

1. Preamble

1.1 SUMMARY

The proposed research unit (RU) will investigate resilience, collapse and reorganisation in complex coupled social-ecological systems (SES) in Africa. Contemporary research shows that Africa not only is the continent most comprehensively affected by global climatic change and environmental transformations, but that societies, economies and environments are also massively impacted by forces of internal mobility and differentiation, violent conflict, economic globalisation and global environmental governance. We acknowledge that Africa related pessimism has deep historical roots and that numerous allegedly catastrophic environmental shifts were rather based on the wish for political control of rural populations than on factual observation. However, we surmise that the present social and ecological challenges are path-breaking and lead to profound transformations of African SES. The savannahs of South and East Africa and especially wetlands within these drylands seem particularly suited to study these processes. On the one hand, savannahs are inherently unstable systems due to major variability of precipitation. On the other hand, pertinent processes of land use change (e.g. land reform in South Africa, voluntary sedentarisation in East Africa) and globalisation (e.g. establishment of horticultural industries in wetlands of East Africa, savannah and wetland orientated conservation efforts and tourism) currently affect savannah systems and the wetlands embedded within them profoundly.

Resilience and vulnerability in coupled savannah SES have attracted considerable attention in both the social and the natural sciences. On the one hand, a great number of scientific contributions and political strategies have dealt with aspects of vulnerability in savannahs. Savannah environments were depicted as overtly fragile and prone to desertification. Local populations have been framed as poor, destitute and underdeveloped. On the other hand, recent ecological literature has stressed the resilience of savannahs and anthropologists have pointed out to the enormous capacity of dryland communities to absorb severe ecological and economic shocks. In contrast to vulnerability and resilience, collapse and reorganisation are processes within SES that are abrupt and highly visible but empirically often difficult to grasp. They have therefore not played a major role in past research. However, these major transformations are crucial for the understanding of the functioning of SES and the emergence and demise of their constituents.

1.2 PROGRAMME

After briefly outlining the general outlook on the research context, problem and theoretical implications the subsequent pages will detail the theoretical context and the research program of the planned RU.

1.2.1 Propositions and guiding research questions

The research unit is based on a common interest in the development of interdisciplinary research in human-environment relations. This general motivation for the project is

formulated in three propositions which touch upon the research context, the research problem and the overall theoretical orientation.

Proposition 1 (Research Context):

The new discourse on complex coupled SES has revealed an amazing trend of convergence and compromise in the concepts applied: vulnerability/resilience, collapse/reorganisation, non-linear system dynamics, emergence, criticality, scales and connectivity, institutions and regulation, and environmentalist discourses and narratives. These concepts are currently discussed in the natural sciences, the social sciences and the humanities – especially in the context of catastrophic or critical forms of climate change, globalisation and risk societies. Ecological change as well as socio-economic and cultural dynamics in East African and South African savannahs have been framed in these very concepts: Populations (human and non-human) have been characterised as vulnerable and/or resilient. Whether vegetation changes display linear or non-linear dynamics has been the content of much debate during the last decade. The construction of narratives of savannah degradation (desertification, over-stocking, tragedy of the commons) has been treated prominently in recent contributions from political ecology and environmental history.

However, the very meaning of these basic concepts is frequently contested both within and between the academic fields. For example, the concept of resilience is used with fairly different intentions across the disciplines and many social scientists find the resilience concept inadequate to capture the adaptive capacity of communities and risk minimizing strategies of individuals. The proposed project aims to prepare common ground in establishing an interdisciplinary discourse on how new concepts and pathways might be developed that could finally lead to a more thorough and widely acceptable understanding of the dynamics of coupled SES. It intends to evaluate, clarify and operationalise key concepts in an interdisciplinary approach.

Proposition 2 (Problem Statement):

Africa and increasingly other large areas of the world, which currently experience rapid forms of social and ecological transformations have been placed in the focus of what might be called collapse literature. African savannahs and wetlands within these savannahs have been especially highlighted by such literature. In the ecological sphere a discourse on a threatening ecological apocalypse of savannahs (e.g. desertification, degradation, soil erosion) and wetlands (e.g. declining lake levels, pollution, biodiversity loss) emerged with the advent of colonialism and has been perpetuated since then. In the socio-political sphere, acute water crises, famine disasters, ethnic upheavals, state failure, and permanent forms of low intensity warfare have resulted in discourses on complex emergencies as a permanent state of affairs in African drylands. Media have been formative in the development of such discourses. They have constituted an apocalyptic narrative on SES dynamics in African savannahs. Research in the fields of archaeology, historical ecology and environmental history, however, shed a critical light on many contributions to the debate which much too easily juxtapose an earlier stability to contemporary instability. Africans have reacted creatively to SES transformations brought about by colonial dispossession, violence and environmental change and have

reorganised regimes of regulation locally. Beyond simplifying collapse-narratives which often prioritise mono-causal descriptions, we will investigate highly complex processes comprising moments of collapse and periods of reorganisation within coupled social-ecological systems. We surmise that such complex transformations can only be understood through interdisciplinary efforts which agree upon a set of key-questions.

Proposition 3 (Theory):

Any attempt to empirically link discourses on agency/ institutions/ regulation/self-organisation, vulnerability/ resilience, and collapse/ reorganisation in complex coupled SES will require a firm conceptual base that endeavours to gain common ground on the convergent but still conflicting theoretical strands. Therefore, we intend to make use of theoretical debates on non-equilibrium dynamics in savannah environments, resilience, risk management, adaptation theory, and regulation theory and further these theoretical strands where appropriate.

Within today's world the phenomena dealt with by these theories are increasingly negotiated on global scales. Efforts to globally regulate SES dynamics often enter the local scene through development programmes and media. At the local level such measures and views are appropriated by local actors. Local systems of meaning and explanation as well as local institutions and organisations are thus progressively entangled with global concepts resulting in hybrid representations that link humans and their environment. For the proposed project it is hypothesised that Africans – as e.g. individual actors, elites, communities embedded in a multitude of formal and informal organisations – are deeply entrenched in a process of searching for new regimes of regulation between nature and society. However, it is also hypothesised that this search is in itself highly contested and conflictive. It is deeply embedded in social struggles and political upheavals which are instigated by competing stakeholders that seek to reach hegemonic positions within new regimes of social-ecological regulation. These regulative regimes, in turn, emerge in the face of collapse and reorganisation and are framed by attempts at the global level to introduce regulative measures of governance to the continent.

The proposed project will seek to provide empirical evidence on resilience, collapse and reorganisation in SES situated in Kenya's and South Africa's savannahs with the overall objective (a) to bridge the converging, but still conceptually hardly compatible discourses of ecologically and socially centred conceptions of regulation, resilience, collapse and reorganisation of SES, (b) to develop an understanding of the intricate interrelationship of a highly diverse set of processes (e.g. climatic perturbations, degradation, land use change etc.) and their effects on the coupling dynamics within complex SES and (c) to understand the political constitution of such processes, the role of power and conflict by fully incorporating a historical perspective into the project.

Based on these three propositions, our research unit will address eight general research questions:

Question 1: Mechanisms constituting SES

How are complex coupled SES constituted and regulated? Which are the mechanisms of regulation and self-organisation that govern the coupling of their spheres, society and ecology? How can such mechanisms be described and analysed?

Question 2: Social actors involved in the coupling mechanisms

Which actors are involved in the coupling process attempting to navigate and control such mechanisms? Which institutions and technical infrastructure do they employ in order to adapt to SES dynamics? How do they learn from experiences and what kind of knowledge do they develop? To what extent do they perceive complex SES dynamics as amenable to regulation and how do they actually regulate social-ecological system's dynamics within specific geo-biophysical, political, economic and cultural settings? What kind of interests do these actors pursue and what kind of conflicts develop between them?

Question 3: Ecological elements and properties of coupling processes

Which geo-biophysical elements are prominent in the coupling process? How do properties of soils, vegetation and fauna, the availability of and access to water, and self-organisational dynamics in these fields impact the coupling processes and how are these properties affected by them? How do these elements react to regulative measures and what kind of adaptive mechanisms are developed? What roles do thresholds and non-linear dynamics play?

Question 4: Resilience versus collapse of SES

What is it that makes complex social-ecological systems prone to rapid transformations or even collapse and what kind of structures, networks and forms of self-organisation and regulation provide for their adaptive capacity in the face of global change? Does higher complexity of social-ecological systems necessarily lead to a higher level of stability or resilience?

Question 5: Scale challenge and cross-scale dynamics

How can the "scale-challenge" (Cash et al. 2006: 8) in the analysis of coupled SES be solved? This question pertains to our aim to understand the factual linkages between different scales better but it also entails the methodological task to develop better 'tools' to monitor and document cross-scale linkages. We will therefore ask: How can the knowledge on dynamic social and ecological interactions between and across different temporal, spatial, institutional, administrative and governance scales be enhanced? How can different levels of ecosystem functioning, resource management, social networks and knowledge systems be bridged?

Question 6: Contested knowledge systems

How are social-ecological dynamics reflected in the contestations about knowledge and how does new knowledge come about in periods of transformation? How can this knowledge be stored and applied when required and how is it used by different groups of actors?

Question 7: Discourses fought out around transformations

How are these dynamics reflected in epistemic structures, narratives and discourses? How do narratives and discourses – contested and fought out by different stakeholders including the affected population – impact on SES dynamics?

Question 8: Modelling and comparison of SES dynamics

How can SES dynamics be meaningfully compared? What are the units of comparison and how can the sensitivity to spatio-temporal scales be introduced to a comparative effort? What aid do different types of modelling offer to the comparative understanding of social-ecological dynamics in savannah environments?

Three clusters build the backbone of this research group, linked through overlapping fields of research and theoretically grounded research questions:

Cluster A: The natural sciences identify the drivers of slow and rapid ecosystem changes, their interrelation and processes of self-organisation in the geo-biophysical sphere in order to elucidate their impact on vulnerability/resilience and collapse/reorganisation within the coupled SES (cluster A: “Ecosystem Dynamics in Complex Coupled SES”). While the sub-projects of cluster A are basically informed by the approaches of the natural sciences, social science perspectives are incorporated where necessary for a full understanding of the complex interplay of drivers.

Cluster B: The social sciences focus on needs and interests, appropriation processes, power-structures, real and expected economic outcomes and social networks in relation to environmental dynamics. These relations on the local, national and global scale are seen as crucial for understanding SES dynamics. The social sciences focus on agency as well as institutional and other (e.g. violent) forms of regulation within the coupled SES (cluster B: “Institutions, Conflict and Regulation in SES”).

Cluster C: The humanities explore the emergence, transcriptions, transformations and hybridisations of knowledge, institutional arrangements, identities, narratives and discourses pertaining to environmental dynamics and social-ecological interaction (cluster C: “Regulation in Precarious SES: Historicity, Mediality and Discourses”).

While each cluster has a distinct profile and consists of a number of closely collaborating sub-projects, intense cooperation across cluster boundaries is anticipated (see para. 1.6 for a detailed description of intended collaboration between sub-projects). Fig. 1 attempts to highlight the basic set up of the project.

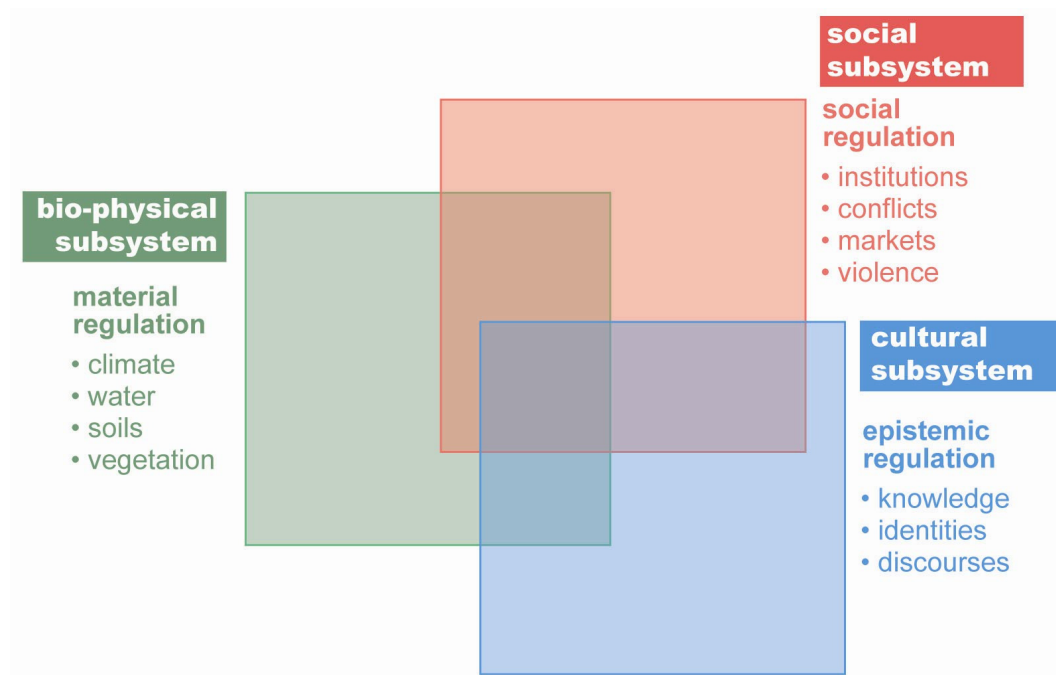


Fig. 1: Basic set up of the research unit

1.3 STANDING OF THE PROPOSED RESEARCH UNIT WITHIN ITS WIDER SCIENTIFIC FIELD

The following paragraphs will outline the theoretical framework of the research unit. The first paragraph (1.3.1) will pinpoint the key concepts which have given orientation to the formulation of the sub-projects, before we focus more narrowly on agency, institutions and regulation (1.3.2), vulnerability and resilience (1.3.3) and collapse and reorganisation (1.3.4). These topics are discussed at a theoretical level first, before we will link them to current debates on changes in human-environment relations in East African and South African savannahs (1.4).

1.3.1 Key concepts of social-ecological research

The first task is to define the unit of analysis adequately. Since generations scientists engaged in interdisciplinary research on human-environment relations have fought with the task to define and describe the subject of their studies which comprised geo-biophysical elements, social organisation, cognitive dimensions and a number of relations between these variables. Humans and their environments are nowadays increasingly theorised as being intricately coupled (Berkes, Colding & Folke 2003, Berkes, Folke & Colding 1998, Peet & Watts 1996, Scoones 1999). In recent years a wide range of concepts has been proposed to best grasp the coupling of various sub-systems. Görg (2007) proposes the concept of “landscape governance” to deal “with the interconnections between socially construed spaces and ‘natural’ conditions of places”. He argues that “the landscape concept, in all its multiple interpretations, fulfils the requirement of representing an object of both social production and natural-spatial conditions. In comparison with competing concepts such as space or nature/environment, the landscape concept offers

the advantage of addressing various societal (aesthetic-cultural, economic, infra-structural) and ecological dimensions (biotic-abiotic, biodiversity, soil, water content, etc.).” He suggests that the landscape concept provides a conceptual link between governance processes in multi-level-politics and natural-spatial conditions. Cultural, aesthetic, economic and social dimensions are as much involved as ecological functioning or abiotic conditions. Landscape governance then is concerned with “a complex reconfiguration of politics, with multi-level decision-making and the transformation of statehood as well as with environmental problems at concrete regions and at particular places” (ibid.). The landscape concept has recently also been used by historical ecologists as a key concept of their inquiries (Crumley 1994, Balée 2007). By making use of the term “landscape”, Görg (2007) and Balée (2007) link back to an older tradition of discussing human-environment relations along this erstwhile focal concept of human geography (Sauer 1925; for a comprehensive discussion of the uses and misuses of the landscape concept see Bollig 2008; also Luig & von Oppen 1997). We concede that the landscape concept is useful in expressing the hybrid character of human-environment relations: landscapes are the materialised result of complex human-environment relations. However, the landscape concept has also been contested over the past decades within geography but also within various disciplines working on human-environment relations (Bollig 2008). Especially in the humanities the landscape concept has been used in the past two decades not so much to emphasise the hybrid result of human-environment relations but rather to highlight cultural and intellectual appropriations of environments (Rössler 2008). Aesthetic readings of landscapes (e.g. Schama 1995, Cosgrove & Daniels 1988), their use as aide memoire for collective memory (Hirsch & O’Hanlon 1995, Küchler 1993) and their political appropriation for identity politics (Ranger 1997, Tilley 1994) are prime topics for studies in environmental history and cultural anthropology but do not render themselves easily for interdisciplinary research. Other concepts have been put forward to focus on the complex interrelationships between humans and their environment: metabolism of societies (Fischer-Kowalski et al 2001), “Gesellschaftliche Naturverhältnisse” (societal relationships with nature) (Görg 2004, Becker & Jahn 2006), ecological regimes (Zierhofer et al 2008) The basic idea of all proposed concepts is that societies and geo-biophysical entities interact on different spatio-temporal scales.

In our opinion, however, the coupling of epistemologically different entities such as “the social” and “the ecological” is best expressed in the concept of “coupled social-ecological systems”. We propose the following working definition:

A social ecological system is an integrated system of geo-biophysical, social and cultural subsystems with reciprocal feedback, interdependence and self-organisation “[...] in which some of the interdependent relationships among humans are mediated through interactions with biophysical and non-human biological units” (Anderies, Janssen & Ostrom 2004: 3, see also Resilience Alliance 2008)

We subscribe to the general tendency in theoretical literature on this topic to acknowledge the basic dichotomy between society and nature which has been framed as the “society-nature” divide in earlier discourses, the “human-environment” or “nature-culture” dichotomy in more recent approximations and the “history-biology divide” in contemporary reflections (see Escobar 1999) while equally emphasizing their close coupling. By focussing on “interdependent relationships among humans [...] mediated through

interactions with biophysical and non-human biological units”, this definition is more precise than many others in pinpointing what is the most interesting part of this kind of human-environment research: it is relations between humans, which interest social sciences and humanities, and how these are mediated through interactions with non-human biological and biophysical units; and it is the natural sciences which help us to understand how these non-human bio-physical units are impacted by human action. By underlining feedback, interdependence and self-organisation in all parts of the system, the definition emphasizes autonomy and linkages of sub-systems at the same time. The SES approach emphasises the mutual interpenetration of both spheres and the fact that relationships between humans are coupled through interactions with geo-biophysical entities which are only partially “captured” by human agendas.

What we are interested in then are processes of coupling and de-coupling, regulation and scale-interdependencies. We are further interested in how these three fields historically evolved and how knowledge is (and has been) gained on them.

(1) Coupling: SES are intricately coupled (Crumley 1994, Turner II 2003b), i.e. they are complex, which means that there exist strong mutual feedbacks between system elements and across scales (Becker & Jahn 2006). Becker & Jahn 2006 argue that coupled systems have internalised formerly external links between two separate systems so as to create only one system with internal relations and feedbacks between different elements. Research focusing on the coupling process within complex SES is essentially non-deterministic, sensitive to the interlocking of scales and interested in various kinds of regulation and adaptation (Lansing et al. 2006, Scoones 1999). While it is a mere terminological exercise to label human-environment relations as coupled, the great empirical task for future research will be to describe and analyse, how the coupling of sub-systems emerges and how de-coupling of sub-systems takes place. How does coupling impact sub-systems that have been self-organising in the past and how is self-organisation re-established when de-coupling processes have taken place? On what temporal and spatial scales are sub-systems coupled and what role does agency play in this context?

(2) Regulation: The dynamic patterns of interrelation (i.e. the coupling) between the social and the ecological spheres are regarded as both self-organised and regulated by human agents (Abel et al. 2006) who are equipped with various forms of capital and distinct cognitive capacities (Becker & Jahn 2006). While the social and the economic sciences regard regulation as a bundle of institutionalised measures directed at specific sub-fields of the SES in order to produce a desirable state of coupling, the natural sciences regard regulation rather in terms of positive or negative feed-back loops. We define regulation as the intentional intervention in systems by politically, historically and culturally situated humans whereas the self-regulating processes of systems driven by mutual feedbacks are referred to as self-organisation (see also Bohle & Fünfgeld 2007, Danielzyk & Oßenbrügge 2001). Regulation is made up by specific epistemic organisations (knowledge and procedures how to gain knowledge), technologies, agency and institutions. Regulation is historically constituted within dominant modes of production, such as the capitalist mode of production and information exchange, and it may take violent and non-violent forms. We differentiate between a dominant mode of regulation and various, partially overlapping regimes of regulation (for example of pastoralists, small-

scale sedentary farmers, agricultural commodity producers and agro-industries etc.). “Environmental governance” is one aspect of regulation and describes “actions, processes, traditions, laws, discursive debates by which authority is exercised and decisions are taken with respect to the treatment of nature by society” (Lebel 2006; IRGC 2008). Randeria (2007) points out to the colonial legacies of environmental governance (e.g. in the field of conservation) in post-colonial India. Both aspects – colonial legacies of environmental governance and its increasing globalisation – are crucial topics of contemporary and future research (for a discussion of these aspects e.g. in an African context see Broch-Due & Schroeder 2000).

Self-organising processes are those that are not or cannot be controlled by human agents and might impact on or modify the outcome of the intentionally introduced forms of regulation. A wide spectrum of geo-biophysical processes is constituted through a variety of positive and negative feedback loops. Soils as well as vegetation are impacted by human activities but their structures are also shaped by intrinsic processes not (or hardly) amenable by human agency. Self-organisation, of course, is also found in the domains of culture and social organisation: classification systems, for example, are not easily manipulated by human agents and so are basic network structures. Bio-taxonomies of e.g. grasses apparently underlie specific processes peculiar to semantic systems that are by and large independent from environmental processes.

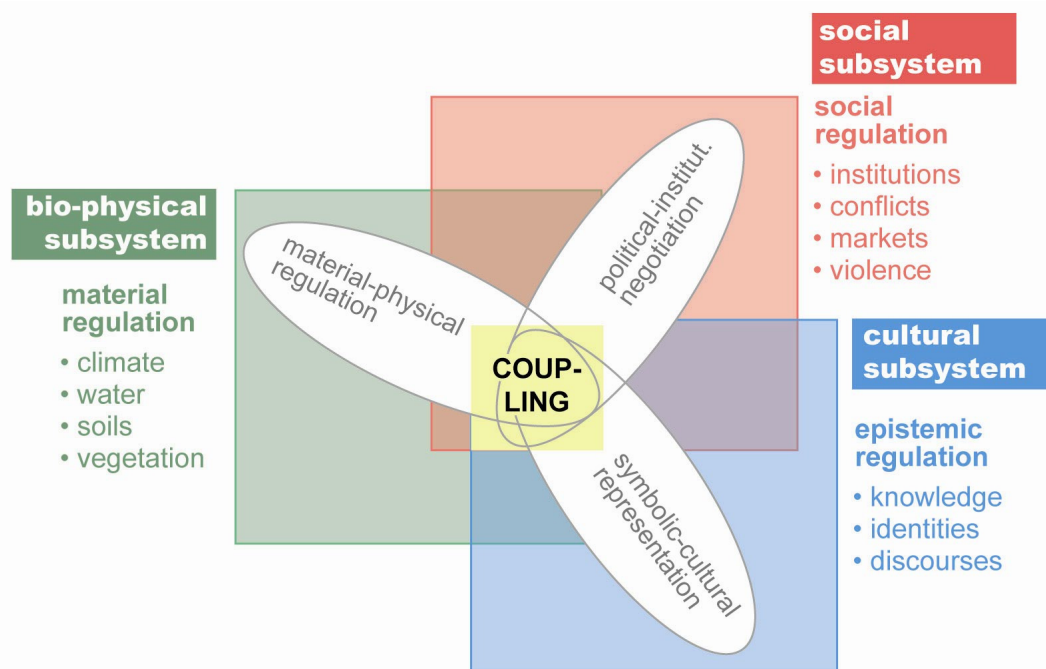


Fig. 2 presents a synopsis on aspects of coupling and regulation. It is a basic argument of our research unit that material-physical regulation, political-institutional negotiation and symbolic-cultural representation are typical coupling processes within complex social-ecological systems

(3) Historical dimension: Current and future states of nature and human strategies can only be understood when the history of coupling is taken into account (Crumley 1994, White 1985). Human impact is often the key to environmental transformations (Chew 2001), but landscapes may also change due to climatic events (e.g. Fagan 2004). More

often, however, it is the complex interface between human impact and environmental disturbances on the one hand and a historically specific political, social and cultural organisation on the other hand which shapes the historical development of SES (Beinart 2000: 287). Escobar (1999) re-frames earlier human-environment approaches to the conceptual pair “biology/history” highlighting the importance of history for the understanding of biological processes (see also Newell et al. 2005). Like Escobar, most contemporary scientific contributions to human-environment relations agree upon the importance of a historical perspective. They do so in order to shed light on temporal variations, to understand path-dependency and to explore how closely contemporary states of the social-ecological system are tied to earlier states. What actually makes for the continuity in social-ecological systems and what makes for their difference is still poorly understood. Are e.g. breaks and ruptures intentionally produced by interested actors or are they rather the product of contingency and stochastic processes within the system?

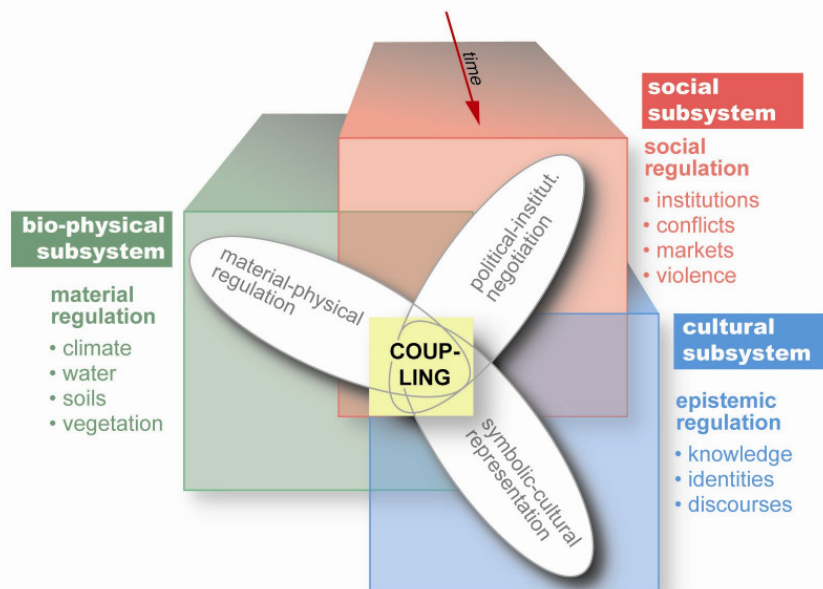


Fig. 3 attempts to show that coupling processes within SES can only be fully understood if the history of its constituents is taken into account

(4) Scales and connectivity: Local systems are not confined and isolated but tightly integrated into the multiple scales of the earth’s system which constantly feed back on each other (Neumann 2009, Rangan & Kull 2009). Networks shape the interaction of different elements within and between scales. Invading species, meta-communities and migration indicate the complexity of connectivities (Hanski & Gaggiotti 2004, Holyoak et al. 2005). Increasingly globalised social networks and governance systems channel the flow of goods, ideas, information and services between different scales (Adger et al. 2005, Schweizer 1997). Scoones (1999) sees this “scale-challenge” as a key topic for further research on human-environment relations. We will have to enquire under what conditions and how linkages across scales emerge, and under what conditions such linkages remain

absent or are muted.

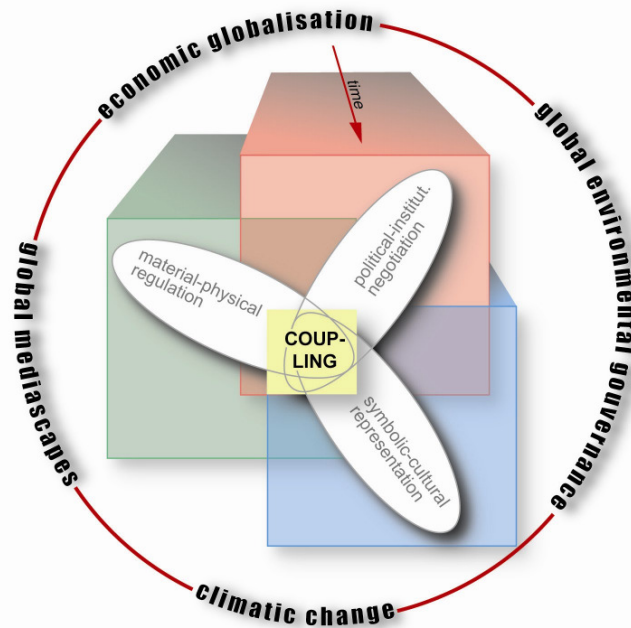


Fig. 4 attempts to show graphically that social-ecological systems need to be conceptualised as embedded within various spatial and temporal scales

(5) Epistemic structures, narratives and discourses: The humanities have stressed that epistemic structures principally guide our understanding of and engagement with nature (Newell et al. 2005). Language codes, communication, ideologies and beliefs are fundamental parts of epistemic structures (Levinson 1996, Kempton 2001, David & Turk 2003). There are a number of different approaches within the humanities that look at intellectual appropriations of SES dynamics: local knowledge has been proven to be detailed, empirically grounded and at the base of sustainable environmental management (Schareika & Bierschenk 2004, Sillitoe et al. 2002); symbolic ecology has stressed the manifold ways in which landscapes (and their elements) are used as symbols and as media and how these symbolic significations have guided human agency within social-ecological systems (Descola & Palson 1996). In recent times social anthropologists, archaeologists and geographers have intensely dealt with symbolic significations of landscape and the linkages between landscapes, memory and identity (Rössler 2008, Bollig 2008). Cognitive anthropology has intensely dealt with the ways in which scripts and schemata are at the basis of our understanding of ecological dynamics. Anthropological linguistics have investigated the structure and emergence of SES related language codes (Möhlig, Karthage, both 2009). While cognitive anthropology and anthropological linguistics have focussed on the basic language related elements of communication about the environment, discourse analysis has looked at complex structures and histories of such communication. Narratives are intellectual approaches to order phenomena in a potentially chaotic and stochastic environment that is characterised

by punctuations and collapses. Discourse analysis in the Foucauldian tradition has stressed the impact of power on such discourses and has described the unfolding and impact of master narratives on human-environment relations (Demeritt 1994, Escobar 1999, Luig & von Oppen 1997, Simmons 1993, Soulé & Lease 1995a, 1995b).

Research on the emergence of environmentally relevant knowledge has focused on learning processes in the sequel of resource crises (Carpenter et al. 2005, Berkes & Turner 2006). Further research will have to inquire how information about the environment and coupling processes is gathered, how regularities in that information are identified and condensed into models and/or “schemata” and how such models/schemata motivate action (Newell et al. 2005: 301, Gell-Mann 1994). As yet there is little research on how narratives feed back on environmental management. In a recent contribution Bassett, Koli Bi & Ouattara (2003) have shown how the degradation narrative informed land reform politics in Cote d'Ivoire.

1.3.2 Research on agency, institutions and regulation

Human agency describes the capacity of actors to make choices and to impose those choices on the world. Giddens contrasts agency with natural forces which he thinks to be governed by underlying deterministic processes. In sociological debates agency is often opposed to structure (Giddens 1984, White 1992). Structure describes the basic economic, social and political conditions under which actors experience the world and evaluate their choices. In a world of heterogeneous agents people have different power to impose choices. Actors – both local and global – have interests that define how they wish a SES to be and what role they picture for themselves within that system. Actor/Network theory (Latour 2005) is especially interested in how human actors interact with non-human entities and emphasizes that the latter have a potential to act. Such hybrid networks are framed as “actants” (Zierhofer et al. 2008: 137). However, together with Zierhofer et al (ibid) we would argue that through the very concept of actants the interaction between human action and non-human entities is rather masked than stringently analysed. While Latour's focus on the hybridity of ‘actants’ may be attractive for research on bio-engineering, it does not seem to have the same potential for human-environment research. Other theories of agency are needed that focus on the interrelation between agency and structure and the relevance this interrelation has for environmental processes. In other sociological approaches agency is defined as intentional action based on specific preferences. It is analytically subdivided into the contextual parameters of the situation in which agency takes place, subjective interpretations of this situation (i.e. the closer consideration of choice within a given situation), goal and intention of action, choice of means, conceptual design of activity, realisation of activity and its consequences (Schweizer 1997). Social structures result from repetitive action and shape the scope for agency. For further research on SES dynamics it is essential to establish on which scales agency is located and how an increase or decrease of scope for agency at one level influences agency on other levels.

Following Bourdieu, we surmise that actors coalesce, cooperate and compete for three types of capital, namely economic, cultural and social capital (Bourdieu 1984). Economic capital comprises goods and currencies amenable to accumulation (e.g. money, livestock, land). We explicitly include public infrastructure our definition of economic capital,

i.e. engineered means such as boreholes, dams, irrigation ditches, terraces (“physical capital” according to Anderies et al 2004). Social capital is constituted by social networks (as potential channels for communication and asserting influence) and social institutions (as rules of the game) used by those controlling and monitoring specific ways of resource use and public infrastructure (ibid.). Cultural capital includes knowledge generated and communicated in social processes on the basis of shared experience, shared information and shared epistemologies. Such forms of capital – economic (including technologies), social and cultural – are linked and such linkages are specific for certain regimes of regulation. Organisations and individuals – in the form of kinship groups, traditional authorities, governmental departments, transnational cooperations, NGOs and CBOs – offer, install, enforce, disseminate and control such capital at specific costs (Anderies et al. 2004, Janssen et al. 2006). While the social constitution of technologies, networks and knowledge and their articulation with the environment have not intensely been treated in human-environment research, institutions have been a key topic of this field of inquiry.

The relevance of institutions is currently intensely discussed in several disciplines interested in SES dynamics. There are three major perspectives on institutions (Anderies 2006). Two of them differ on the intent of social institutions: while the New Institutional Economics suggest that institutions promote efficiency and changes in relative prices create incentives to construct more efficient institutions, the other asserts that institutions are determined politically to benefit special interests (North 1990). Institutions may then be politically efficient from the perspective of a specific group of actors, but economically ineffective and ecologically non-sustainable. A third approach looks at institutions at the actor level focusing on the problem of enforcement. Elinor Ostrom and others (e.g. Ostrom 1990, 2009; Anderies 2006) have identified social institutions as the main determinants for the practice of common property resource management. Institutional change often follows paths that are distinctive for a specific cultural and political setting: this path dependence is defined as “the critical juncture in which events trigger a move on to the path, which is followed by a period in which positive feedback or increasing returns reinforce movement along that path, thus maintaining a given institutional pattern” (Mwangi 2006). Paths may come to an end when new events dislodge such longer-term reinforcing mechanisms.

Regulation is a term used both in the natural sciences and the social sciences. When natural scientists speak of regulation they are interested in processes that ‘regulate’ trophic structure and dynamics in ecosystems (Shuring et al. 2006, see also Odum 1999). Population growth rates, population size and length of food chain etc. determine regulation. Of course, intention as a basic defining criterion for the use of the regulation concept in the social sciences is absent. In the social sciences the attempts of multiple actors to govern and shape system properties at large, the technical and institutional infrastructure they devise and their individual position and capacities within local, national and global regimes of power distribution, the technologies and the knowledge they command are called *regulation*. Danielzyk & Oßenbrügge (2001) frame a “mode of regulation” as an “emergent ensemble of rules, norms, conventions, patterns of conduct, social networks, organisational forms and institutions”. As with Goodwin & Painter (1997) the concept of regulation is not viewed as a static and stabile mode but rather as “a process which is constituted by material and discursive practices” (Danielzyk &

Oßenbrügge 2001: 8) and as generated in temporally and spatially embedded social contexts.

While the regulation approach in the social sciences has mostly been applied to Fordism, a stage of capitalist development characterised by mass production and mass consumption and an intervening welfare state, the Post-Fordist stage, characterised by deregulation, flexibilisation, new forms of governance and a spatial development denoted by heterogeneity on all scales, represents a new challenge for regulation theory (Raza & Brand 2003, Danielzyk & Oßenbrügge 2001). We are fully aware of the fact that Fordism did not impact African savannahs a lot; neither mass-production nor mass-consumption mattered a lot. Perhaps agro-industrial production in South Africa was closest to a Fordist style of production. Nevertheless, deregulation, flexibilisation and new forms of governance do matter nowadays in African savannahs. Hence we are keenly interested in the foundations of regulation (material, institutional and ideational) in such a setting.

In recent discussions on the political economy of nature in a globalised world, it is argued that, in times of crisis, the societal relationships with nature undergo fundamental structural changes to avoid collapse (Raza 2003): new institutions are created in/with new coalitions of actors, new technologies are experimented with and applied and new knowledge is developed and formulated. These changes, however, do not unfold in a space devoid of interest and power: the ways new institutions are devised and the channels along which new technologies are disseminated and employed, of course, are organised within a global mode of regulation. Regulatory changes may happen peacefully and gradually, or rather violently and disruptively. We may call the latter path “violent regulation”. It is hypothesised that violent regulation can be discovered on regional and local scales. It is also assumed that such violent regulation processes are prevalent in violent (Peluso & Watts 2001) and politicised (Bohle & Fünfgeld 2007, Bryant & Bailey 1997) environments that are emerging in the course of the social-ecological transformation.

1.3.3 Research on vulnerability and resilience

Recent developments in human-environment research have triggered a paradigmatic shift of focus from the interpretation of social-ecological interaction as being equilibrium-oriented and characterised by linear succession and gradual change, to an analysis of more complex, often non-linear dynamics in coupled systems (Zimmer 1999, Kottak 1999, Scoones 1999). The dynamics within a social-ecological system are defined as “the way the state of a system changes over time in response to both external (exogenous) forces and internal (endogenous) forces” (Newell et al. 2005: 301). These forces may be addressed as disturbances and stressors. Disturbance then is a major peak in pressure beyond the normal range of variability in which a system operates (Balée 2007, Gallopín 2006: 294 uses perturbation with the same meaning). In contrast to stress, which is continuous or slowly increasing pressure (e.g. soil degradation, climate change), commonly within the range of normal variability (Turner II 2003a), disturbance has an event-like character. We may differentiate between minor (e.g. decline of a specific fodder plant) and major (flooding of a river valley and relocation of population), slow (e.g. environmental degradation) and rapid (e.g. tsunamis), small and large-scale disturbances (e.g. desiccation as an effect of climatic change in Southern Africa).

Stressors are often differentiated into internal and external. The growing interconnectedness of various spatio-temporal scales and the heightened impact of global ecological trends on the local level render the differentiation between external and internal (disturbance) stressors increasingly difficult. This has led to the emergence of competing systems of typological differentiation: The *Millennium Ecosystem Assessment*, for instance, distinguishes between direct and indirect drivers. A direct driver is a driver that unequivocally influences ecosystem processes and can therefore be identified and measured with differing degrees of accuracy. Important direct drivers include climate change, invasive alien species, and pollution. Indirect drivers alter the level of change that is caused by one or more direct drivers; they include demographic, technological, institutional, and economic factors (Millennium Ecosystem Assessment 2006).

The assessment of stressors, disturbances and drivers does not only pertain to their duration and scale. For the humanities it is a key question how stressors and disturbances are perceived and how knowledge on them is constituted and translates into practice. Hence, epistemic structures relating to disturbances and stressors and narratives anchoring such phenomena in the history of a society are of great importance for further research. This perspective is a sorely neglected field within SES approaches and earlier studies on human-environment relations, but is deemed to be of crucial importance in order to understand the coupling within SES (Newell et al. 2005) and to analyse the relation between social-ecological crises and knowledge constitution (Berkes & Turner 2006, Carpenter et al. 2005). The perception and conceptualisation of disturbance depends on past experiences and contemporary cultural norms, social networks and political structures. Epistemic structures, narratives, discourses and communication within and beyond a group of actors are of importance to understand the intellectual approach of actors to disturbances of and transitions within SES. The acquisition of new knowledge is often rapid and ground-breaking in the aftermath of severe stress within SES.

“Vulnerability” and “resilience” both describe attributes of SES in relation to disturbances and stresses. While increasing vulnerability denotes a transition of actors, groups of actors, or other constituents of the SES towards a more precarious or critical state, resilience describes the “opportunities that disturbance opens up in terms of recombination of evolved structures and processes, renewal of the system and emergence of new trajectories. In this sense, resilience provides [is] adaptive capacity that allows for continuous development, like a dynamic adaptive interplay between sustaining and developing with change” (Folke 2006: 259). Vulnerability is perceived as consisting of two dimensions; one is often called the external side of vulnerability which comprises stressors and disturbances to which a social-ecological system is exposed. The other is consequently termed the internal side of vulnerability which is the lack of capacity of actors within the social-ecological system to cope with and adapt to multiple stressors and disturbances (Chambers 1989, Turner 2003a, Watts & Bohle 1993). The higher the degree of stress/disturbance-exposure and the lower the resilience of a social-ecological system (or its sub-systems), the higher is its vulnerability. Both concepts are nowadays widely used in ecology and the social sciences; the multitude of definitions however shows that despite of the fact that there are clear conceptual relationships the precise nature of this relationship is hard to establish (Gallopín 2006).

The term resilience emerged in ecology in the early 1970s originally describing the time it took an ecological system to return back to its stable equilibrium state after disturbance (Gunderson 2000: 426, see also Berkes 2006). This led to the notion of resilience as “determining the persistence of relationships within a system and being a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist” (ibid. referring to Holling 1973). Gunderson surmises that this definition suggests that systems exist near an equilibrium condition. In this tradition resilience can be measured by determining how far the system has moved from that equilibrium (in time) and how quickly it returns to the equilibrium state. Gunderson juxtaposes this version of resilience against a second type of resilience that “emphasizes conditions far from any steady state condition, where instabilities can flip a system into another regime of behaviour — i.e. to another stability domain. In this case, resilience is measured by the magnitude of disturbance that can be absorbed before the system redefines its structure by changing the variables and processes that control behaviour” (ibid., see also Walker et al. 2006a). Resilience can be estimated by

- 1) the magnitude of disturbance that can be absorbed before the system changes its structure,
- 2) the trend to maintain ecosystem integrity when subject to disturbance (Redman & Kinzig 2003),
- 3) the amount of change a system can undergo and still keep the same structures, functions and controls,
- 4) the degree to which the system is capable of self-organisation,
- 5) the ability to build and increase the capacity for learning and adaptation.

Gallopín (2006: 298f) differentiates ecological resilience (“the ability of a multiscale system to keep the values of its state variables within a given domain of attraction in the face of perturbations”) from stability (“the behavior of a system near an equilibrium point or trajectory”). While ecological resilience is measured by the magnitude of perturbations that can be absorbed before the state of the system falls outside its domain of attraction, stability is measured by the speed a system returns to a stable point after perturbation. Gallopín argues strongly that vulnerability and resilience are not oppositions, as vulnerability refers to structural changes within a system while resilience rather connotes state shifts between domains of attraction.

Since the late 1970s the resilience concept has also been applied to social systems. In order to circumvent naturalistic assumptions underlying the concept of resilience some authors have offered “resistance” or “social resilience” as alternative terms. Social scientists such as Anderies, Janssen & Ostrom (2004) have argued that the resilience concept may be difficult to apply to SES, which are in part designed by humans. Instead, they propose the concept of robustness, defined as “the maintenance of some desired system characteristics despite fluctuations in the behaviour of its component parts or its environment” (ibid 18).

While the resilience framework has been fruitfully applied to relatively simple and bounded SES we still lack a convincing methodology to describe resilience in complex social-ecological systems driven largely by anthropogenic influence. While we know about

preconditions for resilience in complex systems, we still have little empirical evidence and hence understanding of how resilience emerges (or is socially produced) or declines as a structural property of SES and how individual risk minimising strategies translate (or do not translate) into the resilience of the overall system. The numerous empirically well-grounded studies on vulnerability only rarely show under what conditions vulnerability moves towards a weakening (or even a collapse) of coupling mechanisms within the social-ecological system (Scoones 1999). A key question of further research asks whether or not higher complexity of social-ecological systems necessarily leads to higher levels of stability and/or resilience. Also little is known on how activities dealing with short-term disturbances may increase the vulnerability of the system to infrequent events or to long-term change, i.e. the trade-offs between vulnerability and resilience (Anderies 2006).

1.3.4 Research on collapse and reorganisation

There are two types of literature on collapse and reorganisation in SES. On the one hand there exists a growing body of literature which focuses on disasters looking at them as complex emergencies and describing immediate consequences of such disasters (e.g. Hoffmann & Oliver-Smith 2002). Such literature is connected to the field of hazard research in geography and to the anthropology of disasters in social and cultural anthropology. On the other hand, a body of literature is emerging which seeks to theorise collapse and reorganisation within the framework of ecological cycles (Gunderson & Holling 2002).

Research on complex emergencies in e.g. African contexts has dealt with drought and violence as major causes for famine and the breakdown of SES (e.g. Müller-Mahn 2005, Watts & Bohle 1983, Spittler 1989, McCabe 2004, numerous contributions in the *Journal Disasters*). One focus of such research has been on coping mechanisms of local communities: social networks, diversification and flexibility have been shown to be of crucial importance to reorganise livelihoods after a severe breakdown (Göbel & Bollig 1997, Bollig 2006). Such literature has by and large been centred on single cases and has offered thick descriptions of risk-management in precarious situations and in specific historical contexts. Hoffmann & Oliver-Smith (2002) and especially Oliver-Smith (2002) make an attempt to theorise the relation between catastrophe/disaster and culture. They take off from the observation that disasters challenge societies and at the same time reveal essential structures and processes within complex coupled SES and conclude that “the role of hazards and disasters in mobilising forces of cultural change is vastly understudied” (Hoffman & Oliver-Smith 2002: 8-9).

Recent developments in the natural sciences and the social sciences have triggered a paradigmatic shift of focus from the interpretation of social-ecological interaction as being equilibrium-oriented and characterised by linear succession and gradual change, to an analysis of more complex dynamics in coupled systems (Scheffer et al. 2001, Scheffer & Carpenter 2003, van Nes & Scheffer 2005, Zimmer 1999, Kottak 1999, Biersack 1999). Whereas the body of literature summarised above rather deals with the concepts “disaster” and “hazard”, here “collapse” becomes the key concept. Collapse is described as the breakdown of a SES or parts of it. It is often the culmination of a drawn out process of increasing vulnerability. During phases of collapse connectivities dissolve and networks become sparse. Institutions and organisations lose their binding force and actors look for

new affiliations, identities and normative orientations. While collapse rarely comprises an entire social-ecological system, such dynamics in some central system components may have major effects on the overall system. The further development of the system is uncertain. Cocks (2003) and Abel et al. (2006) discussed social-ecological collapses in Zimbabwe's and Australia's rangelands using the adaptive cycle model (Gunderson & Holling 2002) and synthesised theories about the drivers of social-ecological change that can lead to collapse. Collapse here is not so much an event but rather a process fundamentally structuring the system.

Brunk (2002) applied complex adaptive systems theory to account for societal collapses. Tainter (1988), Flannery (1994) and Diamond (2005) analysed societal collapses in past and present social-ecological systems. Tainter argued rather technically that societies add organisational complexity to solve new problems and maintain their integrity as long as the benefits of complexity exceed their costs. In his model collapse occurs in situations in which the costs of complexity surpass its benefits and citizens withdraw their support from the state, leaving it more vulnerable to external shocks. Diamond (2005) sees social-ecological collapse to arise from (a) the failure of those navigating SES to perceive and anticipate problems, (b) individual rational behaviour with those benefiting from the current configuration of SES regulation blocking necessary changes at the expense of others, and (c) collective adherence to values that are detrimental to sustainable SES coupling.

The model of the *adaptive cycle* represents an ambitious framework to analyse different dynamics within social-ecological systems in a comparative manner. In contrast to other approaches the adaptive cycle not only sheds light on situations of collapse but also on the subsequent phases of reorganisation. It has been developed by ecologists but is now adapted to depict transformations and transitions in social systems as well (Gunderson & Holling 2002, Redman & Kinzig 2003). It attempts to link various phases of change. Traditionally, ecology has been concerned with succession and processes of transition from growth to conservation (*r* and *K* strategies). The *adaptive cycle* also looks at collapse and the following reorganisation. The phases *r* (exponential growth) and *K* (conservation) are followed by phases of release (Ω) and reorganisation (α). Phase Ω describes the collapse, in which parts of the system break down and numerous functional structures and networks are being reordered. The α -phase of the cycle describes the reorganisation of the system. New species establish themselves, innovative strategies of resource exploitation are developed, networks are reorganised engaging new actors, creating new structures and acquiring new contents for exchanges. Furthermore, power within the system is profoundly renegotiated.

The phases of the adaptive cycle run on different time scales: while the phases *r* and *K* may last over long periods of time, collapse and reorganisation are extremely rapid processes.

Walker et al. (2006b) outline some features which seem typical for phases of reorganisation:

- multiple modes of reorganisation are possible during phases of rapid change in an SES
- cross-scale interactions critically determine the form of the subsequent adaptive cycle at any particular scale
- adaptability is primarily determined by the absolute and relative amounts of all forms of capital, be it social, human, natural, manufactured, or financial, and the system of institutions and governance.

During phases of collapse and reorganisation new regimes of regulation emerge. Reorganisation in social systems may mean both an increase in wealth and stratification and a marginalisation of others, or the complete dissolution of previously held economic, social and symbolic capital.

Overall, the adaptive cycle emphasises the constantly evolving character of social-ecological systems in which collapse does not mean the end of a system but may lay the precondition for innovation and positive change: “In a resilient social-ecological system, disturbance has the potential to create innovation, opportunity and development” (Folke 2006: 253). Collapse opens up the space to learn from experience and create new and better adapted structures in the phase of reorganisation.

While the adaptive cycle represents one way to think about dynamics in complex coupled SES, the consideration of non-linearity is another trajectory to analyse such relations. In anthropology, Lansing (2003) and Lansing et al. (2006) have proposed non-linear dynamics and emergence as analytical concept for the study of change. We surmise that theoretical as well as methodological aspects of the study of emergence have immediate relevance for our interest in reorganisation. In fact, post-collapse scenarios may constitute a space for the emergence of new forms of organisation. Recently Schnegg (2006) has extended the concept of emergence to social networks to study how different distributions of social capital evolve under varying local exchange rules. Most complex systems that emerge from local rules imply non-linear dynamics: when critical thresholds are passed, systems abruptly change their structures and behaviours. Consequently, new distributions of parameters are not necessarily explainable and predictable through reference to earlier states, they are instead contingent. Path-dependencies are partially dissolved and negated during the course (or in the aftermath) of collapse events.

There are as yet still very few studies on collapse and reorganisation in social-ecological systems. As it is rare that entire social-ecological systems collapse at once, there is the need to investigate what effect collapse in subsystems of the social-ecological system has for the overall system. Are there any thresholds which contain collapse within a sub-system before releasing its effects on other sub-systems? While there is some literature on the politics of catastrophes and collapse (Oliver-Smith 2002), we still know very little about the political ecology of reorganisation after collapse: how are diverse forms of capital reallocated after catastrophic events and what is the scope of agency in the aftermath of collapse?

1.4 THE RESEARCH UNIT AND ITS SPECIFIC PERSPECTIVE ON RESILIENCE, COLLAPSE AND REORGANISATION IN EAST AFRICAN AND SOUTH AFRICAN SAVANNAHS

After having delineated the theoretical stand of the planned research unit it is necessary to highlight its perspectives and its analytical approach to East and South African savannahs. While each sub-project will describe in detail the state of current research on specific topics, it is the aim of this paragraph to emphasise a common perspective. Each project addressing resilience, vulnerability, collapse and reorganisation has to deal with the long history of Africa-related discourses on ecological disasters. In fact Africa has been perceived and is still conceptualised as a continent ridden by (or threatened by) ecological ruptures causing social upheavals, poverty and famine. Especially savannah environments and populations have been subject of such discourses. In the past two decades environmental historians have successfully deconstructed many such environmentalist constructs, such as the discourses on deforestation (Fairhead & Leach 1998) and overstocking and savannah degradation (Behnke et al. 1993). However, the deconstruction of colonial and post-colonial stereotypes does not imply that ecological disasters did not happen and that present reports on environmental hazards are mere inventions. In the face of massive social-ecological change in the past and in the present, local populations have reacted creatively to new challenges despite massive interventions of the state. They found new techniques of agricultural production, new modes of resource protection or new approaches to readjust populations to available resources.

In the following paragraphs we will sketch three research trajectories with immediate relevance for social-ecological research on savannahs: discourses on social-ecological change in African savannahs, controversial discussions on ecological dynamics in savannah environments and contributions to the changing political ecology of savannahs.

1.4.1 Discourses on social-ecological change in African savannahs

Social-ecological dynamics in African savannahs have been conceptualised with reference to concepts like collapse and equilibrium since the 19th century (Basset & Crummey 2003). Much of what could be called 'collapse literature' proposed that the demise of savannah systems was recent and stood in stark contrast to earlier, more sustainable human-environment relations (Fairhead & Leach 1996, 2000, Grove 1995). Earlier catastrophist visions of ecological thinking (de Cuvier, Buckland), evolutionist models (Darwin) and early 20th century ideas on succession and climax states of vegetation (Clements 1916) became intertwined to form a "discourse on a threatening ecological apocalypse" of African savannahs (MacKenzie 1997). Earlier ideas on the causal link between deforestation, declining precipitation and drought, famine and political turmoil represented an epistemic formation that was developed through the reception of the Greek philosopher Theophrastus in the writings of Bacon and others. It was popularised in the work of Alexander von Humboldt and first applied in the forestry regulations on islands such as St. Vincent and Mauritius, on the South African Cape Peninsula and in early colonial India during the first phase of the 19th century (Grove 1995). These perceived interrelationships became linked to unquestioned scientific accounts on the rapid decline of the woody cover in savannah environments (Fairhead & Leach 1996), on overstocking (Anderson 2002) and on the subsequent loss of pasture

and the expansion of desert-like environments (e.g. Schwartz 1919: “The progressive desiccation of Africa”, Bovill 1921: “The encroachment of the Sahara on the Sudan”). Since the 1920s the expansion of the Sahara desert into the Sahel became a key topic of geographical research (Bovill 1929, Stebbing 1937). Sensitised by the collapse of ecosystems in the American Midwest in the 1930s (Worster 1979), researchers and colonial officers saw expanding deserts that threatened African savannahs (see e.g. Anderson 1994 for Kenya).

In South Africa, successive administrations focussed on the degradation of savannah environments: soil erosion and the expansion of non-wanted grasses in today’s grassland biomes, and bush encroachment in the so-called savannah biomes were salient topics in governmentally instigated reports on the state of rangelands since the 1920s. After the official introduction of Apartheid in 1948, the policy towards the African reserves changed profoundly. Economic conditions in African reserves were identified as developmental problems. The Long-Term Agricultural Commission working on rural conditions in South Africa and Namibia in 1948 found that “the limit of carrying capacity [...] has been reached” (Botha 2005: 177) and recommended soil conservation, appropriating stocking rates and improved livestock breeds on freehold farm land and in African reserves. Reports of catastrophic degradation of southern African savannahs due to overexploitation haunted the public media (Botha 2005: 176). Reserve economies were to be modernised to produce enough food for a growing population. Population growth, the demands of market production and especially the “irrational” attitude of peasants and herders towards the environment were singled out as crucial factors that contributed to environmental decline.

Environmental historians (Beinart 2000, Beinart & Coates 1995, Carruthers 2005) have shown that these “lies of the land” were used to legitimise the tight control of African farmers and pastoralists. The widely acknowledged hypotheses on environmental degradation led to strict measures of environmental control, e.g. the prohibition of using fire for the management of savannahs (Pyne 1982), destocking (Anderson 2002, Kerven 1992), the restriction of mobility (Bollig 1998), enforced measures of soil conservation (Beinart & Coates 1995), the relocation of people from forested areas and the emergence of parks without people (Carruthers 2005). Clearly, the intertwined discourses on environmental collapse – deforestation, desertification and extinction of game – held the growing African human population responsible for these changes. Fairhead & Leach (1996) showed that the savannah forests of Guinea were rather expanding than contracting and that local farmers actively contributed to the expansion of forest patches within savannahs. Others (Hellden 1991) held that there was very little empirical proof to attest desertification in many cases. Behnke et al. (1993) showed that many African rangelands, which were thought to have been degraded by high stocking densities, had in fact not changed significantly over the past century (Behnke et al. 1993, Vetter 2004). They proved that ecological dynamics, especially in rangelands with a rate of climatic variability higher than 30%, were governed by stochastic precipitation and fires and not by stocking densities. Bassett & Crummey (2003) as well as Anderson & Grove (1995) have shown in two important volumes, how colonial environmentalist discourses have been carried into the present and how governmental organisations, as well as UN organisations

and internationally operating NGOs, still subscribe to major parts of these discourses (Davis 1995).

While the deconstruction of earlier stereotyped versions of environmental degradation in African SES are highly valuable, the assumption that nothing has changed would be naïve and erroneous. While environmental historians are certainly right to allude to the close relation between scientific environmental analysis and governmentality, we may question the over-generalised assumption that all analysis of environmental change was misconceived and the result of colonial hegemony. Beinart (2000) is right in warning against an environmental history devoid of insights from the natural sciences. Since the late 19th century colonialism has also implicated many intended and non-intended forms of degradation of African SES. The introduction of new diseases and livestock epidemics (Bollig 2006), the culling of large game in many savannah environments (for East Africa see for example Steinhart 2001), the introduction of cash crops and the commoditisation of production (e.g. fisheries) has meant major changes for savannah SES (McCann 1999, Harms 1987). Since the 1950s accelerating population growth (Iliffe 1995) and concerted efforts at modernising African SES have led to major changes in human-environment relations. Smallholder farmers were relocated, villagised or relegated to reserves to create modern farming industries. Commons were turned into private farmland to evade the “tragedy of the commons” and to spur market production (Galaty & Johnson 1990). Huge national parks were established to save the remainders of “the old Africa” (Carruthers 1995). An estimated 25 mio Africans have been villagised from 1900 to 1990 (e.g. Braukämper 2003 for an Ethiopian case study), and millions have been relocated due to apartheid policies and the so-called betterment schemes in South Africa (De Wet 1995, 2000a, 2000b, 2006).

Some African regions have witnessed several thorough shifts in environmental regulation in the past century: European settler farms, which during the first decades of the 20th century were often worked by African squatters, replaced autochthonous economies. Between the 1930s and 1960s such farms were modernised: boreholes and small dams changed entire landscapes (for a Zimbabwean context see for example Hughes 2006 and Alexander 2001, for a Namibian context Botha 2005, for a South African context Archer 2002). Since the 1960s many of these farms have been reverted back to small-scale farming in planned or unplanned resettlement programmes (Kenya, Zimbabwe, South Africa, Namibia) while others have been used for extensive game farming (Beinart 2000). These often enforced changes have unleashed ecological and social dynamics, which have led to the massive transformation of savannah SES. This transformation is still proceeding and likely to accelerate with current rates of global climatic change, growing competition for resources, the globalisation of product chains and the rapid expansion and devastating effects of epidemics.

1.4.2 Ecological dynamics of savannah environments

Recent ecological research on savannahs has focussed on non-linear dynamics, diversity and patchiness in savannah environments. Savannah ecologists have been involved in a vivid discussion on an appropriate theoretical framework for resource and livestock dynamics in arid savannah rangelands. This discussion has been focussed on disequilibrium theory (DT), which is based on tenets from population ecology (Behnke et

al. 1993). The core message of DT is: Due to drought events and related high rates of livestock mortality, there is no equilibrium between consumer (livestock, game) and food resource (vegetation). Hence the risk of environmental degradation is limited, as livestock populations rarely reach levels likely to cause irreversible damage to vegetation, i.e. density dependent effects are rare to occur. However, neither the original disequilibrium theory nor refinements incorporating density dependence at different spatial and temporal scales (Ilius & O'Connor 1999), or the distinction between equilibrium, non-equilibrium, and disequilibrium cases (Gillson & Hoffman 2007) offer a consistent theoretical framework. Instead, it has recently been suggested to replace DT by concepts of resilience and multiple stable states. However, although resilience theory may explain system shifts in savannah rangelands (Folke et al. 2006; van de Koppel et al. 1997) better than DT does, it does not address but rather circumvents other conceptual flaws of disequilibrium theory itself. Thus, the question of whether savannahs with a high environmental variability are potentially more degradable than those under fairly stable environmental conditions still warrants further attention.

Inherently unstable savannah ecosystems may oscillate in an intermediate state between those of grasslands and woodlands (Skarpe 1990). There are different explanations for the persistence of different species' mixtures in savannahs, invoking mechanisms as competition for water and nutrients (Walter 1971), demographic bottlenecks to tree recruitment (Frost 1988), disturbances including fire (Scholes & Archer 1997; von Langevelde et al. 2003), and large mammal herbivory (e.g. von Langevelde et al. 2003). At larger scales, patch-dynamics seem to control the co-existence of different grass species or of grasses and trees. Savannahs are like a rag rug of patches with many shrubs, patches with small trees and patches with fewer but larger trees as a consequence of a cyclic succession of grass and tree dominance (Wiegand et al. 2006; Meyer et al. 2009).

The shift to the unfavourable woody state – often labelled as bush encroachment – is accelerated under maladapted human range management. Bush encroachment has been identified as a key challenge of savannah ecology – both in South Africa and Kenya. Heavy grazing by livestock and a concurrent decrease in fire frequency and intensity, for instance, are often believed to be the cause for bush encroachment (Britz & Ward 2007). It leads to a massive decline in local range condition (Smit et al. 1999; Oba et al. 2000) and may trigger a collapse of local management practises (Katjiua & Ward 2007; Angassa & Oba 2008). Accordingly, there has been much debate over the relative importance of fire and herbivory on savannah vegetation structure (Asner et al. 2009; Levick et al. 2009) and for bush encroachment dynamics (van Langevelde et al. 2003). It has increasingly become clear that bush encroachment is a complex phenomenon which cannot be related alone to high grazing pressure or fire impact (Ward 2005).

While respective ecosystems have then be classified into grassland and savannah biomes, depending on the abundance of native shrub as potential vegetations species, literature on disequilibrium dynamics and rangeland degradation in both biomes have rarely addressed soils as a key parameter. It is thus unclear, how soils are affected by disequilibrium dynamics of the vegetation cover, i.e. whether they develop such dynamics as well or if they rather act in a way biased towards equilibrium states. Similarly, the reaction of soils to bush encroachment is largely unresolved. While increasing bush

expansion is definitely bad for livestock husbandry, does it also affect the soils in any negative way? Recent studies discuss how an integrated analysis of interactions between key variables – both biophysical and socio-economic – across multiple spatio-temporal scales may improve our understanding of the vulnerability of savannahs (Reynolds et al. 2007; Okin et al. 2009). Key variables like soil and vegetation give information on vulnerability and resilience of savannahs and grasslands. It is slow (soil) and fast reacting (vegetation) variables that respond to different management practices and environmental conditions and provide the biophysical data base of such an integrated model analysis.

Within wider savannah systems wetlands are buffers and storage areas for water (Bullock & Acreman 2003) and carbon (Euliss et al. 2006), grazing grounds for herders during the dry season (Schuyt 2004), and as of the production for agricultural goods (Torrión 2002). In the more distant past, wetlands of East African savannahs have not been excessively used while in South African savannahs wetlands have been intensely exploited since the early 20th century. Since the mid-1980s, however, the pressure on wetland resources in East Africa has dramatically increased (Smaling & Dixon 2006). Infrastructure development and an intensified agricultural use of wetlands impacted particularly the littoral region of the Rift Valley lakes (Mwanuzi et al. 2003). Additionally, land use options in a growing number of these wetlands are shaped by international conventions (e.g. RAMSAR) and national conservation measures. This implies an increasing use and control of local resources by global players (Brecht & Odada 2006), entailing an overuse of parts of the resource base and the exclusion of other parts from intense use, the offsetting of traditional regulation mechanisms, the decreasing capacity (or interest) of the state to steer social-ecological regulation and increasing conflicts between diverse users. Land drainage and intensified cropping affects soil quality, increase weed infestation (including the colonization of invasive species such as *Proposis*) and reduce production potential for crops. Bush encroachment occurs in arid to sub-humid savannahs but has recently also been reported for the drained riparian zones of wetlands.

1.4.3 The changing political ecology of East African and South African savannahs and creative reactions to crises

Savannahs of East Africa and South Africa are developing into very different directions at the moment, and so are wetlands embedded in these savannah systems. In South Africa, there is a continuing dominance of the state in the formulation of environmental policies and their subsequent implementation. Fractions of rural lands are currently being sub-divided in land reform programmes to reach more equitable access to resources. The state and a host of national and international non-governmental organisations have spun their net over societies and eco-systems. There is hardly a village even in remote dry-land savannahs of the Northern Cape Province which is not affected by measures of land reform and projects on resource conservation.

In contrast, the regulation of human-environment relations within savannahs and wetlands within savannahs ('wetlands within drylands') seems to be progressively fragmented in East Africa: whereas wide areas of dry-land savannahs are being sub-divided due to progressive individualisation of tenure and changing settlement patterns, wetlands are increasingly contested and affected by globalisation (Woodhouse, Bernstein & Hulme 2000, Southgate & Hulme 2000 for a case study on southern Kenya). Due to internal

insecurity and budgetary constraints the bureaucracy dealing with dry-land savannahs in East Africa is retreating and NGOs are gaining more importance. It is especially the rapid armament of the civil population since the 1960s (Matthies 1990), small-arms trafficking (Lumpe 2000), militia strategies (de Waal 1997) and the ethnicisation and politicisation of natural resources which explains the escalation of violence in East Africa's savannahs. Conflicts over resources and livelihoods are carried out under increasing levels of violence which occasionally (like in the 2008 post-election eruptions) develop into open violent confrontations between ethnic communities. Such violence may be seen as an attempt to redefine relations within social-ecological systems (Le Billon 2001, Watts 2004, Broch-Due 2005).

Developments in South African savannahs point into a different direction. While historically physical violence as much as structural violence was of major importance in the dispossession of major parts of the black population, governmental programmes (e.g. targeted subsidies for commercial farmers, agricultural education programmes, land reform) played a major role too. In South Africa freehold farms are currently being subdivided in land reform programmes to reach more equitable access to resources.

While general development perspectives differ profoundly between East Africa's and South Africa's savannahs, there are also parallels between both regions: large scale, technical projects have become prominent during the last two decades. Examples range from radical social-ecological changes such as the installation of horticultural industries at Lake Naivasha in Kenya to major water-projects in southern Africa and gigantic trans-frontier parks between South Africa and adjoining countries. The recently opened Limpopo transboundary park, including the Kruger Park and adjacent protection zones in Mozambique and Zimbabwe, comprises some 100,000 km² – an area almost double the size of Switzerland. Other transboundary parks are rapidly emerging all over southern Africa. During the last two decades large-scale inter-basin water transfer schemes have been constructed in the region in order to transfer water from one river basin with an apparent abundance of water to another river basin that is less endowed with water or to urban areas where water consumption levels are high (Heyns 2002: 157).

At various levels actors are engaged in dampening the worst effects of the various hazards and risks mentioned above and attempt to reorganise their livelihoods. African populations are renowned for creative responses to a diversity of challenges. The same is reported for various ecosystems in Africa: the idea of effective risk management has become a scientific discourse in itself. The social sciences and notably social anthropology have focused on risk management strategies of African herders and farmers living in savannah environments over the past two decades (see Bollig 2006 for a discussion of such literature). While it is certainly right and theoretically inspiring to look at creative responses to crisis, this should not lead us to forget (and empirically disregard) that outright famines with extremely high mortality rates are still present on the African continent and have significantly shaped the contemporary history of the continent in the recent past. Poverty is a non-deniable truth. Not all people can react to collapse and crises in a creative way. Some simply do not have the means to respond while the chances of others to react adequately are severely curtailed by poverty. In Africa the number of poor climbed from 202 million in 1981 to 384 million in 2005 according to a recent World Bank Report. The number of the chronically poor has increased in Kenya

over the past 20 years. Linkages between poverty and child mortality are still of major importance for many regions of the continent. In many parts of Africa poverty has a highly gendered face (Klasen 2007). Any project interested in the reorganisation of social-ecological systems should bear in mind that the capacity to reorganise is connected to the physical status of actors, to their access to resources and their capacity to organise. Such a perspective is important also within the context of our case studies: the upsurge of violence in post-election Kenya in early 2008 left about 1,000 people dead and some 300,000 people homeless – their chances to reorganise are defined by circumstances in refugee camps (Anderson & Lochery 2008). They often only have the choice to migrate to cities or to carve out a living in centres where food for work activities is available. Those millions of people chased off the land during the “surplus-people campaign” in Apartheid South Africa in the 1960/70s saw their chances to react creatively to the collapse of their livelihoods severely curtailed by soaring population densities in homelands and the lack of access to land. Under such circumstances the overuse of the term agency may rather cloud historical circumstances and processes than elucidate them. It is the idea of this project not only to focus on creative measures of reorganisation, but also to look out for those who succumb to crises. We will have to answer the question of who gets the chance to respond to a crisis: agency is not something we can assume as a given.

Taking into account the fact that severe crises leave lots of people with very little space to manoeuvre, the sub-projects will deal in depth with a great number of highly creative responses to crises and collapse. At the local level many reports indicate that economic diversification became a key strategy to buffer risk and to reduce the vulnerability of households to impoverishment. The sharing of food, goods, access and knowledge is of relevance. Social ties and new institutions beyond the domain of kinship are formed to face challenges emerging from demographic growth, epidemics, and migration. Technological innovation may open new perspectives for a more sustainable management of the environment: while the Kenyan Machakos area had been a disaster stricken area with outright poverty and starvation as well as severe ecological degradation, local households invested heavily into terracing since the 1970s (Tiffen et al. 1994). At the national level, decentralisation and delegation of rights from the state level to the community level are attempts to guarantee the basis for more sustainable forms of management. Major international programmes are underway to combat the consequences of the rapid spread of the HIV/AIDS epidemic, to halt violent conflict and to slow down processes of human-induced climate change. These efforts are occasionally well synthesised but more often they unfold as weakly connected efforts aimed at ameliorating some symptoms of a crisis. The question of which of these responses to different forms of crises are able to lead to long-term resilience of the SES is crucial for the research project. The great challenge for approaches informed by the political ecology paradigm is to adequately address cross-scale linkages, to analyze relations between actors' strategies, power and social structures and to relate knowledge, learning and discourse to environmental practices. If this can be achieved without losing ecological dynamics out of sight, political ecology would have surmounted its most salient critical point (Vayda & Waters 1999).

1.5 RESEARCH AREAS

In order to approach SES in a truly interdisciplinary manner, the sub-projects of our research unit focus on spatially explicit SES in Kenya and South Africa (see map 1). The research unit starts out with the assumption that not the SES as such are necessarily comparable (or that such comparison leads to theory building) but that there are a number of comparable processes taking place. Due to our specific interest in complex coupled social-ecological systems, rapid change within such systems, resilience and reorganisation, we singled out, savannah SES as the most appropriate setting for our studies. The following criteria were relevant in the decision making process for specific areas (and against others, see also Map 1):

- the site had to be located in a savannah agro-ecosystem, possibly with wetlands embedded within them
- the presence of rapid changes within these SES
- the availability of and accessibility to long-term data
- regional experience of applying researchers and/or
- close cooperation with local and non-local research projects in the region.



Map 1: Project Sites in East and South Africa

1.5.1 The Kenyan Research Sites

The Kenyan project sites present two types of savannah systems with wetlands embedded in them. While the one case (Lake Naivasha and adjoining savannahs) is shaped by the fragmentation of the landscape with an agro-industrially used wetland and a progressively marginalised savannah hinterland, the other case (Lake Baringo and adjoining savannah) represents a landscape in which wetlands are contested but are an integral part of a wider agro-pastoral landscape. The Kenyan project sites are interconnected through hydrological flows and human migration. They are linked through various regulative patterns designed at the local, national and increasingly also at the international levels. They are also connected through a particular political economy: the post-election violence in January and February 2008 has shown that events in one part of the country are jolting events in others. After the election results had been announced an orchestrated wave of violence swept the country targeting specifically settlement schemes between Mt. Elgon and Lake Naivasha with a majority of migrant Kikuyu populations (Anderson & Lochery 2008). Next to the stratagems of politicians, commentators have sought causes for violence in growing poverty levels (despite overall economic growth), increasing income disparities and the gradual loss of the state's monopoly of legitimate force (Mueller 2008).

The sub-projects co-ordinate their research activities closely on both research sites: A2 investigates ecological dynamics in the Naivasha and Baringo wetlands looking also at savannah-wetland interactions. B1 will conduct research on the related political ecology of both social-ecological systems. As the latter also relies on the interrelationships of global and local economics, the economics' subproject B2 will focus on agricultural decision-making and the emergence of economic institutions and economic and ecological regulation in the Naivasha basin, while the historical part of subproject C3 concentrates on the changing economy and social organisation in the savannahs adjoining Lake Baringo. Yet, much of the human impact on ecosystems and vice versa depend on perceptions. Hence, environmental narratives on social-ecological dynamics in the Naivasha case are documented by sub-project C2. All sub-projects are closely co-ordinated with counter-part projects from the region. Egerton University and the Kenya Agricultural Research Institute (KARI) at Naivasha are focal points of counterpart activities. International collaboration will add importantly to some aspects of the project: e.g. Dr. P. von Hellermann, York University, will work as a counterpart of sub-project B1 on the colonial history of resource management in the Naivasha basin (with some funding through the project), while a research team around John Galaty, McGill University, works on the fragmentation of pastoral lands south of Lake Naivasha (in co-operation with B1 and C3).

The Naivasha case

The catchment of Lake Naivasha comprises about 2,378 km². Unlike other Rift Valley lakes, Naivasha is characterised by freshwater. The lake has two perennial inflowing rivers (90 % from Malewa River). The seasonal fluctuation of the lake surface varies between 100 km² during dry season and 150 km² in the wet season. Currently the lake level is falling due to climatic conditions and possibly as a result of overuse of water (Verschuren et al. 2000). In early 2009 the lake has shrunk to less than 80 km², the result of the near complete failure of this year's rainy season, the up-stream water abstraction of

Malewa River for a large-scale vegetable irrigation project, and the continuous pumping of lake water of the flower farms.

Naivasha

Size of Research area: about 3,000 km²

Climate (Precipitation): 380-620 mm

Population: 250,000 inhabitants, growing at 3.5 % (1977-2001)

Economic strategies: Tourism, flower farms, herders and small-scale vegetable production

Protected under international agreement: RAMSAR

Moments of Crises: conflicts over access to resources; conflicts over natural resource protection and economic development

Over the past century the wider Lake Naivasha area has experienced dramatic changes in land management. Over the course of the past century the lake has been progressively encapsulated from the surrounding savannah. While during pre-colonial times the region – lake and adjoining savannah – had been dominated by Maasai pastoralists, during colonial times the lake was used by white commercial farmers almost exclusively, while agricultural smallholders and herders were relegated to the drier savannah hinterland. After independence many of the large estates remained intact and only parts of the immediate lake surroundings were occupied

by smallholders. During the last two decades agricultural production in the lake area changed massively. The most significant economic activity nowadays in the lake basin is the intensive irrigated greenhouse floriculture and horticulture – Kenya is currently the world's leading exporter of cut flowers and Naivasha supplies about 75% of them. The horticulture/floriculture sector employs some 40,000 workers and contributes significantly to the Kenyan GDP. The intensive usage poses a threat to the research area's integrity due to pesticide and fertilizer use, removal of fringing swamps, and excessive withdrawal of water.

The adjoining savannah to the south has been used by Maasai pastoralists during the past. However, since about three decades the pastoral commons were replaced first by group ranches and then by private ranches of very different size (Galaty 1993). Many erstwhile herders have opted for agriculture in order to diversify their assets and immigrants have obtained land titles in former pastoral commons. In the last two decades also in these pastoral 'hinterlands' a veritable scramble for smaller wetlands set in, which turned many smaller wetlands within pastoral areas into enclosures (Southgate & Hulme 2000).

Continuous population growth around the lake has led to the encroachment of wetlands and the conversion of large parts of the riparian zone into agricultural lands. In particular the continued harvesting of papyrus along the edges has destroyed the natural state of the lake. Population growth in surrounding areas of the catchments has also increased soil erosion, which leads to a nutrient enrichment of the lake and threatens ecosystem structure and functions. Regulation of resource management in the lake area is complicated as communities with very different status and assets have a stake in it: tourist entrepreneurs and environmentalists opt for the reduction of agricultural activities and sustainable resource use; small-holders want access to the lake's fertile banks, horticultural producers claim access to cheap water and little restrictions on its use; herders insist on access to the lake. During the post election turmoil in early 2008

Naivasha became one of the hot-spots of violence (for a closer description of political economy, ecology, history and culture at Lake Naivasha see sub-projects A2, B1, C2).

Lake Baringo and the surrounding savannah

This project area comprises the wider catchment area of Lake Baringo and borders the Laikipia plateau to the east. While the catchment itself spreads out on a total area of 6,800 km² (the lake itself has a surface of 108 km²), the extensions of the project area to the south (Lake Bogoria Region), to the west (Tugen Hills) and the north (East Pokot District, formerly Nginyang Division) are of primary importance. The project area thereby contains a complex mix of highlands (western rim of Laikipia Plateau, Tugen Hills, Cherangani Hills, Mount Tiati) with elevations above 2,000 metres, dryland savannah areas and wetlands (Lake Baringo, Lake Bogoria, several smaller wetlands).

Lake Baringo

Size of research area: 6,800 km²
 Climate (Precipitation): 1,100mm in the highlands to 450mm in the lowlands
 Population (wider catchment): c. 120,000 (est.)
 Economic strategies: pastoral nomadic, small-scale farming, fisheries, tourism; irrigated agriculture;
 Protected under international agreement: RAMSAR site;
 Moments of Crises: Violent conflicts between communities; conflict between environmentalist concerns and smallholder interests;

The ecology of the lake is largely affected by increased turbidity which is caused by heavy soil erosion in the catchment (Ballot et al 2003). The savannahs around the lake are largely degraded. During the last two decades the Baringo plains have suffered from a new ecological disaster: the rapid expansion of the invader plant *Prosopis*. Charcoal production in many places in the vicinity of the lake has led to a near complete denudation of the area.

The region is characterised by the interaction and competition of pastoral nomadic and small-scale farming systems. Many pastoral households have become sedentary over the past few years. They have adopted small-scale farming in addition to livestock keeping while elites from agricultural communities have invested heavily into livestock and are now competing with pastoralists for pastures.

Population growth is one reason for the rapid change of social-ecological relations in the region. Between 1969 and 1999 the entire population of the Rift Valley Province increased from 2,210,289 to 6,987,036 inhabitants. With population growth and increasing relevance of market economies agricultural practices changed: e.g. the number of goats in the East Pokot District rose from some 100,000 to some 500,000 animals – with devastating consequences for the rangelands. Deforestation in the upper reaches of the escarpment zone was accelerated to create more space for smallholder agriculture – between 1976 and 2001 the forested areas declined from some 829 km² to 417 km² (Odada et al. 2005). Rampant soil erosion is one consequence. The damming of several rivers feeding Lake Baringo (Kirndich, Chemeron, Pekerra, Molo, Ol Arabel) has led to reduced rates of fresh water supply. Violent interaction between communities has marred development efforts in the region (see e.g. Bollig & Österle 2008; for an account of the regions prehistory, history and political economy see sub-projects A2, B1, B2).

1.5.2 The South African Research Sites

The South African research sites are located in parts of the Free State Province (notably the region around Thaba Nchu) and the Northern Cape/North-Western Province (notably the region around Kuruman) during the first phase of the project. The research areas are characterised by different ecological systems, denoted as savannah biome in Kuruman and grassland biome in Thaba Nchu, respectively, but comparable farming system structures, characterized by the close proximity of diverse types of farming on communal land and commercial farming on freehold farmland. The involved sub-projects are strongly linked by exchange of data and information on e.g., rangeland properties and land use strategies within a recent-historical perspective of the same geographic area. Sub-project A1 investigates how soil properties change in response to different rangeland management (Thaba Nchu, Kuruman) and how farmers perceive these ecological changes. It is hypothesized that the ecosystems of both biomes respond differently to rangeland degradation. The related spatio-temporal patterns of vegetation dynamics are described by sub-project A3, while information on cattle behaviour in the different tenure systems is obtained from local partners. Added upon this joint assessment of ecosystem processes and farmers' reactions, B2 will explore how farmers' decisions on stocking strategies are linked to specific preferences and institutions. The historical process of agricultural intensification, the landscape transforming *betterment* schemes of the 1960/70s and social differentiation in both project areas are finally merged by sub-project C1. The sub-projects work closely with counterparts from South Africa. Sub-project A1 is a joint application of a German applicant and a South African applicant. The social-anthropological part of A1 will be jointly tutored by scientists of the research unit (M. Bollig) and a South African counterpart at the University of the Western Cape (R. Hall). Sub-project C1 co-operates with Chris de Wet, Rhodes University, on the issue of betterment schemes.

Free State, Thaba Nchu (Mangaung Municipality)

Most of the Free State's 12.9 million ha land, some 11.8 million ha, is used for farming. Grazing land amounts to about 8.0 million ha. A mere 270,000 ha of land is allocated for nature conservation while only 400 ha are used for forestry. The estimated population size for the Mangaung Local Municipality is about 850,000, with about 700,000 of these residents living in urban areas. Bloemfontein is the sixth largest city in South Africa with an estimated 500,000 white and black citizens. The remaining 200,000, of whom the majority is black, live in either Botshabelo, a giant rural township established in the 1960s in the sequel of the surplus people programme, or

Thaba Nchu, a part of the former Bantustan Bophutatswana. While Thaba Nchu has been an African reserve and later part of a homeland with sizeable portions of freehold farmland held by Setswana speaking African citizens, Botshabelo is a highly heterogeneous semi-

Thaba Nchu Region/Botshabelo

Size of research area: 12.9 million ha

Climate (Precipitation): 550 mm and the mean annual evaporation 2,200 mm which results in an aridity index of 0.25

Population of research area: c. 100,000 (est)

Economic strategies: commercial and smallholder farming;

Moments of crises: insecurity of land titles;

imponderabilities of land reform; high rates of unemployment; environmental degradation;

urban area beset with terribly high rates of unemployment and the lack of any meaningful prospects in agricultural activities. Thaba Nchu and Botshabelo are surrounded by mainly white-owned farms. In contrast to e.g. Limpopo Province or Kwazulu/Natal land reform has made relatively little progress in the Free State. However, especially around Botshabelo some land claims under the land restitution act have been settled and citizens of the township have been allotted farms.

White settlers took hold of the land around Thaba Nchu since the 1840s, rapidly displacing indigenous communities and influencing the ethnic reorganisation of Korana and BaSotho. These were formally relocated to reserves. In the 1950s and 1960s local freehold farms underwent a process of rapid mechanisation and modernisation. Research will concentrate on (former) communal lands (Thaba Nchu) as well as on adjacent commercial farm holdings and a number of farming units involved in the SA land reform. Thaba Nchu was part of the former homeland Bophuthatswana which obtained its “independency” from South Africa in the 1970s. However, since 1994 it is again part of South Africa. The Tswana people have made Thaba Nchu their home for more than 180 years. Thaba Nchu comprises an urban area with about 30,000 residents, and a large rural area with people living in 37 scattered villages. The rural people depend inter alia on subsistence farming. Crops like maize and sorghum are cultivated on smallholdings while livestock like cattle and sheep are kept on communal grazing. Urban people depend on small industries catering for tourists (for further details on the project area see sub-project A1).

Kuruman, Northern Cape Province/Northwest Province

The Kuruman area straddles the boundary between the Northern Cape Province and the Northwest Province. The semi-arid savannah has been characterised as Kalahari thornveld, which gradually merges into Kalahari semi-desert vegetation. Within the wider dryland savannah the Kuruman valley with its potent springs offers some arable land. Until the early 20th century, when the last resident San had been exterminated, less than 20,000 Tlhaping and Tlharo Tswana lived in an area, which is comparable to the size of Belgium.

Agro-pastoral strategies as well as hunting and gathering were dominant subsistence strategies. In the 1820s Robert Moffat of the London Missionary Society founded one of the first southern African mission stations at Kuruman. The early foundation of missionary activities is one reason for the presence of excellent archival data on the region. This material has been used by historians (Jacobs 2001, 2003) and anthropologists (e.g. Comaroff & Comaroff 1991, 1997, 2005). The relationship between historical and contemporary demographic trends, climatic perturbations and the political ecology of the area, however, has not been consistently worked on. The establishment of a missionary station invigorated trade contacts and especially ivory and ostrich feathers were exported from Kuruman. Intense hunting led to a rapid decline in game numbers. Since 1823 refugees from the *mfecane*-disruptions in the eastern parts of South Africa led to an increase in the local population and a gradual increase of irrigated agriculture in the

Kuruman

Size of research area: not yet appropriately fixed,

Climate (Precipitation): about 350 mm

Population (state): about 70,000

Moments of Crises: severe forms of rangeland degradation; high rates of unemployment; insecurity of land titles

Kuruman valley. Since the 1850s Boer farmers and hunters tried to establish themselves in the region and conflicts over the access to resources became pertinent. After 1867, when diamonds were discovered in Kimberly, many Tswana went to seek work in the mines and migratory work became part and parcel of the local economy. In 1886, a land commission established tribal reserves and declared large parts of the land as unused farmland, making it accessible for white farmers. At the beginning of the 20th century, some 10,630 black farmers were cordoned off to make space for some 1,230 white farmers. Subsistence agriculture crumbled in the early 20th century as a consequence of enforced removals and relocation to reserves. Supplementary agricultural production, however, remained prominent. In 1960 the population had risen to 42,496 black people, 5,790 whites and 3,036 coloureds. Off-farm income had become of much greater importance than on-farm income in the reserve areas and especially the 1960s saw a climax of labour migration. During the 20th century the black population lost tenure rights to a large degree and only restricted patches of land were still accessible to them. Land degradation was rampant. In the 1960s and 1970s the Homeland Government of Boputhatswana fostered commercialised agriculture in an attempt to curb degradation. Within the boundaries of Boputhatswana the homeland government attempted to launch its own approach to betterment: the great donkey massacre (see Jacobs 2001) of 1980 was perhaps the climax of authoritarian attempts to improve rural agriculture: within weeks ten thousands of donkeys were killed in a concerted effort of the army to eliminate the alleged main culprit for environmental degradation.

Since 1994 land reform tries to curb injustices of the Apartheid era. Community Property Associations (CPAs) may apply for governmental funds to buy lands. Security of tenure for tenants and agricultural workers is improved through various forms of legislation. Land which has been taken away from communities in the course of enforced evictions after 1913 can be re-transferred after an appeal to specific courts. At the moment various NGOs, like for example the Kuruman based Association for Community and Rural Advancement (AnCRA) and the Landless Peoples' Movement, are actively propagating former reforms of tenure rights. Likewise, new forms of land tenure are being experimented with. After some commercial farms have been transferred to CPAs, local NGOs and CBOs see their major task in defining new ways of sustainable agriculture in the area.

The wider area then has been characterised through various major shifts in tenure regimes and at any point in time after the 1820s various tenure regimes have coexisted and competed with each other. Jacobs (2003: 6) reports that climatic variability has increased during the second half of the 20th century. Scenario forecasts predict an increased interdependence between global warming and the frequency of El Niño events, which would mean even more unpredictability of precipitation for the Kuruman area.

1.5.3 The comparative perspective of the project

The four project sites selected in Kenya and South Africa may be sorted in a simple table (Tab. 1) to sketch some of the comparative perspectives of our project.

	Savannahs with major wetlands, mainly agricultural and/or agro-industrial use	Savannahs with minor wetlands, mainly pastoral use
Regulation, distributed across various actors;	Naivasha	Baringo
Regulation, concentrated in the state	(Limpopo, 2 nd phase)	Kuruman/Thaba Nchu

Table 1: The comparative perspective of the project

We fully acknowledge that the difference between savannahs with major wetlands, such as Naivasha, or with smaller or insignificant wetlands are best presented along a continuum; i.e. the Baringo case could be placed between the Naivasha case and the Kuruman/Thaba Nchu case: the wetlands of Lake Baringo are by far not as extensive and as important for local use as the wetlands of Lake Naivasha, Lake Baringo's wetland however is more significant than the small wetlands of Kuruman and Thaba Nchu, the latter rather presenting a gradient from the dryer savannah biome to the moister rangelands, respectively. The same holds true if we look at the second variable 'regulation': the Baringo case clearly is the case which is least regulated by the state; powerful local actors, some linked to the state, some not, steer regulation processes. In the Naivasha case the state comes in as an important actor. The state, however, shares its influence with major international organisations and companies as well as with powerful local stakeholders. In contrast, in both South African cases human-environment relations have been controlled by a 'strong state' since many decades. Governmental impact in the Kuruman case, however, seems to have been most substantial and long-lasting. We will investigate the case studies of Naivasha, Baringo, Kuruman and Thaba Nchu during the first phase. The Limpopo case will be added as a full fourth case during the second phase. From our recent perspective the Limpopo case offers interesting comparative material: just like the Naivasha case, export-orientated industries play a major role here. While in Limpopo's past the state, substantial private enterprises and homeland administrations dominated social-ecological regulation, a comprehensive land-reform programme empowers a number of other actors: 80% of Limpopo's rural lands are currently under claim and will probably change their owners. In many instances agro-industrial enterprises have been successfully claimed by black African communities. Thus, for comparative purposes and first preparations of phase II, initial observations on the history and political ecology of this area are included in C1.

While there are perspectives to compare all cases with each other in the long run, we see distinct comparative potential in the comparative arrangement of pairs.

Naivasha ↔ Baringo (1st phase)

In this pair two pertinent developments affect the dynamics of social-ecological systems: the impact of globalisation has impacted social, economic and ecological dynamics in the Naivasha case for more than two decades, while in the Baringo case local dynamics (demographic change, violence, elite capture) shape savannah dynamics. Both cases differ in one important aspect: in the Naivasha case the wetlands proper have been successively been encapsulated and former pastoral commons have been turned into

enclosures. Exchanges between surrounding savannah and lake environs have been hindered. Horticultural industries, tourist industries and smallholder agriculturalists at the lake rim are interested to shelter the wetland from stakeholders in the wider region and advocate exclusive access to the lake. In contrast to that, Lake Baringo is still part and parcel of a wider agro-pastoral landscape, with pastoralists competing at times violently for access to the lake's wetlands. Our lead hypothesis for the comparison of the Naivasha and the Baringo case is as follows: globalisation leads to a rapid fragmentation of land use patterns; different patches of resources (e.g. lake-side wetlands, scenic parts of wetlands, hinterland savannahs) are managed in very different and contradictory ways. Cross-scale linkages are intensified and for some parts of the SES an increasing number of options for more sustainable land use emerge, while in other areas degradation is accepted as a given fact. Less fragmentation leads to more competition for scarce resources and eventually may lead to more landscape level changes of the ecology (e.g. bush encroachment, expansion of invader plants).

Baringo ↔ Kuruman/Thaba Nchu (1st phase)

In both cases pastoral strategies have shaped the savannah landscape over long periods of time. Environmental problems such as bush encroachment, soil erosion and degradation of vegetation through invader species have been observed in both cases. In the two South African cases, however, the savannah environment has been divided into freehold farmland and communal lands during the latter part of the 19th century, and ecosystem response to land-use pressure might be different in different biomes. Such fragmentation of land holdings has not taken place in the Baringo case. Despite fragmentation the state has maintained a major influence on natural resource management in both South African cases: the state has directly addressed dynamics which have been perceived as environmental problems through research, educational programmes and development projects. Since the 1950s the Baringo basin has been haunted by a great number of development projects, which often have only been loosely integrated.

We hypothesise that pertinent changes and ruptures in the political ecology of the South African cases has led to an overall decline of importance of agricultural strategies but not necessarily to more sustainable land use practises. The continued dominance of agro-pastoral activities in the Lake Baringo case has kept people on the land. Environmental problems here are a consequence of demographic trends and land use intensification. The increasing trend towards sedentary agriculture also in pastoral communities may offer more chances for sustainable land use.

Kuruman ↔ Thaba Nchu (1st phase)

Both South African cases are similar on account of tenure systems and basic characteristics of social-ecological regulation: freehold farmland, communal lands and lands under state control (e.g. game reserves) border directly on each other. Land tenure in the Thaba Nchu case is historically even more complex: here private lands within the commons and municipal commonage (around Botshabelo) are significant. The Kuruman case is in the process of developing such heterogeneity as well, with a number of land reform projects taking place in the region. Both cases, however, differ on some basic

ecological parameters: the Kuruman case is fully located within South Africa's dryland savannah; it is a paradigmatic case for a disequilibrium system. Thaba Nchu is ascribed to a biome more dominated by grasses: disequilibrium dynamics are of less importance but soil quality might control resilience. Bush encroachment has been highly significant in the Kuruman case since decades. This problem is intriguingly just about to unfold in the Thaba Nchu case, where the problem of invader species should have been of greater relevance for the farmers and rangeland usage.

We hypothesize that the specific characteristics of the two different biomes significantly alters the coupling of vegetation and soil dynamics. Degradation in both settings has a different phase. Due to the history of farming in the area, socio-economic processes are largely decoupled from these soil-vegetation interactions. Land reform and the decline of urban employment may lead to a re-coupling of such linkages. In the foreseeable future lands in both settings will probably more intensely used as today.

During the second phase we consider to integrate another South African case into our research programme. The Limpopo province of South Africa offers itself for comparison. In contrast to Thaba Nchu and Kuruman land reform there leads to massive changes in land tenure and possibly land use. It is an open question if land use patterns dominated by export orientated agro-industries will persist. In contrast to the Kuruman and the Thaba Nchu case the political ecology is rapidly changing in Limpopo. Will this also cause and condition changes of human-environment relations in the same way? The Limpopo case offers interesting comparative material to the Naivasha case: Ecologically both cases show some similarities: both belong rather to the humid type of savannah and the presence of wetlands (in the Naivasha case in the form of a lake, in the Limpopo case in the form of a number of rivers and swamps, see Lahiff 2000). Both cases have been gravely impacted by the development of horticultural industries. While such industries have been established in Limpopo since the early 20th century and have been developed in a planned manner after the 1950s, agro-industries have established themselves in the Naivasha case rapidly since the late 1980s only. Both cases have also been shaped by the close proximity of agro-industries and conservation measures. Whereas in the Naivasha case such conservatory measures are currently extended, in the Limpopo case they are expanded (vide the gigantic Limpopo transfrontier park) and diminished (the disbanding of a number of smaller sanctuaries) at the same time.

1.6 COLLABORATION BETWEEN SUB-PROJECTS AND THE ORGANISATION OF INTERDISCIPLINARITY

The success of the research unit hinges upon its capacity to organise interdisciplinary work successfully. According to Defila et al (2008: 12) successful interdisciplinary programs go through three stages: the elaboration of a consensus on common aims and the exact subject-matter to be researched, the integration of research results and finally the diffusion of results to various audiences. While substantial steps towards a consensual definition of research aims have been taken during the preparation phase for this application, the two other phases are placed well within the first funding period of the research project.

1.6.1 The exchange of data between sub-projects

Sub-projects exchange data when working in the same region and they exchange methods when working in different regions. Besides, all sub-projects will continue to communicate on theoretical issues (e.g. resilience concept, institutions and regulation). For our research sites, such collaboration can briefly be summarized as follows (a more detailed description of planned data exchanges is found in the respective applications of sub-projects):

The South African project sites are similar in respect to interdisciplinary co-operation, as the same sub-projects co-operate on both sites. Sub-projects A1 and A3 will contribute data on the ecology of both sites. A1 will be responsible to supply information on soils, water, nutrient patterns and soil degradation. This information is necessary for sub-project A3 to understand the dynamics of the vegetation and system specific thresholds. A3 in turn will supply information on nutritive substance and above ground litter to sub-project A1. It will directly supply information on the vegetation dynamics and nutrient uptake underlying bush encroachment and invader expansion, while A1 will capture the consequences of such processes for soils. Sub-projects A1/A3 together will supply information on the productivity and its variability to sub-project B2. B2's scenarios directly depend on information generated within the sub-project but also by sub-projects A1 and A3. A1's social anthropological component and B2 together will gather information on management activities, which are essential for the understanding of ecological dynamics in sub-projects A1 and A3. A1's social anthropological component will work on micro-processes with a small number of respondents under different tenure regimes while B2 will work with larger samples and apply survey methodologies. B2 will also produce scenarios on possible future developments of the social-ecological system, which in turn will frame the results of A1 and A3. C1 benefits from the understanding of ecosystem development and helps in turn all other sub-projects working on the South African research sites to understand the historical development of key variables: Administration and scientists have gathered data on changing ecologies over the past century. Institutional change has been documented in many instances. South African counterparts will complete the information on cattle farming practice and the complex social changes resulting from land reform and other changes in tenure at both project sites (e.g., C. de Wet, Rhodes University, R. Hall, Western Cape). It is on the basis of these linkages that we jointly deem to achieve a deeper understanding of changing ecological, bio-economical, cultural and epistemic interactions and discourses that characterize the emergence of specific patterns (e.g. vegetation patterns, but also the choice of specific institutions) and regulating mechanisms in the coupled SES of this savannah environment.

In Kenya the sub-projects will work on two project sites as well. While sub-projects A2 and B1 work on both sites, tuning with results of cluster C will be achieved with sub-project C2 and C3, working in Naivasha and the Baringo case respectively. We will depict data exchange for both sites together. A2 also closely cooperates with sub-projects A1 and A3 on methodological issues and, for a later project phase, A1 and A3 also plan to work on the Kenyan project sites, while A2 may extend its activities to Limpopo Province in the 2nd phase. For the two Kenyan sites B1, B2 and C3 supply the information on environmental governance, with B2's focus on resource economics, B1's concern in conflicts, regulation

and scale challenges and C3's emphasis on the relation between gender, age, status, mobility and resource management. The emergence and perpetuation of environmental narratives and discourses and the specific role media have in this respect, is investigated by project C2. All social science approaches supply their information to sub-project A2 (and during the second phase also A1 and A3), whereas A2 will provide the relevant information on ecosystem specific thresholds and vulnerabilities to B1, B2, C2 and C3, and information on the productivity of wetlands to B1 and B2. Important additional tasks are taken over by counter-part projects. T. Lanyansunya of the Kenya Agricultural Research Institute counterpart of sub-project A2 will look on the role of livestock on nutrient exchanges between the Naivasha/Baringo wetlands and adjoining savannahs. Pauline von Hellermann, counterpart in sub-project B1, will contribute on the history of resource management in the Lake Naivasha basin in colonial times. The two counterparts of sub-project C3, K. Ngetich and A. Mahmoud, will contribute on labour migration and livestock trade from the dyland savannahs of Baringo.

In order to organise a smooth transfer of data we plan to develop a web-based data exchange and storage infra-structure. It will consist of a database that permits to store and archive heterogeneous data types and meta-information. The database comprises docking facilities for GIS software in order to enable spatial visualization. It will be completed by a platform for the exchange and publication of materials and results. In Cologne the e-humanities programme facilitates the compilation of such data and will offer advice how to institute a data exchange and storage infrastructure.

1.6.2 Organising interdisciplinarity

The experience of CRC 389 (and probably that of other CRCs) showed that interdisciplinarity needs specific organisational structures in order to work efficiently. Interdisciplinary teams – especially those constituted by scientists from the humanities and natural scientists – often spend a sizeable amount of time on basic epistemological questions (see contributions in Fuest 2006 and own experience during the preparation of this proposal). There is no doubt that such questions need to be discussed and that the research group wants to offer a platform for these discussions. Nevertheless, we surmise that it is necessary to gain at least heuristic clarity on basic approaches at an early stage. In a series of workshops we would like to develop our understanding of crucial theoretical concepts that are of direct relevance for the project during the first year of phase I. Currently, workshops are planned on “Resilience: Conceptual Challenges and Methodological Approaches”, on “Institutions and Regulation”, and on “Methodological Approaches to Scale Challenges in Research on Complex-Coupled SES”. These workshops will have a limited number of participants (possibly not more than 10 or 12). Distinguished specialists on these theoretical concepts will be invited to contribute to the workshops in which mainly members of the research unit will be engaged. It is the aim of these workshops to critically reflect upon the state of art in theoretical discussions and to consider how theoretical concepts can be operationalised for empirical research. Per annum the research unit reserves 6,000 € for supplementing workshops with necessary funds.

Interdisciplinary working groups will be a second measure to develop communication between disciplines. Experience from the prior CRC shows that such working groups need to be small and not exceed five members. Such interdisciplinary working groups should have a well-defined common aim. This could be a publication or a joined presentation or the tackling of a specific scientific problem. In general, each working group is urged to define its goal and milestones as clearly as possible. For reasons of the research group's set-up and its spatial focus the interdisciplinary teams will probably consist of members that cooperate within a region. Working groups should not necessarily be constituted by applicants only but by a mix of applicants, post-docs and doctoral students.

1.7 COMPARABLE RESEARCH ACTIVITIES IN GERMANY AND ABROAD

There have been (and still are) several major interdisciplinary research activities concentrating on human-environment relations in Africa. None of them, however, has the distinct theoretical focus of the proposed research unit, nor is any one of them working at the same field sites. Major topics of Africa related human-environment research have been biodiversity (BIOTA) and the water-cycle (GLOWA-IMPETUS and GLOWA-VOLTA).

1.7.1 The German perspective

The three BIOTA (BMBF funded) projects (BIOTA South, West and East) focus on patterns and dynamics related to biodiversity in African savannahs and woodlands. BIOTA includes a wide range of disciplines from the social sciences over natural sciences to the humanities. In contrast to the proposed research group, its main interest is an assessment of biodiversity and capacity building. Unlike the proposed research group it focuses on recent developments and pays relatively little attention to historical change and local perceptions of crises. In essence, BIOTA sub-projects have a predominantly natural sciences approach. The proposed research unit has some regional overlap with BIOTA East (Kenya), although the hotspots selected by our research group are different from the BIOTA East's hotspots which are largely in western Kenya and concentrated in the few remaining rainforest areas. Prof. Mathias Becker and Prof. Holm-Müller, who are applicants that also work within BIOTA East, will be able to facilitate ample cooperation between both projects. BIOTA South selected its transects in the south-western parts of the continent. While there is no spatial overlap with the proposed research group, there are some similar research questions – especially in the realm of resource economics. Within the BIOTA-South complex a working group around Prof. Jeltsch and Prof. Wiegand worked on the patch dynamics within South African savannahs. There exist excellent working relations with social and political scientists of BIOTA South (Prof. M. Kirk, Prof. H. Lang, Prof. M. Schnegg). Collaboration with BIOTA East and South, however, will be hampered to some extent by the fact that all BIOTA programmes will probably come to an end or will be substantially restructured during 2009.

The BMBF funded GLOWA projects concentrate on the sustainable use of water. The project format is similar to the BIOTA projects. An interdisciplinary set up has been chosen to research applied issues of management of the water cycle. There are two major GLOWA projects conducted on the African continent: GLOWA-Volta, based at the University of Bonn, with a focus on Ghana and Burkina Faso, and GLOWA-IMPETUS,

based at the Universities of Cologne and Bonn, with a focus on Benin and Morocco. While there is no spatial overlap with the proposed research unit, there are some overlapping questions: just like the GLOWA projects the research unit is interested in the effects of global climatic change on local livelihoods. Two researchers partaking in the GLOWA IMPETUS programme are also active within the proposed research unit (Prof. Michael Bollig and Prof. Thomas Heckelei). Anja Linstädter, who worked as a rangeland ecologist on the Moroccan field site of GLOWA IMPETUS, will contribute her methodological and theoretical expertise as a team-member of subproject A3.

The research unit also maintains close contact with the Bayreuth African Studies Centre. Close cooperation is especially envisaged with working groups within social geography and social anthropology. In the recent past, Prof. Müller-Mahn has organised a number of workshops directly pertaining to the topic (e.g. "Conceptualizing natural hazards, risks and resilience in Africa", AEGIS conference, Leiden 2007; a conference on risk in African contexts in November 2008 in Bayreuth). This research focus on hazards, risks and resilience is also present in the Bayreuth Graduate School BIGSAS. Prof. Müller-Mahn will be an invited fellow to our research unit during the course of the year 2011. During his time as fellow at the University of Cologne, Prof. Müller-Mahn will work on conflict around a particular wetland in the arid parts of Ethiopia (working title: Water and conflict in the social-ecological system of the Awashriver basin in Ethiopia).¹

The research unit also intends to maintain close ties to non-university research entities. The Institute for social-ecological research (ISOE) at Frankfurt (here especially Dr. Jahn) has voiced direct interest in the conceptual development of the research unit.

1.7.2 The international perspective

In a European perspective there are some interdisciplinary programmes, which work on sub-fields of the proposed research unit. The Swedish programme PLATINA is a research network initiated by researchers from the Department of Human Geography and the Department of Physical Geography and Quaternary Geology at Stockholm University. The focus is on land use history, environmental change and on interactions between social and biophysical disciplines. The overall aim of PLATINA is to foster inter-disciplinary efforts in these fields of research, mainly in Southern and Eastern Africa, through

¹ The thematic focus of the project rests on the multidimensional problems of water use and water distribution of the Awash river basin in the context of rapidly changing political, socioeconomic and ecological conditions. The aims of the project are to describe the social-ecological system of the river basin, identify its major elements and analyse the critical interactions between societal and ecological factors. The research work combines studies from different disciplinary perspectives (social geography, disturbance ecology, ecosystem services, hydrology) that jointly aim at the following objectives: (a) an assessment of the external driving forces and their relevance for social-ecological change, (b) an identification of triggers, tipping points and types of transformatory processes, (c) an analysis of the relationship between continuity, change and resistance to change, (d) an analysis of adaptation, adaptive governance and the potentials of adaptive capacity. The project prominently deals with water as a reason for conflict and marginalisation and looks at transformations in the hydraulic regime as triggers for ecological changes. Müller-Mahn's approach will decisively enrich research conducted within the research unit. Müller-Mahn will be present in Cologne/Bonn when graduates and junior researchers return from the field – many of them having worked on very similar issues in Kenya and South Africa (e.g. sub-projects A1, A2, B1, C3) as Müller-Mahn in Ethiopia. In common seminars Müller-Mahn will give advice in this crucial situation of data analysis and the drafting of first results. We also plan to join hands in a publication on violence and social-ecological change in Eastern and North-Eastern Africa and would like to use the time of Müller-Mahn's fellowship to conceptualise such a book probably basing it on a workshop to be held at the beginning of Müller-Mahn's fellowship.

collaboration between geography and other disciplines. Researchers within the PLATINA network are interested in the diverse ways in which African landscapes have been used throughout history, as well as in the interactions between human and environmental factors shaping the landscape. Researchers such as Holmberg, Öberg and Widgren have worked extensively on the relation between crises and socio-political dynamics. Although PLATINA came to a formal end in 2007 the proposed research unit maintains contacts to several contributors to PLATINA (Widgren, Östberg, Holmberg). The proposed research unit was portrayed and discussed at a PLATINA workshop in Stockholm on 26th April 2007.

The EU funded archaeological HEEAL (Historical Ecologies of East African Landscapes) project – a Marie Curie Project, located at the University of York – investigates the intricate relationship between climate changes and cultural dynamics over the past 1,000 years. There are very close contacts to HEEAL's director Paul Lane and his ongoing activities on the reconstruction of the Laikipia plateau's history are directly relevant for our planned activities in the adjacent lowlands of Baringo District. HEEAL was started in summer 2007 and may accompany the efforts of the research unit for several years.² Within the HEEAL project Dr. Pauline von Hellermann looks at the environmental history of selected landscapes within the East African savannah. Within the context of our research unit, von Hellermann will work on the history of the Naivasha basin from the 1920s to the 1950s and thereby provide the historical background to research within sub-projects A2, B1 and C2 and will be fellow to the research unit in 2012.

Peter Little from Emory University, Atlanta, will be directly involved in our work at Lake Baringo: he has been doing research with the agro-pastoral Il Chamus community (Kenya, Lake Baringo) since the late 1970s and is interested in comparing his long term perspective on socio-economic change with our long term studies on the Pokot.

John Galaty, McGill University, Montreal, currently conducts research on land use and land tenure change in the region south of Lake Naivasha (Narok District, Kajiado District). John Galaty has visited Cologne University several times. There are informal agreements on the exchange of students and a common research effort in the Lake Naivasha area. Through money made available in the VW Foundation's initiative Knowledge for Tomorrow we will have funds available to start such cooperation. Galaty will directly cooperate with sub-projects B1 and C3.

Terry McCabe, Boulder, Colorado, has worked for three decades on changes in East African pastoral communities. He has published widely on social-ecological dynamics in Turkana (McCabe 2004) and Maasai societies (McCabe 1997). Theoretically McCabe is very close to the research unit's focus on ruptures and rapid changes in SES. McCabe was awarded the Humboldt Research Award in 2009 and will stay in Cologne from September 2009 to April 2010. We will use this time to further explore common theoretical interests and to prepare PhD students and Post Docs of B1 and C3 optimally for their field stay.

² Paul Lane has been co-applicant in the former A2 sub-project of the CRC 810 reviewed in Dec. 2008. The sub-project was reviewed as excellent and we intend to continue to seek funding for it. It was aimed at looking at linkages between massive climatic fluctuations in the past 500 years and cultural dynamics in the Lake Baringo basin.

1.8 AFRICAN COUNTERPARTS AND COLLABORATION WITH AFRICAN SCIENTISTS

Collaboration takes place on different levels:

(a) African researchers are immediately partaking in research within sub-projects either as co-applicants (such as Prof. Du Preez, University of Bloemfontein in A1), as direct counterparts (as in most other sub-projects), or additional supporters such as H. Fouché and H. Snyman, University of Bloemfontein, two local renowned rangeland scientists who promised supporting site selection and who will provide additional information on species identification and the impact of cattle on plant dispersal.

(b) Within three sub-projects (A1, B1, B2), African PhD students will be partaking, financed through stipends provided by the research group. They will also be equipped with research funds to conduct research in the respective field sites.

(c) On the MA level we will engage students which are partaking in various Masters courses of the Universities of Cologne and Bonn. Through the MA course Culture and Environment in Africa five to six stipends are provided per year. For the coming term we have two very good applications from students from Kenya who may directly partake in empirical research.

Established partnerships developed during the funding period of CRC 389 and will be continued in the context of the new project. Like in South Africa also contacts to Kenyan scientists and research institutions are well established. These have been established (among others) by Prof. Mathias Becker in the course of the ongoing Volkswagen Foundation Project on “Agricultural use of small wetlands in East Africa”. Prof. Helida Oyieke, Director of Research of the National Museums of Kenya, is co-applicant of the Volkswagen project and partner for biodiversity-related studies in the current research unit. Dr. Bernard Vanlauwe and Dr. Nteranga Sanginga are soil scientists at CIAT-TSBF (Tropical Soil Biology and Fertility programme of the Center for International Agricultural Research – CIAT) in Nairobi. During a visit at TSBF by Mathias Becker in March 2008, they have agreed to provide methodological backstopping for chemical analyses and Near-infrared Spectroscopy and to advise and co-supervise students in the areas of soil science, plant nutrition and agronomy, mainly in A2.

Kibet Ngetich, lecturer for Anthropology at the Egerton University, Kenya, acts as counterpart to sub-projects B1 and C2 and C3. Ngetich has a particularly close relation to Cologne University as he visited the institution as a DAAD funded PhD student. Ngetich will receive funds to supervise fieldwork on squatters at Lake Naivasha (B1) and on migrant pastoral diasporas in urban Kenyan contexts (C3). With A. Mahmoud, a second anthropologist from Egerton University is involved in the project. He has been visiting fellow at the MPI for anthropological research at Halle and has worked on livestock trade in northeast Kenya. He will contribute to research conducted in C3 and focus on livestock trade in and out of the Baringo area. The Kenya Agricultural Research Institute (KARI) at Lake Naivasha will be academic counterpart (here especially Dr. T. Lanyasunya) and also offer much needed office space and lodging facilities.

Sub-project A1 has a South African co-applicant: Prof. Ch. Du Preez of Bloemfontein University has been working together with Prof. Amelung for some time on related topics.

Next to Du Preez as co-applicant, the sub-project will also work together with Chris De Wet from Rhodes University who will supervise social anthropological work in subproject A1 and the historical research on the betterment schemes launched in the 1960s (within C1). In South Africa the University of Bloemfontein will act as a hub for the research unit's activities in South Africa. Through Prof. Du Preez we have been offered office space and also safe space to leave our cars and working equipment when out of the country. Table 2 lists the counterparts and the expenses each sub-project is contributing to the counterparts. In many cases professors and lecturers act as counterparts: they will mostly spend their counterpart funds on financing MA and/or PhD thesis which directly contribute to the respective sub-projects.

A1	Title	Vulnerability and Resilience of Soils under Different Rangeland Use
	Research Area	Soil Science, Social and Cultural Anthropology
	Principal Researcher(s)	Prof. Dr. Wulf Amelung, INRES, University Bonn
		Prof. Dr. Chris du Preez, University of Free State, RSA
	Counterpart(s)	Social Anthropology: Chris du Wet, Rhodes University, Grahamstown, RSA
	Expenses for counterpart	Stipend (incl. research cost and travel) + 9,390.- €
A2	Title	Functions and Uses of Wetlands in Changing Savannah Environments
	Research Area	Crop Science
	Principal Researcher(s)	Prof. Dr. Mathias Becker, INRES, University Bonn
	Counterpart(s)	Biodiversity: Dr. H Oyieke, National Museums of Kenya, Nairobi, Kenya
		Animal Sciences: Dr. T. Lanyasunya, Kenya Agricultural Research Institute (KARI), Naivasha, Kenya
	Expenses for counterpart	10,000.- €
A3	Title	Vulnerability and Resilience of Rangeland Vegetation as Affected by Livestock Management, Soils and Climate
	Research Area	Crop and Grassland Science, Rangeland Ecology
	Principal Researcher(s)	Prof. Dr. Frank Ewert, INRES, University Bonn
B1	Title	Violent Regulation and Social-Ecological Transformation of Wetland Ecosystems in East Africa
	Research Area	Social Geography, Social and Cultural Anthropology
	Principal Researcher(s)	Prof. Dr. Hans-Georg Bohle, Dep't of Geography, University Bonn
		Prof. Dr. Michael Bollig, Dep't Social Anthropology, University Cologne
	Counterpart(s)	History: Dr. Pauline von Hellermann, University of York, UK
		Social and Cultural Anthropology: Dr. Kibet Ngetich, Egerton University, Nakuru, Kenya
	Expenses for counterpart	Stipend (incl. research cost and travel) + 12,600.- €
B2	Title	Resilience of SES from a Resource-Economics Perspective
	Research Area	Resource and Institutional Economics
	Principal Researcher(s)	Prof. Dr. Karin Holm-Müller, ILR, University Bonn
		Prof. Dr. Thomas Heckelei, ILR, University Bonn
	Counterpart(s)	Dr. Paul Maina Guthiga, Environment for Development Initiative (EiD-Kenya) and Kenya Institute for Public Policy Research and Analysis (KIPPRA)
		Stephen Mailu, MA, Kenya Agricultural Research Institute (KARI), Naivasha, Kenya
	Expenses for counterpart	Stipend (incl. research cost and travel)
C1	Title	Making the Modern World: Science, Education and Social-Ecological Engineering in Rural Southern Africa
	Research Area	History
	Principal Researcher(s)	Prof. Dr. Margit Szöllösi-Janze, Dep't of History, University Cologne
		Prof. Dr. Norber Finzsch, Dep't of History, University Cologne
	Counterpart(s)	Social Anthropology: Chris du Wet, Rhodes University, Grahamstown, RSA
	Expenses for counterpart	4,500.- €
C2	Title	Mediality and Local Creativity in the Negotiation of Social-Ecological Resilience, Collapse and Reorganization
	Research Area	Social and Cultural Anthropology
	Principal Researcher(s)	Prof. Dr. Dorothea Schulz, Dep't Social Anthropology, University Cologne
		Social and Cultural Anthropology: Dr. Kibet Ngetich, Egerton University, Nakuru, Kenya
C3	Title	In Search of Order: Institutional Change, Violent Regulation and Environmental Knowledge under Conditions of Rapid Social Ecological Change
	Research Area	Social and Cultural Anthropology
	Principal Researcher(s)	Prof. Dr. Michael Bollig, Dep't Social Anthropology, University Cologne
	Counterpart(s)	Social and Cultural Anthropology: Dr. Kibet Ngetich, Egerton University, Nakuru, Kenya
		Social and Cultural Anthropology: Dr. Hussein A. Mahmoud, Egerton University, Nakuru, Kenya
	Total costs	Stipend (incl. research cost and travel) + 15,000.- €

Table 2: Subprojects of the RU with counterparts and expenses for counterpart projects

1.9 SCIENTIFIC STAFF AND INSTITUTIONAL BASIS OF THE PROPOSED RESEARCH UNIT

At both universities participating in the proposed research unit, human-environment relations have been highlighted as research priorities. The University of Cologne has defined five research priorities in its “Ziel- und Leistungsvereinbarung III (ZLV 2007-2010)” between the university and the relevant federal ministry. The proposed research group will be a key activity within the research foci “Humans and their Environment” and “African Studies”. The university intends to boost its expertise in these specific research areas by allotting new professorships within the next years (ZLV 2006). A junior-professorship has been given to the Institute for Social and Cultural Anthropology in order to strengthen the research group’s focus. “Junior-professor” Michael Schnegg may take up his duties at the University of Cologne in October 2009 and add an application to the project at a later stage. During its planning phase the research unit has already greatly profited from the University of Cologne’s support: for 24 months the university financed a coordinating position which was essential for the continuous and stringent organisation of the programme. Also after the planned CRC 810 had not been awarded, the University continued funding a coordinator to prepare for this application. In August 2008 the University of Cologne also passed the statute of the Cologne African Studies Centre, which was launched in autumn 2008. This centre is created as a platform to coordinate Africa-related research in the Cologne/Bonn region. The African Studies Centre will also enhance the international visibility of Africa-related research at Cologne and Bonn.

The University of Bonn is an international, research-oriented university with distinct research foci in mathematics, the humanities and environmental research. About 15 percent of its 27,000 students come from abroad and are involved in one of the international master or doctoral programmes (e.g. ARTS). In the context of social-ecological research Bonn University has a long tradition and profound experience in long-term research programmes in developing countries (e.g. GLOWA). This excellent research framework in the Bonn-Cologne region significantly benefits from formalised collaborations with the newly established UN-branches in Bonn, like UNU-EHS, UNCCD and UNFCCC and international NGO’s. Currently the agricultural faculty has re-shaped its research aims into six research lines. Two of those, “ecosystem services and risks” (coordinator: W. Amelung), and “modelling of agrosystems” (coordinator: Th. Heckelei) develop key concepts that are also framed in project outlines of this RU. Along with the definition of major research lines, the agricultural faculty has established the Theodor Brinkmann Graduate School. Up to eight PhD stipends are provided each year to applicants that are willing to promote one of these research lines. The selection process is highly competitive but thus also open to potential applicants willed of joining this RU.

1.10 MEASURES FOR THE PROMOTION OF JUNIOR RESEARCHERS IN THE PARTICIPATING (SCIENTIFIC) FIELDS

At the MA Level: Based on the experience of the CRC ACACIA and in order to improve interdisciplinary teaching on human-environment relations in Africa the master course Culture and Environment in Africa (CEA) was designed and finally accredited with very positive comments in January 2007. It started in spring 2009 with a group of six African

students. For the winter term 2009/10 another 13 students from Africa applied and some 5 more from Germany. The MA course greatly profited from the approval of 5-6 scholarships per annum for MA students from Africa (Albertus Magnus stipends, NRW funding). CEA is an integrated program providing critical skills and knowledge in interdisciplinary African human-environment studies. It enables students from diverse disciplinary backgrounds to acquire a holistic understanding of the complex interrelationships between human agency and bio-geophysical processes. The course combines natural sciences with social and cultural sciences, covering aspects in the history, present state, and the foreseeable future of African human-environment relations. The Master programme offers graduates enhanced career prospects not only in academia, but also in the wider job market. There will be a close cooperation between the proposed research unit and CEA. On the one hand, the research group will add options for practical research experience and research orientated MA theses. On the other hand CEA will provide excellent young researchers to the entire research complex. After two rounds of application we are confident that the programme is attractive for African students, who can then be linked to the research unit.

The International Master of Environmental Sciences (IMES) has been established at the University of Cologne in 2003. The programme is a 2-year master programme leading to a Master of Science in Environmental Science. It takes off from the idea that humans and the environment are closely coupled and that human activities dominate most ecosystems as humans strongly alter the biological, chemical, physical and geological characteristics of their environment. At the same time, humans are affected by their environment, which provides essential goods and services. Therefore, technologies to mitigate environmental problems are invented and regulations of environmental use and impacts are issued at accelerating speed in an increasingly globalised world. The idea of this programme is to enhance the handling of environmental problems and research on environmental issues by fostering multidisciplinary education and thinking. So far, University of Cologne welcomed students from almost 30 countries and all continents (except Antarctica).

Bonn University currently offers three internationally and research oriented MA-programmes, which are of high relevance for the envisaged collaborative research project with its cross-cutting research topics. These are the Master in "Agricultural and Resource Management in the Tropics and Subtropics (ARTS)" from the Faculty of Agronomy, secondly the structured PhD programme within the Bonn International Graduate School for Development Research (BIGS-DR) coordinated through the Center for Development Research (ZEF), and thirdly the interdisciplinary Master in "Geoinformation" from the Departments of Geography, Geodesy and Informatics. All three graduate programmes have a high affinity with the disciplinary as well as with the methodological foci of our collaborative research programme and offer excellent research opportunities especially for young scientists. Besides, potential MSc students might join this RU from the basic MSc courses of agricultural plant or animal sciences as well as from the MSc study "Food and Resource Economics".

The ARTS postgraduate study programme is designed as a research-oriented multidisciplinary approach to expand students' overall background in the basic and applied management of natural resources for agricultural development and research in (sub)tropical environments. Students are trained by experienced international agricultural scientists. They develop a holistic, cross-disciplinary understanding and acquire a

systems' view of structure, use, interactions, endangerment and protection of natural resources. Graduates from the ARTS Master's programme are equipped with skills and tools to recognize and solve problems related to (sub)tropical resource management, thus making them more effective leaders for agricultural development, preparing them for agricultural and environmental research and development positions and providing an entry qualification for PhD programmes. In 2007, ARTS was awarded the label "Top-10 international Master programmes in Germany" by the German Academic Exchange Service (DAAD) and the "Stifterverband der Deutschen Wissenschaft". The ARTS programme extends over 24 months and consists of two "in-class" semesters and two research semesters, including a 6-month stay in a partner organisation or an institutional set-up of a developing country. The proposed research unit will be one of these institutional set-ups for the field research within ARTS.

The diverse MA programmes will create a group of students, which from an early stage will relate to the research group's research agendas and theoretical considerations. Given the fact that interdisciplinary teaching on human-environment relations is rather rare, it is advisable to create cohorts of students with a keen interest and some experience in interdisciplinary research, which can then pass on to a PhD course. The research unit will also offer excellent conditions for doctoral students and post docs. In all we apply for five post doctoral positions and eleven doctoral students (out of which 3 are stipends from South Africa and Kenya).

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