

Is adaptation to climate change gender neutral? Lessons from communities dependent on livestock and forests in northern Mali

H. DJOUDI and M. BROCKHAUS

Center for International Forestry Research, Jalan CIFOR, Situ Gede, Sindang Barang, Bogor, 16680 Indonesia

Email: H.Djoudi@cgiar.org and M.Brockhaus@cgiar.org

SUMMARY

The growing risk of vulnerability to climate change is widely discussed in the scientific and political sphere. More evidence from local case studies emerges that document this risk. Vulnerability to climate change and variability appears most likely to negatively affect poor people, particularly women. Tendencies to widen existing inequalities have been observed. In the Lake Faguibine area in Northern Mali the social, political and ecological conditions have drastically changed in the last three decades. We conducted 6 single gender participatory workshops using PRA in two communities. The workshops assessed 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. 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, women are hindered from realizing the potential of these new activities. This is due to loss of person power in the household, unclear access to natural resources, lack of knowledge and financial resources. Lack of power to influence decision at the household and community levels as well as limited market opportunities for women are additional factors. 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. These impacts could be 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 is needed to realize potential benefits for women in the long term.

Keywords: gender, climate change, adaptation, Faguibine, Mali

L'adaptation au changement climatique est -elle asexuée? Leçons en provenance de communautés dépendant du bétail et des forêts dans le Mali du Nord

H. DJOUDI et M. BROCKHAUS

Le risque croissant de vulnérabilité due au changement climatique va d'abord, et principalement, affecter les personnes démunies, les femmes en particulier, car il a tendance à élargir les inégalités existantes. Dans la région du lac Faguibine au Mali du Nord, les conditions sociales, économiques et politiques ont changé de manière radicale ces 30 dernières années. Nous avons opéré 6 ateliers participatifs en séparant les hommes des femmes dans deux communautés pour évaluer la vulnérabilité et les stratégies d'adaptation à la variabilité et au changement climatique affectant les revenus dépendant de la forêt et du bétail. La migration représentait l'une des stratégies les plus importantes pour les hommes. Les femmes, par contre, percevaient cette stratégie comme une cause de vulnérabilité, plutôt qu'une stratégie d'adaptation, car les activités des hommes ont été traditionnellement ajoutées au fardeau des femmes (comme la garde des ruminants). Les axes historiques montrent que les projets de développement visant les femmes n'ont pas intégré le changement climatique et la variabilité dans leurs plans. La plupart des activités ont été façonnées autour de l'agriculture à petite échelle. Le lac de Faguibine s'asséchant, ces activités, dépendant de l'eau, ne sont plus d'actualité. Les femmes ont développé leurs propres stratégies d'adaptation basées sur des ressources forestières nouvelles dans la région du lac, comme, par exemple, la production de charbon. Toutefois, la perte du labeur de l'homme dans la famille, l'accès vague aux ressources naturelles, le manque de connaissance, de ressources financières, et de pouvoir, ainsi que des possibilités de marché limitées pour les femmes, les empêchent de réaliser le potentiel de ces nouvelles activités. Bien que la vulnérabilité des femmes soit accrue à court terme, il se peut que les changements naissant dans le rôle des femmes puissent conduire à des impacts positifs à long terme, autant au niveau de la société (division du labeur et du pouvoir, nouveaux espaces sociaux), que de l'économie (accès au marché, santé du bétail). Une analyse locale spécifique et sensible au sexe de la vulnérabilité est nécessaire pour comprendre la dynamique et l'interaction de stratégies d'adaptation divergentes. Des changements politiques et sociaux de plus grande envergure, allant au delà de la rhétorique sont nécessaires pour réaliser les bénéfices potentiels pour les femmes à long terme.

¿Es la adaptación al cambio climático neutral en cuanto al género? Lecciones aprendidas de comunidades dependientes del ganado y el bosque en el norte de Mali.

H. DJOUDI y M. BROCKHAUS

El riesgo creciente de vulnerabilidad al cambio climático afectará en primer lugar y en mayor medida a las personas más pobres, y en particular a las mujeres, ya que tiende a agrandar las desigualdades existentes. Las condiciones sociales, políticas y ecológicas en el área que circunda al Lago Faguibine en el norte de Mali han cambiado drásticamente en los últimos 30 años. Llevamos a cabo seis talleres participativos con participantes del mismo sexo, empleando un DRP en dos comunidades para evaluar la vulnerabilidad y las estrategias de adaptación respecto de la variabilidad y el cambio climático para aquellos medios de subsistencia basados en el ganado y el bosque. Nuestros resultados muestran divergencias en las estrategias de adaptación entre hombres y mujeres. La emigración se mostró como una de las estrategias más importantes para los hombres. Las mujeres consideraron que esta estrategia era más una causa de vulnerabilidad que una estrategia adaptativa, ya que actividades tradicionalmente masculinas (p.ej. el pastoreo de pequeños rumiantes) se han incorporado a las tareas de la mujer. Una revisión histórica mostraría que los proyectos de desarrollo centrados en la mujer no han incorporado el cambio y la variabilidad climática en su planificación. La mayoría de actividades se han planificado pensando en agricultura de pequeña escala. A medida que el lago Faguibine se seca, aquellas actividades dependientes del agua dejan de ser relevantes. Las mujeres han desarrollado sus propias estrategias adaptativas basadas en recursos forestales aparecidos recientemente en lo que antes era el área del lago (p.ej. fabricación de carbón vegetal). Sin embargo, la pérdida de mano de obra en la unidad familiar, las dificultades de acceso a los recursos naturales, y la falta de conocimientos, recursos financieros y autoridad así como la escasez de oportunidades de mercado para la mujer la impiden explotar al máximo el potencial de estas nuevas actividades. Aunque la vulnerabilidad de la mujer está aumentando a corto plazo, estos cambios recientes en el rol de la mujer podrían causar a largo plazo impactos positivos, tanto sociales (reparto de tareas y autoridad, nuevos espacios sociales) como económicos (acceso a mercados, riqueza ganadera). Localmente, es necesario un análisis de vulnerabilidad específico que tenga en cuenta el enfoque de género para entender la dinámica e interacción de estrategias de adaptación divergentes. A mayor escala, y más allá del discurso retórico, hacen falta cambios políticos y sociales para que estos beneficios potenciales se hagan realidad a largo plazo para la mujer.

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. The marginalized will especially be affected (Tompkins and Adger 2004).

Environmental changes have different consequences for regions and for people. Academic disciplines and knowledge practice communities use the term 'vulnerability'. This term denotes a condition in which human communities and/or their assets and livelihoods are susceptible to injury, loss, or disruption (Wisner 2009). There is little consensus about the meaning and implications of vulnerability (Dow 1992). Vulnerability is highly related to adaptive capacity. Susceptibility to harm associated with environmental and social change is determined by the capacity to adapt.

As Adger (2006) has summarized, the three main vulnerability drivers are: resource availability, resource distribution and regulatory institutions. Entitlement and endowment, empowerment, and political economy drive vulnerability (Davies 1993, Sen 1987, Watts and Bohle 1993). This entitlement approach introduces a household perspective on vulnerability. It replaces 'ecocentric' approaches to environmental change (Ribot 1996). The main contribution is to highlight and focus on the differential vulnerability of social groups and individuals. The drivers are economic (lack of entitlement), political (lack of power) and structural (exploitation of one group by another). Turner *et al.* (2003), however, has

noted the high level of interaction between ecological and human drivers of vulnerability.

The IPCC 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'. Various types of adaptation are distinguished, such as ecosystem based adaptation. This type denotes 'adaptation policies and measures that take into account the role of ecosystem services in reducing the vulnerability of society to climate change, in a multi sectoral and multi scale approach' (Vignola *et al.* 2009). Evidence is growing that sustainably managed ecosystems are more effective than physical engineering structures for coping with climate change. Additionally, ecosystem based adaptation is readily available to the rural poor. If integrated into community-based adaptation it could address many of the most vulnerable people's priorities and concerns (Colls *et al.* 2009).

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

Women cannot be viewed as a homogenous category. Variabilities are determined by and depend on wealth, class, age, and other social and economic categories. Women's vulnerability is mostly linked to natural resource dependency and poverty. Other evidence links women's vulnerability to lack of assets, access to resources and control (Tompkins and Adger 2004). The literature on gender and climate change shows differing perspectives on components of climate. The disaster reduction literature provides evidence and local case studies showing gendered roles and impacts to mitigate and

prevent disasters (Dankelman 2002). But evidence about gendered climate change mitigation and adaptation, especially at the local level, is lacking or still at an early stage.

Beyond the discourse around women’s climate change vulnerability, a body of evidence shows women’s abilities and contribution to sustainable resource management (Agarwal 2001, 2009). The recognition and integration of those abilities in the adaptation debate will enhance and strengthen societal adaptation generally and ecosystem based adaptation specifically.

In this article we link these different strands in the literature. We also provide further evidence on women’s vulnerability and its role in adaptation using a case study from Northern Mali. We present first some aspects as discussed in the literature. Then we show women’s context specific vulnerability and adaptation in the socio-ecological system around Lake Faguibine.

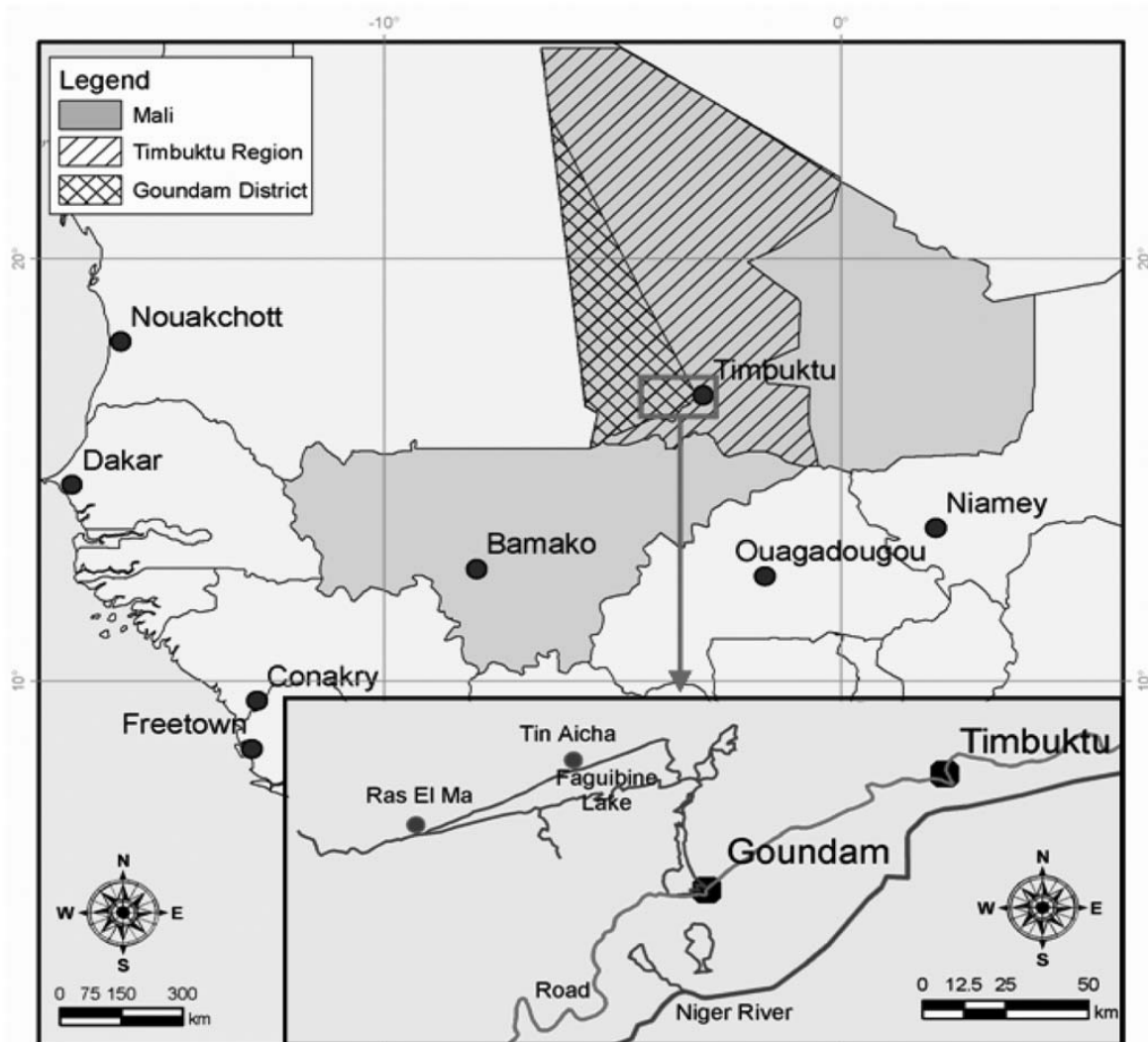
We focus on women’s preferences and contributions for adaptation and adaptive strategies. We show both opportunities and barriers for enhancing their roles in reducing vulnerability. We also consider the barriers and opportunities for

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.

Gender, vulnerability and adaption

The linkages among 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 a result of poverty *per se*. How much of women’s vulnerability is due to their poverty and how much is apportioned to societal gendered roles and restrictions? Several publications (Cannon 2010, Skutsch 2010) pose this question. However evidence is well documented that poverty affects women and men disproportionately. ‘Poverty has a woman’s face – of 1.3 billion people living in poverty, 70% are women’ argues the UNDP Human Development Report (1995). Economic studies also project a gendered trend in which women become far poorer than men,

FIGURE 1 Location of the study area in northern Mali



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.* 2002).

Fortmann and Rocheleau (1997) argue that the lack of access to credit and to land is a common obstacle experienced by women over the world. This different access to and control of resources further determines how women's vulnerability to climate change will evolve.

Even though women depend highly on natural resources (land, forest, water), their control is socially restricted across societies and cultures. As Meinzen-Dick *et al.* (1997) argue, generalization across cultures and resources is impossible. It is important to understand differences in land rights held by men and women, and how such rights are acquired and transferred. Nevertheless the academic and knowledge communities agree that women's participation in decision making over resource use and management is limited. This is shown in studies in different contexts (Rocheleau and Edmunds 1997, Fortmann and Rocheleau 1997, Colfer 2005, Porro and Stone 2005). 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, the sustainability of programs and projects and their implementation can be questioned. The emerging gender equality as a mandatory item in most development projects seems to be insufficient. Even in projects where women were asked for their perspectives, perceptions and concerns, those were overlooked when the project was implemented (Porro 2010). Women's exclusion is evident in the absence of gender specific issues in national adaptation and mitigation plans. 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).

Although vulnerability is a key issue in gender and climate change analyses, more social and economic differentiation is needed to avoid a generalized victimization discourse. Two different arguments exist. One discourse in adaptation focuses only on women's vulnerability *per se*. The other focuses on the need to integrate women in decision making and planning. Neither debate heeds women's active roles. Nor do they heed women's contribution to reduced vulnerability at household or community level, and women specific adaptive capacity. Since women are not a homogeneous group, further differentiation between women's conditions and status is lacking. We argue that women are critical and strategic actors in adaptation because of their differentiated views on environmental and social change. Also important are their preferences in managing natural resources and their involvement in resource based activities to secure livelihoods.

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

Beyond climate change vulnerability, another body of evidence related to women and natural resource management exists. It confirms the assumptions of women's important but neglected roles in ecosystem based adaptation. Indeed several works highlight how women specific social and economic roles shape sustainable use of natural resources. Examples include community forestry management in India and Nepal (Agarwal 2001). We argue that those well documented and women-specific skills and abilities present the layers of women's adaptive capacity. This is a crucial element in a population's adaptation to climate change.

Three identified aspects related to gender, natural resources and collective action could be relevant in the analysis of gender and climate change. They are: knowledge and skills, preferences in natural resource use and management, and social organization. The question is how gender specific knowledge, preferences and networks could shift and influence ecosystem based adaptation.

Women's activities are strongly interlinked with the services provided by local ecological systems. Their reliance on natural resources increases women's ability to acquire and disseminate knowledge and information about ecosystems, sustained practices and conservation techniques (Sydie 1994). We argue that those women specific abilities and knowledge present an opportunity for climate change adaptation. In this way women could be key actors, and agents of change in realizing adaptation projects and plans. This is especially the case for projects based on a sustainable use and management of ecosystem services.

Conditioned by their social roles and responsibilities, women and men tend to 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. The evidence illustrates how gender specificities in natural resource use could affect ecosystem based adaptation.

The first one is gender based preferences and perceptions of forest products as highlighted by several studies (Agarwal 2000, Bolanos and Schmink 2005). Those studies show that while men focus on timber productivity, women often prefer trees with multiple uses because these trees offer more domestic and supplementary value (fuel, fodder and shade). This difference is relevant in managing forest ecosystems for climate change adaptation. Empirical studies demonstrate positive diversity-stability relationships in ecosystems (Ives and Carpenter 2007). This means that biodiversity of ecosystems affect positively the adaptive capacity to climate variability and climate change.

The second body of evidence is related to livestock keeping in the Sahel as reported by Turner (1999). The livestock mix tends toward more small ruminants and fewer cattle. Laws and rules governing divorce and access to land, as well as migration of men, has led to a feminization of livestock keeping. The author demonstrates that this feminization is reflected in changes in herd composition. Herds have shifted

away from cattle towards small ruminants (goats and sheep) dominated flocks. The changes have a direct impact on land use patterns as cattle and small ruminants have different grazing behavior and affect vegetation differently. Cattle are also well known to be more sensitive to drought and other climate impacts than small ruminants. Changing land use patterns and the differential sensitivity of cattle and small ruminants are decisive factors in planning ecosystem based adaptation in the Sahelian context.

Other development and donor project reports (Rankin 2001) show further gender differences in project implementation. This is especially the case in microfinance based projects, which might be crucial to successful implementation of adaptation strategies and projects. Those reports show that women in agrarian societies perform the main part of productive labour. They also contribute more of their income to household well being, and have a higher repayment rate on loans (Rankin 2001). Those gender specific differences in knowledge and preferences, if incorporated properly and in a complementary manner at the local level, will enhance the implementation of sustainable livelihood strategies. This approach can lay the foundation for long term adaptation to climate change.

Ecosystem based adaptation aims for sustainable management 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 2008). As women are generally excluded from public institutions, only a few research results relate to the gendered differences in creating and applying institutional frameworks. An example is the rules and regulations in the management of ecosystems. The results of Agarwal (2000, 2009) are highly relevant. They 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 evidence that local forest management groups with a high proportion of women in their principal decision making structure correlate with significantly greater improvements in forest condition. Moreover, all female executive committees have better forest regeneration than other groups. This is despite receiving much smaller and more degraded forests to manage. Evidence from Latin America and East Africa shows, however, that mixed gender groups exploit the complementary advantages of women and men. Mixed groups perform consistently better in all management functions of the forest (Mwangi *et al.* forthcoming, Sun *et al.* 2010).

Despite existing evidence of women's roles in the sustainable management of natural resources, gender considerations, perceptions and impacts of climate change are largely ignored. Women's active roles in and for adaptation are not yet fully recognized.

The following case study shows women's preferences, and their priorities for adaptation and development. It shows the limits and opportunities for women in adapting to climate change in forest based livelihoods in Northern Mali under past and present stressors.

A CASE STUDY FROM NORTHERN MALI

Research area

The average population density around Lake Faguibine is low, with 1.1 persons/km² in the Timbuktu region and 1.7 persons/km² in Goundam district (DRPSIAP-T 2006). The density has wide spatial variation. Settlements are concentrated around Lake Faguibine and along the Niger River. Densities are as high as 59 people /km² 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 live in the western and northern parts, where research was conducted. In Tin Aicha in the north, most residents are from Kel Tamacheq a sub-group within the Berbers. Most households belong 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. They 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.

Lake Faguibine is part of a Niger River-fed lake system. It was a productive area for agriculture and fisheries, but has experienced wet and dry phases in the 20th century. 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. More than a third of the lake area has 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. Several programs have sought to return water and restore water based economic activities. UNEP (2009) describes such projects as aiming to prevent conflicts between farmers and livestock keepers. They also aim to strengthen the national policy dialogue on water and sustainable ecosystem service 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 behavior. This has adverse impacts on efforts to empower them. Drawing on 12 indicators, the

OECD Social Institutions and Gender Index (SIGI) captures the underlying reasons for existing gender gaps. The index ranked Mali 99 among 102 countries (1 is the smallest gap). Legally, women and men in Mali have the same access to land. However, 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).

Approaches and methods

The research took place from July to October 2008. We worked at different levels: national (Bamako), regional (Timbuktu), district (Goundam), and two local Lake Faguibine communities (Tin Aicha and Ras El Ma). We focus in this article mostly on the results from the local community level workshops. Six participatory workshops were organized in the two communities, Tin Aicha (sedentary farmer community) and Ras El Ma (pastoral community). Each workshop had 25 to 35 participants. Various perspectives were captured by holding workshops with three 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). The tools included are fodder calendars and resource maps, historical axes and ranking exercises.

Vulnerability is a theoretical concept and subject to different interpretations. At the local level we tried to define vulnerability in a palpable and adapted way to the local realities. We asked questions about the socioeconomic, institutional and political factors influencing past and present coping strategies. We also asked why some people cope better than others and which conditions allow people to cope better with climate events.

We used historical time lines to draw up the bundle of strategies used in the past to cope with droughts. In a second step we ranked these strategies regarding their application in the past. This was important to differentiate between preferred but not applicable or feasible strategies. It also helped to understand the relation to the resource base on which they were applied. Therewith we identified the degree to which they are based on the use of forest.

RESULTS AND DISCUSSION

Impact of climate change and variability on women's livelihood strategies

During the six community workshops, participants identified the main events of recent history on an historical axis. The droughts in the 1970s and 1980s were always mentioned first, by both men and women. Participants clearly argued that they were still dealing with the social and environmental consequences such as migration and desertification. People adapted spontaneously by diversifying their livelihoods, rebuilding their herds and migrating. However, a series of major climatic and political events, such as Lake Faguibine drying out

and the rebellion (1995–2003), put pressure on the socio-ecological system. These events reduced its adaptive capacity by reducing resources and resource availability and altered the social structure of the community (e.g. migration). Layers of vulnerability have resulted from multiple successive stressors. These are aggravated by their cumulative effects. Additionally, as identified in the historical axes, most State or aid organization interventions focused on emergency relief. They did not build strategies to increase the community's adaptive capacity in the medium or long term.

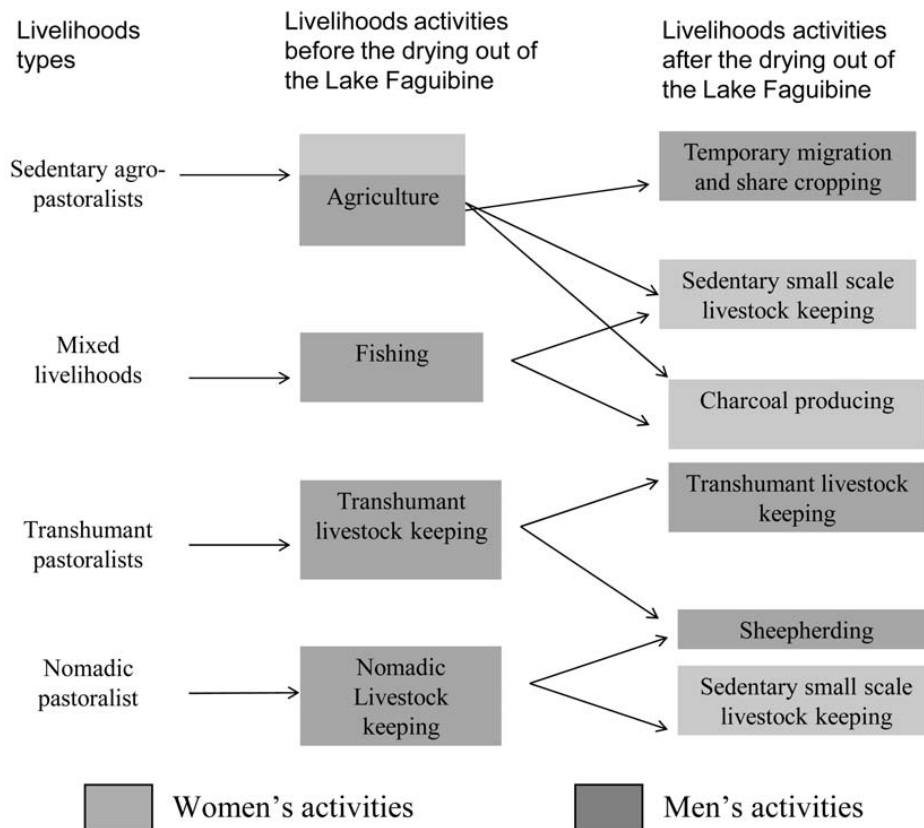
The historical axes show that in the last 10 years the major environmental change, the lake drying out, has challenged households. Livelihoods shifted from water based to forest and livestock based systems (Figure 2). Those shifts have different impacts on women's daily life activities and social roles, as the following sections will show.

The results indicate increasing daily vulnerabilities due to restricted food availability and greater health risk. The first direct impact of Lake Faguibine drying out was related to health and nutrition. The quality and quantity of food, as well as its availability during the year, has deteriorated drastically. Especially during the dry season, when the Niger River levels are 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 distributing household meals, men are served first followed by the elderly and children. This means food scarcity during the drought is likely to burden more women. Men also have more opportunities to access food outside the household, for example, during market days.

Women's workload has increased as livelihoods shifted from water to forest based systems. The division of labor along gender line has also shifted. Several activities such as livestock herding and charcoal production were in the past explicitly associated with men. They have now been added to women's responsibilities (Figure 2). 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. But it increased women's burden because they have to manage traditionally male activities such as tending livestock. The transformation from a lake to a forest also brings new income generating activities such as charcoal production. In the absence of male labor due to migration, those new activities have been automatically undertaken by women. With more work and fewer men to do it, participants in the women's workshops explained that they were increasingly vulnerable.

A defeminization of agricultural activities took place following 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 lake's eastern part) can be used for agriculture because it's still flooded, with some irregularities spanning years. Communities are coping by migrating temporarily to the

FIGURE 2 *Shifting livelihoods and the resulting gendered repartition of livelihood activities before and after the drying out of Lake Faguibine*



ONLINE COLOUR ONLY

former lake’s southeast or close to the Niger River to cultivate land under a shared cropping system (Figure 2). In this new system, land access is no longer regulated by traditional mutual arrangements. Instead, it is regulated by monetarily capitalized and annually negotiated contracts. As the demand for land is greater than the supply, financial speculation is common. Thus, changes in resource availability, or the loss of former assets because of the loss of their arable land, increase migrant households’ vulnerability.

Power struggles related to land access and acquisition, monetary speculation and the far distance from the community area mean women no longer have access to agricultural land. In this new institutional system of access, women have no networks and decision making opportunities. They therefore have no access to irrigated agricultural land. However, harvesting and transportation are still women’s activities. The women’s workload is therefore further burdened by the long distance between the village and the fields during harvest.

The defeminization of agriculture does not result automatically in decreasing women’s workloads. This is because their loss of agricultural tasks was replaced by new responsibilities in activities previously affiliated with men. Women also now have to go further and spend more time accessing water supplies. The higher workload and decreased access to assets and decision making on the newly acquired agricultural land increased women’s vulnerability.

A feminization of the use of forest ecosystem services also took place. With the lake drying out, short term and long term migration by men became a part of the local coping strategies. As a mainly male dominated strategy, it has different layers of impacts on gender roles and norms.

The historical axis shows that the most important impact is the shift in forest related activities from men to women in the last 10 years. In the sedentary communities charcoal production was strictly men’s work in the past but it is now managed by women. However this activity was taken up exclusively by the Iklan households, which represent a “lower class” in the hierarchical structures of northern Mali. Women have assumed responsibility for producing and selling charcoal. However, challenges related to land tenure and market access hinder women’s efforts to optimize their income as charcoal producers.

The workshop results also indicated clearly the institutional dimensions of charcoal production. Due to the transition from lake to forest, rights and tenure over the forest are still unclear. Forest resources are subject to speculation and profit seeking from some individuals. Charcoal production is theoretically regulated by state agreements. The lack of transparency and equity in regulating access, and the behavior of charcoal producers, led to ambiguous and opaque access and use rights. Some local political leaders use this ambiguity to 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. Local government institutions lack transparency and accountability in regulating access. This shapes the behavior and the income of women who produce charcoal. Generally women are not included in personal and political networks and are therefore sidelined to produce charcoal in an 'illegal way'. This makes them more dependent on the arbitrariness of some local authorities and individuals. It increases their vulnerability and production costs. This leads us to question local government's role in creating or hindering incentives for sustainable charcoal production as a part of an ecosystem based adaptation. Diversification, as an adaptive strategy is undermined by institutional failures at different scales and levels. An example is inadequate control over the production and sale of charcoal.

In addition, women's socially restricted mobility and access to markets hinder their optimal charcoal commercialization. Women only have access to small local markets or they sell the charcoal in the village to traders. Our observation at the big regional markets (Diré and Goundam) reveals prices that are five times higher than in the villages (Tin Aicha and Ras El Ma). Other studies, using qualitative data, have identified gendered barriers to market access. Men sell regardless of the distance to market while women find it more difficult the further away they are (Little *et al.* 2001).

Gender, ethnicity and identities shaping vulnerability to climate change around Lake Faguibine

The comparison of local coping strategies shows differences between the two communities studied. Pastoral communities in Lake Faguibine are mostly represented by the Illelan social group. This group is traditionally the highest socio-cultural group in the hierarchical Tamacheq society. Despite their higher societal roles, Illelan women seem to face more barriers as they diversify their livelihoods than Iklan women. One important strategy adopted by Iklan women is charcoal production. This livelihood activity is not practiced by Illelan women. Cultural and societal barriers related to identities and hierarchical roles hinder women in Illelan communities from producing charcoal. This is because this activity is perceived as 'beneath them'. We also observe that Illelan women experience stronger mobility restrictions and seclusion than Iklan women. They are therefore more constrained in taking on new diversification opportunities. Social class was identified in several societies as a determining factor of women's seclusion, mobility and autonomy. Stronger seclusion and mobility restrictions of upper status women were reported in different contexts in North Africa, Middle East and Afghanistan (Moghadam 2003).

The class structure was once strongly correlated between social status and wealth. Due to the migration induced by drought and rebellion, the structure is now evolving, as confirmed by other studies (Randall 2002). Our results confirm this finding. They show that women from the former Iklan social class are more able to diversify their livelihoods than

Illelan women. Power relationships and their interlinkages with gender and class are evolving in a complex way.

Adaptive capacity is not only determined by wealth (assets) but also by the ability to seize livelihood diversification opportunities. This ability is inhibited by gender restrictions. It is also inhibited by rules and norms for labor division and self-perceptions in class and ethnic groups. Vulnerability to climate change is dynamic and can shift following social, ecological, economic or political changes. This means linear assumptions and conclusions, such as socio-economic higher classes have more assets and therefore higher adaptive capacity, have to be reconsidered. Otherwise, these assumptions can lead to biased vulnerability assessment of different groups (Djoudi *et al.* 2011).

Identities, expressed in class, gender and ethnicity, affect the options that are available and socially feasible for a group or individuals at the local level. Similar evidence has also been found in other ethnic and cultural groups in West Africa. The recognition of those contexts is crucial for climate change adaptation (Nielsen and Reenberg 2010). Sound, differentiated and gender sensitive vulnerability assessments are useful. They allow changing social realities to be successfully incorporated into adaptation plans and development interventions and projects.

Women's views of adaptive strategies at the local level

In the strategies framework developed by women in the workshops (Figure 3), participants identified and ranked different adaptive strategies. Women in both communities ranked children's schooling as the most important strategy (biggest circle size in Figure 3) to deal with the recurrent drought. Women aspire for educated children to obtain wage work and therefore reduce their livelihood dependency on natural resources.

Participants highlighted the time dimension of vulnerability (long and short term). They also highlighted the interdependency between current strategies and future vulnerabilities. Achieving long term strategies was highly dependent on the success or failure of short and medium term strategies.

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

The increasing workload and social restrictions mean the current vulnerability of women is high. Women's short term adaptation practices serve as a starting point to address the urgent vulnerability to longer term climate change. Those strategies involve, for example, technical measures to reduce work time and improve health and nutrition. One example is technological improvement in daily activities such as mills for millet or local transport for water (donkeys and camels). The focus group discussions show that women's workload was very high but they suffered poor nutrition and therefore low energy, especially during the drought. Technologies and improved nutrition and health could provide women with better conditions. This way they could achieve their goals in livelihood diversification and reduce structural vulnerability.

Medium term strategies: Diversification of livelihoods based on charcoal, livestock, and handicrafts

The medium term strategies are based on the diversification of livelihoods. Wood, charcoal, handicrafts and agricultural activities in still-flooded neighboring regions contribute to the diversification. However our results show that those activities must simultaneously fulfill two separate objectives. The first is to respond to immediate food and subsistence needs. The second is to cover the cost of future adaptation strategies. In the current situation households struggle with trade-offs between investing in future strategies or securing their basic needs. Workshop participants described the dilemma between long term investment in educating girls and boys versus short term access to food by investing or reinvesting in livestock.

Long term strategies: Decrease of livelihood dependency on natural resources

Women were focused on the education of both girls and boys as the most important long term strategy to deal with climate change. Long term strategies were also based on the rationale that natural resources like forests are highly sensitive to climate change. Therefore, future perspectives should reduce dependency on natural resources.

Women pointed, however, to a vicious circle between doing the activities needed to meet urgent livelihood needs and achieving long term adaptive strategies. For instance, the investment in future human capital by schooling children constantly conflicts with the need for person power and the financial means to secure daily needs. One example that emerged in the workshops is the NGO flock rebuilding programs started after droughts. These provide farmers with female animals of good stock. By selling the offspring farmers could contribute to paying children's school fees. But cereal prices (especially rice) increased and seed stocks were lost because of drought. This forced the benefiting farmer to sell the female animals and therefore fail to invest in future strategies. Male migration also meant most households stopped schooling their children in part or completely to replace the lost person power. 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. The identified past and present strategies are based to a different degree on the use of the available forest resources in the two communities (see Figure 3). Migration, even though practiced outside the communities and therewith outside the forest, is still linked to the forest resource. This is because revenues are reinvested in livestock (to different degrees in the two communities and groups). "Reflooding the lake" and restarting agriculture as the most preferred strategy is placed inside the forest circle in the Figure 3. This strategy is based on the forest resource by reconvertng it into agricultural land. The ranked importance of a specific strategy is expressed in different circle sizes in the figures. It reflects the above mentioned group specific practices and preferences.

Men in both communities see as one of the most important long term strategies to cope with recurring droughts. Women prefer enhanced education for girls and boys to allow them a secure income from activities that are less directly dependent on the ecosystem. In farmer communities, men's response to climate change seems highly influenced by the political discourse at the meso- and national level (Djoudi *et al.* 2011). The lake refilling project is highlighted and ranked as the most important adaptive strategy in the men's workshops. Men see this as an opportunity to go back to the former production system based on agriculture and fishing. Women in both communities didn't consider these as a potential strategy for the future. The women's perception appeared to be based on a more realistic assessment of what's possible. This can be related to women being isolated from the political discourse and influences. Therefore their strategic choices are based instead on their experienced realities.

During the design and discussions of the historical axis, participants mentioned some past gender specific activities initiated by international NGOs, including a local women's association. NGO activities mentioned were related to improved women's health and nutrition. For example, seedlings and techniques for small gardening activities around the lake were provided. After the loss of water resources, those women's associations became inactive. It seems the focus only on practical women needs did not change the structural drivers of gender inequities. These activities also did not sustainably enhance women's adaptive capacity.

WOMEN, ADAPTATION AND CHANGE

From victimization to empowerment: Women-specific adaptive capacity and climate change adaptation

Published work related to gender and climate change aims to understand the specific impacts of climate change on women. Most studies are focused on the well known higher vulnerabilities of women. However, these studies pay less attention to the positive roles women can actively play in adaptation at local, national and global levels. The case study around Lake Faguibine shows that adaptation has various gender related gaps, but also the potential to change societal roles and considerations. These could have different impacts on gendered traditional and societal roles and responsibilities.

Women's differences in preferences and perceptions for adaptive strategies are relevant. Ecosystem based adaptation especially can take advantage of women's roles and knowledge in managing natural resources. It can build on the well documented positive experiences of gender balanced institutions in collective forest management. Gender balance in decision making related to rules and norms to regulate the use of ecosystems also provides positive examples.

Changes in gender roles in decision making

Climate change and variability have meant new gender burdens but also some new positive shifts and fluxes in gender

FIGURE 3 Adaptive strategies and their dependency on forest, developed by women and men in pastoral and farmer communities during the PRA workshops. (Size indicates the ranked importance; Overlap indicates the degree of dependency)



roles. This gendered repartition of responsibilities 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. Male migration can allow new opportunities for women in the gendered division of labor, power, 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 emergence of new roles and responsibilities for women. Gender relations are therefore in flux, depending on the bundle of opportunities households are using to cope with climate change and variability. Whether this translates into women contributing more to decision making depends on how local and national governments facilitate empowerment and policy enhancement. To support

women in turning short term negative impacts into long term positive developments, gender sensitive analysis of adaptive strategies is required. However, broader societal and political changes are needed to realize the potential. In addition, investment in women’s capacity building and knowledge will avoid gender roles changing with negative impacts on the forest ecosystem. An example is non-sustainable forest management for charcoal production.

CONCLUSION

This case study provides evidence of the shifting vulnerability of women in northern Mali in a shifting ecosystem due to climate change. Higher risks are related to increasing

workloads without increasing incomes and the defeminization of agricultural activities due to the loss of former arable land around the lake. This is accentuated by the loss of access to land in the new institutional land allocation and access systems. However, the feminization of the use of forest products and services has the potential to minimize the risk of vulnerability. New income generating activities include charcoal production and fodder provision. Women's workload has clearly been increased by the 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, women are impeded by limitations related to insecure land tenure and social restrictions on access to markets.

Male migration is increasing women's workload in the short term. But in the long term, it could give women the social space to assume leadership in household decision making. It could also allow women to get more involved in activities that were once strictly a male domain.

Male and female traditional roles and activities are evolving faster under recurrent drought and migration. Women are increasingly undertaking 'male' activities, but without acquiring automatically the same rights. Successful adaptation means reconsidering the usual theoretical dichotomies, in classifying 'male' and 'female' activities. The most important question is the how the women's new roles and responsibilities affect and change power relationships. We argue that the emerging new societal roles could empower women to negotiate new institutional arrangements to access and control resources.

We have seen strong differences in women's and men's preferences for adaptive strategies and their vision for adaptation. Women have a long term perspective focused on educational investments and non ecosystem based strategies. These could release pressure on the ecosystem.

Additional social and societal changes are necessary to make use of the new opportunities inside and outside the forest ecosystem. Changes are also needed to remove barriers to the above described vulnerability shift. The question is, what types of changes specifically? And how will these changes be instituted, and by whom? What type of additional research is needed to inform policies for needed changes? Institutions and knowledge are needed to ensure and enable sustainable use of new forest resources.

So far, women are reduced to being vulnerable. Their active roles in reducing vulnerability and enhancing adaptive capacity are not fully recognized. Women's roles need to be enhanced and their contribution to adaptation should, like men's, be a focus for planning at all scales and levels.

Further research is needed for a deeper understanding of local realities and women's active roles in adaptation, particularly on the following fronts:

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. A key issue is how to enhance the role of women in the collective management of forest ecosystems and in decision making on ecosystem based adaptation. A related issue is market access and value chain governance.
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 realize their potential for enhanced adaptive capacity in socio ecological systems, in Mali and elsewhere.

ACKNOWLEDGEMENT

The authors thank all participants and interviewees in the local communities (Tin Aicha, Ras El Ma), Goundam, Timbuktu and Bamako. We also thank Barun Gurung, Esther Mwangi, and two anonymous reviewers for their valuable comments and suggestions.

This document has been produced within the framework of the 'Tropical Forests and Climate Change Adaptation' (TroFCCA) project executed by CATIE and CIFOR and funded by the European Commission under contract EuropeAid/ENV/2004-81719. The contents of this document are the sole responsibility of the authors and can under no circumstances be regarded as reflecting the position of the European Union.

REFERENCES

- ADGER, N. 2006. Vulnerability. *Glob Environ Change* 16: 268–281.
- AGARWAL, B. 2000. Conceptualizing environmental collective action: why gender matters. *Cambridge Journal of Economics* 24: 283–310.
- AGARWAL, B. 2001. Participatory exclusions, community forestry, and gender: An analysis for south Asia and a conceptual framework. *World Development* 29(10): 1623–1648.
- AGARWAL, B. 2009. Gender and forest conservation: The impact of women's participation in community forest governance. *Ecological Economics* 68: 2785–2799.
- AGRAWAL, A. 2008. The role of local institutions in adaptation to climate change. Paper prepared for the Social Dimensions of Climate Change, Social Development Department, The World Bank, Washington DC, 5–6 March 2008. 65 p.
- BOLANOS, O. AND SCHMINK, M. 2005. Women's place is not in the forest. Gender issues in a timber management project in Bolivia. *In: COLFER, C.J.P. (ed.): The equitable forest: diversity and community in sustainable*

- resource management. *Resources for the Future and CIFOR Publication*, Washington D.C, pp. 274–295.
- BOUARD, S. AND TIERS, S. 2004. Le lac Faguibine, une espace agropastoral au nord Mali: dynamiques agraires, gestion des ressources naturelles et stratégies des acteurs. Mémoire ESAT2-DIAT, option AGIR., CNEARC, Montpellier.
- BROCKHAUS, M. AND DJOUDI, H. 2008. Adaptation at the interface of forest ecosystem goods and services and livestock production systems in Northern Mali. *CIFOR Info brief No.19*. http://www.cifor.cgiar.org/publications/pdf_files/Infobrief/019-infobrief.pdf. Accessed 24 November 2009.
- CANNON, T. 2002. Gender and climate hazards in Bangladesh. *Gender & Development* 10(2): 45–50.
- COLLS, A., ASH N., AND IKKALA N. 2009. Ecosystem-based Adaptation: a natural response to climate change. Gland, Switzerland: IUCN. 16 p.
- COLFER, C.J.P. 2005. The equitable forest: diversity and community in sustainable resource management. *Resources for the Future and CIFOR Publication*, Washington D.C, 335 p.
- DANKELMAN, I. 2002. Climate change: learning from gender analysis and women's experiences of organizing for sustainable development. *Gender & Development* 10(2): 21–29.
- DAVIES, S. 1993. Are coping strategies a cop out? *IDS Bull* 24: 60–72.
- DJOUDI, H., BROCKHAUS, M., AND LOCATELLI, B. 2011. Vulnerability to climate variability and change among communities depending on livestock and forest in northern Mali: a multi-level analysis. *Regional Environmental Change* (in press).
- DOW, K. 1992. Exploring differences in our common future(s): the meaning of vulnerability to global environmental change. *Geoforum* 23(3): 417–436.
- DRPSIAP-T. 2008. *Annuaire statistique Année 2006*. Direction Régionale de la Planification, de la Statistique, de l'Informatique, de l'Aménagement du Territoire et de la Population. Timbuktu, Mali.
- FORTMANN, L. AND ROCHELEAU, D. 1997. Women and Agroforestry: Four Myths and Three Case Studies. In Sachs, C. E (Ed.): *Women working in the environment*. Washington, D.C. Taylor & Francis Edition, pp. 193–211.
- INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC) 2007. *Climate Change 2007 – The IPCC Fourth Assessment Report (AR4)* http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf 11. Accessed August 2010.
- IVES, A.R. AND CARPENTER, S.R., 2007. Stability and diversity of ecosystems. *Science* 317, 58–62.
- KONATE, M.K., GUÉYE, M. AND NSEKA VITA, T. 2004. Scolarisation des enfants au Mali selon le profil des ménages et étude de leur maintien à l'école. Background paper prepared for the Education for All Global Monitoring Report 2003/4. *Gender and Education for All: The Leap to Equality*. <http://unesdoc.unesco.org/images/0014/001467/146798f.pdf>. Accessed August 2010.
- LAXEN, J. 2007. Is Prosopis a curse or a blessing? An ecological-economic analysis of an invasive alien tree species in Sudan. University of Helsinki, Viikki Tropical Resources Institute. *Tropical Forestry Report* 32: 203.
- MEINZEN-DICK, R.S., BROWN, L.R., FELDSTEIN, H.S. AND QUISUMBING A. R. 1997. Gender, property rights and natural resources. *World Development* 25(8): 1303–1315.
- MOGHADAM, V. M. 2003. *Modernizing women: gender and social change in the Middle East*. 2nd edition, London.
- MWANGI, E., MEINZEN-DICK, R. AND SUN, Y. (forthcoming) Gender and sustainable forest management in East Africa and Latin America. *Ecology and Society* (forthcoming).
- NIELSEN, J.Ø., REENBERG, A. 2010. Cultural barriers to climate change adaptation: A case study from Northern Burkina Faso. *Global Environmental Change* 20(1): 142–152. doi:10.1016/j.gloenvcha.2009.10.002.
- NELSON, V., MEADOWS, K., CANNON, T., MORTON, J. AND MARTIN, A. 2002. Uncertain predictions, invisible impacts and the need to mainstream gender in climate change adaptation. *Gender & Development* 10: 51–59.
- OECD, 2009. The OECD social institutions and gender index. http://www.oecd.org/document/39/0,3343,en_2649_33935_42274663_1_1_1_1,00.html Accessed 10 November 2010.
- PORRO, N.M. AND STONE, S. 2005. Diversity in living gender: two cases from the Brazilian Amazon. In Colfer, C.J.P., (2005) *The equitable forest: diversity, community in sustainable resource management*. *Resources for the Future and CIFOR Publication*, Washington D.C, 2005 pp. 242–255.
- PORRO, N.M. 2010. For a Politics of Difference. In: Tsikata, D. and Golah, P. (ed.). *Land Tenure, Gender and Globalisation. Research and Analysis from Africa, Asia and Latin America*. Zubaan, New Delhi, 271–294.
- REYES, R. 2002. Gendering responses to El Niño in rural Peru. *Gender & Development*, 10(2): 60–69.
- RANDALL, S.C. 2005. Demographic consequences of conflict, forced migration and repatriation: a case study of Malian Kel Tamasheq. *European Journal of Population* 21(2): 291–320.
- RANKIN, K. 2001. Governing Development: Neoliberalism, Microcredit, and Rational Economic Woman. *Economy and Society* 30(1): 18–37.
- RIBOT, J.C. 1996. Climate Variability, Climate Change and Vulnerability: Moving Forward by Looking Back. In: Ribot, J.C., Magalhães, A.R. and Panagides, S.S. (eds.) *Climate Variability, Climate Change and Social Vulnerability in the Semi-arid Tropics*. Cambridge: Cambridge University Press.
- ROCHELEAU, D. AND EDMUNDS, D. 1997. Women, men and trees: Gender, power and property in forest and agrarian landscapes. *World Development* 25(8): 1351–1371.
- SEN, A. 1987. *Hunger and entitlements: research for action*. World Institute for Development Economics Research, Helsinki.

- SKUTSCH, M.M. 2002. Protocols, treaties, and action: the climate change process viewed through gender spectacles. *Gender & Development* 10(2): 30–39.
- SYDIE, R.A. 1994. *Natural women, cultured men: a feminist perspective on sociological theory*. UBC Press, Vancouver, Canada.
- TOMPKINS, E.L. AND ADGER, W. N. 2004. Does adaptive management of natural resources enhance resilience to climate change? *Tompkins. Ecology and Society* 9(2), 10. <http://www.ecologyandsociety.org/vol9/iss2/art10>. Accessed 29 November 2010.
- TURNER, M.D. 1999. Merging local and regional analysis of land-use change: the case of livestock in the Sahel. *Annals of the Association of American Geographers* 89(2): 191–219.
- TURNER, BL., KASPERSON, RE., MATSON, PA., MCCARTHY, JJ., CORELL, RW., CHRISTENSEN, L., ECKLEY, N., KASPERSON, JX., LUERS, A., MARTELLO, ML., POLSKY, C., PULSIPHER, A., SCHILLER, A. 2003. A framework for vulnerability analysis in sustainability science. *Proceedings of the National Academy of Sciences of the United States of America* 100(14): 8074–8079.
- UNDP 1995. Human Development Report http://hdr.undp.org/en/media/hdr_1995_en_contents.pdf. Accessed 12 November 2010.
- UNDP 2009. Gender and Climate Change: Impact and Adaptation. UNDP Asia-Pacific Gender Community of Practice Annual Learning Workshop, http://asia-pacific.undp.org/practices/gender/publications/Gender_and_Climate_Change-Impact_and_Adaptation-5.pdf. Accessed 8 November 2010.
- UNEP 2009. Ecosystem Management for improved human well-being in the Lake Faguibine system: conflict mitigation and adaptation to climate change (draft). <http://www.unep.org/pdf/Lake-Faguibine.pdf>. Accessed 10 November 2010.
- UNFPA and WEDO 2009. Making NAPAs work for women, climate change connections http://www.unfpa.org/webdav/site/global/shared/documents/publications/2009/climateconnections_4_napas.pdf. Accessed 25 October 2010.
- VIGNOLA, R., LOCATELLI, B., MARTINEZ, C. AND IMBACH, P. 2009. Ecosystem-based adaptation to climate change: what role for policy-makers, society and scientists? *Mitigation and Adaptation of Strategies for Global Change* 14:691–696, doi:10.1007/s11027-009-9193-6.
- WATTS, MJ., BOHLE, HG. 1993. The space of vulnerability: the causal structure of hunger and famine. *Prog in Hum Geography* 17:43–67.
- WISNER, B. 2009. Vulnerability. *International Encyclopedia of Human Geography* pp.176–182, doi:10.1016/B978-008044910-4.00129-2.
- SUN, Y., MWANGI, E. AND MEINZEN-DICK, R. 2010. Gender, institutions and sustainability in the context of forest decentralisation reforms in Latin America and East Africa. *CIFOR Infobrief*, CIFOR, Bogor, Indonesia.