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Creating 'Learning Laboratories' for Sustainable Development in Biospheres - A Systems Thinking Approach

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This paper discusses the application of systems thinking concepts and tools in establishing 'Learning Laboratories' for Sustainable Development. It first presents a brief description of the potential value of utilising biosphere reserves for implementing the learning laboratories concept, followed by how systemic processes have been developed to establish a Learning Laboratory through a comprehensive pilot project in the Cat Ba Biosphere Reserve (CBBR) in Vietnam. In this project Causal Loop Modelling were used to determine the components and interactions between the policy, social, environmental, and economic dimensions of the CBBR. The resultant model has been used to identify key leverage points and where systemic interventions will be most effective (potential research projects). The model also serves as a platform for learning and research collaboration through alliances and cross-sectoral teams to address the various domains, leverage points, and interventions identified. The role and importance of systems thinking methodology and applications to deal with ever-increasing complexities of sustainable development are discussed. The modelling approach and various processes that were used in this pilot project could be extended to other biosphere reserves in Vietnam and globally, in that way creating a worldwide network of 'Learning Laboratories for Sustainable Development'.

Keywords systems thinking; causal loop modelling; collaborative learning; learning laboratories; sustainable development

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INTRODUCTION

Sustainable development is now a globally endorsed principle whose nature and practice is multi-dimensional and complex (Ishwaran *et al.*, 2008). The most important conceptual issue today in the development and management of our resources and businesses is that our society and economy has to craft innovative ways of development within increasing physical limits, in terms of both source (e.g. fresh water) and sink (e.g. CO2). To do this we need to greatly advance our understanding of how to apply our economic, social and, political tools and systems to develop ways to maintain our qualities of life within ecosystem limits. In this paper we describe the potential usefulness of biosphere reserves (UNESCO, 1971) as platforms for implementing and 'testing' policies and practices that could facilitate such an enhanced understanding of the complex systems we have to manage.

Biosphere reserves (BRs) are sites recognised under UNESCO Man and Biosphere (MAB) program (UNESCO, 1971) to demonstrate integrated and innovative approaches to conservation and sustainable development. There are currently 553 biosphere reserves in 107 countries (UNESCO, 2009). The diversity of biospheres around the world provide an opportunity to conduct many context-specific experiments in sustainable development at varying scales (Ishwaran *et al.*, 2008), in this way creating a World Network of 'Learning Laboratories' to the benefit of sustainable development learning and practice for present and future generations.

Given the complex, multi-dimensional and dynamic nature of biosphere reserves and sustainable development, there is a clear need for a systems approach in addressing this complexity. Complex problems facing society today cannot be solved in isolation with the linear, narrowly defined approaches of the past. Systems based thinking and integration are increasingly recognised as being at the basis of understanding complex multi-stakeholder issues such as sustainability.

This paper develops and elaborates on this concept, and will discuss in particular how systems approaches and participatory processes have been used to establish the Cat Ba Biosphere Reserve as the first 'Learning Laboratory for Sustainable Development'.

BIOSPHERE RESERVES AND THE LEARNING LABORATORIES CONCEPTS

The development of the biosphere reserve (BR) concept at the UNESCO Biosphere Conference in 1968 laid the first foundation for a meaningful framework that reconciled conservation and use of natural resources. A comprehensive description of the origin and the evolution of the BR concept are presented in a recent paper (Ishwaran *et al.*, 2008). The biosphere reserve as a concept and a tool of UNESCO has its origin in the protected areas domain but has now evolved into an international designation that allows context-specific conservation and development relationships to be developed in land and seascapes where more than 80% of the designated area lies outside of legally protected core zones (Ishwaran *et al.*, 2008).

The learning laboratory (LLab) concept has appeared recently in the literature with some degrees of ambiguity. In the context of biospheres, it is also referred to as a learning site or learning space. Therefore, it is important to differentiate the use of the term 'laboratory' in this paper with the conventional use of the term to avoid confusion. Conventionally, the term 'laboratory' normally refers to an area or a place where researchers and scientists carry out specific experiments (e.g. chemistry, soil analysis). In this paper, the learning laboratory is defined as 'a process as well as a setting in which a group (e.g. a management team) can learn together'. It is a 'practice field' for group learning and experimentation. The purpose of the leaning laboratory is to enable managers and other stakeholders to experiment, test their mental models (assumptions, values, understandings) and to anticipate the consequences of their actions, policies, and strategies (Maani and Cavana, 2007). This concept will be further explained and demonstrated in this paper.

While the biosphere reserve concept was originated almost four decades ago (UNESCO, 1971), one important stream of thought has only emerged in the last three years - that is the notion that biosphere reserves could serve as international learning laboratories for sustainable development (Ishwaran *et al.*, 2008).

UNESCO has recommended the launch of pilot projects for biosphere reserves to address the gap between biosphere reserve knowledge systems (scientific, experiential, and indigenous) and the imperative for wider sustainable development. This served as the stimulus for initiating a pilot project in the Cat Ba Biosphere Reserve (CBBR) in northern Vietnam. The CBBR pilot project is used as a 'case study' in this paper to demonstrate how systems thinking processes have been used to create learning laboratories for sustainable development.

THE CAT BA BIOSPHERE RESERVE

This brief description of the CBBR highlights the current issues and challenges that the biosphere reserve is facing. Comprehensive descriptions of the CBBR can be found in several publications on various work and studies conducted on Cat Ba island (Jepson and Tran, 2000; Viet and Lin, 2001; Nguyen *et al.*, 2002; CHPC., 2005; Brooks, 2006; Dawkins, 2007).

The Cat Ba archipelago is located about 50 km east of Hai Phong city (the third biggest city in Vietnam), 25 km south of Ha Long Bay (a World Heritage site), and 150 km southeast of Ha Noi (the capital city of Vietnam). Cat Ba island (situated in Cat Hai district, Hai Phong city) is the largest island of the Cat Ba archipelago, which consists of 366 offshore islands.

The island has a significant biodiversity value. It is home to a number of rare and endangered species of plants and animals, with the most noteworthy species being one of the world's rarest primates, the Golden-headed Langur (FFI., 2003). In addition to Cat Ba's high importance to biodiversity in Vietnam, it is also recognised as a high priority for global conservation (WB, 2005; Zingerli, 2005; Brooks, 2006). Cat Ba island is also considered as one of Vietnam's most beautiful places and, increasingly, is a favoured destination for both foreign and domestic tourists (Nguyen *et al.*, 2002). In 2004, Cat Ba island was designated as a UNESCO Biosphere Reserve (HPPC, 2005).

Cat Ba is currently experiencing strong growth in tourism (and revenue), while environmental degradation continues and high levels of poverty in several of the communes persist (Bosch *et al.*, 2007a). In addition, Cat Ba is currently facing a number of other issues and challenges including waste treatment, pollution, low education standards, poor health care, high number of floating farms, overuse of underground water, lack of fresh water and electricity (especially in the tourist season), lack of skilled labour for the tourism industry, uncontrolled tourism development, insufficient infrastructure, lack of access to suitable markets for local products, seasonal typhoons and the lack capacity for effective integrated planning.

Due to the biodiversity significance of Cat Ba island it has been the site of a number of international funded projects implemented over the past two decades (Dawkins, 2007). However, a recent study by Brooks (2006) found that, despite more than ten years of interventions, many of the issues that these projects tried to address on Cat Ba still remain. This is largely due to the fact that many of the projects had only focussed on and addressed the 'symptoms' of the issues or problems (or the tip of the iceberg illustrated in Figure 1). In this paper a systems thinking approach is used to identify the core issues rather than addressing the symptoms of the problems.

SYSTEMS THINKING APPROACH

Systems thinking is the underlying paradigm and research approach for the pilot project. Systems thinking is increasingly being regarded as a 'new way of thinking' to understand and manage the 'natural' and 'human' systems associated with complex problems in sustaining and enhancing the natural resources (Bosch *et al.*, 2007a). Although the range of methods and methodologies are extensive, many of these new ways of thinking have emerged from or embrace the concepts inherent in systems thinking (Bosch *et al.*, 2007b).

Maani and Cavana (2007) use the analogy of an iceberg to illustrate the conceptual model known as the Four Levels of Thinking (Figure 1) as a framework for systemic interventions. In this model while events represent only the tip of the iceberg, yet in reality most decisions and interventions take place at this level. This is because events are the most visible part of day to day reality which often require immediate attention and action. The next level of thinking is patterns where a larger set of events (or data points) are linked together to create a 'history' of past behaviours or outcomes. The next level of thinking is systemic structures which reveal how such patterns relate to and affect one another. Thus, systemic structures unravel the intricate lace of relationships in complex systems. There is yet another, deeper level of thinking that hardly ever comes to the surface. *'This is the mental models of individuals and organisations that influence why things work the way they do. Mental models reflect the beliefs, values and assumptions that we personally hold, and they underlie our reasons for doing things the way we do*' (Maani and Cavana, 2007, p.15).

Figure 1 to be inserted here

Figure 1: Four levels of thinking model

Source: Maani and Cavana (2007)

The systems thinking paradigm and methodology embrace the four levels of thinking. They move the stakeholders and decision-makers from the event level to deeper levels of thinking and provide a systemic framework to deal with complex problems (Maani and Cavana, 2007).

The application of systems thinking has grown extensively and encompassed work in many diverse fields such as health systems (Cavana *et al.*, 1999), business (Sterman, 2000), ecological economic systems and policy (Rosser, 2001), commodity systems (Sawin *et al.*, 2003), agricultural production systems (Wilson, 2004), decision making and consensus building (Maani, 2002; Maani and Maharraj, 2004), natural resource management (Allison and Hobbs, 2006), environmental conflict management (Elias, 2008), education (Hung, 2008) and organisational learning and change (Maani and Fan, 2008). Nevertheless, this is the first project using a comprehensive systems thinking approach to apply in the context of managing a biosphere reserve sustainably. It is envisaged that the process and methodology employed in this project would have high potential to be applied globally, considering the extensive network of world biosphere reserves, in that way creating a global network of 'Learning Laboratories for Sustainable Development'. The following sections illustrate the process and application of systems thinking in this pilot project to establish the CBBR as a learning laboratory for sustainable development.

Stages of the pilot project development

The concept of the learning laboratory for sustainability has been developed in collaboration with various stakeholders in Vietnam as shown in Figure 2. It is envisaged that this will evolve in three stages:

Figure 2 to be inserted here

Figure 2: Developing stages for Learning Laboratories

1. Using the Cat Ba BR as a pilot study area to develop a model and processes for establishing and operationalising it as a Learning Laboratory for Sustainability;

2. The lessons learned through the pilot study will form the basis for creating Learning Laboratories in other Biosphere Reserves in Vietnam; and

3. Extending the concept globally (creating a network of Learning Laboratories worldwide).

Conceptual model of Cat Ba Biosphere Reserve

As part of a two-day system thinking workshop at the University of Queensland (UQ) a conceptual model and a high level causal loop model of the CBBR (Figures 3 and 4) were developed to help identify the core issues and possible leverage points in the system. A researcher from the International Union for Conservation of Nature (IUCN) in Ha Noi, who has a rich experience and knowledge of the CBBR, provided the context and issues related to CBBR to participants of the workshop. Some of the 25 workshop participants also had prior experience working in several projects in the CBBR.

Figure 3 shows the conceptual model, which was developed at the workshop to broadly describe the current situation in CBBR. The model explains the sources of complexity that has given rise to Cat Ba's predicament. From the model it is apparent that the relationships between the key variables are far from simple or linear. An inspection of this model revealed that the current adverse outcomes (poverty, environmental degradation and unsustainable tourism growth) could be traced back to the lack of integrated planning and governance leading to fragmented and uncoordinated government policies. Although much funding has been spent on issues such as poverty and environmental degradation by international aid organisations, they have been working relatively uncoordinated, each attempting to 'fix' a different problem in isolation (Bosch *et al.*, 2007a).

Figure 3 to be inserted here

Figure 3: Initial conceptual model of Cat Ba Biosphere Reserve

Source: Bosch, O., Maani, K. & Smith, C. (2007a)

The above model (Figure 3) was further developed into a high level causal loop diagram (CLD) of the current system in Cat Ba (Figure 4). A causal loop diagram provides '… *a framework for seeing interrelationships rather than things, for seeing patterns of change rather than static snapshots*' (Senge, 1990, p.68). In a CLD, each pair of variables can move either in the same or opposite direction. If an increase (or decrease) in variable X at the tail of the arrow causes a corresponding increase (or decrease) in variable Y at the head of the arrow, then this is a change in the same direction (denoted by '+' or 's' near the head of the arrow). That is, the two variables move up and down together. On the other hand, if an increase (decrease) in one variable causes a decrease (increase) in the other variable, then this is a change in the opposite direction (denoted by '-' or 'o' near the head of the arrow). In other words, as one variable moves up, the other will move down and vice versa (Maani and Cavana, 2007).

Once a representative CLD is constructed and validated, the appropriate intervention strategy can be devised to address the root causes and leverage points of complex problems and persistent issues (Maani and Cavana, 2007). Leverage points are places within a complex system '*where a small shift in one thing can produce big changes in everything'* (Meadows, 1999, p.1). In the case of Cat Ba, the leverage points lie in integrated planning and coordinated government policies. The effects of these 'shifts' are shown in Figure 4. It is clear that the systemic changes create two positive reinforcing 'loops' (shown by 'R'). These loops (dynamics) represent the reciprocal and beneficial effects of integrated planning and international co-operation (through aid agencies) and their chain effects on sustainability and livelihood of the communes (the link from tourism revenues to livelihood of the communes) (Bosch *et al.*, 2007a).

Figure 4 to be inserted here

Figure 4: Initial CLD of Cat Ba Biosphere Reserve

Source: Bosch, O., Maani, K. & Smith, C. (2007a)

In summary, the causal diagramming process reveals the systemic structures underlying a complex system (i.e. the four levels thinking model described previously). It shows that the factors affecting a system are not isolated and independent but are dynamically linked and cause growth or decline in each other as well as in other key areas of the system. One of the strategic insights of the CLD process is that trying to improve the parts in isolation is counterproductive and can hurt the overall system and its performance (Maani and Cavana, 2007).

The two CLD models discussed above, however, have been developed primarily based on researchers' perspectives and understanding of the system in question. In order to validate the CLD models it was essential to involve relevant stakeholders in a confirmation process to help refine the model and to identify key leverage points and possible barriers to implementation. This process of 'group thinking' was important as it could further facilitate consensus building and alignment of thoughts and actions (Maani & Cavana, 2007).

Learning Laboratory workshop

Following the initial workshop at UQ, a joint workshop was conducted in Hanoi in October 2007 to unravel the issues and propose strategies to address the identified leverage point in the system ('lack of integrated planning' – see Figures 3 and 4). The strategies significantly helped the participants to determine themselves the nature of the capacity building they would require to improve the planning processes. Workshop participants came from Government and private sectors, academic institutions, NGOs agencies, and representatives from four biosphere reserves in Vietnam.

The capacity building requirements identified during the workshop were used as a basis for a successful application for an AusAID grant (Australian Leadership Award Fellowship –

ALAF) to conduct training workshops, short courses, and field visits in October and November 2008 in Australia for ten senior and middle managers from Vietnam. This activity addressed the first leverage point identified for systemic intervention (i.e. 'lack of integrated planning').

The Cat Ba capacity building program

The ten selected participants came from four levels of government (District, Provincial Departments, Provincial People's Committee, and National Government), representing relevant technical and administrative agencies of the CBBR. The training program has been pivotal in bringing these agencies together in a single learning forum held at The University of Queensland, Australia for two months and forming a strong foundation for joint planning and policy development upon their return.

The program has enhanced capacity amongst current and emerging leaders by developing skills and expertise in systems thinking and integrated planning and management of natural resources. Evidence suggests that this training program has gone a long distance in overcoming the first barrier towards improved integrated planning.

In addition, because the participants represented different levels of governance and decision making, the program has resulted in a common understanding of the issues and barriers of communication, improved information flows and decision making processes, and development of a shared vision and commitment for action. The process and outcomes of the training program were presented recently at the International Society for the Systems Sciences (ISSS) 2009 Conference (Nguyen *et al.*, 2009b).

Systems Model of Cat Ba Biosphere Reserve

In order to carry out a successful implementation of the learning laboratory for sustainability it is essential to first understand the main components, interactions, drivers and dynamics of the CBBR system. Figure 5 shows these dynamics (the interrelationships and dependencies amongst the key components of the system) via a causal loop model (Maani and Cavana, 2007) and its sub-systems. This model has been developed and informed by relevant literature and available documents as well as consulting with the participants of the Cat Ba training program during their visit to Queensland. In addition, the model (Figure 5) has been refined and validated by various relevant stakeholders (managers, policy makers, rangers, local people, and hotel owners) in a series of workshops and in-depth interviews conducted in Hai Phong city and on Cat Ba island during December 2008 and January 2009.

It is not within the scope of this paper to describe the systems model in detail. A description of the model was reported in a recent paper (Nguyen *et al.*, 2009a). The systems model shown below will further evolve over time and be validated by quantitative data where available. While no model represents a 'true' or complete representation of reality, a systems model can usefully unravel important dynamics of a complex system (Jørgensen and Bendoricchio, 2001). Nevertheless, the development of this model, and subsequently an advanced systems model of CBBR, has served several well-defined purposes as mentioned in the discussion section of this paper.

Figure 5 to be inserted here

Figure 5: Current systems model of CBBR – A Platform for Collaboration

Legend: S (same direction), O (opposite direction), R (reinforcing), B (balancing)

T (Tourism), Eco (Economic), Env (Environment), S (Social)

Identifying possible systemic interventions

A follow up workshop was conducted (in Hai Phong city in May 2009) with the main objectives to identify key leverage points and intervention strategies (based on the systems model of CBBR) that could guide the identification of future projects across the CBBR in a systemic way. The project team also made several field visits and met with various stakeholders. Close collaboration and early involvement of relevant stakeholders has been a core feature of this project. The model refining process has also helped to identify key potential barriers to implementation of actions. This process of 'group think' has been instrumental for collective learning, consensus building and alignment of thoughts and actions. Following the workshop, a meeting was held (with the Vietnam MAB National Committee) for the preparation of funding proposals for demonstration projects as identified in the workshop.

DISCUSSION

A picture is worth a thousand words

Decision makers often find it difficult to 'see' the big picture and account for all relationships and interdependencies (Morecroft, 1985; Maani and Li, 2004). Therefore, it is instrumental to have an overall picture of the system to show the interconnectedness and roles of various players and agencies and their impacts. The systems model (Figure 5) represents a 'big picture' of the CBBR system and provides a powerful platform for learning, collaboration and collective decision making for various stakeholders including policy makers, managers, and community representatives. In the case of Cat Ba, the BR Management Board has members from different technical departments each with different expertise but no decision-making authority. Moreover, their recommendations to the decision makers tend to be biased, favourable to their own departments.

The systems model has been developed and validated through extensive consultation with relevant stakeholders. This is of vital importance because through this process they have taken 'ownership' of the model which will enable deeper understanding and commitment to future interventions and actions to improve the system towards sustainable outcomes.

Key research areas

The systems model has been used to identify key research areas and possible alliances as well as to create a collaborative platform for natural resource management and social, economic and environmental development in the CBBR. Through this model several research opportunities and gaps have been identified. Currently, there are four PhD studies being carried out (or are in the planning phase) that complement each other and will contribute significantly to the scope and impact of the Cat Ba sustainability project. These studies focus on a deeper understanding of tourism development and carrying capacity (a major component of the system that may be hampered by various factors such as fresh water availability), socio-ecological system, agricultural system, and water management issue of the CBBR.

This research draws from and links several disciplines including management, tourism, conservation, social science, economics, ecology and sustainable development. The research has identified key reinforcing cycles within the systems model that positively affect the key leverage areas. The model also highlights the priorities for local level planning (e.g. in agriculture, tourism, and conservation). The development of a further advanced systems model of the CBBR will also address the four main action areas of the Madrid Action Plan for Biosphere Reserves (2008-2013) (UNESCO, 2008). These areas include cooperation, management and communication, zonation – linking functions to space, science and capacity enhancement, and partnership.

The Cat Ba pilot project has now entered a second phase to refine the list of intervention strategies and demonstration projects identified, and to develop funding proposals for these projects to be carried out. Of particular importance is the value of the systems approach being followed, in that projects are identified that will address the core issues rather than the symptoms of the system. This would significantly help to ensure that research funding could focus on core problems in the system and avoid the mistakes of the past where many years of research have resulted in little or no change in the system (Brooks, 2006).

The learning laboratory

As defined previously, the learning laboratory is a process as well as a setting and place in which a group of stakeholders can think and learn together. It is an environment where policy makers, managers, local people, and researchers collaborate and learn together to understand and address complex problems of common interests in a systemic way (Maani and Cavana, 2007). The ultimate goal is to achieve coherent actions towards sustainable outcomes.

The learning laboratory process can be embedded in an adaptive management framework where longer cycles of planning, actions, monitoring and change take place. While the learning lab takes place in short cycles of 'group think' and learning together in a lab environments, the adaptive management steps take place in longer cycles of actions and results in the real world.

Figure 6 is a generic illustration of a learning laboratory embedded within an adaptive management framework. This figure suggests a collaborative learning environment involving a cyclical process as proposed by Bosch *et al.* (2003). All stakeholders share the results from their respective adaptive management cycles (Smith *et al.*, 2007) in the collaborative learning environment. The learning lab process provides opportunities for the participants to experiment and anticipate the consequences of their actions, policies, and strategies, especially with the assistance and use of computer models known as microworlds which would allow them to 'see' instantly the outcomes of their actions and policies (Maani and Cavana, 2007).

Figure 6 to be inserted here

Figure 6: Learning Laboratory concept within an Adaptive Management Process

In the CBBR pilot project, stakeholders in the management cycle include managers (e.g. National Park managers and hotel owners) and practitioners (e.g. rangers). Local people (e.g. farmers) represent the community cycle. Policy makers include government bodies such as Cat Hai People's Committee, Hai Phong People's Community, and Vietnam MAB National Committee. Researchers (e.g. the project team, researchers in Vietnam and Australian institutions) and higher degree students represent the research cycle.

The early and consistent involvement of key decision makers and relevant stakeholders (nearly 200 participants to date) has been of paramount importance for the successful formation and implementation of the creation of the CBBR as a Learning Laboratory for Sustainability. This involvement will be of significant importance for the seamless continuation and sustainability of the project.

The Learning Laboratory process will provide new management strategies and policies (through evaluation of the outcomes of those identified through the systems model) as well as refine the systems model which can be regarded as the knowledge base for defining strategic and systemic interventions. The collaborative learning process will also identify new research ideas that will inform and improve understanding of the systems and the interactions between components.

CONCLUSION

Using systems thinking and modelling as research paradigm and methodology, we have laid a theoretical foundation and practical framework for creating a biosphere reserve as a learning laboratory for sustainability. We concur with Ishwaran *et al.* (2008) that documenting and disseminating such case studies are an important part of the work to be undertaken as part of the learning laboratories focus.

To this end, a systems model has been developed to capture key forces and dynamics affecting the Cat Ba Biosphere Reserve. The model has served as a collaborative platform for natural resource management and social, economic and environmental development in the CBBR. It has also helped identify leverage points, potential research areas, and possible alliances. The systems model will be continually refined in a process of collective learning. The process and approach used in this pilot project could be adapted for other biosphere reserves in Vietnam and globally. Finally, not only does this project offer a model for other biosphere reserves worldwide, it could contribute materially to poverty alleviation (Strategy for Development and Poverty Alleviation, Vietnam 2003, and global priority) and environmental sustainability objectives (Millennium Development Goal 7).

Even though the concept of creating Learning Laboratories for Sustainability is still in its early stages of development, the project team has already been invited by the Cambodian Ministry of Tourism to commence a similar initiative in Siem Reap (Angkor – the World Heritage Site) and Tonle Sap Biosphere Reserve in Cambodia. A similar process has also begun in the Noosa Biosphere in Australia. Likewise, a learning laboratory project will soon be operating in the Nen River Basin in China. Although the main objectives of the sustainable management may differ (e.g. from poverty alleviation to maintain quality of life or sustainable tourism systems and sustainable utilisation of water resource), the methodology and systems approaches are generic and can be potentially applied to all or many of the biosphere reserves, to eventually form a network of Learning Laboratories that can share their experiences with each other. The important prerequisite for the creation of Learning Laboratories for Sustainability is engagement, involvement of all stakeholders and demonstration of benefits. Further research is required to ensure the laboratories will become institutionalised and ongoing when the research team moves on to new areas.

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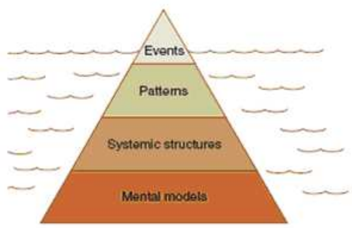

Figure 1: Four levels of thinking model
222x138mm (96 x 96 DPI)

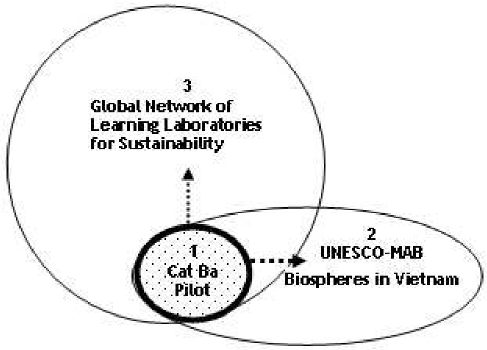

Figure 2: Developing stages for Learning Laboratories
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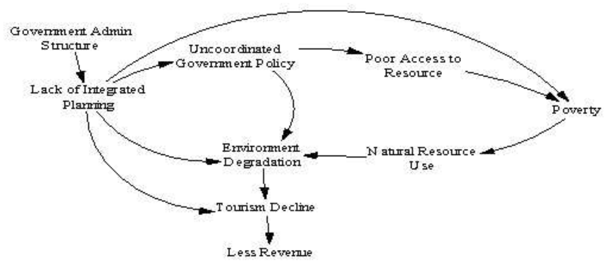

Figure 3: Initial conceptual model of Cat Ba Biosphere Reserve
222x138mm (96 x 96 DPI)

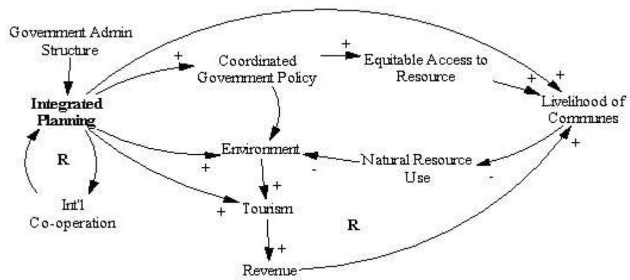

Figure 4: Initial CLD of Cat Ba Biosphere Reserve
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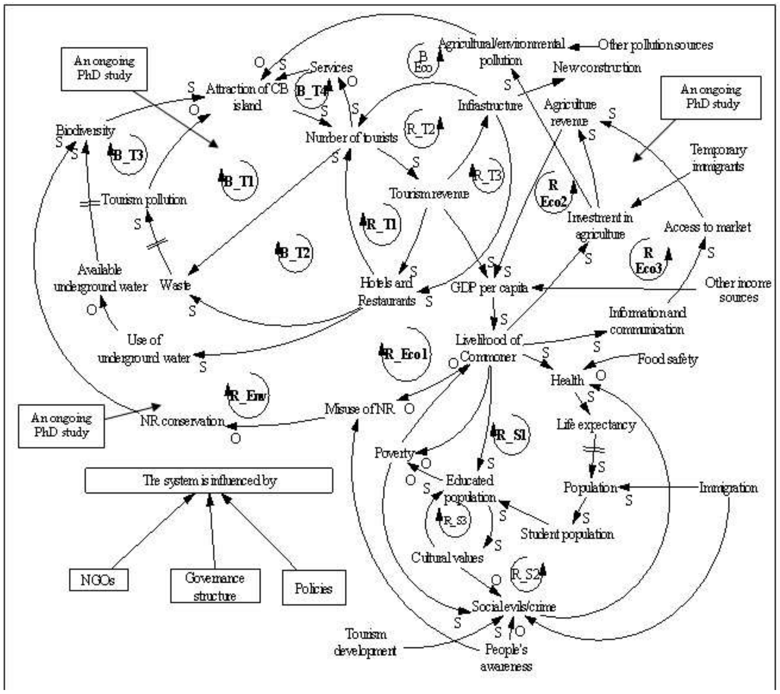

Figure 5: Current systems model of CBBR – A Platform for Collaboration
222x152mm (96 x 96 DPI)

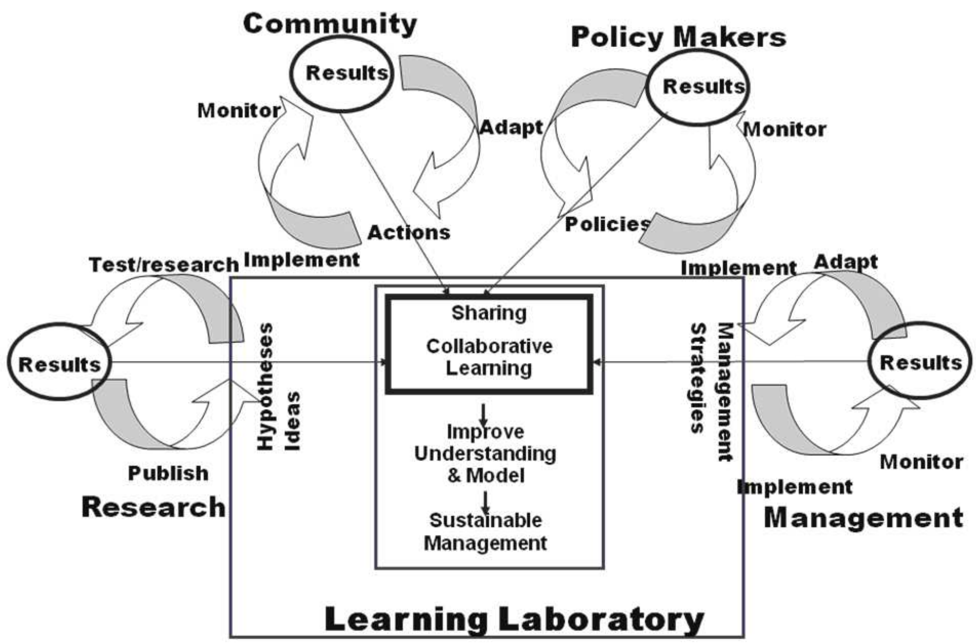

Figure 6: Learning Laboratory concept within an Adaptive Management Process
257x168mm (96 x 96 DPI)