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Envisioning the future and learning from the past: Adapting to a changing environment in northern Mali

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ABSTRACT

In West Africa, rural livelihoods depending on natural resources develop coping and adapting strategies to face climate variability or change and economic or political changes. The former Lake Faguibine in northern Mali has experienced drastic ecological, social, and economic changes. Forests have emerged on the former lake and have become important for local livelihoods. This paper analyses the coping and adapting strategies of forest- and livestock-based livelihoods facing ecological changes. Results from field research at different levels indicate that most local strategies are based on diversification including migration within the livestock production system or in complement to it, with differences according to gender, age, and ethnicity. Political discourses, cultural identities, and past experiences influence and shape adaptation strategies at the local level. The sustainability of the observed strategies depends on the access to natural resources and the sustainable management of these resources, which in turn depends on institutions at local and national levels. Many local strategies are reactive to external events but would need strategic support from higher levels to move from coping to adapting. Examples are the development of institutions and technical actions for natural resource management, as well as development actions supporting local strategies and sustainable investments. Researchers, practitioners and development planners will need simple methods and tools for understanding and analysing local adaptation perceptions and actions to achieve an effective support of sustainable and gender-equitable local adaptation and to avoid mismatches between strategies proposed by local and by sub national and national actors.

1. Introduction

Vulnerability and adaptation to external shocks and changes, whether societal, economic, or climatic, have long been a reality of life for societies. Climate change threatens to create an additional burden on already vulnerable groups. As the body of evidence on climate change impacts grows, so too does awareness of the need to adapt to climate change (McCarthy et al., 2001; Burton et al., 2002; Parry et al., 2007). Reducing the vulnerability of socio-ecological systems to climate change is a challenge for organisations, groups, and individuals, from the global to the local level (Adger, 2006; Ribot, 2010). As adaptation first takes place at the local level, it is important to understand what "adaptation" means locally and how socio-ecological systems respond to multiple stressors, including climate change and variability (O'Brien et al., 2004; Van der Geest and Dietz, 2004; Mertz et al., 2009).

Perceptions of adaptation and its priorities vary across scales and levels (Smit et al., 2000). National adaptation planning processes and their outputs, such as the NAPAs (National Adaptation Programmes of Action, a process for Least Developed Countries), do not always capture local specificities—a necessary aspect for supporting existing

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adaptation efforts and local institutions in planning sustainable adaptation strategies (Agrawal, 2009; Stringer et al., 2009). This gap can lead to increased vulnerability or maladaptation by disproportionately burdening the most vulnerable, generating high opportunity cost, or creating path dependencies that will limit the choices of future generations (Barnett and O'Neill, 2010); as Eriksen et al. (2011) put it, because of unexpected consequences and negative externalities, ''not every adaptation is a good one'' (Eriksen et al., 2011:1). In this context, therefore, the key questions concern (1) what is experienced as adaptation, (2) what is perceived as preferred adaptation, and (3) what the enabling conditions are for successful and sustainable adaptation.

Inadequate technological solutions and strategies relying on unsustainable resources may increase the risk of maladaptation. For example some irrigation projects can increase soil salinity, affect freshwater ecosystems, and deprive some farmers from access to water (Klein et al., 2007); forest product harvesting as an adaptation strategy provide short-term incomes but can degrade forest in the long term (Djoudi and Brockhaus, 2011). The lack of congruence between stakeholders' views on adaptation and the lack of knowledge of policymakers about local adaptation can lead to ill-informed policies and maladaptation. In the Sahel, for example policies and projects increasing sedentarism of pastoral communities reduce the flexibility of livestock herders to cope with drought (Mortimore, 2010). As adaptation depends on local ecological and social realities, addressing local diversity is crucial for understanding local adaptive capacity (Agrawal, 2008; Paavola, 2008).

In this paper, we applied a set of methods and participatory tools to analyse local strategies for coping with, or adapting to, ecological changes in a context of political and economic changes in Northern Mali. We compare preferences and perceptions of adaptation at the community, district, regional and national levels. We discuss key issues of coping and adaptive strategies: their effect and dependence on natural resources, the role of social interactions and local institutions for the sustainability of strategies, and the implications of conflicting views on adaptation strategies.

The findings contribute to a deeper understanding of the complexity of coping and adapting strategies in Northern Mali. They highlight the need to analyse the interactions between strategies and natural resources, in order to explore the sustainability of strategies. They show the relevance of mixed methods for analyzing strategies at different levels and gender differentiated, for example to understand the effects of political discourses, cultural identities, and experiences on strategies. Such analyses can be useful to identify sustainable adaptive strategies and to avoid maladaptation.

2. Theoretical background

2.1. *Coping and adapting*

The Intergovernmental Panel on Climate Change defines adaptation as ''an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities'' (McCarthy, 2001: 869).

This definition has a strong focus on the specific threats caused by climate change and variability. However, the adaptation of livelihoods to broader environmental, economic and political changes has been studied previously, for example with the sustainable livelihood framework (Chambers and Conway, 1992; Scoones, 1998; Ellis, 2000). This framework focuses on how people use livelihood assets (human, natural, financial, social, and physical) in a context of shocks, trends and seasonality. The choice of strategies is mediated by structures (e.g., levels of government, private sector) and processes (e.g., laws, policies, culture, institutions) and results in livelihood outcomes, such as income, well-being, or food security (Chambers and Conway, 1992; Ellis, 2000).

The IPCC distinguishes several types of adaptation: anticipatory (or proactive), reactive (or autonomous or spontaneous), and planned adaptation (''the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state'' McCarthy, 2001:869). By contrast, Heyd and Brooks (2009:275) defined maladaptation as the ''pursuit of policies and practices which make people more vulnerable to changes in the natural environment in which human systems are embedded''.

The definition of adaptive strategies remains ambiguous. Arguably, ''adaptive strategies'' is a catch-all term used to describe any action beyond primary production activities (Davies, 1993). Van der Geest and Dietz (2004) defined coping strategies more accurately and distinguished them from adaptive strategies. ''Coping'' can be defined as a spontaneous reaction to crisis, mostly at the local level (Osbahr et al., 2008), but often reflect a constant trade-off between immediate subsistence and long-term sustainability, in particular in the context of small-farms (Frankenberger and Goldstein, 1990). Ravera et al. (2011) drew on definitions in Osbahr et al. (2008) and Nayak (2004) to differentiate between (1) coping mechanisms as unplanned reactions undertaken spontaneously and regularly by local people in response to crisis; and (2) adaptive strategies as planned, frequently revised, and mainly longer-term actions to be implemented.

2.2. *Adaptation in the Sahel*

The Sahel is currently experiencing complex economic changes (e.g. in markets), political changes (e.g., decentralisation and changes in land tenure or access to resources), and climatic changes and variability (e.g., drought). Since the severe droughts of the 1980s, scientists have studied the local livelihood strategies developed in reaction to external stressors. Livelihoods have undergone a continuous process of coping with environmental, economic, and political stressors, by adjusting their strategies or adopting new ones (Brooks et al., 2009). Under environmental uncertainty and high spatial variability in precipitation, pastoralists have developed flexible individual and collective strategies for coping in reaction to shocks. Mobility of people and animals through transhumance and migration represents a pillar in the adaptation of livestock systems to climate variability (Brooks et al., 2009). A wide range of technical and institutional innovations such as

changes in herd composition to ensure productivity or in traditional resource management rules have been observed among pastoralists in Niger (Michael et al., 2011). Households have also diversified livelihoods by combining livestock, agriculture, and other activities (Mortimore and Adams, 2001). The complexity of the dynamics between vulnerability and adaptation in pastoral systems becomes even more apparent in relation to conflicts: as Turner (2010) noted, conflicts are both an outcome of vulnerability or resource scarcity and a driver of institutional change and adaptation by pastoral communities.

Despite evidence about coping and adapting strategies in the Sahel, a low adaptive capacity is often assumed in the climate change literature (Parry et al., 2007) but several studies challenge this assumption and focus on the transformational adaptive experiences in the Sahel (e.g., Mortimore, 2010; Sendzimir et al., 2011), for example in the case of "regreening" the south-central Niger. Those studies suggest that such transformational changes need policies enabling flexibility and recognizing the diversity of local contexts (Mortimore, 2010).

The literature on coping and adaptive strategies has concentrated on diversification (including migration) and intensification. Diversification strategies refer to the portfolio of activities that not only generate income but also reduce the sensitivity of livelihoods to climate exposure. Some scholars have argued that diversification has created sustainable agricultural systems even under high population densities and climatic risk (Mortimore and Tiffen, 1994). Diversification in agricultural systems, based on both "on-farm" and "off-farm" activities, has been widely observed in farmer communities (Barrett et al., 2001). However, pastoral systems are based mostly on collectively used large areas and the "on-farm/off-farm approach is difficult to apply. More evidence is needed to understand pastoral diversification. Migration is often considered as a possible negative consequence of climate change but also as an adaptive response to climate-related vulnerability (McLeman and Smit, 2006). Migration is a strategy to generate and diversify incomes and to support livelihoods at the origin via remittances. This strategy can have considerable poverty-reduction effects but more evidence is needed (Bebbington, 1999; De Haas, 2010).

Agricultural intensification is defined as increasing output (in quantity or value) of cultivated or reared products per unit area and time, achieved by increasing the inputs (Lambin et al., 2001). In Africa, intensification of livestock systems presents ecological, economic, and socio-cultural challenges. It can increase profit during years of favourable market or climate conditions but may reduce the resilience of production systems to shocks and changes (Ravera et al., 2011). The three strategies outlined above have been studied mostly in studies on agricultural systems and less in forest and livestock based systems, such as those in our study area in northern Mali.

3. Study area

3.1. *General characteristics*

Our study focused on the Timbuktu region in northern Mali. We worked in two villages, Tin Aicha and Ras El Ma, in the district of Goundam (Fig. 1), located at the northern fringe of the former Lake Faguibine area.

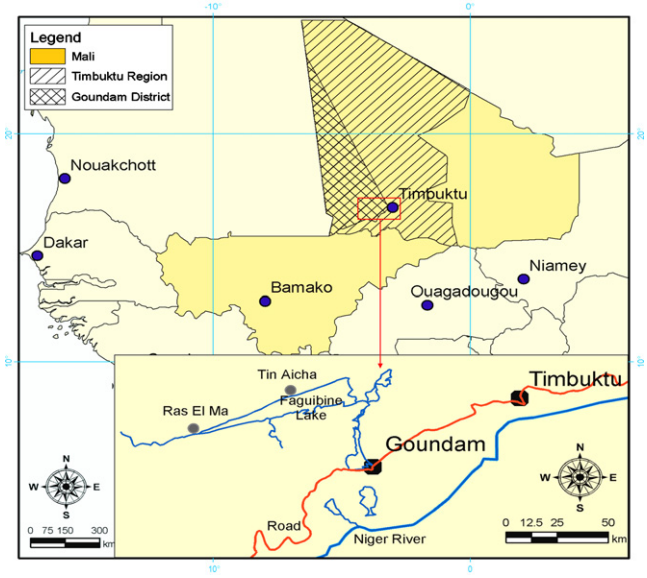

Fig. 1 – Location of the study area in northern Mali.

Low and variable rainfall characterises the region, with numerous years of extreme rainfall anomalies (Fig. 2). Most climate scenarios predict decreasing rainfall by 2050 (Hijmans et al., 2005).

The region has a long history of climate variability and extreme events (droughts), with oscillating water levels of Lake Faguibine and reports on drying out and reflooding of the Lake area for example in the beginning of the 20th century (Bouard and Tiers, 2004). People in the area have been responding to this climatic variability by enhanced mobility of people and animals (sheep, goats and cattle) as well as by shifting parts of or entire livelihoods (Benjaminsen and Berge, 2004; Benjaminsen, 2008; Djoudi et al., 2012).

Most residents of Tin Aicha are of the ethnic group Kel Antessar, a subgroup within the Berbers Kel Tamacheq. Most households belong to the Iklan class, which is descended from

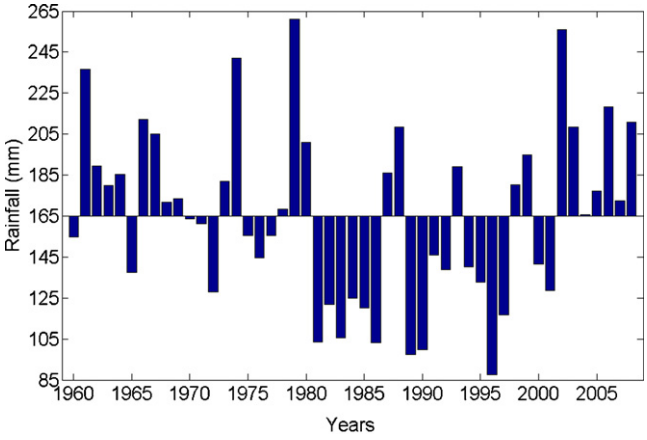

Fig. 2 – Annual rainfall anomalies compared to the mean rainfall (165 mm/year) in Lake Faguibine between 1961 and 2009 (from CRU TS 3.1, Mitchell and Jones, 2005).

slaves and has the lowest social status. In Ras El Ma, to the west, most people belong to the Arab (Moorish) group Tormoz or the Kel Tamacheq. They are mainly from the Illelan class, which has a high social status.

The main sources of livelihood are mobile and sedentary livestock breeding. We identified four livelihood systems (1) nomadic livestock herders (mostly of sheep and goats) with migration of people and livestock over long distances, (2) transhumant livestock herders (mostly of cattle) with seasonal movements of people and livestock over relatively short distances (for both these livelihoods systems, nomadic (1) and transhumant (2), livestock contributes more than 50% to the livelihoods), (3) sedentary agro-pastoralists with the main household activity being agriculture around areas of Lake Faguibine where water is still available (mostly under share-cropping arrangements), and (4) diversified ''mixed economies'' livelihoods (commerce (mainly of convenience goods), small livestock, non-timber forest products (NTFPs)), including forest harvesters producing charcoal, firewood, construction timber, or other forest products for handicrafts.

3.2. *Social and ecological history*

The area has experienced complex social, economic, and political changes in recent decades (Bouard and Tiers, 2004; Djoudi and Brockhaus, 2011; Djoudi et al., 2012). As part of a Niger River-fed lake system, Lake Faguibine used to be a highly productive area for agriculture and aquaculture (Bouard and Tiers, 2004). However, during the 20th century, the area experienced wet and dry periods, and the lake has been almost completely dry since the mid-1970s (UNEP, 2008). Since then, the Lake Faguibine area has been dramatically transformed to a forest ecosystem, with more than a third of the lake area naturally reforested with acacia and prosopis. Prosopis was introduced in the 1980s by an NGO-led development project, the Association Sahel, to counter desertification and protect the lake against siltation. After the lake dried out, the highly invasive prosopis occupied the former bed more quickly than local species such as acacia (Brockhaus and Djoudi, 2008; Djoudi et al., 2012). Now, acacia is prevalent in the lake's western part (Ras El Ma community) and prosopis dominates in the northern part (Tin Aicha community). Prosopis is controversial in the literature, perceived as either a ''curse'' or a ''blessing'' (Laxen, 2007). Despite its resistance to drought and provision of multiple products, the invasive character of prosopis has led to elimination programmes in several countries (Mwangi and Swallow, 2008). High soil fertility and a dramatic reduction of animal pressure during the rebellion in the 1990s have facilitated forest growth.

The repercussions of the 1990s rebellion, when Tamacheq groups rebelled against the Malian state, continue to be felt. The rebellion was motivated in part by lost livelihood resources due to state interventions and development projects, but also by political marginalisation in the post-colonial state (Krings, 1995). The deterioration in security drove large segments of the population in the northern parts of Mali to migrate to neighbouring countries (especially Mauritania). In addition, as Randall (2005) observed, living in refugee camps forced the sedentarisation of former mobile herders. This affected the social and economic structure of the hierarchical Tamacheq communities. Furthermore, large numbers of livestock were lost during conflicts with the Malian authorities and local groups (Randall, 2005).

3.3. *Political processes*

Since the early 1990s, Mali has been undergoing a process of decentralisation, including in relation to forest and pastoral resources. As part of this process, a large number of institutions have been created across different levels, including 49 ''conseils de cercle'' at the district level, where elected mayors represent communities. The transfer of resources and rights to the local level had not been completed at the time of our research (late 2008). Dembélé (2009) noted that, despite the introduction of several initiatives, such as the facilitated elaboration of local conventions for natural resources management, the establishment of rural markets for wood, and co-management of classified forests, less than 10% of forested land falls under the decentralised units. The rights to levy forest taxes, introduce forest management plans, and establish quotas for extraction (including NTFPs) have not yet been fully transferred to the local level. In addition, as set out in the 1995 Forest Code, the state owns all ''vacant'' land, including forests and fallows older than 10 years. Pastoralists have access to unprotected forests, provided they follow general environmental and forest management rules (GoM, 2001). However, although pastoralists are recognized as forest users, they do not play a major role in the decentralisation process (Dembélé, 2009).

4. Approach and methods

The research was conducted between July and October 2008. We organised workshops at the community level (Tin Aicha and Ras El Ma) and the district level (Goundam) and conducted interviews at the national and regional or district levels.

4.1. *Community-level workshops*

At the community level in Tin Aicha and Ras El Ma, we organised six participatory workshops, each with 25–35 participants. In each community, we held separate workshops to capture the various perspectives of three different groups: adult men, adult women, and young men (even though both genders were invited, only young men appeared for the workshops). To identify and assess participants' responses to external events such as droughts, we used a range of tools from Participatory Rural Appraisal (PRA), such as fodder calendars, resource maps, and historical timelines. During the local-level workshops, participants first identified important past events and discussed their individual and group responses to those events. We used historical timelines to identify the bundle of strategies used in the past to cope with droughts, fodder calendars to initiate discussions on the role of forests in those strategies, and resource maps for discussions of access rights and management rules for natural resources. We discussed participants' preferences and perceptions about past, present and future options. In a second

step, participants ranked the identified strategies according to the extent to which they had been actually applied. This was important to differentiate between strategies that might have been preferred but were not applicable or practically feasible. It also helped to understand the relationship between strategies and resources, such as the degree to which strategies were based on forests. This approach allowed us to identify and compare strategies and their importance assessed by different communities and groups (women, men, young men).

4.2. *District-level workshops*

We organised two participatory workshops in Goundam, each with a different group of participants. In the first workshop, the ''local'' representatives comprised 12 leaders (village leaders and/or representatives of herders) from six local communities in the areas around the lake. In the second workshop, the ''meso'' representatives included 14 participants such as state officials active at the district level e.g. in outreach services (on agriculture, forests, and livestock), and from decentralised structures, and development organisations. All participants designated as representatives by their organisations or villages were male. In both workshops, participants proposed adaptive strategies for responding to climate impacts and vulnerabilities. In a next step, they ranked on a scale of 1 (not important) to 5 (very important) the relative importance of these strategies for different livelihoods (sedentary, transhumant, nomadic or mixed). Finally, the participants discussed and assessed the strategies with regard to costs, benefits, conflict risk, feasibility, and sustainability.

4.3. *National and regional-level interviews*

We conducted semi-structured interviews at the national level (in Bamako, with 12 government and 14 NGO representatives) and regional or district level (in Timbuktu, three government and six NGO representatives; in Goundam, with 18 representatives of decentralised administrative structures and NGOs). These interviews dealt with climate change adaptation in general, the identification of stakeholders and their policy roles, ongoing national adaptation processes (especially the NAPA, which was submitted by Mali at the end of 2007 and is being implemented), and strategies for local adaptation in Lake Faguibine. The results of the semi-structured interviews are not presented in detail and more information can be found in Brockhaus et al. (2012) and Djoudi et al. (2012).

5. Results and discussion

5.1. *Strategies realized at the local level*

5.1.1. *What strategy by whom?*

The participants in the local workshops described realized strategies for coping and adapting to ecological changes (a disappearing lake and growing forests) and climate variability (droughts) (Table 1). Livestock activities remain the core strategies and livelihood diversification occurs either within the livestock system or in complement to it, with differences according to gender (e.g. women focussed on education as a strategy in both community workshops, but men did not), age (e.g. young men use remittances for livestock in cooperation with migrants), and ethnicity (Iklan in Tin Aicha and Illelan in Ras El Ma: for example only Iklan women in Tin Aicha reported charcoal production as an important strategy).

Transhumant livestock husbandry (cattle, sheep, and goats) was the most important strategy of adult men in the pastoral community who described it as ''the soul and the proud of a Tamachek pastoralist'' and an opportunity to be integrated into large social networks and to reduce the exposure to climate variability, because of spatial heterogeneity of rainfall and fodder.

Sedentary livestock husbandry (cattle, sheep, and goats) was perceived as a major strategy by all groups in the pastoral community and secondary strategy by adults of the farmer community. According to workshop participants, the preference of herders has evolved from cattle to goats and sheep. Sheep and goat keeping becomes a key element of women' strategies in the pastoral community when the men temporally migrate.

Migration (Example 1) is a strategy implemented by men and was perceived as a necessary but undesirable form of adaptation, because of instability and loss of social networks. This result has to be interpreted carefully, as ''successful'' migrants were not in the community and hence did not

Table 1 – Realized coping and adapting strategies and their importance, as expressed in participatory workshops by women, adult men, and young men in pastoral and farmer communities. The number of plus signs indicates the importance of realized strategies for livelihoods.

Realized strategies	Pastoral community (Ras El Ma)			Farmer community (Tin Aicha)		
	Women	Adult men	Young men	Women	Adult men	Young men
Livestock (transhumant)		+++				
Livestock (sedentary)	+++	+++	++++	+	++	
Migration		+++	++		+++	++
Livestock (with remittances from migrants)			+++			+++
Agriculture in flooded areas				++		++++
Child education	++++			++++		
Charcoal				++		
Trade	+	+	+	+	+	+
Handicrafts	+	+		+	+	
Craftsmanship			+			+

participate in the workshops. Investing remittances from migrants in livestock was mentioned as an important strategy for young men in both communities. This strategy provides incomes by using the received money and the rights that the household holds to pasture access.

Example 1. Migration:

In Northern Mali for the last three decades, migration has been driven by the rebellion and by droughts. Migration due to political insecurity is mostly ''collective'', whereas climate-driven migration is generally individual, except for extreme large-scale droughts (for instance in the 1970s and 1980s), which caused collective and ''no-return'' migration: Men migrate individually in search of employment in the urban areas of Mali (Bamako) or neighbouring countries (Mauritania, Ivory Coast, and Algeria). They support the family in the place of origin through transferring capital from outside or investing capital in agriculture and livestock when returning to the community.
Timbuktu has the second highest emigration rate in Mali (0.32% of the population), with more than 50% of migrants going to Bamako, 25% to other African countries and the rest outside of Africa (IOM, 2009). In Mali, the financial international inflow of remittances had a share of 5.1% of the GDP in 2010, and the flows increased from 154 to 405 Million USD between 2003 and 2009 (World Bank, 2011). These numbers capture only the formal flow of remittances, the total volume of remittances, including the remittances sent in cash through acquaintances, is believed to be larger, especially in areas where banks are rare.

Agriculture is still possible in one-third of the former lake that can be irrigated and this the preferred strategy of young Iklan men of the Tin Aicha farmer community. Their short-term local migration to neighbouring villages for agriculture has led to a new tenure regime under a share-cropping system, in which land access is no longer regulated by traditional authorities but by annual monetary deals. Women, who lack power, financial capital or relationships with landholders, have no access to these irrigated agricultural lands but considered this strategy important for their households.

Agriculture in a possibly refilled lake (see Example 2) was identified as the most promising strategy by men in the farmer community, even though this strategy is not realized (and thus does not appear in Table 1). In the pastoral community, this strategy was not mentioned.

Example 2: Interventions around the Lake Faguibine:

After the droughts of the seventies and eighties, several NGOs have developed ''work for food'' programs and projects to combat desertification in Northern Mali. In 1986, an NGO called SOS Sahel started a Prosopis plantation in Tin Aicha and Mbouna to protect soils from erosion and the lake from siltation. When the lake dried out, the highly invasive Prosopis spread into the former lake area and is now used by local communities for their livelihoods (e.g., with charcoal or fodder). Nowadays, the major planned intervention aims at reflooding the lake and should last until 2015, with a budget of 1 million USD. It is a governmental project supported by UNEP for restoring the hydrological functioning of the lake. Project interventions will re-open the channels connecting the lake to the Niger river and stabilize dunes bordering the channels. These activities were ongoing during the time of research and outcomes were not yet measurable. According to UNEP (2008), the project will prevent conflicts between farmers and livestock keepers and strengthen Mali's capacity to engage relevant actors in a national policy dialogue.

Children education was considered as the most important strategy by women of both communities. Their long-term objective is to give children new livelihood opportunities, preferably independent from natural resources. But, because of the workforce needs in the household, girls must often realize domestic tasks and boys look after goats or sheep rather than attend school. This shows a trade-off between coping with current problems and adapting in the long-term.

Charcoal production is part of the strategies of Iklan women in the farmer community, who invest generated incomes in long-term strategies (e.g., children education) and increase their social integration. In the pastoral community, Illelan women argued that charcoal production does not match their high perceived social status: this limits their diversification opportunities.

The workshop participants gave little importance to the remaining three identified strategies (trade, handicraft, and craftsmanship). However, all gender groups in the two communities practice trade (small commerce of convenience goods as well as animal trade). Lack of transportation means restrict larger scale trade (at longer distances): at the time of the research, only one young man had access to a vehicle. Young men work as craftsmen (mainly in housing construction) and men and women produce and sell handicrafts (partially based on wood, but also other products such as leather work).

5.1.2. *Coping and adapting: sustainable strategies?*

Many local strategies can be considered as coping mechanisms, because they are reactive to external events. Even though women currently apply coping strategies, they consider it important to develop long-term strategies, such as investing in children's education. However, because of their exclusion from decision-making and increasing workloads (particularly as a result of men's migration), opportunities are lacking. Moving from coping to adapting is challenging because of their limited access to agricultural lands, the lack of market access, and insecure access to natural resources (e.g., forest rights).

Participants in the workshops highlighted some factors that can help moving from coping to sustainable adaptive strategies. They include rules (e.g. with regard to access to water points) and organisations for natural resource

management (e.g., local organisations such as farmer, herder or women groups and associations, responsible for rule setting, management and mediation, and cost and benefit sharing if applicable), see Example 3), technical actions for natural resource management (e.g., improved livestock husbandry systems, soil fertility management), development actions supporting adaptive strategies (e.g., support to mobility through mobile health and education services), development actions for sustainable investments (e.g., providing opportunities for investing remittances in sustainable activities reducing women and children's workload, in collective assets for water or energy), and access to markets (e.g., marketing, training for increased quality and new craft products).

5.2. *Adaptation strategies proposed at the district level*

In the two workshops with local representatives from communities and meso representatives from state, decentralised structures, and development organisations, adaptation strategies were proposed and assessed. The two workshops highlighted differences in preferences between the two groups; with local representatives proposing diverse strategies including institutions and diversification, and meso representatives focusing on technical solutions.

5.2.1. *Local representatives: institutions first*

Local representatives proposed eleven different adaptation strategies, including five livestock-related strategies (Fig. 3): improving pastures with high-value species, protecting pastures for regeneration, rebuilding herds, improving husbandry systems, and improving livestock health (e.g. with medicines and vaccines). They proposed two institutional strategies (the creation of new structures for conflict mediation and local committees for natural resource management, see Example 3), one strategy based on diversification, and three strategies for forest, soil and water management. The two strategies with the highest importance for all livelihoods were water management (for example building and maintaining water points and establishing access and exclusion rules) and the creation of a conflict mediation structure. On average across the five evaluation criteria, the highest assessed three strategies were diversification, the improvement of husbandry systems (nutrition, fattening, management of stocking density in pastures, destocking, commercialisation), and the creation of a conflict mediation structure. During the discussions on the sustainability of strategies, participants raised issues of dependence on external interventions (e.g., for animal treatments) and the pressure caused by other activities (e.g., protecting pasture may not be sustainable when pasture is lacking).

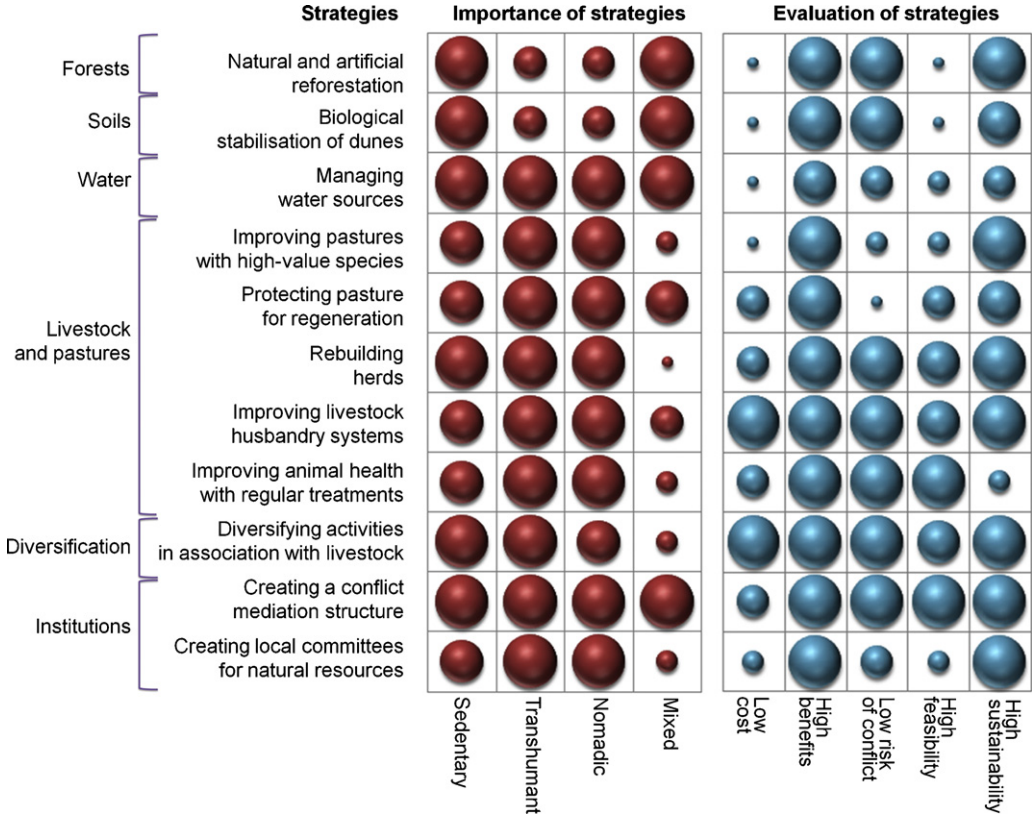

Fig. 3 – Adaptation strategies proposed and evaluated by local representatives during district-level workshops in Goundam: relative importance (indicated by size of dots) for four types of livelihoods and evaluation based on five criteria (values 1 (low)–5 (high) indicated by size of dots).

Example 3: Local organisations and external interventions:

> Since the seventies and because of recurrent droughts, food shortages and political conflicts, many external interventions (e.g. development projects and disaster response) had incentivized the creation of local associations and cooperatives, mostly for dealing with natural resource management, agriculture and food security. During our field work, representatives of governmental services or local communities reported that all planned activities for natural resource management were currently driven by local organisations created by external interventions. An interviewer stated that ''the best adaptation strategy for us is to know how to attract development projects and donors'', with potential drawbacks for example when donors' agendas are conflicting with ongoing local adaption, for example in the use of emerging forest resources. Another drawback is the lack of long-term strengthening of local organisations: most cooperatives and associations created by development projects disappear when the projects end. Examples given by interviewees and workshop participants were among others a women vegetable producer group in Tin Aicha or a pastoral association in Ras el Ma that fall apart after project interventions ended.

5.3. *Meso-level representatives: technology first*

Meso-level representatives proposed five broad adaptive strategies (Fig. 4): forest management, water management, pasture management (e.g., management of stocking density in pastures), pasture improvement (with high-value species), and livestock intensification (e.g. new breeds, animal housing, production and marketing of hay and fodder). They considered that forest management was very important for mixed livelihoods, whereas water and pasture management were more important for transhumant and nomadic livelihoods. During the discussions, participants highlighted the technical aspects of those strategies, for example forest management was discussed mainly as the plantation of fast-growing Eucalyptus. The ''meso'' representatives evaluated their proposed strategies evenly and very positively with regard to sustainability, conflict risk and benefits. Governmental representatives believed that actions such as forest and pasture management can be implemented without conflicts. Regarding the role that local customary law and institutions should play in these strategies, they argued that there are ''clear'' state laws and regulations in place, which can be enforced to realize those strategies. Very vocal advocates among the participants convinced the group about the value of sedentary intensive livestock systems. Other participants remained less enthusiastic and reminded that this strategy has not yet been put into practice in the area.

5.4. *Adaptation strategies proposed at the regional and national levels*

Interviews at the national (Bamako) and regional levels (Timbuktu and Goundam) revealed that information on local vulnerabilities and adaptive strategies was limited. Few people in Bamako or Timbuktu knew about local realities, such as past and present responses to climate variability, differences in strategies between ethnicity, gender, and age, or about specific activities of forest- and livestock-related livelihoods. Only interviewees at the national level mentioned the NAPA as a first step towards adaptation but the NAPA was subject to some criticism, especially by representatives of international NGOs, who noted that although the NAPA mentions the need for local participation and consideration of local specificities, neither the process nor the proposed actions do reflect this need. At the regional level, the emphasis was on links between food security and technological measures, such as agricultural irrigation projects. At the

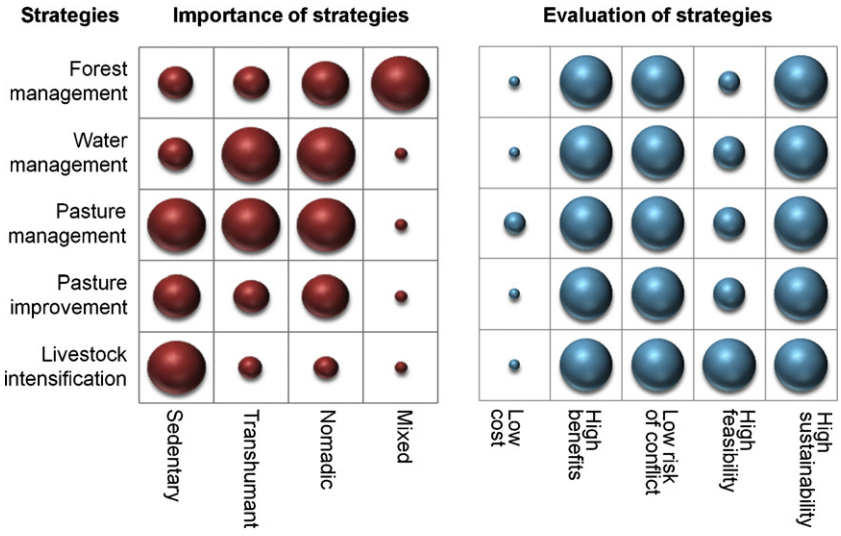

Fig. 4 – Adaptation strategies proposed and evaluated by meso representatives during district-level workshops in Goundam: relative importance (indicated by size of dots) for four types of livelihoods and evaluation based on five criteria (values 1 (low)–5 (high) indicated by size of dots).

regional level, interviewees mentioned the planned refilling of Lake Faguibine as an adaptation measure linked to national and international levels (Example 2). At all levels, interviewees highlighted the importance of capacity building and financing for adaptation. Interviewees also highlighted the lack of horizontal and vertical coordination and information flows between actors.

5.5. *Strategies and ecological sustainability*

In most strategies (such as livestock and charcoal production), natural resources are central, for example the new forests that provide fodder, charcoal, wood for building and handicrafts, and a safety net in the case of extreme events. Women and young men in both communities have a long-term aim of reducing their dependence on natural resources (for example through child schooling, the strategy preferred by women), but their current activities continue to rely on forests. At the same time, most strategies affect natural resources such as pastures or forests. Even remote activities (such as paid work by migrants) can have an impact on local natural resources: as young men invest the remittances sent by migrants in livestock, this strategy increases pressure on pasture, water and forest resources. For these reasons, understanding the sustainability of strategies requires exploring the feedbacks between strategies and natural resources and analyzing the factors influencing the access to, and the sustainability of, natural resources upon which strategies rely.

5.5.1. *Ecological sustainability of strategies: different scales*

Analyzing the sustainability of strategies is challenging as it requires understanding the complexity of the livestock, water and forest based systems. In particular different temporal and spatial scales need to be considered. Regarding temporal scales, people can develop strategies that rely temporarily on some natural resources (e.g., fodder for livestock) before switching to other strategies or natural resources. An example is that many pastoralists shift their activities outside pastoralism after a drought and return to it once they have earned enough money to re-establish herds. Regarding spatial scales, strategies can affect ecosystems locally (e.g., charcoal production) or regionally (e.g., mobile pastoral production systems using ecosystems in different places at different times). Migration is a good example of how remote activities have an impact on local use of forests for fodder. Therefore differentiating strategies according to their spatial and temporal dimensions could be a conceptual adjustment of the distinction between ''on-farm'' and ''off-farm'' strategies to the pastoral context.

5.5.2. *Sustainable resource management and the sustainability of strategies*

Charcoal production is a diversification strategy of women in the pastoral community but will be sustainable under two conditions: first, sustainable forest management should guarantee the availability of forest resources in the long term, second, access must be secured to users. The two conditions represent a trade-off, as unrestricted access could lead to forest depletion, whereas exclusion could limit opportunities for women. Similarly, the investment of remittances in livestock may not be sustainable unless water, pasture and forests are sustainably managed. Institutions for natural resource management are thus crucial.

Workshop participants mentioned the lack of management practices and regulations for the prosopis forest that has recently grown close to the farmer community. Such practices include thinning, back cutting of fringes, and forest road building for maintenance and exploitation. Such regulations include the definition of ownership and access rules, especially where the forest now covers former agricultural lands, which had formal and informal property rights. In a context of decentralisation with new structures at the community level but no empowerment of local citizens, forest resources are perceived as being under the control of the elites that have gained new powers under decentralisation. The highlighted challenges related to forest management can be summarised as follows (1) no clear rules have been defined regarding land-tenure in the former lake and forest access or use, (2) no management plans or local institutions have been established to manage the forest sustainably, (3) government agencies have offered no technical or capacity support for forest management, and (4) development and government agencies have made no effort to valorise the forest (e.g., by facilitating market access for forest products). Because of the lack of transparency and accountability of the new actors in the decentralised system and because of the forestry service's existing taxes, local people claimed that they are not incentivized or supported to produce charcoal sustainably or manage the forest.

Workshops and interviews showed clearly that, the further the actors are from the local level, the less attention they give to issues of natural resource management and the need for creating or strengthening institutions with this purpose. At the local scale, workshop participants proposed that new institutions for natural resource management should be created by the local actors themselves for making adaptive strategies sustainable. Local representatives participating in the district workshops also proposed the creation of local committees for natural resource management, in addition to three strategies based on forest, soil, and water management (natural and artificial reforestation, biological stabilisation of dunes, and management of water sources). On the contrary, meso-level representatives participating in the district workshops focused mainly on technical aspects of resource management and considered that building or strengthening local institutions was not needed because existing state regulations were clear enough. At the national and regional levels, interviewees did not mention issues of environmental sustainability or institutions for natural resource management.

5.6. *Strategies, social interactions and local institutions*

Results show that the adaptive strategies of some stakeholders affect or depend on the strategies of others. These interactions can occur at the scale of households or the community. Women reported that men migration causes an increased work burden on the rest of the household especially if men do not send regular remittances. This additional burden affects mostly women but also children, who have to work

instead of going school. In both communities, women considered children education as their most important strategy to increase their opportunities in the long-term but this strategy was constrained by the strategies of male family members.

Migrants sent remittances that are invested in the village, for example for young men investing in livestock and considering this strategy as very important for them. These interactions between migrants and young men represent an opportunity for local strategies but also a risk of dependence on unsecure remittances. Strategies can also interact in terms of competition for land, as has been shown with the example of agriculture in the parts of the lake that can still be irrigated. As demand for land exceeds supply, land access is not guaranteed and its cost can increase unexpectedly, for which this strategy depends on landowners and the number of people engaging in this strategy. Access to land depends on social networks and power relationships, which explains why women are disadvantaged.

The participants in local workshops highlighted the importance – for sustainable adaptation – of investing remittances in activities that reduce women and children's workload and in collective assets for water and energy, but it was not clear how private remittances could be invested collectively. In the district workshops, local representatives emphasized the role of local institutions for adaptation, particularly a conflict mediation structure, because technical solutions affecting common natural resources often result in lower access for powerless members and can lead to potential conflicts.

Conversely, meso-level representatives in district workshops were confident that adaptive strategies could be implemented under existing state laws, without induced conflicts and without the need to strengthen local institutions. Results show that these stakeholders proposed individualistic and private strategies and ignored institutional solutions to overcome possible obstacles for common resource management. Interviewees at the national and regional levels did not address the issues of local institutions and social interactions.

5.7. *Strategies and conflicting views at multiple levels*

The differences in the strategies proposed by local and meso representatives challenge the success of adaptation in different ways. Adaptation happens locally and planned strategies need an engagement of local stakeholders and institutions to be successful. Top-down strategies, if they are not perceived as useful and feasible at the local level, have a high risk of failure. For Lake Faguibine, our results show a plurality of perceptions and preferences, and we found technology-oriented solutions proposed at the district or regional and national levels – but in disconnection from local realities. For example, the success of livestock and fodder intensification programmes, proposed by meso-level representatives, requires that preliminary conditions such as market access, economic incentives, technical support and land tenure reforms are in place (Mortimore and Adams, 2001).

5.7.1. *Mobility vs. sedentarity*

Top-down strategies can also limit options for coping locally with climate variability. An example is about policies and projects that encourage sedentarisation (Example 4): they can reduce crucial assets for the resilience of pastoral livelihoods, namely: flexibility, traditional knowledge and social reciprocity. Transhumant livestock is part of local cultural identities and traditional values, which can contribute to livelihood resilience (Daskon, 2010). But participants in the local workshops reported that transhumant people have low access to infrastructure, education, emergency programs, and health services and are not well represented in political processes and decision making, which can reduce opportunities in the long term. They recommend developing policies for supporting mobility (e.g., through mobile health and education services) as a way of adapting to changes. Divergences between national and local views on mobility are also reflected in the National Adaptation Programme of Action. For example, none of the 19 projects proposed in the Malian NAPA address specifically mobile production systems, even though some of them seek to intensify fodder and livestock production.

Example 4: Sedentarisation programs around the lake Faguibine:

> Members of the ethnic group Kel Antessar, a subgroup within the Berbers Kel Tamacheq, are nomadic pastoralists, herding goats, sheep, cattle and camels. Their animals graze pastures and woody savannah around the lake between November and June and move to the drier areas of the north between July and September. Since the colonial times, programs have aimed at increasing sedentarisation, for instance through forced children schooling (introduced in 1894) or the official authorisation that people had to request for moving (''laisser passer'', introduced in 1908). Colonial policies led to a first wave of sedentarisation in the North Faguibine. Later, after several droughts (e.g. 1963, 1973, and 1985), NGOs developed food aid projects, such as the American Friends Service Committee, a Quaker organisation which established a food aid programme for nomads in 1974. In order to benefit from aid, households had to practice vegetable gardening and therefore to settle in a new camp in Tin Aicha (the village of Tin Aicha was then created and recognized officially in 1976).

5.7.2. *The return of the lake: engineered solutions vs. natural assets*

Men in the farmer community identified the return of Lake Faguibine as a major opportunity for them (Example 2) and envisioned starting cultivating again close of the reflooded lake. The refilling of the lake was also mentioned as a promising strategy by interviewees at the national level. If realized and successful, the refilling of the lake could increase agricultural production and resilience, fish production and food security in the short term. A drawback would be the destruction of the forests and a new change for households depending on forests for their livelihoods.

However, the sustainability of such a project is questioned. Strategies based on the hypothetical return of the lake would face risks linked to problems of siltation of water channels from the Niger river and changes in water use and management in the upper Niger watershed (e.g. dams) (Bouard and Tiers, 2004). With future climate change, higher temperatures will mean higher evapotranspiration in the upper Niger watershed and may reduce water levels and flows to the lake. If the lake dries out again, communities will be left with neither forest nor water for agriculture. This calls for in-depth assessment of the sustainability of the project and its side-effects on different livelihood groups.

In the farmer community, the attitude of older men, who experienced the period when the lake was full and agricultural production in the area earned the title of ''le grenier'' (breadbasket), can be explained by psychological barriers. The massive change and the transformation of the ecosystem may have caused distress and a feeling of powerlessness or lack of control (Albrecht, 2005). At the same time, the wish for the lake to return has been nurtured by three decades of promises from politicians or development agencies. This combination of psychological barriers and official discourse on re-flooding seems to prevent some people from developing and valorising their own strategies and visions based on the forest that has emerged.

6. Conclusion

The research results indicate that local communities in the northern part of Lake Faguibine are coping and adapting to ecological changes in an autonomous way, but that long-term resource management planning under climate change is lacking. Because of the impacts of recurrent shocks (droughts, rebellion, displacement, etc.), the ambiguity of access rights to forest, the limited access to financial and technical resources and the lack of two-way knowledge exchange across levels, local communities have often to turn to short term coping strategies rather than long term sustainable adapting strategies.

Perceptions and preferences for adaptation differed between the sub-national and local levels, and between genders at the local level. Factors shaping perception include political discourses, cultural identities, roles, and past experiences. However, when different perceptions and preferences are combined with asymmetric power relationships across levels (for example between policy maker and pastoralists), there is a risk that top-down adaptation measures fail for not taking in account local adaptation and coping practices.

Diversification – identified in this study as a key strategy for pastoral and forest-based systems – will need enabling conditions (e.g., regulatory framework on forest rights) and financial incentives (e.g., with facilitated market access) if it is to be effective. Migration, often perceived as a diversification strategy, needs to be conceptually reconsidered, at least in the Sahelian context: its complexity requires analyzing it as a particular coping or adaptive or strategy.

A number of conditions have to be put in place to enable the shift from reactive to planned strategies and to develop adaptation projects or policies that avoid maladaptation (i) awareness of, and agreement on, adaptation objectives; which consider the vulnerability of different social groups and genders, (ii) exchange of knowledge on adaptation and natural resource management, for example between forest extension services and forest users for managing the new prosopis forest, (iii) transparency in institutional arrangements regarding rights over forests, and (iv) flexibility of legal framework for enabling planned local adaptation, e.g., by realising the potential of decentralising planning authority and empowering local residents.

Unless development interventions analyse current local adaptation processes and consider the sustainability of their actions in a context of climate change, they can disrupt local adaptation efforts and waste opportunities for sustainable long-term development, as the example of reflooding the lake shows. Further studies should aim to narrow the gap between local and national arenas, by offering simple methods and tools for understanding and analysing local adaptation perceptions and actions.

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