecological and Social-Institutional Processes: Experience from Adaptive CFM systems

The institutions in adaptive community forest management follow a process of evolution that corresponds and keeps pace with the growth of the forest resource. Since the status of forest influences the structural, normative and functional arrangements of the CFM institutions, it remains a challenge to develop within a dynamic ecological context which brings in elements that could be detrimental to the institution building process if not meticulously dealt with.

At a structural level, the CFM institutions grow into various sub-layers over a period of time (see diagram below), beginning with a two-tier structure: a Village Assembly with the decision making authority and an Executive Committee that takes up a supervisory role. Frequent meetings of the Village Assembly during the initiation of protection create enabling space for larger participation and helps build stake of all villagers in forest management. This also provides opportunity to discuss and negotiate issues of common importance and find alternatives. These meetings bring in all members of the community together and often prove to be instrumental in projecting a combined strength to the immediate neighbours who may pose a threat to the forest. During this time the structure of the institution includes a full time forest protection group to patrol the forest against any threat.

Interaction of Ecological and Social-Institutional Systems leading to Building of Conservation Knowledge: Experiences from the Evolution of Adaptive CFM Systems at Different Stages of Resource Growth

STAGE 5 Established forest with good crown cover and return of biodiversity	In addition to stage 1, 2, 3 and 4 arrangements: ▪ Squad to control poaching	▪ Forest management rules ▪ Rules pertaining to access and use ▪ Conflict management rules ▪ Boundary rules ▪ Monitoring and sanction rules
STAGE 4 Establishment of species and good resource condition	In addition to stage 1, 2 and 3 arrangements: ▪ Special committees on conflict resolution, forest offence cases, etc. ▪ Increase in Executive Committee members ▪ Audit and Accounts Committee	▪ Forest management rules ▪ Rules pertaining to access and use ▪ Conflict management rules ▪ Monitoring and sanction rules
STAGE 3 Stabilization of degradation and establishment of ground cover	In addition to stage 1and 2 arrangements: ▪ Advisory Committee with old and experienced community member	▪ Forest management rules ▪ Protection rules ▪ Monitoring and sanction rules
STAGE 2 Regenerating	In addition to stage 1 arrangements: ▪ Number of members in the Executive Committee increased	▪ Protection rules ▪ Monitoring and sanction rules
STAGE 1 Highly degraded	▪ Strong and active General Body for decision making ▪ Vigilant Executive Committee to supervise ▪ A full time protection committee with more members	▪ Boundary rules ▪ Protection rules ▪ Monitoring and sanction rules
Manifestation of Resource condition in the Processes of Ecological Conservation	**Evolution of Structural Layout in the Social-Institutional Processes**	**Evolution of Normative Arrangement in the Social-Institutional Processes**

(Source: Nayak 2003)

Once there is progress in the protection initiative - when the existing root stocks have started to establish and the forest is in a regenerating state; the institution has received certain degree of recognition from the adjoining villages and beginning to interact with other similar institutions including the forest department; the villagers are able to take up primary silvicultural operations in the protected forest - the structure undergoes certain changes. CFM

groups often increase membership in the Executive Committee at this stage with an aim to distribute the increasing responsibility of protection among a selected group of members.

With stabilization of degradation, many CFM institutions create an Advisory Committee. There are two purposes of forming such a layer of institution. One, the wide range of experiences in the community, especially the old people, could be effectively integrated into the ongoing protection initiatives. Two, after renewal of the membership in the institution's Executive Committee the dropout members generally chose to stay out of the affairs of the forest management institution. In some cases it also results in unhealthy power dynamics within the village. In order to cope with these negative trends as well as accommodate all the positive energies within the community the Advisory Committees are formed with specifically assigned functions.

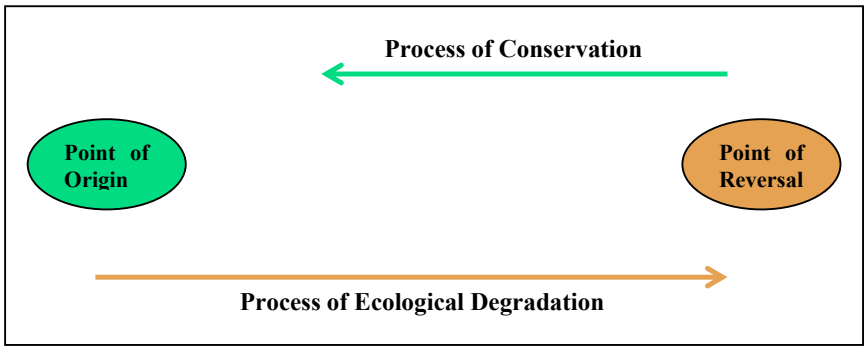
Better forest growth pushes the structure of the CFM institution into forming different layers as they constitute several sub-committees or special committees to deal with conflict resolution, forest offence cases, benefit sharing, etc., which enhances the functional efficacy of the institution. Separate Accounts and Audit committees have also been formed in some cases to deal with finances of the institution. These layers of arrangements are found in places where the community efforts in protection have resulted in establishment of species and good forest vegetation. Places where the forest has improved further and the signs of floral and faunal diversity are visible the community institutions have created special Squad Parties to check poaching and safeguard wildlife.

Corresponding with the resource growth and the structural layout of the community institutions the evolution of normative arrangements takes place in the CFM systems. As shown in the diagram above, these normative arrangements take shape in various combinations at different stages of resource development as well as its analogous structural design.

3. Reversal – Origin Framework

The evolution of CBRCM systems mostly fluctuates between two extreme points that are defined by the ecological status of the resource and the context of its being. These points, denoting the resource conditions, are termed as the 'point of origin' and the 'point of

reversal' which together form an evolutionary track for the local conservation units to develop.



REVERSAL – ORIGIN FRAMEWORK
(Building conservation knowledge through the process of ecological degradation and conservation)

The point of origin reflects an earlier state of the resource where it had retained good ecological health and was able to generate several valued services with social, economic and ecological implications. However, due to developments in the micro-macro environment such ecologically stable resources follow a process of degradation leading to loss of biodiversity and local livelihoods. At a certain stage of this process of ecological degradation, mostly due to the negative impacts of the depleting resources, there is community realization leading to local actions to arrest the pace of degradation through protection and conservation initiatives. The stage at which this community action takes place is termed as the point of reversal, which implies that the ongoing process of ecological degradation is reversed into an active process of ecological conservation. The reversal – origin framework clarifies that what precedes the point of reversal is a process of ecological degradation and what follows it is a course of ecological conservation leading towards the point of origin. It further explains that the community action at the point of reversal is not often an attempt to go back to the point of origin, but in most circumstances, it is only a movement towards it. The point of origin is almost unachievable due the extent (state of extreme degradation where the forest is bereft of sufficient rootstocks and cover soil) as well as nature (extreme diversification in the existing land use pattern leading to conversion in the resource status) of degradation of resources. Consequently, any attempt at restoration only moves towards it. If, during the process of degradation, some of the basic elements are missing or have become extinct then the process of conservation receives a major set back and the point of origin or any point closer to it remains unattainable.

I draw a semblance of this understanding with what Aldo Leopold, the foremost conservationist, had summed up as the conclusion of his research in a speech at the University of Arizona: soil "is the basic natural resource." He said, "Destruction of the soil is the most fundamental kind of economic loss which the human race can suffer. With enough time and money, a neglected farm can be put back on its feet – if the soil is there. By expensive replanting and with a generation or two of waiting, a ruined forest can again be made productive – if the soil is there . . . . But, if the soil is gone, the loss is absolute and irrecoverable."

While in majority of CBRCM systems the process of ecological conservation moves from the point of reversal towards the point of origin, there are exceptions observed in certain cases where the process of ecological conservation takes a totally different track but not the one which leads towards the point of origin. Degraded forests where exposed rocks have led to local mining operations or attracting non-forestry activities, thereby permanently shifting the character of the land to a point of no return so far as the processes of reversal towards the point of origin is concerned.

How do communities determine what far one can go in the move towards the point of origin? Does the level of conservation knowledge facilitate an understanding of the ecological history of the resource as well as determining a course of intervention? The time of initiation of forest protection by local communities is also the time to estimate whether efforts on the current state of degradation will result in restoring the forest vegetation and biodiversity, or, if another approach is needed? Much will depend on how the community values the forest and on the network of its connections with the other natural resources of the village. A large area of degraded forest lands in the semi-arid areas of western India have now been converted into grass lands and this precludes any simple restoration of tree cover. Community resource management need not imply its return to some previously existing condition. The CFM groups decide on a course of action depending upon their needs, the status of the resource and its capacity to respond to interventions. This can result in the communities actually integrating various resources and needs - such as soil, water, agriculture, floral and faunal diversity, timber and non-timber forest products, animal husbandry, etc. (Nayak 2003).

The reversal – origin framework looks at both the processes of ecological degradation leading to the point of reversal and ecological conservation moving towards the point of origin as processes through which evolution of conservation knowledge takes place. It maintains that the interaction between the point of reversal and the point of origin is critical to the development of conservation knowledge in the CBRCM systems. While a set of existing conservation knowledge leads these two processes, new knowledge develops, some existing knowledge is renewed and some others are replaced by more appropriate conservation knowledge in the course of developments.

The process of ecological degradation is in itself a process of building up new conservation knowledge that gradually brings in a realisation in the community about reversing the trend of ecological depletion. Sooner this realisation occurs better it is for the revival of the degrading resources. In other words, smaller the degradation process (arrow shown as process of degradation in the diagram) greater would be the possibility for the process of ecological conservation (arrow shown as process of conservation in the diagram) getting closer to the point of origin. A set of conservation knowledge actually facilitates the understanding of the process and the consequences of ecological degradation, thereby helping the community in arriving at the point of reversal. Once the community arrives at the point of reversal another set of conservation knowledge guides this process in its move towards the point of origin.

A number of studied on the CFM systems in the Eastern India have analysed how local communities gradually convert the causes of forest degradation into factors for initiation of forest protection (Nayak and others 1996, Singh and Nayak 1996, Singh and Nayak. 2001, Nayak 2002, Nayak and others 2003). Nayak 2002 has observed that forest degradation had manifold impacts on the socio-economic life of the communities. The ecological fallout of such degraded surrounding forests negatively affected the local agriculture, animal husbandry practices and completely shattered the forest based livelihoods of many. People started travelling to far off forest areas for need fulfillment resulting in conflicts with other communities and harassment by the forest department. In such circumstances many communities gradually turned to their adjacent degraded forests and initiated protection measures perhaps as a last resort to restore back the forests as well as local livelihoods. Gradually, such local efforts turned the negative impacts of forest degradation into initiating factors for community-based forest management in the country." What brings in this

transformation is the experiences and learning of the community during the phase of degradation as well as the existing conservation knowledge. I have already discussed in the previous section on how experiences and learning consolidate into conservation knowledge through the process of convergence and divergence.

While in the process of conservation (towards the point of origin) many CFM systems have often come up with a withdrawal syndrome thereby going back into the degradation phase. In such situations conservation knowledge, both the existing as well as new and modified knowledge, has an important role to play. It sees that the ongoing process of conservation (movements towards the point of origin) does not revert back into a process of ecological degradation.

Conclusions

It is only at points of deep crisis in both the ecosystem and social system that fundamental conceptual and structural change is possible (Holling 1986). A successful process of adaptation sustains this change through maintaining the knowledge base and resilience in the community based resource conservation and management systems. The factor that remains critical to the continuity of both the process of adaptation as well as the process of knowledge building in CBRCM systems is the interaction between the social-institutional and ecological systems. Understanding ecosystem processes and how to manage them seems to be a progression of social-ecological co-evolution, and it involves learning and accumulation of ecosystem knowledge and understanding in a "social memory" (Olsson and others 2003).

Parallel to the processes of adaptation building of conservation knowledge progresses and both behave as factors of influence for each other in varying contexts. While adaptation is facilitated by the existing conservation knowledge, it also creates a favorable environment for knowledge building and nurtures a steady evolution of the community knowledge base. In the analysis of the conceptual frames it is sufficiently indicated that knowledge building takes place through the processes of adaptation, interaction between the social-institutional and ecological systems and attempts at reversing the course of ecological degradation towards conservation. Even though adaptation remains a constant factor in the building of conservation knowledge, the trajectories taken by the CBRCM systems in shaping and

maintaining their knowledge base differs. This combination of approaches and methods involved in building and maintaining conservation knowledge makes the CBRCM systems resilient and robust enough to deal with disturbances and uncertainties. Successful knowledge and resource management systems will allow disturbances to enter on a scale, which does not disrupt the structure and functional performance of the ecosystem, and the services it provides. Such resource management systems have to be able to recognize the feedbacks that signal these disturbances. Thus, it would seem that they require mechanisms by which information from the environment may be received, processed and interpreted (Berkes and Folke 1998). The continuation of the process of knowledge building through a parallel process of adaptation remains critical to this purpose.

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