Is adaptation to climate change gender neutral? A case study among communities depending on livestock and forest in northern Mali

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The growing risk of vulnerability under climate change will first and foremost affect poor people, particularly women, as it tends to widen existing inequalities. In the Lake Faguibine area in Northern Mali the social, political and ecological conditions have drastically changed in the past 30 years decades. We conducted 6 single- gender participatory workshops using PRA in two communities to assess vulnerability and adaptive strategies to climate variability and change for livestock and forest-based livelihoods. Our results show divergences in the adaptive strategies of men and women. Migration represented one of the most important strategies for men. Women perceived this strategy more as a cause of vulnerability than an adaptive strategy, as traditionally male activities have been added to the workload of women (e.g. small ruminant herding). The historical axes show that development projects targeting women have not integrated climate change and variability into their planning. Most activities have been built around small-scale agriculture. With the drying out of Lake Faguibine, those water-dependent activities are no longer relevant. Women have developed their own adaptive strategies based on newly emerged forest resources in the former lake area (e.g. charcoal production). However, loss of manpower in the household, unclear access to natural resources, lack of knowledge, financial resources, and power as well as limited market opportunities for women hinder them from realizing the potential of these new activities. Even though women's vulnerability is increasing in the short term, over the long term the emerging changes in women`s roles could lead to positive impacts, both societal (division of labor and power, new social spaces), and economic (market access, livestock wealth). Locally specific gender-sensitive analysis of vulnerability is needed to understand dynamics and interaction of divergent adaptive strategies. Societal and political change at broader scales and beyond rhetoric's is needed to realize potential benefits for women in the long term.

Key words: *Gender, Climate Change, Adaptation, Forest, Faguibine, Mali*

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1. INTRODUCTION

Observed and projected climate related changes will have significant impacts on ecosystems, societies and on individuals. These changes will affect people and communities differently depending on their exposure and adaptive capacity. The Intergovernmental Panel on Climate Change (IPCC) concludes that the negative impacts of climate change will strongly affect people and communities with the least resources and least capacity to adapt, especially those who are already marginalized (Tompkins and Adger, 2004).

The gender dimension of climate change is specifically recognized in the IPCC. Its Fourth Assessment Report, notes that climate change impacts will differ according to gender. It also notes that most studies of climate change impacts tend to group countries together without considering disparities within groups such as gender (IPCC, 2007).

Women's vulnerability is mostly linked to natural resource dependency, and poverty. Other evidence links vulnerability of women to lack of assets, access to resources and control (Tompkins and Adger, 2004). The review of the literature related to gender and climate change shows differing perspectives on components of climate change as well. While the disaster reduction literature provides evidence and local case studies showing gendered roles and impacts to mitigate and prevent disasters (Dankelman, 2002), evidence about gendered climate change mitigation and adaptation, especially with local level evidence, are lacking or still at an early stage.

Beyond the discourse around women and climate change vulnerability, we find a body of evidence showing women's significant contribution to sustainable resource management (Agrawal, 2002 and 2009). Properly integrated in the ongoing debate on gender and vulnerability, this evidence will enhance and strengthen women's roles and the recognition of those roles in adaptation generally and in eco-system-based adaptation specifically.

In this article we will link these different strands in the literature and provide further evidence on women's' vulnerability and its role in adaptation with a case study from Northern Mali. We present first some aspects as discussed in the literature, and then show women's context-specific vulnerability and adaptation in the socio-ecological system in the area around Lake Faguibine. We focus on their preferences and contributions for adaptation and adaptive strategies, and show both opportunities and barriers for enhancing the roles of women in reducing vulnerability and increased adaptive capacity in the socio-ecological system. Focused on local realities and evidence, this article aims to improve understanding of gendered climate change impacts and the gendered dimension of adaptation.

1.1 Gender, vulnerability and adaption

The linkages between gender, poverty and vulnerability are a key issue in the climate change adaptation and gender discourse. Gender subordination occurs globally in different ways depending on societal, cultural, economic and political contexts, therefore it is not only and *per se* a result of poverty. How much of women's vulnerability is due to their poverty and how much is apportioned to societal gendered roles and restrictions?

Several publications (Skutsch, 2010, Canon, 2010) pose this question. However evidence is well documented that poverty affect women and men disproportionally. 'Poverty has a woman's face – of 1.3 billion people living in poverty, 70 percent are women' argues the UNDP Human Development Report (1995). Economic studies also project a gendered trend in the future in which women become far poorer than men, and faster (UNDP, 2009). Because vulnerability is highly interlinked with poverty Nelson suggests that climate change impacts are very likely to be gendered (Nelson et al. 2009).

A further determinant driver in women's vulnerability is different access to and control of resources based on gender. Even though women depend highly on natural resources(land, forest, water), their control over those resources is socially restricted across societies and cultures . Therefore their participation in decision making, over the use of those resources to respond to climate change and variability using livelihoods diversification, is limited, as shown in studies in different contexts (Reyes, 2010). Additionally women and other socially marginalized groups are likely to be most vulnerable to climate change because of the socially and politically driven lack of participation in decision making and access to power. Tompkins and Adger (2004) argue that because women and marginalized groups are often excluded from decision-making structures, the sustainability of programs and projects and their implementation can be questioned. Women's exclusion from public institutions is clearly shown in the absence of gender-specific issues in adaptation and mitigation plans at the national level. The emerging National Adaptation Program of Action (NAPA) documents are a case in point. Few NAPAs look at how climate change impacts relate specifically to women's economic, political and social status. Even fewer incorporate women as key stakeholders or primary participants in NAPA activities (UNFPA and WEDO, 2009).

This accepted understanding of gender and vulnerability has led to two different arguments in adaption planning. One discourse in adaptation focuses only on women's vulnerability *per se* while the other focuses on the need for integration of women in decision making and planning. Neither debate heeds women's active roles and their existing contribution to reduced vulnerability at household or community level, and women-specific adaptive capacity. Even though vulnerability is a key issue in the analyses of gender and climate change, more differentiation is needed to avoid a victimization discourse. We argue that woman's specific perceptions, preferences and their strong interaction with natural resources makes women crucial actors in climate change adaptation. As key users of natural resources, women have specific preferences and adaptive capacity which, integrated properly, will lead to higher adaptive capacity of the whole society. If we look beyond vulnerability and adaptation in relation to climate change, another body of evidence related to women and natural resource management confirms these assumptions on women's important but neglected roles in adaptation.

1.2 Gender, the sustainable use of natural resources and ecosystem based adaptation

Several works related to natural resource management and collective action, for example community forestry management in India and Nepal, highlight how women-specific social and economic roles shape sustainable use of natural resources (Agarwal, 2002). Even through those evidence are not directly related to climate change adaptation, we argue that those well-documented and women'-specific skills and

strategies present key abilities and potential in shaping adaptation to climate change, especially ecosystem-based adaptation. Those skills and abilities are the layers of the women's adaptive capacity, which is the crucial element in adaptation to climate change.
There are three identified aspects related to gender, natural resources and collective action that could be relevant in the analysis of gender and climate change. They are: knowledge and skills, preferences in the use of natural resource management and social organization. The important question here is how gender-specific knowledge, preferences and networks could shift and influence ecosystem-based adaptation.

Gender specific knowledge

Several studies of societies that rely on natural resources argue that women's activities are strongly interlinked with the services that the ecological systems where they live provides. The reliance of women on natural resources increases their ability to acquire and disseminate knowledge and information about ecosystems, sustained practices and conservation techniques (Sydie, 1994). We argue that those women's specific ability and knowledge in the sustainable management of resources presents an opportunity for climate change adaptation, and are highly relevant especially for ecosystem-based adaptation. Because of their know-how, these women are potential key actors, agent of change and a prioritized target group' in realizing ecosystem-based adaptation projects and plans.

Gendered preferences in natural resource use

Ecosystem services are the most important resource to insure livelihoods and food security in societies that depend on natural resources. Conditioned by their different social roles and responsibilities, women and men have different perceptions and preferences in using, managing and regulating ecosystems. Two bodies of evidence related to gendered preferences in forest and animal species will be used here to illustrate how gender specificities in natural resource use could affect ecosystem based adaptation to climate change and variability?.
The first one is the gender-based preferences for trees and plants, as highlighted by Agarwal (2000). Her results show that women often prefer trees with multiple uses because they offer more domestic and supplementary value (fuel, fodder and shade), while men typically opt for more productive trees that bring in more cash (such as Eucalyptus). This difference in preferences is relevant in managing forest ecosystems for climate change adaptation, as diversified forest ecosystems are less vulnerable to climate change and variability then monospecific forest ecosystems.
The second body of evidence is related to the case of livestock keeping in the Sahel as reported by Turner (1999). The livestock mix trends toward more small ruminants and fewer cattle. Due to laws and rules governing divorce and access to land, as well as migration of men, a feminization of livestock keeping has occured in several countries in Sahel. The author demonstrates that this feminization of livestock keeping is reflected by changes in herd composition, shifting away from cattle towards small, ruminants dominated flocks. The changes in flock composition have a direct impact on land use patterns. as cattle and small ruminants have different grazing behavior and affect vegetation differently. Additionally cattle are well known to be more sensitive to drought and other climate impacts then small ruminants. Both, changing land use pattern and

the differential sensitivity of cattle and small ruminants are decisive factors in planning ecosystem-based adaptation in the Sahelian context.

Gendered differences in project implementation

Other evidence from development and donor project reports show further gender differences specially in microfinance based projects, which might be crucial to successful implementation of adaptation strategies and projects. Those report have accumulated evidence that women in agrarian societies perform the main part of productive labour, contribute more of their income to household well-being, and have a higher repayment rate on loans (Rankin,2001). As adaptation happens locally, those gender-specific differences in knowledge and preferences incorporated properly and in a complementary manner, will enhance the implementation of sustainable livelihood strategies that can lay the foundation for long-term adaptation to climate change.

Gendered networks and motivation

Ecosystem-based adaptation aims for the sustainable management of ecosystems in order to respond to climate change and variability. Institutions, expressed in norms and rules, affect how communities respond to climate change; institutional arrangements can facilitate or impede individual and collective responses (Agrawal, 2009). As women are generally excluded from public institutions, there are only a few research results related to the gendered differences in creating and applying institutional frameworks, for example, rules and regulations in the management of ecosystems. The results of Agarwal (2000 and 2009) are highly relevant as they effectively illustrate why institutional integration of women in ecosystem management is crucial. Agarwal emphasizes that gender differences in social networking, values and motivations provide an important basis for organizing sustainable environments. She presents data-based evidence that local forest management groups with a high proportion of women in their principal decision-making structure (the executive committee) correlate with significantly greater improvements in forest condition. Moreover, all-female executive committees have better forest regeneration than other groups, despite receiving much smaller and more degraded forests to manage. Evidences from Latin America and East Africa show however, that mixed gender groups exploit the complementary advantages of women and men and perform consistently better in all management functions of the forest (Sun et al., 2010).

These results indicate that the consideration of women in the ecosystem based adaptation is one of the preliminary conditions for the long-term success of adaptation strategies and measures.

Despite existing evidence of women's roles in the sustainable management of natural resources in societies that depend on them, male-dominated organizations and structures are the majority in decision making processes related to climate change at global, national and local levels. Gender considerations, perceptions and impacts of climate change are largely ignored and their active roles in and for adaptation is not yet fully recognized.

The following case study shows women's preferences, their priorities for adaptation and development, and limits and opportunities for women in adapting to climate change and

extreme events in forest-based livelihoods in Northern Mali under a multitude of past and present stressors.

2. THE CASE STUDY

2.1. Research area

2.1.1.Population and livelihoods around Lake Faguibine

The average population density around Lake Faguibine is low, with 1.1 people/km^2 in the Timbuktu region and 1.7 people/km^2 in Goundam district (DRPSIAP-T 2008). The density has wide spatial variations: settlements are concentrated around Lake Faguibine and along the Niger River with densities as high as 59 people /km^2 in Diré district, south of Goundam district.
Different ethnic groups with different livelihoods make up the population around the lake. Mainly Arabo-Berber livestock keepers lived in the western and northern parts, where research was conducted. In Tin Aicha in the north, most residents are from the Berber ethnic group Kel Tamacheq, with most households belonging to the Iklan class, with the lowest social status, descended from slaves. In Ras El Ma to the west, most people belong to the Arab (Moorish) group Tormoz and the Berber ethnic group Kel Tamacheq, and are mainly from the Illelan class with high social status. Members of the Bozo ethnic group are traditionally fishermen.
Livelihoods depend mostly on mobile and sedentary livestock breeding. In the Timbuktu region, around 72% of the land is used as pasture and the rest is reported as forested land use (DRPSIAP-T 2006). Two kinds of mobile livestock breeding systems are practiced: transhumant and nomadic . Livestock breeding is also associated with sedentary agropastoralism.

2.1.2. Social and ecological history

Lake Faguibine is part of a Niger River-fed lake system. It was a productive area for agriculture and fishery, but has experienced wet and dry phases in the 20th century and the lake has been almost completely dry since the mid 1970s (UNEP 2009). Lake Faguibine has drastically transformed from a water-based to a forest ecosystem, with more than a third of the lake area naturally reforested with Acacia and Prosopis. Prosopis was introduced by an NGO-led development project, the Association Sahel, in the 1980s 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 did local species such as acacia (Brockhaus and Djoudi 2008). Acacia is prevalent in the lake's western part (Ras El Ma community) and Prosopis in the northern part (Tin Aicha community). Prosopis is controversial and perceived either as a 'curse' or blessing' (Laxen 2007).
Various development interventions have taken place in the region. Since the lake dried out, several programs have sought to return water and restore water-based economic activities. UNEP (2009) describes such projects as aiming to restore Lake Faguibine's ecosystem functions to prevent conflicts between farmers and livestock keepers, and strengthen the national policy dialogue on water and sustainable ecosystem services delivery for human wellbeing. The plans are controversial, however, particularly as their sustainability is questionable under continuing climate change and variability (Bouard and Tiers 2004).

As in other countries, traditions, rules and norms in Mali still restrict women's empowerment. Drawing on 12 indicators, the OECD Social Institutions and Gender Index (SIGI) which captures the underlying reasons for existing gender gaps, ranked Mali 99 among 102 countries. Legally, women and men in Mali have the same access to land, but in practice and by tradition, women are entitled only to the less fertile land and often obtain a life interest only in its "use", not in its ownership (OECD, 2009)

2.2 Approaches and methods

The research took place from July to October 2008. We worked at different levels: national (Bamako), region (Timbuktu), district (Goundam), and two local Lake Faguibine communities (Tin Aicha and Ras El Ma). A fourth phase, in which the results were presented back to the development community and government at the national level to inform their responses to climate change vulnerability and adaptation, is not described here. We focus in this article mostly on the results related to the local community level workshops. Six participatory workshops were organized in the 2 communities, Tin Aicha (sedentary farmer community) and Ras El Ma (pastoral community), with 25 to 35 participants in each workshop. Various perspectives were captured by holding workshops with 3 different groups in each community: adult men, adult women and youth. We assessed vulnerability and adaptation strategies and measures using different tools from Participatory Rural Appraisal (PRA), such as fodder calendars and resource maps, historical axes and ranking exercises.

3. RESULTS AND DISCUSSION

3.1. Impact of climate change and variability on women's livelihoods strategies

During the 6 community workshops, participants identified the main events of the recent history on an historical axis. The droughts in the 1970s and 1980s were always mentioned first. Participants clearly argued that they were still dealing with the social and environmental consequences. People adapted spontaneously by diversifying their livelihoods, rebuilding their herds and migrating. However, a series of major climatic and political events, such as the drying out of Lake Faguibine and the rebellion (1995-2003), put pressure on the socio-ecological system and reduced its adaptive capacity. This shows that actual layers of vulnerability have resulted from multiple successive stressors, and are aggravated by their cumulative effects. Additionally, as identified in the historical axes, most State or aid organization interventions focused on emergency relief without building strategies to increase the community's adaptive capacity in the medium or long term.

The results of the historical axes show that in the last 10 years the major environmental change, the drying out of the lake, challenges households in the two communities. Livelihoods shifted from water-based to forest and livestock-based system (Figure 1). Those shifts have different impacts on women's daily life activities and social roles.

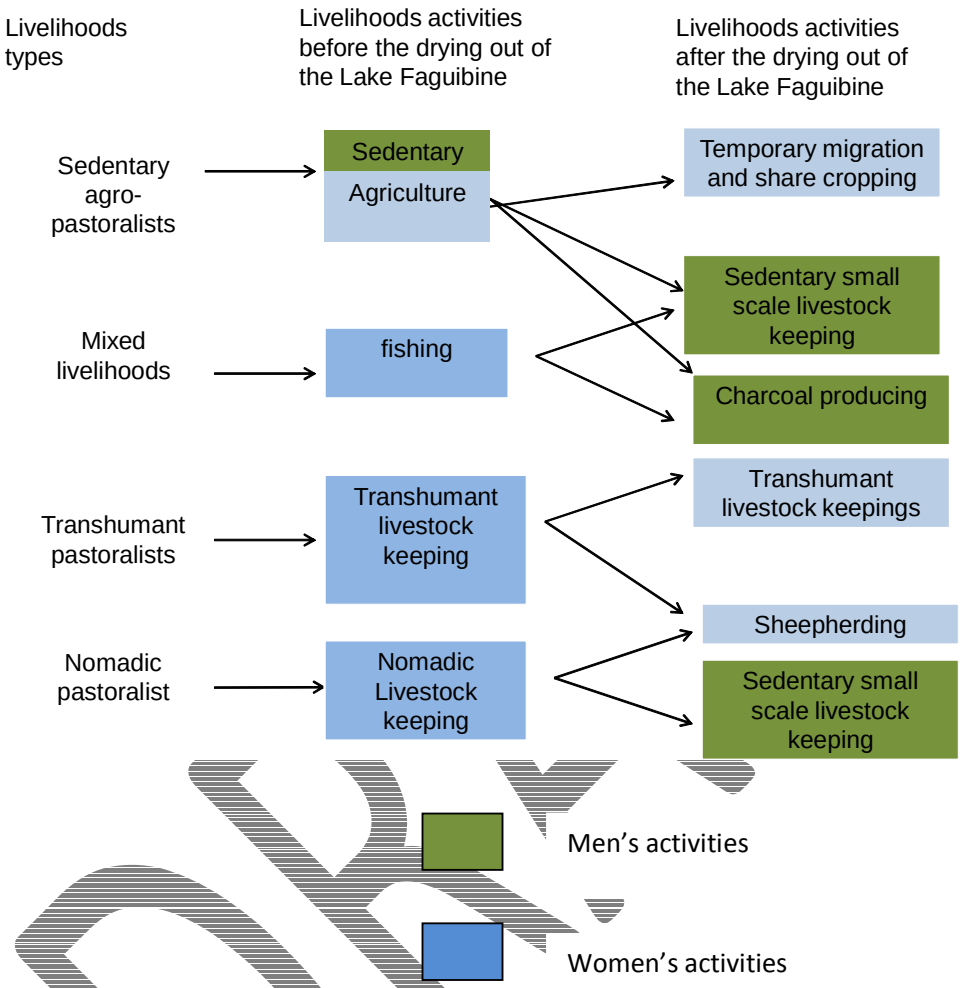

Figure 1: Shifting livelihoods and the resulting gendered repartition of livelihood activities before and after the drying out of Lake Faguibine

3.1.1. Increasing daily vulnerabilities due to restricted food availability and greater health risks

The first direct impacts of the drying out of Lake Faguibine was related to health and nutrition issues. The quality and quantity of food, as well as its availability during the year, deteriorate drastically. Especially during the dry season, when the water level in the Niger River is low, the supply of vegetables and fish from the south (Mopti) is interrupted. Nutritional rations in households are very poor 11 months of the year. August is the exception because more milk is available,. Due to the strongly gendered social rules in the distribution of the meal among household members (e.g. men are served first) and the social responsibility of women for feeding the elderly and children

first, the scarcity of food during the drought is likely to burden more women. Additionally, men have more opportunities to access food outside the household, for example, during the market days.

3.1.2. Increasing women's workload

As the livelihoods shifted from water- to forest-based systems, divison of labor along gender line has also shifted. Several activities that were in the past explicitly associated with men have been added to women's responsibilities (Figure 1). As a consequence, women's workload has increased with the evolution of adaptive livelihood strategies. Sedentarisation, a consequence of drought and seasonal and non-seasonal migration of men, was a coping strategy that increased women's burden as women have to manage community activities traditionally undertaken by men, like livestock activities. Additionally, the transformation from a lake to a forest brings new income-generating activities from the emerging forest ecosystem such as charcoal production. In the absence of male labor due to migration, those new activities has been automatically undertaken by women. Due to those contradictory trends (more work needed and fewer men to do it) participants in the women's workshops explained that they were increasingly vulnerable.

3.1.3. Defeminization of agricultural activities around the Lake

One of the most important changes after the drying out of the lake was the drastic decrease in agricultural areas in the formerly flooded northern and southern parts of the lake. Sedentary agriculture households, mainly from the Iklan social class, lost access to water and arable land. The workshop resource maps show that only one-third of the areas (the east part of the lake) still floods irregularly with some irregularities spanning years. Communities are coping by migrating temporarily to the southeast part of the former lake or close to the Niger River to cultivate land under a shared cropping system (Figure 1). In this new system, land access is no longer regulated by traditional mutual arrangements but by monetarily capitalized and annually negotiated contracts. As the demand for land is greater than the supply, financial speculations are common. Thus, changes in resource availability, or the loss of former assets because of the loss of arable land in the former lake area, increase migrant households' vulnerability. Because of power struggles related to access to and acquisition of land, monetary speculation over land access as well as the far distance from the community area, women no longer have access to agricultural land. In this new institutional system of access, women have no networks and decision-making opportunities and have therefore no access to irrigated agricultural land. However, because harvesting and transportation are still women's activities, the workload of women in those household is burdened by the long distance between the village and the fields during harvest. Vulnerability of women increased due to an increasing workload and decreasing access to assets and decision making related to the newly acquired agricultural land.

3.1.4 Feminization of the use of forest ecosystem services

With the lake drying out, Short-term and long-term migration of men became a part of the coping strategies at the local level. In the Lake Faguibine area migration is mainly a mal- dominated strategy with different layers of impacts on gender roles and norms. The most important impact of the men's migration shown by the historical axis is that the forest-related activities have shifted in the last 10 years from men to women. In the sedentary communities charcoal production, which was in the past strictly men's work, is now managed by women. However this activity was taken up exclusive by the Iklan households, which represents a "ower class in the hierarchical structures of northern Mali. Women have assumed responsibility for producing and selling charcoal, but there are some challenges related to land tenure and access to markets that hinder women's efforts to optimize their income as charcoal producers.

1. *Institutional dimensions of charcoal production.* Due to the transition from lake to forest, rights and tenure over the forest are still unclear and subject to speculation and profit-seeking from some individuals. Charcoal production is theoretically regulated by state agreements. The lack of transparency and equity in the application of norms for regulating access and behavior of charcoal producers lead to ambiguous and opaque access and use rights. This insecure land tenure and access ambiguity is misused by some local political leaders who profit personally at the expense of the local producer. One example is the distribution of charcoal production permits, which is determined by power and personal networks. The transparency and accountability of local government institutions that regulate access shape the behavior and the income of women who produce charcoal. Indeed, generally women are not included in those personal and political networks and are therefore sidelined to produce charcoal in an "illegal way", which make them depend further on the arbitrariness of some local authorities and individuals, and increases their vulnerability and production costs. This leads to the questioning about the role of local government structures in creating or hindering incentives for a sustainable charcoal production as a part of an ecosystem-based adaptation perspective.

2. Socially restricted mobility and access to markets hinder optimal charcoal commercialization, as women only have access to small local markets or they sell the charcoal in the village to middlemen. Our observation at the regional big markets (Diré and Goundam) reveals that prices (Tin Aicha and Ras El Ma) are five time higher than in the villages. Other studies, using qualitative data, identified the gendered barriers to access to market. Men sell regardless of the distance to market while it became more difficult for women to sell their product the further they were from market (Little et al., 2001).

3.2 Gender, ethnicity and identities shaping vulnerability to climate change around the lake Faguibine

The comparison of coping strategies identified at the local level shows differences between the two communities studied. Pastoral communities in Lake Faguibine are mostly represented by the Illelan social group who are traditionally the highest socio-cultural group in the hierarchical Tamachek society. Despite their higher societal roles,

Illelan women seem to face more barriers as they diversify their livelihoods than Iklan women face. One important strategies adopted by women in Illelan communities is charcoal production, this livelihood activity is not practiced by Illelan women. Indeed, there are cultural and societal barriers related to identities and hierarchical roles which hinder women in Illelan communities from producing charcoal, because they perceive this activity as one that must be done by Iklan.
Due to the migration induced by drought and rebellion, the class structure, once strongly correlated between social status and wealth, was finally eroded, as confirmed by other studies (Randall, 2002). Our results show that women from the former Iklan social class are more able to diversify their livelihoods than women from the Illelan social class are. Those results show that power relationships and the question of gender and class are evolving in the perspective of climate change adaptation in a very complex way. Indeed adaptive capacity is not only determined by wealth (assets) but also by the ability to seize existing opportunities for livelihoods diversification. This ability seems to be not only inhibited by gender restrictions but also by rules and norms related to division of labor and self-perceptions specific to class and ethnic group . Because vulnerability to climate change is dynamic and can shift following social, ecological, economic or political changes, linear assumptions and conclusions (for example, that socio-economic higher classes have more assets and therefore higher adaptive capacity) has to be reconsidered and can lead to biased vulnerability assessment of different groups. Identities, expressed in class, gender and ethnicity determine the bundles of options that are available and socially feasible for a group or individuals at the local level. Similar evidence was also found in other ethnical and cultural groups in West Africa and the recognition of those contexts seems to be crucial for climate change adaptation (Nielsen and Reenberg, 2010).

3.3 Women's perception of adaptive strategies at the local level

In the strategies framework developed by women in the workshops (Figure 2), participants identified different adaptive strategies depending on their time perspectives. Therefore, despite their time scale, those strategies are highly interlinked, as the achievement of long term strategies is highly dependent on the success or the failure of short- and medium-term strategies.

3.3.1. Short-term strategies: Immediate needs to reduce the workload and the actual vulnerability

Due to the increasing workload and social restrictions, the actual vulnerability of women is high. Therefore, women's short-term adaptation practices serves as a starting point to address the urgent actual vulnerability to longer-term climate change. Those strategies involve, for example, technical measures to reduce work time and health and nutritional improvement. One example of those activities is technological improvement in daily activities like mills for millet or local transport for water (donkey and camels). The results of the focus group discussions with women show that women's workload was very high and the available energy from food low leading to poor nutrition, especially during the drought. Therefore, those technologies and nutrition and health improvement could provide women better conditions so they can achieve their goals in livelihood diversification and reducing structural vulnerability.

3.3.2. Medium-term strategies: Diversification of livelihoods based on: charcoal, livestock, and handicraft

The medium-term strategies are based on the diversification of livelihoods. Wood, charcoal, handicraft and agricultural activities in neighboring regions (which are still flooded) are the bundle of activities which contribute the diversification of livelihoods. However our results show that those activities must simultaneously fulfill times two separate objectives. The first is to response to immediate food and subsistence needs, the second is to cover the cost of future adaptation strategies. However, in the actual situation households are struggling with, there are trade-offs between investing in future strategies or in securing their basis needs.

3.3.3. Long term strategies: to reach the optimal livelihoods independency from natural resources

For the long-term strategies women focused on building human resources by assuring education of both girls and boy as the most important strategies to deal with climate change. Long-term strategies were also based on the rationale that natural resources like forests, that directly affect their livelihoods, are highly sensitive to climate change. Therefore, future perspectives should decrease dependency on natural resources. Women argued, however, that there is vicious circle between assuring they can still do the activities indispensable for urgent livelihood needs and achieving long-term adaptive strategies. For instance, the investment in human capital of future generations by schooling children is constantly conflicting /diverging from the needs of manpower and financial means in the household to ensure daily needs. One example that emerged in the workshops is the NGO flock -rebuilding programs started after droughts, which provide farmers with female animals of good stock. By selling the offspring farmers could contribute to paying children's school fees. Due to the increase in cereal prices (especially rice) and loss of seeds stocks because of drought, the benefiting farmer must sell their female animals and therefore fail to investin future strategies.
In addition and due to migration of men, as a reaction to drought and scarcity of local opportunities to diversify livelihoods, and in order to substitute the absent manpower for subsistence activities, most households in the region stop schooling their children in part or completely. Other studies have identified a positive correlation between the number of available adults in a household and the schooling rate of children (Konate et al., 2004).
Our results show that men and women have different preferences in coping with climate change and variability. Migration is seen in the long-term perspective by men in both communities as one of the most important coping strategies to deal with recurring -droughts. Women prefer in the long term perspective the enhancement of education of girls and boys to allow them a secure income from activities which are less directly dependant from ecosystem. In the farmer communities men's response to climate change and variability seems to be highly influenced by the political discourse coming from the meso and national level. The lake refilling project, as an opportunity to go back to the former production system based on agriculture and fishery, is highlighted and ranked as the most important adaptive strategies in the men's workshops. Women in

both communities didn't consider these as a potential strategy for the future. This can be related to the fact that women are isolated from the ongoing political discourse and influences and therefore their strategic choices are based instead on their experienced realities.

During the design and discussions of the historical axis in both communities, participants mentioned some past gender specific-activities initiated by international NGOs and a local women's association, which was initiated by these NGOs. NGO activities mentioned were related to women's health and nutritional improvement, for example, provision of seedlings and techniques for small gardening activities around the lake. After the loss of water resources, those women's association vanished as an active element in the community. It seems that with a focus only on the gender practical needs, those initiatives have failed to take into account the structural drivers of gender inequities and could not suggest any institutional long-term change, by empowering women to use their adaptive capacity and to challenge the existing inequitable social framework which hinder women to participate actively in the sustainable changes and adaptation of the whole community.

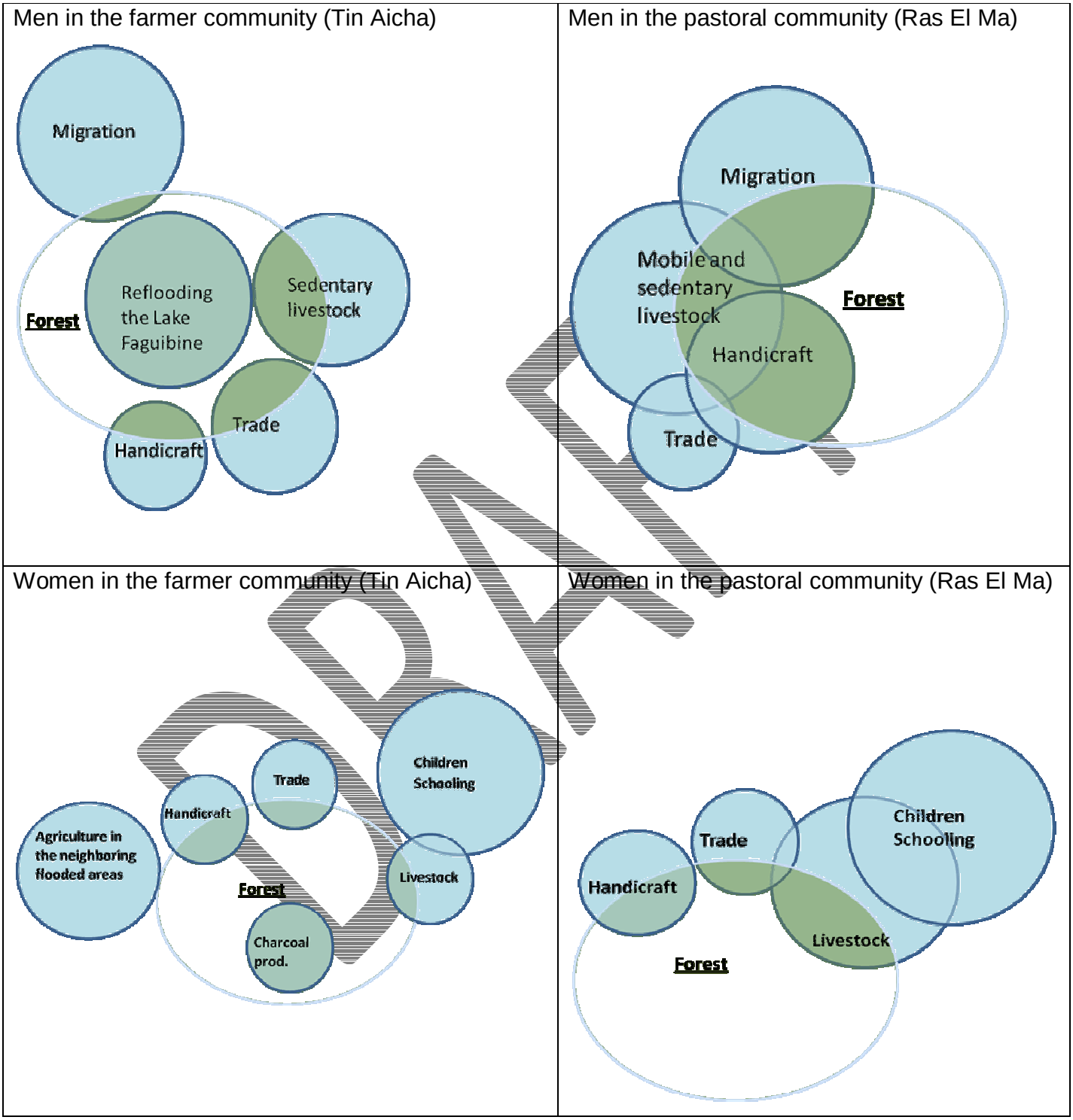

Figure 2: Adaptive strategies developed by women and men in pastoral and farmer communities during the PRA workshops

4. WOMEN, ADAPTATION AND CHANGE

4.1 . From victimization to empowerment: Women's specific adaptive capacity and climate change adaptation

Published work related to gender and climate change aims to understand the specific impacts of climate change and women. Mostly focused on the well-known higher vulnerabilities of women, those studies pay, however, less intention to the positive role women can actively play on the climate change adaptation at local, national and global levels. The case study around Lake Faguibine shows that adaptation to climate change has various gender-related gaps but there also potentials in changing societal roles and considerations and which could have different impacts on gendered traditional and societal roles and responsibilities.

Women's differences in preferences and perceptions related to adaptive strategies are relevant for adaptation to climate change. Ecosystem-based adaptation especially can take advantages of women's roles and knowledge in managing natural resources and the well-documented positive experiences of gender-balanced institutions in collective forest management and decision-making related to rules and norms to regulate the use of ecosystems.

4.2 . Changes in gender roles in decision making

The climate change and variability has new gender burdens but there are also some new shifts and flux in the gender roles, the gendered repartition of responsibilities and could lead to shifts in social norms and roles. Long-term dynamics must be considered when analyzing the possible evolution of women's future vulnerability. As a result of male migration, new opportunities could emerge for women regarding the gendered division of labor, power participation repartition, decision-making processes and market access.

Current gender roles in decision making are emerging in the local communities. Those new roles are enhanced by the forced migration of men and the emerging of new roles and responsibilities for women. The gender relations are therefore in flux, depending on the bundle of opportunities household are using to cope with climate change and variability. If those evolving gender roles will be translated in more women's contribution in decision making depend on how local and national government are playing their role in the empowerment and policy enhancement. To support women in turning short-term negative impacts on their vulnerability into a long-term positive development, these new spaces and opportunities have to be accompanied by gender-sensitive analysis of existing and planned adaptive strategies. However, broader societal and political changes are needed to realize the potential. In addition, investments in women's capacity building and knowledge will avoid changing gender roles that result in negative impacts on the forest ecosystem, for example non-sustainable forest management for charcoal production.

5 CONCLUSION

Results presented here from a case study in northern Mali on women's role in forest and livestock-based socio-ecological systems provided evidence about shifting women

vulnerability in a shifting ecosystem due to climate change. Higher risks for vulnerability can be related to increasing workloads without increasing incomes and a defeminization of agricultural activities due to loss of former gardens and lost access to land. However, potential to minimize the risk of vulnerability emerges due to new income-generating activities related to the feminization of use of forest ecosystem products and services, e.g. charcoal production and fodder provision.

Women's workload has clearly been increased by both climate event itself (drought) and by the responses to it. But some climate change–induced effects on women are still unclear. Charcoal production, especially based on the invasive species Prosopis, offers an opportunity for women to improve their income. However, limitations related to insecure land tenure and social restriction to access to market impede women who are trying to generate more income.

Migration of men is increasing in the short term the workload of women. Therefore the impact of men's migration on women in the long term can allow women to get more social space by taking leadership in household decision making and by getting more involved in activities which were once strictly a male domain.

We have seen strong differences in women's and men's preferences for adaptive strategies and their vision for adaptation, indicating that women have a long-term perspective that focuses on education investments and non-ecosystem based strategies, that can release pressure on the ecosystem.

To make use of these potentials related to new opportunities inside and outside the forest ecosystem, as well as to remove barriers to the above described vulnerability shift, additional social and societal changes are necessary. Institutions and knowledge are needed to ensure and enable a sustainable use of new forest resources.

So far, women are reduced to being vulnerable and their active role in reducing vulnerability and enhancing adaptive capacity is not fully recognized. Women's role needs to be enhanced in adaption and their existing contribution to adaptation should be focus for adaptation planning across scales and levels.

Further research is needed for a deeper understanding of local realities, and women's active role in adaptation, particularly on 1. Women-specific adaptive capacities and their complementarities and roles with men in shaping adaptation and decreasing vulnerabilities; 2. The links between local adaptive strategies and women's vulnerability, especially gender and migration; 3. Societal, cultural and policy barriers and obstacles to women's participation in short-and long-term decision making related to adaptation to climate change and variability. One of the key issues here is how to enhance the role of women in the collective management of forest ecosystems and how to enhance their role in the decision making related to ecosystem-based adaptation, and 4. Developing and mainstreaming best practices for gender-sensitive responses to climate change across levels and scales.

Change, societal and institutional, is necessary to support women to fully unfold their potential for enhanced adaptive capacity in socio-ecological systems, in Mali and elsewhere.

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