

Session>25624> Vulnerability and Resilience of Livestock Farming Systems Facing Global Changes

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As any sector of agriculture, the livestock farming systems are impacted by the different components of the global change along the last decades. The change has always made part of the factors which lead the breeders strategies, especially the mobility and savings. However, may be it has never been so important and diversified in such a short time. Moreover, the combination of different factors of changes increases the complexity of the processes and therefore the responses in terms of practices and policies.

In arid areas, the rainfall reduction, the global warming and high frequency of hazards force breeders to adapt the management practices of the pastures. The strong urban development and new lifestyle require different resources as for example land, water and food, impacting the countryside and the breeding areas. New technologies of information and communication, especially mobile phone and transport, help the breeders to have a better knowledge about the price of the products and the dynamic of the market. During the last decade, the globalization of the economy gets high the animal product prices, as it never happened. The social demand, mainly young people and women, requires significant transformations in terms of living conditions and relationships between the generations and the traditional governance. The new social and environmental awareness at different level result in new rules and practices in natural resource management and sustainable development.

The breeders have to face important changes in the same time, have to take decisions, frequently in a short time and may be leading to irreversible modifications of their livestock farming systems, their living conditions, with risks for their sustainability. In this global change context and according to the differences between the biomes and regions of livestock activities, what are the main differences and common issues in adaptive strategies and resilience process at farm and local level, especially in management of the pasture, the feed and the herd, land-use, labor organization, long-term farming trajectories and public policies.

Based on contrasted study cases in different biomes, the session will focus on the three following themes:

- What does global change mean at the local level?
- What are the main adaptive strategies at farm and local level?
- What about the resilience of the livestock farming systems in harsh conditions?

We are waiting for at least presentations and paper from 8-12 study cases: The Qilian Mountains, Tibetan Plateau, in China (R.Long & L.Dong); North Western Coast Zone in Egypt (M/Abd El Zaher & I.Daoud); Gharb Plain in Morocco (MT.Srairi); North Senegal (C.Corniaux), North Uruguay (H.Morales), South Patagonia in Argentina (F.Coronato), Western Brazilian Amazon (L.Navegantes), Special Areas in Western Canada (P.Strankmann), New Zealand (L.Wedderburn), Mountains areas in France (J.Lasseur), ...

Transforming Pastoralism in the Horn of Africa

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This paper explores the traditional knowledge systems of pastoral communities in Ethiopia, justifications for large-scale agricultural investment, its implications, and policy considerations. Pastoralists are by-passed by development, because of their incompatibility to most development proposals. Transforming pastoral communities into large-scale agriculture entrepreneurs comes with a lot of resistance to relentlessly protect original community values engraved in the spiritual, cultural, mental, social, economic, and political aspects. This is done with the right human tools, with a clear understanding of pastoralists' unique traditions and the knowledge associated to it, such that the identities of endangered societies are protected and conflict associated to de-identification and de-nationalization is prevented; so that while solving challenges of famine, low incomes, and poor standards of living, traditional aspects are integrated in economic reforms. The unique culture soon becomes an economic force and a source of pride, unity, peace, and solidarity. And tourism turns out to be an alternative driver to country's economic success and beauty, from the attractions arising from strong cultural traditional, arid landscape, featured wild animals, plants, and how all are related. There is need for mindfulness of foreign conspiracies to alienate traditional life-knowledge systems in the name of development. And Investment should be one that concerns itself with advancement of local solutions to solving local, regional, and global problems

24258 > Application of payment for ecosystem services in China's rangeland conservation: a social-ecological system resilience perspective

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Payment for ecosystem services (PES) is adopted by China government in the past decade as an approach to combat regional-scale rangeland degradation. Applying the PES project of “retire livestock to restore rangeland” in Inner Mongolia as a case, we analyzed some fundamental problems associated with PES application in rangeland management from the perspective of social-ecological system (SES) resilience. The study findings demonstrated that PES project resulted in obvious negative impacts on local pastoralists' livelihood and society networks, while also failed to reach rangeland restoration. Such failures are rooted in that PES strategy, with the logic of using cash to purchase ecological services, fragmented and simplified the localized and diverse relationship within the SES thus weakened its resilience. We concluded that PES should be aimed at SES function and improving its resilience during disturbances and problems, but not just simply maintain ecological service. In this sense, we argue to use Payment for SES Resilience instead of Payment for Ecological Services in the future.

24605> Overcoming Winter Mortalities and Poverty in Mongolian Pastoral Systems: Which Framework for the Definition of Resilience-Based Strategies?

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Peaks of livestock mortality regularly occur in Mongolia when harsh winters follow droughts. These frequent events called dzuds are one of the main factors of vulnerability for the Mongolian pastoralists; vulnerability which contributes to maintain 30% of the country's population in a state of poverty (World Bank 2012). A resilience-based approach is therefore needed to define any development strategy.

Resilience is a measure of the ability of systems to absorb perturbations and still persist (Holling 1973). It is often represented by the attraction basin metaphor which describes the movements of a system around its equilibrium point, in response to perturbations: the largest the basin is, the most resilient the system is (Elmqvist et al. 2003).

However for most systems, it is difficult to use this approach because it requires a topographical representation of their dynamics.

The viability theory makes it possible to overcome this difficulty. Viability is a mathematical framework whose aim is to define, through a state-control approach, strategies that respect pre-defined constraints, possibly in a stochastic environment (Aubin 1991). To apply the viability theory, no topographical basin representation is required. One of the main principles of the viability framework is to identify a set of initial states – the viability kernel – from which at least one strategy ensures that the studied system respects the constraints through time. Moreover, a variant of the viability kernel can be used on systems that are not respecting yet the defined constraints. It is called the capture basin and is the set of initial states from which at least one strategy points toward the viability kernel. It is very close in meaning to the attraction basin (Martin et al. 2011).

Viability could therefore be particularly well adapted to the Mongolian pastoral systems confronted with frequent climatic shocks and poverty. Definition of development strategies in this framework would have to identify the management schemes with the largest capture basin possible, to maximize their chance of success.

Practically, a capture basin would look like a set of initial states defined by density intervals of livestock species. From this area there would be one or more production strategies that lead the system into a state where herders maintain their livestock in a satisfactory productive situation, by decreasing their vulnerability to climate uncertainties while securing their income above the poverty line, despite the risks of dzuds. This state would belong to the viability kernel.

To define the capture basin as such, the strategies would have to take into account the different resistance and productivity patterns of the five local species that are sheep, goats, cattle, horses and camels. The large species are much more resistant to dzuds than the small ones, but the production of the small animals are more profitable (goats produce cashmere and sheep one the most popular meat in Mongolia). Strategies

would therefore have to arbitrate between the genders and proportions of the different species, and to preserve the renewal capabilities of the supporting pastures, their numbers should also be taken into account.

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24880> Does resilience-based management of communal grazing land address gender inequity? A case study in the highlands of Ethiopia

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The literature on resilience indicates that diversity in social-ecological resilience plays an important role to enable the system to cope with and adapt to change. However, more attention has been given to the influence of ecological diversity than to social diversity. Social diversity arises from e.g. age, ethnicity, wealth and gender. In communities dependent on natural resources, each of these social distinctions lead to differences in roles, thus influencing the interaction with natural resources and the knowledge about them. Social differences, especially linked to gender, also tend to be linked to differences in power, and thus control over resources. Yet, it is unclear whether harnessing social differences – e.g. through including women in decision-making bodies so as to include their knowledge and take their needs into account – can be directly linked to an increased resilience of the social-ecological system, i.e. its persistence, adaptability and transformability.

This analysis builds on a case-study which aimed at capturing whether women were excluded from the management of communal grazing land, and how this exclusion may impact the resilience of this social-ecological system. The community studied is in the highlands of Ethiopia, where the farming system is subsistence-oriented, with the communal grazing land playing a key role, esp. in ensuring adequate nutrition for oxen used in ploughing and dairy cows. Data was collected through focus group discussions and key informant interviews and analysed through content analysis.

The results show that women are excluded from informal institutions governing the use and management of communal grazing land resources, so that their preferences are not taken into consideration. For example, women have been banned from harvesting a specific grass species used to craft traditional plates; oxen are systematically privileged over dairy cows whose produce women control; and women-headed households – which are often poorer and thus do not own cattle – tend to be excluded from access to the grazing land altogether. Yet, while there are clear social injustices, the grazing land has been managed in a fairly sustainable manner for the last 20 years despite a variety of shocks and stresses. Thus – from the point of view of ensuring a sustainable management of the natural resource – there is no apparent need to address women's exclusion. The case could thus be made that the gender dimension is not relevant for resilience thinking. And indeed, very few papers in the resilience literature address gender issues.

Yet, we argue that this 'gender blindness' is problematic for three reasons. Firstly, the exclusion impoverishes the knowledge base, so that future adaptation options might be overlooked. Secondly, excluding women can undermine the legitimacy of institutions, thus threatening the whole management system. And thirdly, being 'gender blind' may make resilience-thinking attractive to those who wish to perpetuate gender inequality. Indeed, as resilience becomes more popular in policy circles, claiming the aim of managing natural resources for resilience can be used as a justification to continue excluding marginalised social groups.

24879> Linking the social and the ecological for resilience and adaptability: The case of a controlled grazing system in the Ethiopian highlands

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Ensuring a sustainable flow of ecosystem services is a challenge: long-term trends such as demographic growth increase the pressure on natural resources, and communities need to cope with 'surprises' such as political shifts. Understanding how communities perceive change and seize windows of opportunity, how they learn and adapt management practices may be crucial to achieve sustainability and face an uncertain and turbulent future.

In Ethiopia, governments guided by different political ideologies have led to radical changes in the land tenure system and the rules governing access to communal grazing land. The latter is an essential element in the highland farming system, esp. to ensure adequate nutrition for oxen used for ploughing and dairy cows. As the communist Derg regime ruled between 1975 and 1991, all land was declared government property and producer cooperatives were established. During that period, communal grazing land was in effect 'open access' and overgrazing resulted in severely degraded land. With the regime change in 1991, communities regained some say in how the grazing land was managed. Despite this, land degradation and erosion is severe in most of the Ethiopian highlands. Yet, a few communities are able to manage their communal grazing land in a sustainable manner. This study aims at understanding how one such community was able to recognize windows of opportunity, to learn from past mistakes, and to adapt their management. Data was collected through focus group discussions, key informant interviews and participant observation and analysed through content analysis.

The results show that three factors played a key role in enabling the community to cope with the impact of policy changes over the last 25 years. Firstly, traditional leaders stepped forward at the collapse of the producer cooperative in 1990, recognizing and seizing the window of opportunity and mobilizing the community. They built on their previous experience and authority as 'father of herders' and on the wide-felt need to change the management of the grazing land, as it was severely degraded and no longer secured adequate nutrition for the oxen, needed for ploughing. Secondly, an informal institution was established which governs the access to and use of the communal grazing land. Through the community-level, participatory approach, the management rules are adapted based on experimentation (e.g. with enclosures allowing regeneration), sharing of knowledge (e.g. rotational grazing, keeping animals on the land at night to fertilize through dung) and negotiating practices (e.g. allowing some access to dairy cows so that poorer households (i.e. those who do not own oxen) also benefit from the grazing land). Thirdly, the community was able to effectively interact with various official government agencies to safeguard their autonomy, and to enrol them to help enforce rules (e.g. excluding cattle from neighbouring villages). The study thus shows that while ecological knowledge is essential for social-ecological resilience, so is social knowledge, i.e. recognizing and seizing opportunities despite uncertainties, mobilizing for collective action, and ensuring a continuous process of social learning.

25011> Managing the resilience of a livestock-production socio-ecological system in South Africa – A SES modeling approach

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Grazing livestock plays a vital role for livelihoods in communal areas of South Africa as it constitutes either a mean of subsistence or a financial buffer in unfavorable times (Dovie et al. 2006). Increasing the economic benefits generated by these rangeland systems is thus becoming an increasingly important goal on the agenda of the South African Department of Rural Development and Land Reform. However, increasing economic returns should be accompanied by sustaining or improving the resilience of desirable configurations of the social-ecological system (SES) towards external disturbances. That is, increasing the risk of system collapse in favor of short-term profits is not a viable option for sustainable development. The notion of SES involves the acknowledgement that ecological and social processes are intertwined and can thus not be investigated in isolation (Berkes et al. 2003). To estimate the impact of proposed system alterations is thus inherently complex. Moreover, to quantify resilience is problematic as “the only sure way to detect a threshold in a complex system is to cross it” (Carpenter et al. 2005, p.941). The latter is often not feasible in real-world SES due to ethical or practical issues (Carpenter et al. 2005). However, simulation models can be a useful alternative to detect changes in SES dynamics stemming from changes in the structural set-up (Schlüter et al. 2012; Carpenter et al. 2001).

We used case study data from a local SES in South Africa to specify a SES agent based model to investigate the resilience of the coupled system. Data was gathered by a multi-disciplinary research group of soil and rangeland scientists, anthropologists and economists. The investigated village community of Sediba utilizes a common rangeland for beef cattle production under continuous grazing. Local experts as well as villagers have expressed the expectation of substantial economic benefits from the introduction of rotational grazing. The rationale in support for this measure is the avoidance of path-selective grazing as well as rest periods for the vegetation which is supposed to increase total forage available for animal intake and thus economic performance (Briske et al. 2008). However, even disregarding the costs for implementing the required infrastructure, there is no agreement in the scientific community on whether rotational grazing is actually superior in areas coined by low precipitation, high climatic variability and socio-economic depression (Briske et al. 2008; Holechek et al. 1999; Vetter 2013). Moreover, institutional issues of self-governance in common pool resource regimes with respect to rule conformance and enforcement have to be taken into account (Ostrom 2005). Here, social embeddedness and norms are framing the local context (McAllister et al. 2011; Tavoni et al. 2012) and are thus considered in the model.

Our objectives are (1) to evaluate if the construction of an infrastructure necessary for rotational grazing in Sediba is actually improving biomass quantity, forage quality and livestock production and (2) to compare the resiliencies of the SES under both management schemes in the light of social and ecological disturbances, such as drought periods as well as changes in subsidization and ownership.

25147> Adopting a resilience lens to analyze adaptation to climate change on alpine pastures

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Alpine pastures represent an important forage resource for many agropastoral farming systems, whose herds graze these areas during summer. They also present a very high level of biodiversity. The extensive pastoral management of these areas enables to preserve both the forage value and the biodiversity of the vegetation. However climate change threatens the fragile equilibrium of these complex agro-ecosystems, by influencing biomass production and vegetation composition, while the combined effects of climate change and grazing practices remain uncertain on long-term. The major issues for the stakeholders involved in the management of alpine pastures are (1) to preserve both the pastoral resource and the high level of biodiversity of alpine pastures in this changing context, and (2) to develop adaptive capacities to face perturbations brought by climate change and by a more general context of great uncertainties (climate, but also economy, regulations, animal health...). These stakeholders (farmers, shepherds, technical advisors, managers of protected area) need to have a better understanding of the alpine pastures functioning, to evaluate their adaptive capacity to climate change, and to manage them in a sustainable way.

Ecological resilience can be defined as the capacity for a agro-ecosystem to conserve its structure and properties despite perturbations. Alpine pastures are a typical model of complex agro-ecosystems in a changing environment; adopting a resilience lens to analyze their functioning seems in consequence to be interesting, as it can help to draw general conclusions for a better understanding and management of complex agro-ecosystems in a changing environment. It also allows to study interests and limits of the resilience concept in this type of situations. Finally it may help stakeholders in the management of their alpine pastures.

We studied both the management and the ecological functioning (climate – vegetation - grazing practices interactions) of the alpine pastures. Despite important climatic uncertainties and a lack of knowledge in the ecological functioning of alpine ecosystems, this work led us to take an original view on farmers and shepherds' practices and their adaptation processes, but also to reconsider some of the stakeholders' representations of the alpine pastures functioning. We underlined in particular the necessity (1) to move from a management mainly annual in an environment considered as stable, to a multiannual management in a changing environment, (2) to adopt a more integrated vision and to manage as a whole pastoral and environmental issues, and (3) to consider all the forage resources used by the herds during the whole year, that is to say, to analyze the management of the alpine pasture within the management of the farms using it.

This work was based on the study of a diversified sample of alpine pastures in the French Alps. Technical advisors' tools were analyzed, and local experts' knowledge was mobilized during collective modeling sessions.

25323> To what extent can droughts drive transformations of pastoral households?

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Livestock grazing in drylands supports pastoral livelihoods but is facing multiple changes including shocks such as drought. Often, herdsman mentioned specifically drought events as the reason for their exits from pastoralism. The purpose of this study is to assess the relevance of drought as driving force for losses of livelihood security leading to a specific systemic change - the exit of households from pastoralism.

We present and apply a framework for systematic analyses of the social-ecological functioning of pastoral resource use that consists of the following components: (1) A spatially social-ecological model for analysing the system dynamics, esp. in face of drought (2) an operationalized measure for assessing livelihood security and (3) a strategy for systematic vulnerability assessments of pastoral households by scenario comparison. Exemplarily, this approach is applied to the land use system of the transhumant pastoralists in the High Atlas Mountains of Morocco.

The results indicate that, only in few cases, drought is the main threat to livelihood security forcing households to exit from pastoralism. Instead of, other (endogenous and exogenous) sources of variability were found to be the main driving force for vulnerability, depending on the household characteristics such as income needs and the level of pastoral mobility. These driving forces dominate over the effects of drought. We discuss implications on the role of drought in interplay with other processes of global change such as social change and land use change for livelihood security in pastoral systems.

Moreover, on the basis of these findings, some conclusions are drawn on adequately exploring the relevance of shocks as driving force of systemic changes in coupled human-nature-systems. These conclusions concern the interplay of exogenous and endogenous factors, the propagation of changes through the coupled system, upscaling and the response to uncertainty and unintended side-effects of intended changes.

23892> A social-ecological network approach of landscape management: Transhumant pastoralism in the Andean Mountains of North Patagonia, Argentina

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Many mountain regions are widely characterized by harsh environments, scarce infrastructure, low human density and extreme contrasts regarding these attributes between mountains and neighboring plateaus and plains. Many cultures have co-evolved in such contexts by developing their livelihoods moving around within a large spatial landscape (both family and herd), in order to cope with environmental variability such as seasonal and regional rainfall and snowfall, and natural heterogeneity (e.g. lowlands and highlands). We propose that analysis of regional connectivity is a crucial step in order to understand the strengths and vulnerabilities on human land use and related communities. In the Andean mountains of North Patagonia (Neuquén, Argentina) many families rely on transhumance for their well-being. Families and their herding system that moves between fragmented environments are embedded in a regional network of social, biophysical and productive connectivity. We analyzed the regional transhumant system from a network perspective, depicted by the connectivity promoted by the seasonal movements of herds and families (edges) among different ecosystems, defined as lowlands and highlands (nodes, $n=793$). The network topology explicitly described the hidden institution regarding landscape management, and the biophysical connectivity promoted by the transhumant system as a whole. We identified 238 transhumance networks, and the highest frequencies corresponded to small network structures (i.e. 53% dyads, 23% triads) suggesting that landscape management is highly decentralized. Most transhumant networks (92%) promoted connections of at least two different regional ecosystem units, and there was a positive relationship between the diversity of ecological connections and network complexity. With regards to biophysical connectivity, we identified 8 regional ecosystem units with structural importance for the whole network, highlighting zones where conservation and management should be oriented in the face of future environmental and social change. Based on inferences from these analyses, we emphasize that policy design, intervention, and the development of institutions involved with governance systems in mountain-plain social-ecological regions, requires to acknowledge the cross-scale spatial and temporal interconnectedness, in order to avoid problems of scale mismanagement. From a scientific perspective, the results are encouraging as a step towards the integration of social-ecological patterns and processes. Linked social and ecological studies should advance, from the design of research, in a more tied relationship between geographic (i.e. biophysical patterns) and network dimensions (i.e. social processes).