A Complex Systems Approach to Pastoral Commons

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Abstract

Recent years have seen the emergence of a new approach in commons scholarship that draws on complex systems thinking, and that makes use of concepts such as *fit*, *scale*, and the *adaptive renewal cycle*. This paper explores what complex systems thinking has to offer for commons scholarship by applying these concepts to the pastoral commons of the Gabra ethnic group of north-central Kenya. The concepts of fit and scale can help us to understand why some features of the Gabras' institutional regime do not conform to mainstream principles such as clearly defined boundaries, clearly defined membership rules, and subsidiarity. The notion of the adaptive renewal cycle can help us to describe and understand some aspects of dynamics of Gabra institutions, especially those institutions related to the management of shallow wells. Applying the adaptive renewal cycle to larger and longer scales highlights the possibility that the Gabra social-ecological system is becoming increasingly brittle, with evolving institutional arrangements putting more and more constraints on adaptation and especially on nomadic mobility. An examination of the distinctive nature of dryland pastoral commons, and in particular, a complex systems approach to this examination, suggests a number of issues that relief and development organizations should consider, including how to foster novelty and innovation through all the phases of the adaptive cycle. Such an examination can also provide insights for those who are studying and working on problems associated with global commons, suggesting for example that some degree of institutional fuzziness, overlap, and plurality may sometimes be preferable to 'neat', unitary accords.

Keywords: *adaptive renewal cycle, complex adaptive systems, complexity, fit, institutional interplay, pastoralists, pasture, scale, water, wells*

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Complex Systems and Commons Institutions

In recent years mainstream commons scholarship has received numerous critiques, particularly from a group of perspectives that is typically referred to as either the 'entitlement school' (Johnson 2004) or the 'social-practice model' (Young 2002). While scholarship that falls under the *social-practice* heading may be a somewhat disparate group, it is united in agreement that the mainstream rational choice perspective gives insufficient attention to questions of power, culture, meaning and history. However, a critical problem with the image of commons scholarship as being dichotomized into these two schools of thought—the mainstream, rational choice approach and the social-practice perspectives—is the very idea that there are only two. This conception neglects the existence a third cluster of commons scholarship. This alternative position is neither the 'middle ground' between the rational choice and social-practice perspectives as described by Beck and Fajber (2006), nor is it a modified version of either of the other two perspectives. While the literature contributing to this emerging approach builds to a certain extent on earlier scholarship and while very little of it makes any explicit claim of being based on an alternative paradigm, it nevertheless draws on complex systems thinking to apply a distinct set of concepts to commons scholarship. Some of these concepts are *self-organization*, *non-linearity*, *scale*, and the notion of *linked social-ecological systems* (Berkes 2007).

This paper explores what complex systems thinking has to offer for commons scholarship by applying it to the pastoral commons of the Gabra ethnic group of north-central Kenya. The paper is based on field research that was conducted there in 2007, as well as on existing literature on the Gabra. This section of the paper continues with a discussion of some of the relevant features of a complex systems approach to commons scholarship. This is followed by a brief overview of the Gabra social-ecological system and some of its institutions. I then take two key concepts from the emerging complex systems approach to commons—*fit* and *scale*—and use them to make some sense of the nature of Gabra commons institutions. Following this, one of the influential concepts that emerges from complex systems thinking—the *adaptive renewal cycle*—is used to examine the dynamics of Gabra commons institutions. The paper concludes by considering whether an examination of the distinctive nature of pastoral commons through the lens of complex systems thinking may produce lessons that are relevant to commons scholarship as a whole and to current issues of global environmental change.

Some of the concepts based on complex systems thinking that are relevant to commons scholarship come from the literature on social-ecological resilience, especially the idea that the social and the ecological are integrally linked. This body of literature holds that neither the ecological system nor the social system can be adequately understood without understanding the other and the linkages between them, and that essentially they function together as a *social-ecological system* (Berkes and Folke 1998). Social-

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ecological systems, furthermore, exist in complex nested hierarchies that bridge scales—a social-ecological system is made up of smaller systems and is itself part of a larger system (Berkes et al. 2003).

Another important concept from the literature on social-ecological resilience—a concept emphasized in this paper—is the *adaptive renewal cycle*. Originally, the cycle was used to help make sense of the dynamics of ecosystems, but in recent years several authors (e.g., Gunderson and Holling 2002; Holling and Gunderson 2002; Scheffer et al. 2002; Seixas and Berkes 2003; Grant 2006) have suggested that it can help us to understand institutional dynamics. The idea is that ecosystems, and by implication social and social-ecological systems, tend to go through cycles of four stages: exploitation, conservation, release, and reorganization (See Figure 1). In a forest for example, the exploitation and conservation phases relate to the periods when plants are colonizing a landscape and one or more climax species is becoming established. During these phases, interconnections within the system gradually increase, the resources and potential that exist in the system are increasingly locked up, and the system gradually becomes more rigid (Holling and Gunderson 2002). In social systems, these are typically the phases of *institutionalization* of solutions to problems (Scheffer et al. 2002). As the conservation phase extends itself and connectedness within the system increases, the system becomes more and more susceptible to a disturbance causing a 'release'—a forest fire that benefits from the accumulated energy and sweeps through the forest or a social upheaval that results when long-standing institutions are unable to deal with new stresses and problems. This is followed by a reorganization. If disturbances and the *release* phase are suppressed and the conservation phase

Figure 1: The Adaptive Renewal Cycle
Adapted from Holling and Gunderson (2002).

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artificially extended, the resilience of the system can be compromised as it becomes vulnerable to a much more serious release and potentially a 'flip' into a qualitatively different state. Scheffer and coauthors suggest that, as new problems emerge, in order to ensure adaptability and to allow the social system 'to incorporate new stakeholders or allow for a new definition of the situation', there may need to be a deinstitutionalization—the *release* phase of the adaptive renewal cycle (2002: 235).

Another set of concepts influenced by complex systems thinking and relevant to commons scholarship comes from the work of Oran Young (2002) and the International Human Dimensions Programme on Global Environmental Change. While Young himself does not outline a full-fledged complex systems theory of institutions, he does argue that the frontier of institutional theory—at least institutional theory for natural resources management—relates to three concepts: *fit*, *interplay*, and *scale*. *Fit* refers to how well an institutional regime matches the ecosystem in question. *Interplay* is concerned with how institutions interact with other institutions. The concept of *scale* in institutional analysis considers how institutions relate to the social-ecological environment at various spatial and temporal scales.

One other concern prominent in complex systems thinking deserves mention: dynamics. Most of commons scholarship has assumed that both ecosystems and well-designed institutions are stable; however, the recognition that societies are rarely, if ever, 'in balance' with their resources and that commons institutions are seldom stable for long has forced attention onto dynamics, cycles and change (Seixas and Berkes 2003; Berkes 2006). To understand dynamics, a number of factors are important, including the scale at which particular institutions operate, the drivers impacting on institutions, and institutional interplay. This concept of *interplay* reminds us that institutions are not self-contained units but are shaped by their interactions with other institutions (Young 2002). Berkes (2002) similarly affirms the relevance of examining the effects of larger scale institutions on smaller scale institutions. Examining common property institutions through the lens of resilience theory, he emphasizes adaptive change and argues that commons researchers need to look beyond the forms that institutions take and give more attention to adaptive capacity, to the role of institutions in relation to shocks and stresses that accompany social, political and environmental change, to institutional linkages across scales, and to institutional dynamics (Berkes 2002).

The Gabra Pastoral Commons

The traditional territory of the Gabra ethnic group is situated in north-central Kenya and extends into southern Ethiopia. Livestock are the foundation of the Gabra household economy, with milk accounting for over 60% of household food consumption among those still primarily engaged in the traditional economy (McPeak 2003; McPeak 2005).

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Typically, a Gabra household's livestock mix is diverse, being based on camels but also including sheep, goats, donkeys and sometimes cattle (Ganya et al. 2004). Most respondents interviewed for this research said that livestock and food aid were the only sources of their livelihood. The diversity of livestock is part of their regular coping strategies and is related to the varying lengths of time that different animals can go without water (Ganya et al. 2004). Movement of herds and households is a key part of survival in this arid region, and even households which have established a permanent residence still rely primarily on livestock for their survival and still send some household members and their livestock long distances in search of water and pasture. Indeed, diversity and flexibility of movement is a key feature of the livelihood system (Robinson 1985; Ganya et al. 2004; Haro et al. 2005). As noted by Haro and co-authors (2005), this flexibility of nomadic movement functions alongside territorial boundaries that traditionally have been quite fuzzy.

Gabra commons institutions, embedded in a clan-based social structure, include well councils and other institutions involved in governing water sources (Robinson 1985; Ganya et al. 2004), exclusion of outsiders from grazing in the core areas of Gabra territory (McPeak 2003), and institutionalized norms for negotiating access to water and

Figure 2: Gabra Territory and Surroundings

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pasture resources controlled by others (Ganya et al. 2004). Gabra territory also has numerous sacred sites which are important ecologically. Because grazing and other activities are restricted at sacred sites, they tend to have a somewhat different mix of flora and fauna than the surrounding territory and in this way they contribute to biodiversity across the landscape, as well as being a natural source of seeds and hence biological memory for these surrounding areas (Ganya et al. 2004). Gabra society has an intricate set of nested decision-making institutions, and lines of authority which, like territorial boundaries, are fuzzy, with different scales of 'communities' making competing claims on the same resources (Haro et al. 2005). Decision-making institutions include both permanent bodies and ad hoc *korra* meetings that are held at various levels of social organization as the need arises.

Commons institutions exist to govern trees, pasture and water. At sacred sites and in the vicinity of water points there are rules about cutting trees and branches. For example, in the vicinity of some towns and water points, branches of certain trees are to be cut only on one particular day of the week. As well as having traditional norms governing use of pasture, such as limitations on grazing near sacred sites, some settlements have recently adopted rules governing milk herds and *foora* (dry) herds. Within walking distance of the settlement and its water points only animals in the milk herd should be grazed. Males, unproductive females, and productive females beyond the number that the household needs for its daily milk consumption are to be put in *foora* herds and kept on more distant pastures. Generally, however, Gabra livestock owners enjoy essentially unrestricted access to pasture throughout Gabraland (McPeak 2003; McPeak 2005). An elder of one of the Gabras' five Yaas, the traditional councils of elders for the Gabras' five phratries (groups of clans), went so far as to say that it would be 'very shameful' for a Gabra to tell any other Gabra that they cannot use a particular pasture or that his livestock numbers should be limited. It is water, rather, that is more tightly regulated in the traditional system, and access to water is the main factor limiting accessing to pasture (Robinson 1985). Shallow, hand-dug wells, for example, are governed by numerous rules and norms. The person who digs a well (with the help of physical labour on the part of friends and fellow clan members) is the *abba ela*, literally 'father of the well'. Although Gabras refer to the *abba*

Table 1: Some of the Key Features of the Gabra Institutional Environment

Standing Institutions: institutionalized positions and corporate institutions

- Yaa councils, one for each of the Gabras' five phratries (groups of clans)
- Heerega (well council)
- Abba heerega (head of the heerega, lit. 'father of the watering rotation')
- Abba ela (lit. 'father of the well')
- Water Users Associations governing boreholes

Rules, Norms and Understandings Regarding the Use of Natural Resources

WATER:

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- Heerega (rotation system) governing access to wells and to water in some pans and rock catchments
- Norms for accessing wells and some other water points and for receiving a slot in the heerega
- Wells are nominally 'owned' by the abba ela, but held in trust for his clan
- Detailed rules about what activities are permitted at and near wells
- Access to springs is more relaxed as supply typically exceeds demand. However, in recent years committees have been emerging regarding the apportionment of spring water for horticulture.

PASTURE

- Rules regarding sacred sites
 - Rules regarding where foora (dry) herds may be grazed
 - Exclusion of outsiders from the core of Gabra territory
- (Generally, however, there are few restrictions on the use of pasture)*

OTHER NATURAL RESOURCES

- Rules regarding sacred sites
- Rules limiting the cutting of trees and branches in particular locations

Other Features of the Institutional Environment

- Key relationships are structured through the clan and phratry system
- Ad hoc *korra* meetings tend to be more important to collective decision making than standing institutions
- Territorial boundaries are fuzzy
- Nested decision-making institutions with lines of authority that are not always clear

ela as the owner of his well, he is essentially a trustee, caring for the well on behalf of his clan. Wells and other water sources like rock catchments may also have a *heerega*. The terms *heerega* refers to both the schedule of turns for bringing livestock to the water source, and to the committee of elders who oversee the schedule. When a newcomer arrives and requires water for his herd, he will typically ask permission from the *abba heerega*. On one occasion I witnessed this firsthand, when an interview with an *abba heerega* was interrupted by someone just who had just arrived in the village and who came asking permission to water his livestock. Permission will seldom be denied initially, but if a large number of livestock are already using the well, the newcomer may be given water once but not given a regular turn in the rotation and then politely asked to find another water source. The *abba ela* is one of the members of the *heerega*, and does enjoy certain rights regarding 'his' well. For example, he usually is given the first morning slot in the watering rotation and hence does not need to spend any time waiting in a queue for others to finish watering. Ultimately, however, it is the *heerega* as a whole that determines watering turns, and, as one *abba ela* explained to

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me, depending upon circumstances the *abba ela* may not even get a slot at his own well.

Fit and Scale

The concepts of *fit* and *scale* and the notion of linked *social-ecological systems* help us to understand the imperatives imposed by biophysical and ecological constraints, imperatives that have not always received adequate attention in commons scholarship. Young argues that because various social and ecological scales each have their own unique characteristics, the pursuit of design principles for institutions of the sort advocated by Ostrom (e.g., Ostrom et al. 1999) must be undertaken very carefully and that the principles that apply at one scale may not apply at another. Berkes (2007) similarly asserts that concepts and principles that apply at different levels of social-ecological organization overlap and are linked, but that each level also requires new concepts and principles. For example, the principle of *subsidiarity*—the idea that decision-making should be relegated to the lowest capable level of social organization—is not easily implemented for large-scale ecosystems (Young 2002).

In the case of the Gabra, because of the extreme variability of the climate in which they live and the resulting nomadic lifestyle, the relevant social-ecological system exists in a territory that covers tens of thousands of square kilometres. This also explains why territorial boundaries are not clearly defined. For those still living the traditional life, the notion of a village and its surrounding territory as a 'community' is largely irrelevant. This accords with Scoones' discussion of the implication of the new ecology and non-equilibrium systems (1999; 2004) and seems to contradict the mainstream commons view that clearly defined boundaries are key to well-functioning commons regimes (Ostrom 1990; Ostrom 1992). The variability of rainfall and pasture, the size of the territory used by a Gabra household and the scale of the social-ecological system in which a household operates are such that some 'principles' of effective common property regimes, such as clearly defined boundaries, clearly defined membership rules, and subsidiarity, cannot easily be applied.

Gabra Institutions and the Adaptive Renewal Cycle

This section uses the notion of the *adaptive renewal cycle* to describe and understand a few aspects of the dynamics of Gabra institutions. In studying Gabra institutions the utility of the adaptive renewal cycle is most obvious at a time-scale of a few years and in relation to livestock and to the institutions that govern the use of shallow wells. The *exploitation* and *conservation* phases of the cycle relate to times when rainfall is adequate and herds are expanding (points A and B in Figure 3). Eventually a disturbance upsets the system: typically a drought, but occasionally loss of livestock because of disease or theft (C). In response to drought, numerous coping strategies are employed, most notably splitting herds and moving herds to distant locations in search of water and pasture. Some households and even entire nomadic camps will

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relocate to a new range and may not return to the previous range for many years. The release phase of the cycle corresponds to a drop in the livestock population (D): in response to the drought, many animals will be sold or slaughtered, and in severe droughts many more will die of thirst and hunger despite the coping strategies that are employed. The system responds to these changes—the drop in livestock population, the fact that many households and camps have relocated, and the fact that many water points thereafter have a different set of people using them—and it reorganizes with new relationships and linkages being established (E).

Figure 3: The dynamics of livestock population and access to shallow wells

The dynamics of the institutions governing wells follow this same cycle. As mentioned above, the notion of the adaptive renewal cycle suggests that as the conservation phase progresses, relationships become more rigid; institutions, as those human relationships that have become structured and legitimized, are no exception. Early in the exploitation phase, when herds are small, access to water sources is relaxed as the

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heerega has no need to exclude anyone who wants to water their herd (A). Herd owners, furthermore, have several options open to them: a number of different water points that could accommodate their herds, and green pastures in between. But as livestock numbers and the competition for water increase, the *abba ela* or the *heerega* will apply rules more rigidly and begin to restrict usage of the well, and livestock owners find fewer options available for watering their herds (B). Eventually, drought or some other disturbance (C) triggers the release phase of the cycle which is signified by a reduction in livestock numbers (D). Sooner or later the rains return, and with livestock numbers greatly reduced the rules for accessing wells are once again relaxed (A).

One should not infer from the above discussion that this cycle repeats itself according to a regular and predictable cycle. Droughts and other disturbances occur at varying intervals and with varying durations and degrees of intensity. Essentially though, it could be said that the cycle as described above occurs over a period of between three and ten years.

At larger and longer scales external drivers play a strong role, so the pattern is not quite as clear as at smaller scales; nevertheless, the adaptive renewal cycle does seem to play itself out over longer time frames. The social-ecological system in Gabraland underwent a major reorganization in the late 1800s, when there were a series of shocks: an outbreak of Rinderpest in 1889, outbreaks of malaria in 1890 and smallpox in 1891, conflict with neighbouring ethnic groups from 1894 to '97, the virtually simultaneous arrival of Ethiopian and British colonialism in 1897-98, and drought through most of that decade (Robinson 1985). During this time, many Gabras died of starvation, their territory shifted slightly southward into more arid land, and the prominence of cattle in the livestock mix was greatly reduced in favour of camels (Robinson 1985). Another reorganization took place in the 1920s and '30s when the colonial administration began to restructure the governance of the area, facilitated the settlement of Mount Marsabit by Burji agriculturalists (Robinson 1985), and permanently reduced the military strength of the Gabra by prohibiting them from owning horses (Torry 1973). During both of these periods, Gabra institutions proved to be quite flexible, and this was a key component in their adapting to new situations (Robinson 1985). Since then, none of the shocks and disturbances that the Gabra have faced seem to have been on the same magnitude as these two episodes, and the organization of nomadic Gabra society, although undergoing new stresses now, is quite similar to what it was in the 1930s.

There are some signs, however, that social-ecological system is currently near the peak of a conservation phase. The human population has grown from about 11,000 in 1969 to over 45,000 at present (Ganya et al. 2004), resulting in increased competition for scarce resources. Droughts and theft of livestock function to keep livestock numbers within certain limits, but the ever-increasing human population means that in per capita terms, the system is tighter. One institutional response to this in Gabra communities has been the adoption of rules to restrict grazing near settlements and to require *foora* herds to be sent to distant pastures. A number of Gabra elders explained to me that the

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growing importance of such rules is a recent development, a departure from the more open and permissive grazing regime that has existed since Kenyan independence. Another recent institutional development is the delineation of new, smaller local government units, an action which typically receives strong political support at the local level. New local government boundaries, especially District boundaries, have a tendency to become de facto ethnic boundaries defining clearly marked grazing territories for various ethnic groups, as happened with the creation of Moyale District, when the Moyale-Marsabit border became one of the de facto dividing lines between Gabras and Boranas.

As the marginal cost of securing scarce resources increases, so too does competition for those resources. This is leading to new mechanisms for distributing access and laying claim to resources, new rules, new institutions. As mentioned above, this is the stage of the adaptive cycle that sees the *institutionalization* of solutions to problems. In the case of the Gabra social-ecological system, this entails the creation of new boundaries between ethnic groups and between local government units, the strengthening of existing boundaries, and the tightening of rules for access to grazing land, such as the rules for foora herds mentioned above. The concept of the adaptive cycle also implies, however, that increasing institutionalization and increasing competition for resources go hand in hand with increasing brittleness. Whereas the rainfall regime remains as variable and unpredictable as it always was, these recent developments, while adding to the ability of the social ecological system to manage competition, also restrict the primary means of dealing with the climatic variability: nomadism. The result is an overall loss of resilience.

NGO personnel and other development agents working with the Gabra and other pastoralist populations in Africa, whether or not they are aware of Holling's adaptive renewal cycle, are well aware that when a social-ecological system undergoes a 'release' and 'reorganization', a great deal of human suffering can result. Among the Gabra this applies at both scales that were discussed: people suffer through every revolution of the drought cycle, and they have suffered during the larger scale reorganizations of the entire Gabra social-ecological system, as happened in the 1890s. And if at the time of the release resilience has been greatly eroded, people may not recover at all, as testified to recently by the number of Gabras who have been ejected from the pastoral economy and now live in permanent settlements relying on food aid. So the question arises of what governments, NGOs and other agencies might best do to limit this kind of suffering. Clearly, policies and programmes that merely extend the conservation phase of the cycle are to be avoided, as this just opens up the possibility of a bigger collapse. Programmes for the distribution of relief food to Kenyan pastoralists, to the extent that they reduce the need for reorganization and for local institutions to adapt to changing circumstances, may be doing exactly that.

However, this should not be taken to mean that human beings are trapped and at the mercy of such cycles. Nor should the concept of the adaptive renewal cycle and other concepts associated with complex systems thinking be understood as a form of

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environmental determinism. The cycle indicates tendencies, not rigid, predetermined paths and trajectories (Holling and Gunderson 2002). Strategic policy and programming interventions can affect the dynamics of a social-ecological system and potentially reduce the amount of suffering that can accompany a release and reorganization, whether a release-reorganization at the scale of an individual community or ecosystem, or a release-reorganization on a larger scale. For example, novelty and innovation are most prominent in the reorganization phase of the cycle—development agencies might consider how institutional novelty and innovation can be fostered throughout the cycle (before a disturbance triggers a release/collapse) so that less drastic reorganizations can take place.

Conclusion

Some of the criticisms levelled against mainstream commons scholarship by those adopting a social-practice perspective are valid. Furthermore, until recently, the bulk of commons scholarship has assumed that community-level institutions are relatively stable and has focused on the kinds of natural resources that community-level institutions can effectively manage. But it must also be noted that commons scholarship has not stood still over the past decade. New questions are being asked and theory is being pushed in new directions. One emerging concern relates to questions of dynamics, cycles of change, and ongoing adaptation in commons institutions (Wilson 2002; Dietz et al. 2003; Seixas and Berkes 2003; Folke et al. 2005; Berkes 2006). Pastoral commons present an ideal subject for the study of such questions. Dryland ecosystems are usually non-equilibrium systems (Scoones 2004), and the pastoral institutional regimes that relate to such ecosystems tend to be very different than the regimes that commons scholarship has until recently focused on. It has long been recognized that pastoral tenure regimes seldom fit into the typology which divides property regimes into four types—private property, state property, commons and open access (Riddell 1982; Swallow 1990)—yet this has received relatively little attention in commons scholarship. Now however that commons scholarship is directing more attention to questions of dynamics, adaptation, and scale, the study of pastoral commons may have a great deal to offer to the field as a whole.

Also, I would suggest that an examination of the distinctive nature of dryland pastoral commons, and in particular, a complex systems approach to this examination, can also provide insights for those who are studying and working on problems associated with global commons. There are at least a couple of features of dryland pastoral commons regimes like that of the Gabra that make them relevant to global-level questions. Unlike community-level institutional regimes, such as might pertain to a village forest, it seems that the Gabra never developed overarching, tight controls on the use of pasture. Rather, like some global scale commons such as the atmosphere, there has been little need for tight controls until recently: the frequency of droughts functioned to limit livestock numbers; this, combined with limitations of technology for harvesting and storing water, functioned to limit overuse of pasture; and the extreme variability of

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rainfall functioned to limit the usefulness of clear boundaries. Furthermore, just as the Gabra social-ecological system may be reaching the peak of a conservation phase, there is concern that the human race as a whole is pushing our global ecosystem dangerously close to critical thresholds. One feature of the Gabras' institutional regime is that territorial boundaries and lines of authority and decision-making are fuzzy, with territories and spheres of influence that overlap. Those involved in shaping global environmental regimes might consider whether a similar level of fuzziness, overlap, and institutional plurality may in some cases actually be preferable to 'neat', unitary accords.

This paper has focused on only a few of the consequences of complex systems thinking for commons scholarship, based on the concepts of *fit*, *scale*, and especially the *adaptive renewal cycle*; however, the complex systems perspective certainly has further insights to offer. More importantly, this perspective seems to be based on a number of fundamental assumptions that are distinct both from those of the mainstream rational choice approach and from those of social-practice perspectives. While a consideration of these fundamental assumptions, including the ontology, epistemology, and approach to human agency of the complex systems perspective, is beyond the scope of this paper, I would argue that this perspective seems to be gradually crystallizing as a distinct paradigm, one that puts dynamics and adaptation at the centre of inquiry.

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