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Complex problems…negotiated solutions: The practical applications of chaos and complexity theory to community-based natural resource management

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Acronyms

ADR	Alternative dispute resolution
CBRNM	Community-based natural resource management
CPR	Common property resource user groups
DFID	Department for International Development
IUCN	International Union for the Conservation of Nature
MoU	Memorandum of understanding
NGO	Non-governmental organisation

Summary

Discussed from the perspectives of chaos and complexity theory, this paper examines three approaches to the adaptation of community-based natural resource management (CBNRM) organisations in the face of development pressures. First, conventional 'reductionist' approaches are shown to be at odds with the emerging understanding that complex 'people-environment' systems cannot be deconstructed into their causal components. Second, 'inductionist' approaches adopted to identify generic 'rules' for intervention are shown to take insufficient account of the behavioural idiosyncrasies that characterise human organisations. Third, and in response to the weaknesses of the first two approaches, complexity theory lends support to methods of 'interest-based negotiation' as a pathway to organisational *facilitated self-restructuring*. The paper argues that, within certain limits, methods of interest-based negotiation can be applied to solicit organisation-specific rules that draw CBNRM organisations away from development-induced conflict and social exclusion towards an 'edge of chaos' where creativity and adaptation flourish.

1. Introduction

The world is a rapidly changing place. In the developed nations, businesses, government authorities and civil society groups and organisations all struggle to adapt to the pressures and opportunities presented by new technology and changing human values. In many developing nations organisations and individuals are subject to even greater levels of perturbation, since the above pressures often take place within a context of both industrialisation and globalisation. Development pressures on organisations involved in the management of community based natural renewable resources (agricultural land, forests, fisheries, grazing areas and water resources etc.) are further magnified by finite limits to the rate of exploitation and competing interests.

Some of the pressures directly affecting CBNRM organisations include:

- New technologies (e.g. synthetic fertilisers, agricultural mechanisation, permanent irrigation, joint management regimes etc.) which introduce localised positive and negative economic, environmental and social impacts
- Commercial pressures which increase the 'opportunity cost' of common property resource management
- The increasing importance of the cash economy and associated rising local aspirations
- Declining public expenditure on essential services, e.g. health, education, water and electricity supplies and transportation
- The introduction of public conservation policies, e.g. wildlife and watershed protection legislation
- The introduction of environmental standards, e.g. quality requirements for agricultural and forest produce, pollution control for agricultural processing etc.
- Continuing rural to urban migration, and
- Shifts in rural employment activities arising from new rural-based industries, e.g. crop processing, manufacturing, extractive industries, oil and gas, construction projects etc.

A wide range of organisations are subject to these pressures. These include:

- Government natural resource departments and related extension staff
- Research institutions
- Local trade and associations
- Local suppliers and distribution businesses
- Local community groups (such as those formalised under new common property resource management policies)
- Local producer cooperatives and associations
- Elected village and district councils
- Customary hierarchies e.g. elders
- Youth and women's groups
- Micro-finance community 'peer' groups

This paper investigates the practical application of complexity theory to the question of how these organisations can be assisted to manage and adapt to increasing development pressures. First, the key aspects of complexity theory are discussed with reference to social systems in general and CBNRM organisations in particular. Second, complexity theory is used to evaluate the appropriateness of two common approaches to the design of interventions for CBNRM organisations. Third, given weaknesses exposed in these approaches, interventions that utilise the

methodology of interest-based negotiation – e.g. consensus building, conflict management, dispute resolution and partnership building – are advocated as an alternative. Conclusions are then drawn on the application of interest-based negotiation to protect and improve the sustainability of CBNRM.

1.1 Complexity theory

1.1.1 'Edge of chaos'

Despite the many practical applications of chaos[1] and complexity[2] theory in biology, information technology, mathematics and business, few have looked at their application to international development. Fewer still, have looked at how these theories might help in the design of interventions that promote environmental sustainability and reduce poverty in the rural areas of developing nations. One exception in this latter category is Chambers (1997). With particular reference to issues of community development, Chambers cites Waldrop's (1994) 'edge of chaos' theory as a possible explanation of why community groups in rural areas are able to exist in, and adapt to, a permanence of development pressures and social change.

In general, those who apply 'edge of chaos' theories to social systems believe that the survival of social organisations in the face of rapid 'environmental' change (i.e. change in the external environment of an organisation) is achieved by the organisation striving to remain at the confluence of, on the one hand, a predictable (if sub-optimal) level of 'order', and on the other, an unpredictable level of 'chaos'. As argued by Stacy (1991) 'edge of chaos' is a state in which a system combines both stability and instability to generate patterns of behaviour that are irregular and unpredictable, but yet have structure. At the 'edge of chaos', as the overall argument continues, organisations are at their most adaptable and innovative (Waldrop, 1994). As Kauffman (1996) notes, achieving 'edge of chaos' in a human organisation is not necessarily a pain-free activity. In social terms individuals may lose their membership of the organisation, be relocated geographically, or be forced to perform unfamiliar tasks. Despite this, 'edge of chaos' is the best that can be achieved. We are at the 'edge of chaos' (or we inherently strive to be there) simply because that's where all organisms, human or otherwise, collectively do best.

As Chambers and others have concluded (in particular Tiffen et al., 1994), many of the organisations involved in CBNRM in developing countries have in the past adapted well to environmental perturbations induced by development. For example in India, farmers have successfully made the transition from rain-fed to irrigated crops; in Nepal, forest 'user groups' have formed to exploit new community-friendly forestry policies; and in East Africa, government wildlife departments and local communities have developed joint management arrangements for exploiting and sustaining safari hunting and tourism. By voluntarily venturing a small distance away from the order and familiarity of their traditional practices, these organisations have been able to restructure, learn new skills, develop synergistic partnerships and adapt to their changing environment.

1.1.2 'Edge of chaos': A permanent or temporary state?

Chaotic organisations are an unsustainable state. Complexity theorists argue that such organisations will eventually be drawn back towards order and simplicity by so called 'attractors'. It is thought

[1] The study of how iterations of simple algorithms leads to unpredictability and chaos
[2] The study of patterns, fractals, order and simplicity found within chaos

that these ‘attractors’ also work in the other direction, drawing organisations that are in states of sub-optimal order – i.e. that have lost their creativity and productivity and are redundant within society – back out towards the ‘edge of chaos’ where they can once again integrate with society and flourish.

As with chaotic organisations, though ‘edge of chaos’ is acknowledged to be a desirable state, it is unlikely that social organisations can reside there on a permanent basis, at least not without external assistance. Social organisations tend not to be creative and innovative on a continuous basis, but in a series of spurts commensurate with the extent of environmental perturbations and external ‘shocks’ that afflict them. For example, over the last 200 to 500 years various phases in the development of ‘southern’ nations have induced successful social organisations to periodically restructure in order to stay at the ‘edge of chaos’. We are arguably in the middle of one such phase – a phase that began at the end of the Second World War with the granting of political independence to colonial countries, and which has since accelerated with industrialisation and globalisation.

For those working in the field of CBNRM, the relevance of such broad temporal perspectives is not particularly helpful. Where, for example, is there benefit in understanding that CBNRM organisations might actually be in a state of dynamic equilibrium, fluctuating between sub-optimal order, edge-of-chaos and chaos, when what is far more relevant is a permanent perceived state of ‘development siege’? What many of today’s CBNRM organisations experience, is that no sooner has one new development technology exerted itself than another appears and business, government and civil society organisations have to restructure and adapt yet again. In practical terms then, ‘edge of chaos’ is not a temporary state at all, but a place where CBNRM organisations need to be permanently situated to survive.

1.1.3 Autopoiesis

Many of the core concepts of complexity theory stem not from the exploration of social systems, but from experimentation with the nature of living biological systems. For example, the various works of Maturana and Varela suggest that living systems comprise not only nested fractals (as proposed by chaos theory), but that these fractals are self-producing, i.e. *autopoietic.* Autopoiesis is the notion that living systems ‘are organised in such a way that their processes produce the very components necessary for the continuance of these processes’ (Mingers, 1995: 11).

Autopoiesis is important because it provides useful definitions that help frame our understanding of complexity. Most critical to understanding complex social organisations are the definitions of *structure* and *organisation*. Maturana (1978) describes *structure* as a combination of the ‘components of the system’ and how they must ‘fit together’ in order to become the ‘entity’ that is the system. Thus, in this definition, *structure* refers to both the static elements of the system and the dynamic processes that govern it. In contrast, o*rganisation* is described as the fundamental aspects of the entity that identifies the system as belonging to, and a recognisable member of, a particular type or class.

A further attribute of autopoiesis is the precept that many different structures can realise the same organisation (Mingers, 1995). This means that during self-reproduction an autopoietic system will restructure itself in such a way that its overall organisational identity is retained.

1.1.4 Autopoiesis and social systems

There is some debate as to whether social systems can be classed as truly autopoietic. On one side of the argument, Beer (1975) asserts that human societies are indeed living biological systems and are therefore, by definition, autopoietic. The following case is made: social systems frequently retain a recognisable organisational identity over time – often in the face of significant changes in their external environment and/or their internal structure – and social organisations can sometimes lose sight of their initial purpose and instead be driven primarily by their own 'egocentric' goals, i.e. behave as self-producing systems.

On the other side of the argument, is the view that the autopoietic (self-producing) tendencies of social systems and organisations are not simply reactions to the wider environment, but (in part) are a product of it. For example, most social organisations require a degree of education on the part of its members if it is to successfully adapt. However, such education is the product of a completely different social system – a combination of a 'schooling' system and a 'parental' system. Further, it is argued that social organisations are not mechanistic – that is, they are not governed by pre-defined 'cause-and-effect' processes in the same way as are biological systems. Social organisations are far more flexible in their response to 'cause' since they are predominantly governed by human behaviour (Mingers, 1995).

It is the arguments for some 'middle ground' position that are perhaps the strongest. Maturana (1981), Robb (1991), Stacy (1991), Mingers (1995) and Mitleton-Kelly (1997), all accept that social systems are not autopoietic in the strict closed-system, 'self-producing' sense; but to varying degrees, each accepts that such systems exhibit certain 'characteristics' of autopoiesis. Most important of these, is that social systems and organisations have a capacity to change their internal structure whilst maintaining their externally and internally perceived organisational identity. In other words, although social systems may not 'self-produce' in response to perturbations and 'shocks' arising in their external environments, they nevertheless do have a capability to 'self-restructure'[3]. This is exemplified in the conclusions of Stacy (1991) in reference to organisational change in businesses. Stacy argues that there have been many organisational management paradigms over the last two decades, and the results have been mixed. The only management practices which have been proven are those that focus on attaining strategic flexibility – the ability of the business to restructure in order to move from one mode of competitive advantage to another.

1.1.5 Organisational identity

Applying this analytical framework to organisations involved in CBNRM generates some interesting conclusions. For example, if a CBNRM organisation (such as a forest department, local forest 'user' group, seed business or village council) is inherently capable of 'self-restructuring', then, without the need for external interventions, it should be able to adapt to development pressures and at the same time retain its overall identity.

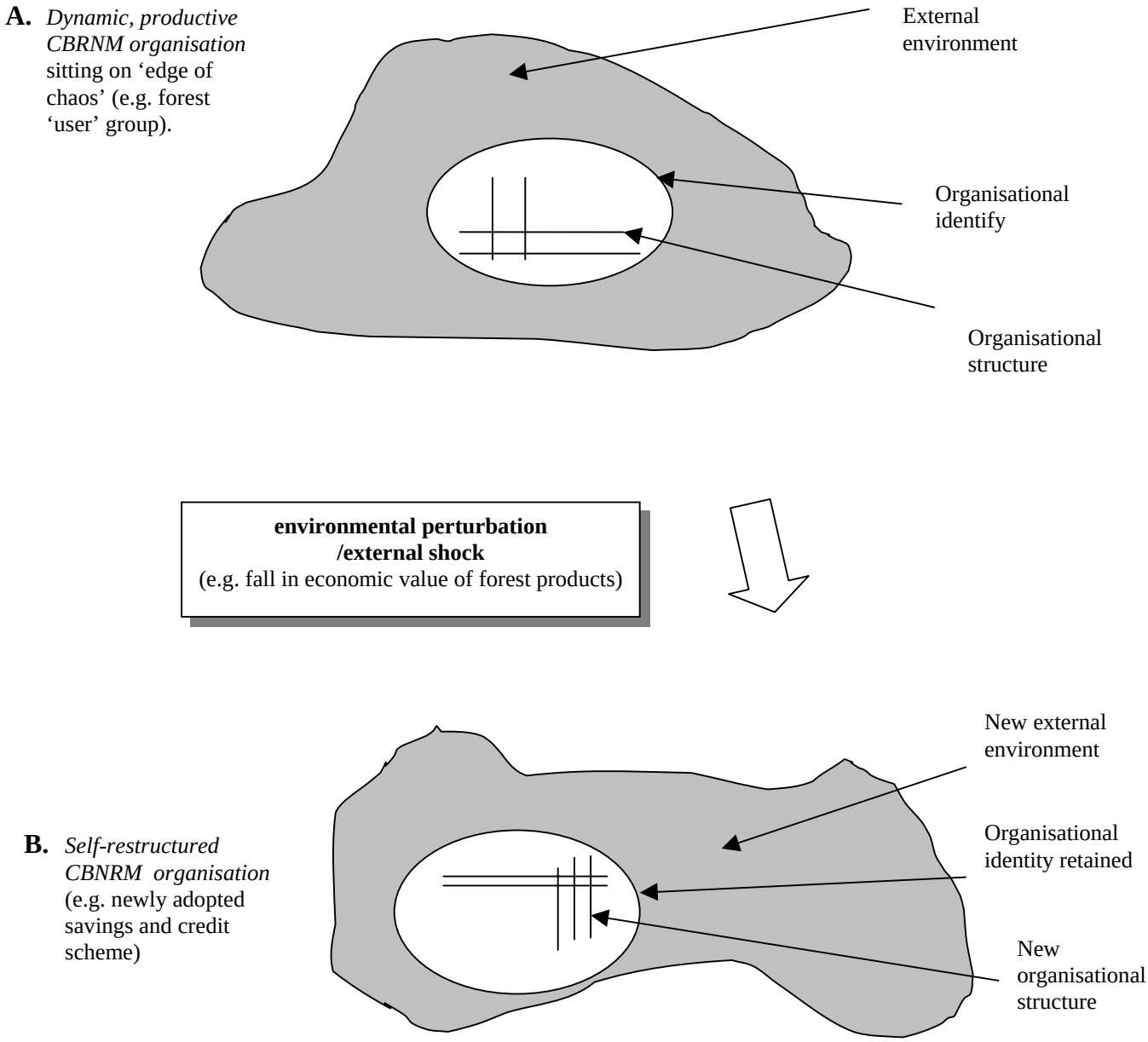
In social systems terminology, a social system exists as an 'organisation' if its participants perceive themselves to share a common identity. This might be common behaviour, language, decision-making process, culture, workplan etc. or some combination. It is perhaps this 'identity' which is the driving force behind the desire of social organisations to self-restructure in the face of external

[3] The substitution of 'self-restructuring' for the more conventional term of 'self-organising' is intentional. It is felt that the 'self-restructuring' is a more accurate reflection of the process of organisational adaptation in social systems.

environmental pressures. In other words, 'identity' is perhaps the mysterious 'attractor' that draws an organisation back away from chaos and sub-optimal order towards 'edge of chaos'.

Figure 1 shows how a CBNRM organisation (in this case a community-based forest 'user' group) with a unique organisational identity (a common set of membership rights, responsibilities, language and behaviour), might respond to a manageable environmental perturbation (a temporary fall in the value of forest products). In this example, the inherent self-restructuring capability of the group enables it to react to an economic downturn by instituting a savings and credit scheme to tide its participants over a period of uncertainty. What is important, is that throughout this period of self-restructuring, the group's shared 'identity' is maintained. Note also, that whilst assistance from other social systems in the wider environment may have been solicited (e.g. to provide start-up funds) and new links formed between the group and its external environment, the group had the internal capacity to seek this assistance itself in such a way that the boundaries and overall identity of the organisation remained intact.

Figure 1 Example of a self-restructuring CBNRM organisation



The propensity for community groups involved in CBNRM to self-restructure is supported by the research of Tiffen et al. (1994) in the semi-arid Machakos district of Kenya. This influential work looked at the sources of biophysical recovery from natural resource degradation arising from a history of inappropriate farming methods. The researchers found that far from local farming groups being passive 'victims' of pressures on the natural resource base, they were resourceful, innovative and able to transform their activities and their livelihoods accordingly. They record, for example, that 'the adaptive capability of Akamba people has been underestimated…[and that]...they are not unique, and it is equally likely that the capabilities of others have been similarly underestimated' (1994: 285).

Others, such as Richards (1997), have concluded that in contrast to the popular view it is not inevitable that forest common property resource 'user' groups (CPR) should break down in the face of commercial pressures. In particular, the longer established indigenous 'user' groups show marked resilience to the temptations for elites to 'free-ride' and resources to be over-exploited. In addition, the emerging findings of a multi-donor funded community forestry programme in Nepal demonstrate that both indigenous and more recently formed forest 'user' groups can, and do, adapt to commercialisation whilst retaining their overall identity (Hobley and Shah, 1996).

The general lesson from these examples, is that in the presence of what can be quite severe development pressures, local CBNRM organisations have a capacity to self-restructure.

2. Dysfunctional organisations, conflicts-of-interest and social exclusion

Knowing that the successful adaptation of a social organisation to a changing external environment can result from the organisation, *self-restructuring* is important. It suggests that when organisations fail to adapt, what is actually happening is that the self-restructuring capacity of the organisation is being overwhelmed. With regards to CBNRM, what seems to be taking place is that certain development pressures are so severe they cause one or more CBNRM organisations to become dysfunctional, a situation manifested as either:

(i) a chaotic organisation, plagued by debilitating conflicts-of-interest between the organisation's members and/or between the organisation and social systems in the wider environment; or
(ii) a redundant organisation, by-passed by the development process and excluded from society.

Wyatt (1996) provides a recent example of these outcomes. On the South Pacific Island of Vanuatu, a number of village groups were unable to adapt to the introduction of community-managed sawmills. The presence of sawmills led to resentment towards the project leaders, disputes over the unequal distribution of profits, the exclusion of weaker groups in the community (i.e. women and elders) from the project, and the unsustainable harvesting of areas of available forest. This scenario exemplifies Mingers argument that '...[social organisations] may fail to develop in ways necessary to maintain their *autopoiesis* tendencies, and [that] they may discover this only when it is too late' (1995: 151).

Table 1 lists some examples of conflicts-of-interest over natural resource management and socially excluded CBRNM organisations. Both outcomes have arisen from the failure of CBNRM organisations to adapt to external development pressures. The table draws on the inventory of common development pressures listed in the introduction

It is often claimed that conflicts-of-interest over the use of natural resources are an inherent part of change in society, and that if these conflicts are managed intelligently, they can prove to be a positive force (DFID, 1997; IUCN, 1995). What complexity theory contributes, is a framework for understanding why some development pressure are so severe that the conflicts they generate are unable to be managed in a productive manner.

The remainder of this paper employs complexity theory to investigate the effectiveness of different development intervention strategies in assisting CBNRM organisations to adapt to potentially overwhelming development pressures through the management of debilitating conflicts-of-interest, and the re-energising of organisations excluded from society. Three approaches are considered: a 'reductionist' approach, an 'inductionist' approach, and an approach built on methods of 'interest-based negotiation'.

Table 1 Examples of conflicts and social exclusion in CBNRM organisations arising from overwhelming development pressures

Overwhelming development pressures	CBNRM organisation	Outcomes *(conflicts-of-interest and social exclusion)*
New irrigation technology	• Agricultural cooperative	Conflicts between upstream and downstream cooperative members over use of new irrigation scheme
Continuing rural-to-urban migration of young males	• Individual household	Resentment of women burdened with additional agricultural labour, and witness to growing gap between male/female purchasing power
Increasing affluence among certain residents of rural village	• Village council	Authority of village council undermined by political influence of growing village economic elite
Declining public expenditure	• Government agriculture department • Community-based agricultural cooperatives	Competition between agricultural cooperatives over shrinking government extension services
New wildlife protection legislation	• Local forest 'user' group • Government wildlife department	Forest 'user' groups excluded from habitat protection areas
Location of industrial processing in remote rural areas	• Fruit processing plant • Agricultural cooperative	Agricultural cooperative loses members to processing plant, with consequence that cooperative's total productivity falls below levels required for economic viability
Change in donor agency policy	• Agricultural scientific research station	New policy of principal donor to promote rainfed agricultural research renders many research institute staff redundant

2.1 'Reductionist' approaches

In the field of CBNRM, the modern approach to assisting community organisations adapt to development pressures and manage conflicts-of-interest and social exclusion is exemplified by the new sustainable rural livelihoods framework (Carney, 1998). The framework builds on the 'theory of environmental entitlements' developed in part by Scoones (1998). The latter was designed to enable an analysis of how development assistance agencies, authorities and organisations might develop interventions that 'protect and promote the environmental entitlements of a particular social group, or...foster particular environmental outcomes' (ibid.: 6). The subsequent sustainable rural livelihoods framework (Carney, 1998) seeks to make sense of the following question: given the complexity of livelihoods in relation to people and their environment, how do different social actors gain access to, and manage natural resources?

To answer this the proposed framework deconstructs sustainable livelihoods into the following:

- different forms of **capital assets** (financial, social, human, natural and physical) and how these assets are, or are not, transformed by internal and external structures and processes into viable livelihood strategies;
- the **external structures** (levels of government, private sector etc.) and **processes** (policies, institutions, law etc.) that govern the way in which livelihood assets are accessed and capabilities employed; and
- the impact on livelihoods of **external events, trends** and **shocks** (economic, climatic, natural environment, violent conflict etc.).

Drawing on the work of Scoones (1998) and others, the capital assets component of sustainable rural livelihoods can be further deconstructed into:

- **endowments** – attributes of particular social actors that 'should' allow access, control or utilisation of resources (including ownership, land and resource rights, resources, opportunities, institutional skills, etc);
- **entitlements** – attributes that in practice constrain or promote social actors in exercising their endowments (including social class, household distribution of resources, public action, proximity to resources, proximity to market, economies of scale etc.); and
- **capabilities** – what can be done with entitlements to improve well-being.

These components of the sustainable livelihoods framework are given by way of an illustration of a 'reductionist' approach to designing development interventions in CBNRM. Its proponents would argue that the framework offers a tool for systematically analysing and deconstructing the complexity of 'people-environment' systems. In terms of complexity theory, the argument would continue and thereby enable, targeted interventions to be designed to assist CBNRM organisations restructure in the face of overwhelming development pressures and related conflicts-of-interest and social exclusion. In summary, the reductionist approach to repositioning CBNRM organisations at the 'edge of chaos' involves interventions designed from a detailed understanding and deconstruction of the system's component parts.

Critique

Complexity theorists would suggest that such reductionist approaches are leading researchers in the wrong direction (Cohen and Stewart, 1994). The argument is that the range of interconnections between 'cause' and 'effect' are too numerous to be able to predict a specific outcome from a particular intervention, regardless of the sophistication of the process of system deconstruction. Instead of trying to deconstruct 'people-environment' (i.e. social) systems as the pathway to designing effective interventions that allow social organisations to be adaptive and successful, we need to stand back and look for the 'patterns' of effectiveness within the complexity of the system itself. Our problem, Cohen and Stewart suggest, is that we have been looking at 'cause' instead of 'effect'. What we should be doing is 'collapsing' the chaos of complex systems into identifiable 'patterns' and simple 'rules'. In other words we should be adopting an 'inductionist', not a 'reductionist' approach.

2.2 Inductionist approaches

A recent CBNRM research programme in India funded by the UK Department for International Development (DFID) exemplifies this new inductionist approach. By looking across a range of different development projects for local level watershed management, the researchers identified those projects that demonstrated clear success in achieving sustainability and adaptability to development pressures.

The key 'rules' governing this success were then deduced, and a model developed which could be 'scaled-up' to a regional programme. The generic 'rules' identified included (Turton and Farrington, 1998):

- optimum community characteristics (size, boundaries, relative power of sub-groups)
- start-up preconditions (existing problem solving arrangements, punishment arrangements, distribution rights etc.)
- investment rules
- appropriation rules
- provision rules
- detection and graduation rules
- collective choice arrangements
- monitoring rules
- rules governing the relationship between the users and government, and
- rules for conflict resolution

Such approaches are increasingly favoured by development assistance agencies looking for cost-effectiveness, rapid solutions and replicability.

Critique

However, there is possible danger looming. What is happening here (by design or default), is the mapping of an understanding of complexity theory grounded in experimentation with non-linear mathematical dynamics with computers onto human social systems. The understanding that a few key 'rules' can govern the emergence of order and adaptability within complexity is the result of running multiple iterations of mathematical algorithms. But, as emphasised in recent work by Mitleton-Kelly (1997), whereas computer generated 'rules of interaction' do not change, the behaviour of humans within social organisations means that the 'rules of interaction' are likely to alter and evolve over time.

Mitleton-Kelly argues that whereas 'human systems are made up of *conscious* individuals *aware* of and *capable* of making choice… physical, chemical and biological systems are *not conscious* and do not learn in the sense that humans learn' (1997: 6). The conclusion is that social systems cannot be reduced to generic 'rules' or laws that govern human behaviour across regions or even within communities. Referring back to the work of Chambers, it is also noted that any such simple 'rules' for social organisations will need to enable 'people to manage in many ways with the local, complex, diverse, dynamic and unpredictable conditions, and facilitating not uniform behaviour of flocks but diverse behaviour of individuals' (1997: 200).

What this means for CBNRM organisations is that whereas a few 'rules' may indeed lead government authorities and community-based organisations to the 'edge of chaos' (from where they can be creative and adaptive to development pressures), it is incorrect to assume that these 'rules'

are generic and applicable to other social organisations or systems. We can only be sure that they are applicable to 'that' organisation which functions within the bounded complex system from which the 'rules' were derived. This conclusion would seem to support the example offered by Chambers (1997) where, in setting-up a programme of savings and credit schemes the implementing non-governmental organisation (NGO) entrusted local 'rule-making' to individual communities.

Complexity theory seems to suggest that the 'scaling-up' of generic 'rules' observed in successful CBNRM projects fails to take fully into account the behavioural peculiarities that characterise CBNRM organisations. What complexity theory seems to support then, is not an analytical framework for finding a set of 'golden generic rules', but a methodology that establishes 'sets of rules' idiosyncratic to each social organisation. Some of these organisation-specific rules may indeed be the same as the rules in other organisations within the wider environment, however, the overall 'set' of rules will be unique to only one organisation.

Returning to the central question of this paper, this alternative methodology will need to address how, in the face of overwhelming development pressures, rising conflicts-of-interest and social exclusion, CBNRM organisations can identify organisation-specific 'rules' that enables the organisation to self-restructure and reposition itself at the 'edge of chaos'.

2.3 Approaches based on interest-based negotiation

This paper asserts that the search for this methodology need look no further than the existing processes of organisational restructuring. In many social organisations, the nature of most conventional decision-making is 'hierarchical' (top-down); the process adopted to resolve conflicts and disputes 'adversarial', and the approach to working with others 'acquisitional'. In terms of CBNRM organisations, these processes have increasingly dominated the way in which local businesses, government departments and community groups manage development pressures. However, when faced with potentially overwhelming pressures, this type of decision-making becomes less effective. An alternative approach can be seen within indigenous community 'user' groups and some enlightened businesses. The approach involves decision-making that is more collective with conflicts and disputes resolved by consensus, and strategic alliances involving excluded groups based on mutual benefit. The key methodology underpinning these alternative decision-making, conflict resolution and partnering approaches, is 'interest-based negotiation'. The principles of interest-based negotiation can be summarised as follows, characterised by a process that:

- is voluntarily undertaken;
- involves prior (and continuous) trust and confidence building;
- is inclusive, by seeking to identify and involve all relevant stakeholders (i.e. all 'types' of system participants[4]) necessary to the task of organisational restructuring;
- is directed towards exploring the 'underlying interests' that lie beneath the surface of people's immediate and often emotional 'positions' and 'demands', since there are many more solutions to meeting an 'interest' than there are to a 'position';
- seeks out 'common ground' within these underlying interests and uses this a base for building consensus;
- employs joint problem solving to generate new and creative solutions, it aims to increase the size of the 'pie' before it is divided up;

[4] including organisations and individuals from the wider environment where relevant.

- encourages the formulation of integrative solutions that combine the needs and interests of a number of parties;
- fosters mutually acceptable i.e. *win-win*, outcomes, rather than simply minimising trade-offs or reaching compromise;
- is seen as legitimate in the eyes of the various organisational memberships, and the decisions taken transparent and accountable; and
- tests the solutions for financial, political, social and technical 'feasibility' and 'desirability'.

It is rational to conclude, that if collective decision-making, consensus building and voluntary partnerships and other forms of interest-based negotiation are the 'natural' way for social organisations to adapt to potentially overwhelming environmental perturbations, then the principles that underpin these approaches need to lie at the heart of any methodology designed to identify organisation-specific 'rules'. In short, what is needed for CBNRM organisations to manage potentially overwhelming development pressures is a methodology that builds on the existing propensity of these organisations to use interest-based negotiation to self-restructure.

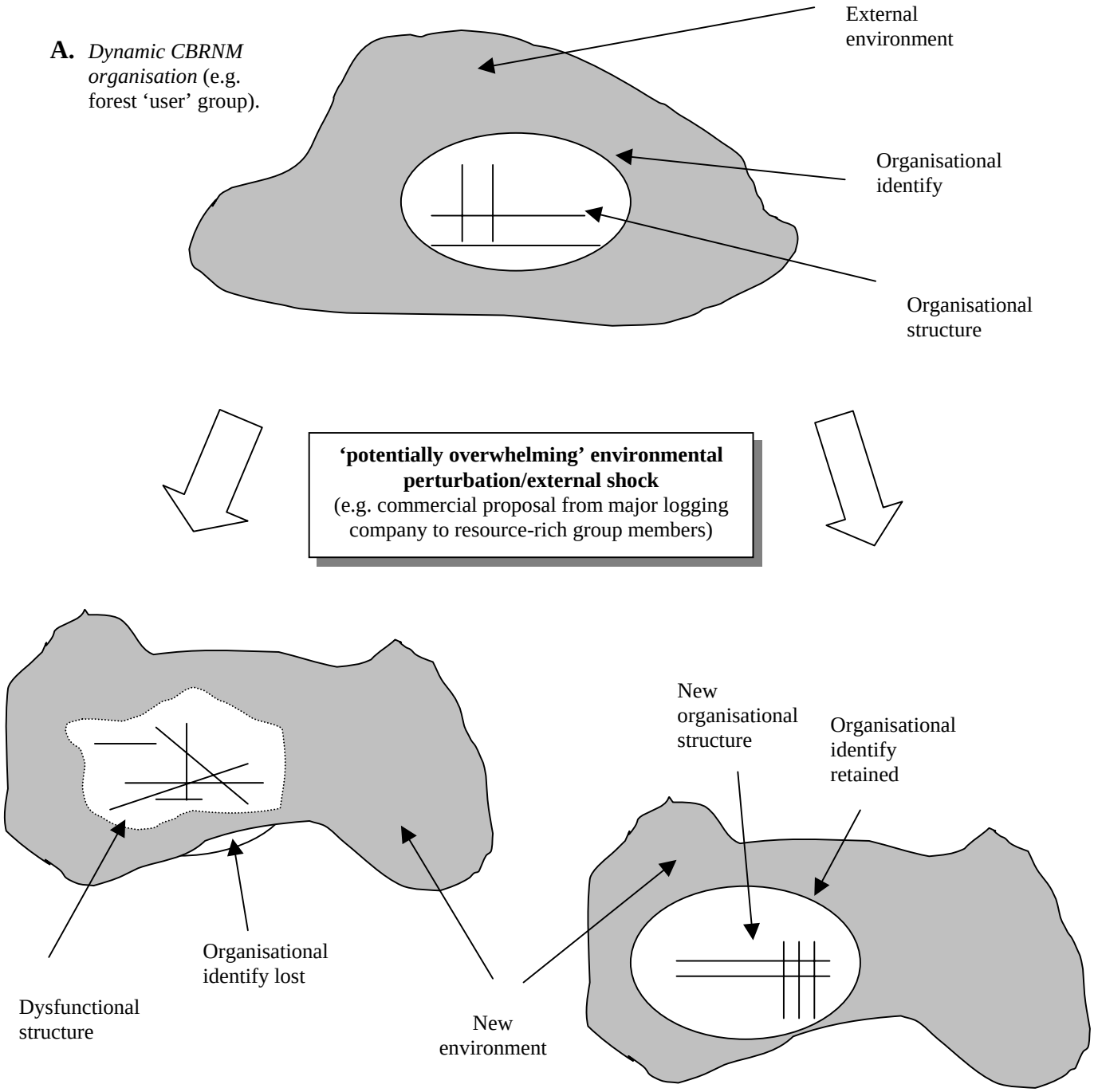
There are essentially two ways that methods of interest-based negotiation can be employed. The first, is to use them to strengthen the internal capacity of an organisation, by applying the methods to itself. This can take the form of training in skills such as stakeholder analysis, trust building, process design and consensual negotiation combined with the introduction of institutional incentives that encourage risk-taking and behavioural change. The second, is to bring third-parties into the process of self-restructuring in the form of third-party 'facilitators' or 'brokers'.

There is now an emerging body of practitioners intent on helping CBNRM organisations adapt to development pressures through applying various methods of interest-based negotiation. Conflict management, alternative dispute resolution (ADR), partnership building and consensus building are all forms of interest-based negotiation. Some of these focus on preventing and resolving conflicts, others on developing new partnerships. Either way, the principles of interest-based negotiation are being applied to draw conflict-afflicted and socially excluded CBNRM organisations back towards the 'edge of chaos'.

A process of *'facilitated self-restructuring'* driven by interest-based negotiation is illustrated in Figure 2. Taking the same example as before, the forest 'user' group is this time faced with a potentially overwhelming environmental perturbation: the presence of a logging company willing to pay individuals to sell their 'user' rights. In scenario **B**, the perturbation overwhelms the self-restructuring capacity of the group and the organisation dysfunctions. This results in internal disputes and conflict between those who have 'sold out' (mainly the resource-rich members), and those wishing to remain faithful to the group's established 'rules' (mainly the resource-poor). Eventually, the 'rule-keepers' find themselves both excluded from the new arrangement and without access to the forest resources necessary to maintain the group's economic viability.

In scenario **C**, capacity strengthening in interest-based negotiation for the leaders of the 'user' group combined with independent third party brokering, enables the 'user' group and logging company to negotiate a mutually satisfactory agreement. The agreement combines a creative temporal and land use harvesting strategy with a formula for shared revenues and new sustainable management practices. For the 'user' group, these new agreements (and the group's new internal structure and modalities for their implementation) are the new organisation-specific 'rules' that drive the group back to the 'edge of chaos'.

Figure 2 Example of the facilitated self-restructuring of a CBNRM organisation



A. *Dynamic CBRNM organisation* (e.g. forest 'user' group).

B. *Dysfunctional CBNRM organisation* (resource-poor members excluded from new arrangement with logging company, leading to conflicts and jealousies between resource-rich and resource-poor members).

C. *Facilitated self-restructured CBNRM organisation* (interest-based negotiation applied by third-party to broker agreement between 'user' group and logging company, resulting in creative temporal and land use harvesting strategy and formula for revenue distribution).

There is now growing evidence that various methods of interest-based negotiation can be effective in delivering a *facilitated self-restructuring* of CBNRM organisations. Box 1 provides some examples.

Box 1 Applications of interest-based negotiation to the facilitated self-restructuring of CBNRM organisations: Examples from around the world

Strengthened capacity in interest-based negotiation

- Training of village chiefs in the Fiji Islands in facilitation skills for use in building consensus between community landowners to agree 'rules' for harvesting forest resources, profit distribution and project membership.

- Training various community based organisations in Papua New Guinea to be able to better negotiate with private companies, for example:
  - to remove threat of large-scale clear felling by a private oil palm company;
  - to negotiate revenue sharing arrangements between private logging companies and local land owners; and
  - to agree profit distribution and tourist trail routes between community leaders and tour operators.

- Strengthening formal institutional processes of conflict management at the local level so that they are better able to mediate disputes. For example, the training of local land mediators, village magistrates and local officers from the Government Lands Department in the Solomon Islands.

Third-party brokering using interest-based negotiation

- In West Bengal, India, the brokering of a Memorandum of Understanding (MoU) defining the roles and responsibilities of a voluntary partnership between a coal mining company, local NGOs and district level government authorities to undertake a community livelihoods assessment.

- A local NGO acting as third-party broker in an Integrated Conservation and Development Project in Papua New Guinea affected by multiple land claims. Intended outcome is for disputing parties to agree proportional share of future revenue streams (e.g. from logging, oil palm, or tourists) as an alternative to the delineation of land ownership boundaries.

- In Venezuela, a third party facilitated process of dialogue between a gold mining company, international community development NGOs and local community groups, over how to promote sustainable small-scale mining.

- Employing 'third-party' facilitation skills to formulate rules for project participation. For example, the formulation of an MoU in a coral aquaculture project, which set out the expected benefits and responsibilities of each party and the individual 'deeds of agreement' between each participating household and the project sponsor.

2.4 Application of interest-based negotiation

Evidence from the field, suggests that interest-based negotiation is most effective at helping to restructure CBNRM organisations when stakeholders external to the immediate organisation are brought into the negotiation process (Warner, 2000; DFID, 1998). This suggests that successful 'facilitated self-restructuring' is unlikely to be independent of an organisation's wider environment.

Both the earlier discussion on autopoiesis and classic social systems theory (Checkland, 1981), would seem to support this conclusion.

The conclusion also shares much in common with the growing criticism of community participatory approaches to CBNRM, viz. that by themselves these methods are too insular to facilitate durable change (Grimble and Wellard, 1997; Warner and Robb, 1996). As Grimble and Wellard note: 'increasing the participation of beneficiaries or target groups alone cannot guarantee that projects will work…[instead]…the interests of the whole range of stakeholders who can influence or be influenced by the project or policy need to be taken into account' (1997: 184).

2.5 Characteristics of complexity and interest-based negotiation

Research at the London School of Economics is beginning to identify the key 'characteristics' common to all self-restructuring social organisations (Mitleton-Kelly, 1997). If a process could facilitate the emergence of these characteristics, it would go some way to enabling organisations adapt to otherwise overwhelming environmental perturbations. The 'characteristics' of adaptive social systems should not be confused with the identification of 'rules'. 'Rules' of adaptation are (as a set) idiosyncratic to a particular organisation. In contrast, 'characteristics' are the underlying principles that govern why social systems in general are able to adapt at all. The search for 'characteristics' should also not be confused with the idea of universal laws of human behaviour since, as has been argued, such laws have no place in the fluid, rule-changing world that is a human complex system.

Relating this to adaptive CBNRM organisations, it is noticeable that some of the generic 'rules' identified in the Indian Watershed Management example mentioned earlier, are closer to 'characteristics' than 'rules'. For example, within the inventory of rules listed by Turton and Farrington (1998), one such rule is the need for those sub-group members affected by various resource management rules to be able to participate in rule-modification. This is an extremely general rule, and quite likely applies to all social systems.

Some of the general 'characteristics' of successful, adaptive social organisations are given below:

Co-evolution – a process where the adaptive changes of each social system alters the 'landscape' of its neighbouring systems (Kauffman, 1996), such that neighbouring systems effectively co-evolve rather than adapt to their environment;
Emergence – that social systems often self-restructure through the emergence of a novel function for an existing activity or product (Kauffman, 1997);
Exaptation – a structure that is apt for a particular purpose, but was not built by natural selection for that purpose but has become useful by virtue of being co-opted (Gould, 1995).

One way to test the utility of interest-based negotiation as a methodology for facilitated self-restructuring is to assess whether the methodology abides by these characteristics.

2.5.1 Interest-based negotiation and co-evolution

The requirement that successful interest-based negotiation involves stakeholders both internal and external to the organisation is a manifestation of the concept of 'co-evolution'. For example, drawing on Figure 2, the forest 'user' group is only able to adapt if it negotiates and co-evolves 'rules' with the logging company. What interest-based negotiation achieves in this case, is to turn what is usually hidden (i.e. the co-evolutionary process of rule-making) into something that is visible and actively encouraged.

2.5.2 Interest-based negotiation and emergence

It is the characteristic 'emergence' and the creation of novel functions that are most manifest in processes of interest-based negotiation. Novel functions arise during interest-based negotiation in a number of ways:

- by searching for solutions not to people's immediate demands and positions, but to their underlying 'interests' and 'needs'. A key precept of any method of interest-based negotiation is that there are many more solutions to meeting an 'underlying interest' than there are to meeting a 'position'. An example within CBNRM would be the use of a third-party facilitator to broker 'rules' that supported the diversification of the activities of a forest 'user' group into community-based tourism. The aim being to meet the group's underlying 'interest' in raising its income-earning capacity, rather than its original position of demanding an increase in the rate of tree-harvesting;
- by redirecting or 're-framing' a discussion embroiled in personal hostility into a joint problem-solving exercise, i.e. removing human emotions from the search for a solution;
- by bringing to the negotiation process stakeholders and organisational representatives from the wider environment, not only those who are affected by the environmental perturbation, but also those who might be able to contribute new ideas to the search for solutions;
- by promoting creativity, lateral thinking and the generation of a wide range of options before focusing down on those most practicable; and
- by formulating integrative or 'packaged' resolutions that through the sum of their parts are novel and synergistic.

2.5.3 Interest-based negotiation and exaptation

A third concept of complexity theory is 'exaptation'. In terms of social organisations, this is the idea that the solutions to resolving conflicts-of-interest or overcoming social exclusion might be co-opted. The principles of stakeholder inclusion and lateral thinking that underpin methods of interest-based negotiation, often lead to the discovery that existing solutions and ideas can be applied to problems for which they were not designed. In short, innovation and the cross-fertilisation of ideas, is nearly always one of the outcomes of interest-based negotiation.

3. Conclusion

Applying complexity theory to CBNRM suggests that it may not be possible to design predictable development interventions through the use of 'reductionist' methods. Reductionist methods are based on the premise that there is a prerequisite need to know how the parts of the 'people-environment' system work and fit together in order to design effective and predictable interventions. This is illustrated in the tendency towards system deconstruction that underpins both the 'environmental entitlements framework' (Scoones, 1998) and the emerging sustainable rural livelihoods 'analytical framework' (Carney, 1998) and related 'assessment methodology' (Ashley and Hussein, 2000). The problem with applying reductionist methods to CBNRM is that the degree of complexity presented by these 'people-environment' systems means that the more each system is deconstructed, the more unknowns are introduced. As complexity theory suggests, in terms of the ability to design predictable interventions, deconstructing complex systems soon leads to diminishing returns.

A progressive alternative to reductionism is to deploy 'inductive' methods. Here, highly successful CBNRM projects are analysed to distil the generic 'rules' (key success factors) of organisational adaptation. The problem here is that methods of induction tend to overlook the behavioural, experiential and experimental nature of human organisations. These characteristics mean that it cannot be correct to assume that 'rules' of intervention which work for one CBNRM organisation are applicable to organisations in other systems.

Complexity theory points the way to a third approach. What is needed is a means to facilitate the natural propensity of CBNRM organisations to self-restructure, but without either the need for a 'hard' systems analysis of the system's constituent components, or an expectation that the identified solutions and rules will be scaled-up. Methods of interest-based negotiation provide this means. Assuming an initial minimum level of stakeholder analysis in order to bring the right people into the negotiation process, methods of interest-based negotiation require no further process of detached 'hard' systems analysis in order to arrive at interventions that satisfy the underlying interest of each stakeholder within the system. This is because methods of interest-based negotiation ask the participants, not: 'what is the detail of your lives' or 'what successes can we replicate?' but: 'where would you like to be in the future' and 'how are you all going to get there?'

If it is true that social organisations can, and do exhibit *autopoietic* tendencies and are capable of *self-restructuring*, then complexity theory carries some important implications for the long-term sustainability of CBNRM. For one thing, it challenges the view that local level CBNRM organisations are passive 'victims' of development pressures and external 'shocks', lending support instead to recent research findings that such groups are able to innovate, self-restructure and adapt to quite substantial development pressures. More importantly, it explains what is happening when development pressures and shocks are simply too great and give rise to CBNRM organisations plagued by conflicts-of-interest or excluded from the development process. In these cases, development pressures are simply overwhelming the natural capability of CBNRM organisations to self-restructure.

The conclusion that methods of interest-based negotiation are a pathway to organisational *facilitated self-restructuring*, is supported by the close 'fit' that seems to exist between the core principles of interest-based negotiation and the 'characteristics' of successful, adaptive social systems. In the ever changing 'people-environment' systems that define CBNRM, methods of interest-based negotiation provide practical tools for drawing CBNRM organisations away from debilitating conflicts-of-interest that result from overwhelming development pressures, towards an

‘edge of chaos’ where the organisation’s creativity and innovation can flourish. The same methods can likewise be applied to CBNRM organisations excluded from the development process, enabling them to form new alliances and partnerships that drive them towards a more integrative and productive ‘edge of chaos’.

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