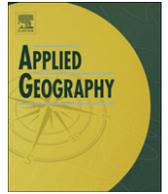


Contents lists available at [SciVerse ScienceDirect](http://www.sciencedirect.com)

# Applied Geography

journal homepage: [www.elsevier.com/locate/apgeog](http://www.elsevier.com/locate/apgeog)

## Migration as a contribution to resilience and innovation in climate adaptation: Social networks and co-development in Northwest Africa

Jürgen Scheffran<sup>a,\*</sup>, Elina Marmer<sup>a</sup>, Papa Sow<sup>b</sup>

<sup>a</sup> Institute of Geography, KlimaCampus, University of Hamburg, Grindelberg 7, 20144 Hamburg, Germany

<sup>b</sup> Center for Development Research (ZEF), University of Bonn, Germany

### A B S T R A C T

#### Keywords:

African Sahel  
Climate adaptation  
Co-development  
Institutional innovation  
Migration networks  
Social resilience

Human migration has been described as one of the conflict constellations in regions affected by climate change, but can also contribute to climate adaptation. Migrant social networks can help to build social capital to increase the social resilience in the communities of origin and trigger innovations across regions by the transfer of knowledge, technology, remittances and other resources. These could increase the flexibility, diversity and creativity of communities in addressing climate stress and open new pathways for co-development connecting the home and host communities. Based on a conceptual framework connecting migration and adaptation, the paper explores possible opportunities, innovative approaches and institutional mechanisms for migration as a contribution to climate adaptation. The Western Sahel will be used as a case study region, with a focus on Mali, Mauritania and Senegal, using qualitative and quantitative analysis of remittances at the national level, and a micro-level analysis on the role of migrant networks in these countries in specific co-development projects in water, food and energy.

© 2011 Published by Elsevier Ltd.

### Introduction

Climate change has been described as a stress factor that increases migration pressure in vulnerable regions (Gemenne, 2011; Warner & Afifi, 2011). There is still lack of empirical evidence and understanding of the complex causal relationships between climate change, migration and conflict (Nordas & Gleditsch, 2007; Scheffran & Battaglini, 2011; WBGU, 2007). While there is no commonly agreed definition of climate migration (for an attempt see EACHFOR, 2009), some sources estimate several hundred million climate refugees (Myers, 2002) which has been challenged as speculative and exaggerated (Jakobeit & Methmann, 2011). Other scholars criticize the threat terminology regarding migrants (Oels, 2011), or emphasize that those who are vulnerable and exposed to climate risks are victims, requiring international support to protect them (Laczko & Aghazarm, 2009).

With this article we will pursue a differentiated approach beyond the threat-victim discourse. We describe communities and migrants as active social agents who shape their livelihood under changing environmental conditions. Throughout history, human migration has been an adaptive response not only to poverty and

social deprivation but also to environmental and climatic change. Though migration was often associated with hardships, it also offers opportunities to acquire new knowledge, income and other resources or create social networks across regions. This social capital contributes to the adaptive capacity and resilience of home and host communities and helps to develop joint responses against climate change. Which role institutions play in supporting such co-development processes, remains an open question.

In the following we will address this research deficit and investigate opportunities and innovations for the development of migration as a contribution to climate adaptation. In Section 2 (Framework for integration of migration and climate adaptation) a conceptual framework will be introduced that integrates migration and climate adaptation regarding theoretical concepts (social capital and networks, human capability and sustainable livelihood, social resilience and co-development). This will set the context in Section 3 (Climate change, migrant networks and co-development in the Western Sahel) to focus on the Western Sahel as a case study region, in particular on Mali, Mauritania and Senegal. Qualitative and quantitative analysis of remittances at the national level will be accompanied by a micro-level analysis on the role of migrant networks in these countries in selected co-development activities with relevance for climate adaptation. In Section 4 (Migration-for-adaptation: country case studies) we investigate the migration–adaptation relationship for cases in the Western Sahel.

\* Corresponding author. Tel.: +49 40 42838 7722; fax: +49 40 42838 9211.

E-mail addresses: [juergen.scheffran@zmaw.de](mailto:juergen.scheffran@zmaw.de) (J. Scheffran), [elinamar@gmx.net](mailto:elinamar@gmx.net) (E. Marmer), [investigation4@yahoo.fr](mailto:investigation4@yahoo.fr) (P. Sow).

## Framework for integration of migration and climate adaptation

The impact of global warming on human communities depends on their vulnerability, which is a function of the exposure and sensitivity to climate change, and the adaptive capacities. Adaptation is meant here as the “adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities” (IPCC, 2007: 869). Focussing on the beneficial opportunities offers the chance to develop innovative strategies that strengthen the adaptive capacities and livelihood of communities. This would involve not only technical innovations that facilitate sustainable management of natural resources, but also institutional innovations that shape, organize and coordinate individual and community actions and interactions (Adger, Lorenzoni, & O’Brien, 2009; Agrawal, 2009; Mearns & Norton, 2009).

Related is the concept of social resilience which is “the ability of communities to absorb external changes and stresses while maintaining the sustainability of their livelihoods.” (Adger, Kelly, Winkels, Huy, & Locke, 2002: 358) Resilient communities are active agents that influence their environment, anticipate and resist to future stresses and recreate themselves according to their motivations and capabilities. Combining absorption, resistance and recreation in social resilience transcends the reactive nature of adaptation towards anticipatory learning (Tschakert & Dietrich, 2010).

These concepts are relevant to analyze the multi-faceted relationship between migration and climate adaptation that involves three ways of interaction.

**1. Adaptation preventing forced migration:** In this approach, adaptation aims to avoid forced migration as a distressed response to livelihood destruction caused by climate change. When communities are exposed to harsh environmental conditions and climate stress, they are forced to respond to diminish adverse consequences, increase the chances of survival and improve livelihood. Farmers and pastoralists have developed various adaptation mechanisms to deal with a changing climate, including seasonal migration. Less desirable is permanent distress migration caused by hostile conditions such as the loss of vital assets. What is possible and adequate depends on the vulnerability to climate change, the resilience and capability for self-help, the social organization and institutional mechanisms of the community (Christoplos, 2010).

**2. Migration-as-adaptation:** Where communities are threatened by climate change despite efforts for local adaptation and protection, migration is a legitimate adaptive response to look for opportunities elsewhere. Before families are relocated, individual members are sent away to diversify income, gain knowledge, spread risk, and gather capabilities to sustain a community, including assets to insure against future shocks and stresses (de Haan et al., 2000). Accordingly, migration is a coping strategy that reduces population pressure, lessens the strain on scarce resources, facilitates risk reduction and offers better chances for survival. However, it implies the loss of valuable labour, income, wealth and knowledge that is missing to sustain the livelihood and adaptive capacity of a community. Migrant societies establish new social capital and networks among themselves, as well as with their host and home communities, thus connecting both (regarding the origins of these concepts see Granovetter, 1973; Portes, 1998). If migration movements are sudden, unexpected and large-scale, communities and governments face considerable challenges that can overwhelm their management capacities and provoke conflict. If migration occurs at a moderate rate and migrants are absorbed in the target region, problems are easier to handle. Institutions can help to accommodate immigrants in their new locations and avoid conflicts by creating links and benefits with host communities.

**3. Migration-for-adaptation:** New opportunities, resources and networks of migrants in the host regions can diversify household livelihoods, support climate adaptation and build social resilience in the regions of origin, partly compensating for initial resource losses. Capabilities and transfers of resources in migrant networks, including knowledge, remittances and return migration, can contribute to technical and institutional innovations in the home communities for climate adaptation, sustainable development and peace-building. Remittance income has direct effects on the resource base, economic well-being and resilience of the home community (Adger et al., 2002). In many countries young, professionally-trained returnees are involved in successful environmental initiatives. They understand the local socio-ecological conditions at home and are in a good position to support their communities. Technology use and transfer support better resource efficiency, new types of natural resources and crop varieties, sustainable energy supply and disaster management. Governance and institutions facilitate livelihood through co-development and co-management of natural resources and agricultural systems.

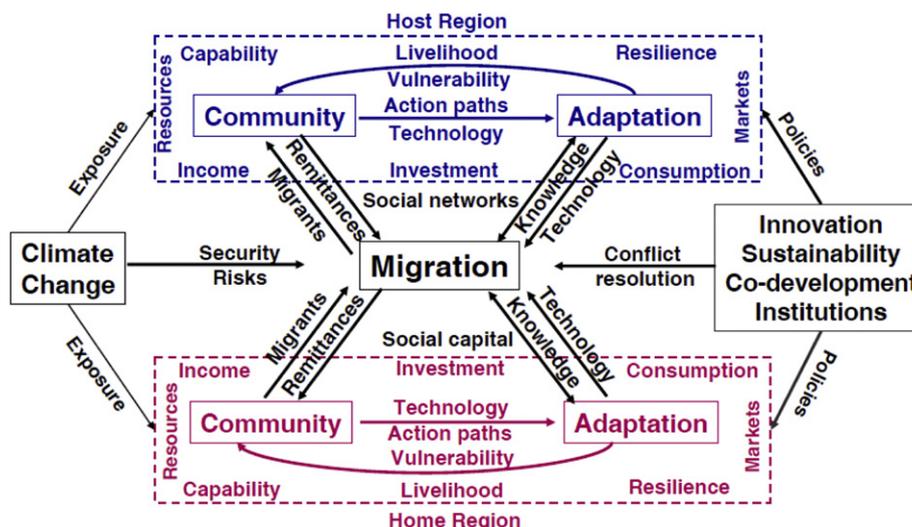


Fig. 1. Framework for integrating migration into community adaptation to climate change (source: own work).

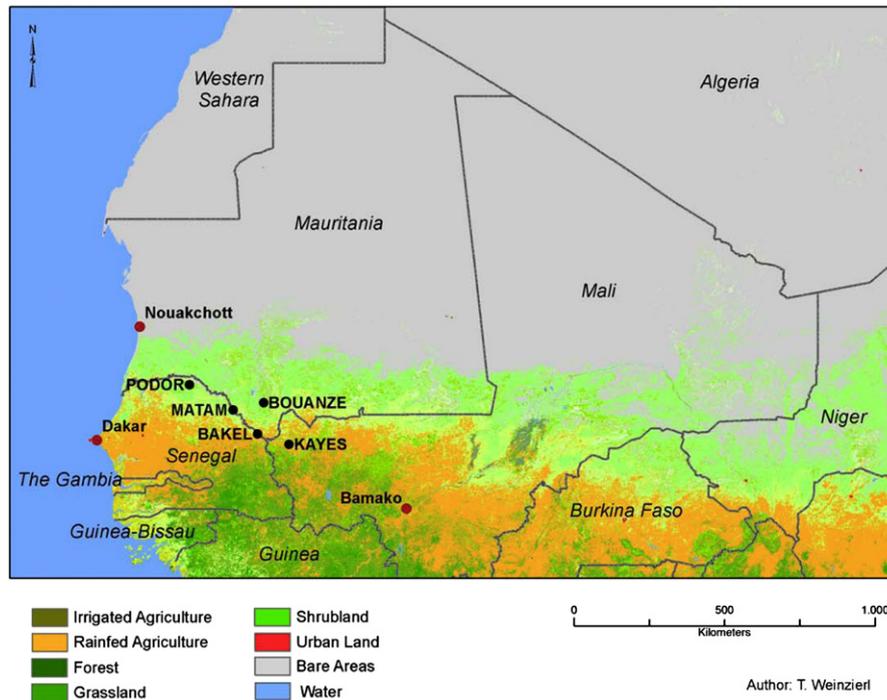


Fig. 2. West Africa land use and case studies in the Senegal River Valley (marked with black dots and capital letters).

The multiple pathways between migration and climate adaptation in home and host communities are expressed in Fig. 1 which provides a landscape for key concepts shaping the conditions and opportunities for innovative approaches that are explained in the following.

1. *Community income and migrant remittances*: Being an important income source in developing countries, migrant remittances have substantially increased (World Bank, 2011). Investing remittances offers opportunities for development and environment if used to preserve natural capital or protect against climate-induced risks. However, remittances could exacerbate income inequality and support passive, non-productive communities using this income source for consumption rather than investment (Adger et al., 2002; de Haas, 2006).

2. *Capability, livelihood and development*: Migrants acquire resources that support human capabilities which are essential for development and sustainable livelihoods (Sen, 1985; Valdes-Rodriguez & Perez-Vazquez, 2011). The new economics of labour migration (Taylor, 1999) argues that migration has considerable innovative potential through “North–South”<sup>1</sup> transfer of capital and exposes traditional communities to modern knowledge and education (de Haas, 2006: 567). There are however concerns that celebrating migration as self-help development from below could “shift the attention away from structural constraints and the vital role of states in shaping favorable conditions for positive development impacts of migration” (de Haas, 2010:227).

3. *Diversity, resilience and social capital in migrant networks*: Facing hardships, affected communities diversify their livelihoods to pursue alternative action pathways, such as agricultural intensification and non-farm activities (McDowell & de Haan, 1997). Social linkages and networks are vital parts of social capital. They “tie the migrant to the source community” (Conway & Cohen,

1998:33) and empower local communities to strengthen their resilience. Return migrants can revive existing social networks to home regions and reverse the brain drain by direct transfers of knowledge and experience. Networks established through migration provide access to resources that enrich the human, social and cultural capital of home communities (Woodruff & Zenteno, 2007).

4. *Institutions, cooperation and co-development*: The challenge is to develop adequate institutional mechanisms that help to overcome the barriers and enable innovative solutions in the migration process, such as self-help, social rules, joint and sustainable management. These serve as a basis for cooperation between governments, citizen groups and businesses. To maintain resilience individuals need to merge their social capital by co-development which is a bottom-up and participatory approach initiated by immigrants organizations (Østergaard-Nielsen, 2010). These projects are financed by the migrants, or co-financed by governmental and non-governmental institutions and private entities in countries of origin and destination.

Western countries often apply the concept of co-development in order to regulate migration, by linking the funding of projects with returnees’ programs and signing of readmission agreements of so-called “irregular immigrants” (Panizzon, 2008). Rather than preventing migrants from circulating their resources, sensible immigration policies could promote the exchange in resources between origin and destination areas, seeking to enhance the mutual benefits of building social capital, livelihood and resilience between migrants and their origin communities (see the following section).

### Climate change, migrant networks and co-development in the Western Sahel

#### Climate change and migration-as-adaptation

Irregular rainfalls, prolonged drought periods and vulnerable ecosystems in the Sahel have always required a high level of adaptation from its populations (Rain, 1999). Population mobility in

<sup>1</sup> The World Bank applies “North” to the so-called high-income economies (all countries with \$12,196 or more GNI per capita). The UN applies “North” to all high-income OECD member-countries.

the form of diverse types of migration is the most common strategy to cope with the variable climate: For centuries, nomadic pastoralism and transhumance contributed to sustainable utilization of the Sahel by moving in search of new pastures and land, but also for trade and conquest. With circular migration, migrants move from rural to urban areas in search of income during the dry season and return home during the rainy season to participate in the agricultural activity. During their absence they usually send remittances home and contribute to their families' income.

The case studies presented here are located in the valley of the Senegal River (Fig. 2) which provides water to the semi-arid parts of Mauritania, Senegal and Mali. A large north-south precipitation gradient ranges from high rainfalls in the South to less than 200 mm/yr in the North. Since the early 1970s these regions report a sharp increase in emigration, probably as an adaptive response to the unprecedented droughts that have hit the Sahel from the late 1960s to 1990s, when the annual rainfall went back by 40% (Fig. 3) compared to the previous thirty years (IPCC, 2007). The availability of fresh water was drastically reduced challenging the adaptive capacities of the affected communities. The Sahelian droughts have been observed to be "... among the largest climate changes anywhere" (Bates, Kundzewicz, Wu, & Palutikof, 2008).

Sahelian economies largely depend on the mostly rain-fed agriculture and livestock making it difficult to explicitly distinguish between economical and environmental migration, especially in the case of transnational migration. Unlike short-term circular migration, it is usually long-term since it requires higher resources and therefore takes longer time to pay-off. But even if migrating transnationally, Sahelian people usually continue to maintain strong links with their areas of origin over extended periods of time, sending money home and in many cases planning to return (McDowell & de Haan, 1997).

#### Migration-for-adaptation: role of remittances in the region

Most of the transnational Sahelian emigrants remain in the African countries (called "South"); a smaller number migrate to the OECD countries ("North"). Remittances transferred home from countries with stronger economies are usually higher due to higher incomes and stronger currency (Table 1).

On average, African immigrants were found to remit twice as much as immigrants from other developing countries (Bollard, McKenzie, & Morten, 2010). For example, Malians and Senegalese living in France transfer 10–15% of their monthly income (ADB, 2007). In the Senegal River valley, migrant remittances provided

**Table 1**  
Emigrants and remittances flows 2010 (source: World Bank, 2011).

Country	North emigrants % total	North remittances % total	South emigrants % total	South remittances % total
Mali	10%	33%	90%	67%
Mauritania	26%	57%	74%	43%
Senegal	40%	70%	60%	30%

for 65% of households' cash income (household survey, Findley & Sow, 1998). Data on remittances are based on estimates (Fig. 4) since 25–80% of all transfers are sent using informal channels like hand delivery (ADB, 2007; Page & Plaza, 2005; Sow & Alissoutin, 2010).

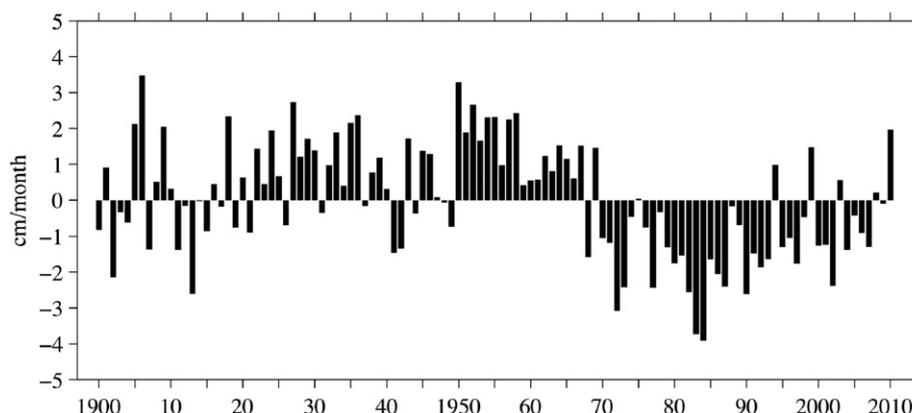
#### Migration-for-adaptation: co-development and migrant networks

In the 1960s, sub-Saharan African migrants in France have created organizations and initiated co-development projects directed to the construction of schools, clinics, drinking water and irrigation systems. Since the 1990s migrant organisations and co-development activities have been extended to Spain and Italy. Governmental support has been made available in France, Spain and Italy and by the EU. However, European states have the tendency to use developmental strategies to achieve immigration control following the *adaptation-to-prevent-migration* path, which can sometimes lead to cooperation failures, as in the case of Mali (see Section 4.3 Mali). Institutional support for co-development programs is being offered by the countries of origin, albeit to a different degree (see country case studies in the following section).

A French study of projects initiated and financed by migrants from the Senegal River valley living in France showed that 36% of them were dedicated to health care and education and 23% to water and agriculture (Gonin, 2001). Apart from physical and social capital invested in co-development, innovation and knowledge transfer also play an important role (Babu & Asenso-Okyere, 2010). For example, the Diaspora Association of Engineers for the Development of the Sahel provided support and advice for over 200 projects in the Kayes region of Mali (Sall, 2005).

#### Migration-for-adaptation: country case studies

Three case studies demonstrate contributions of migrants to climate adaptation of their communities of origin (Table 2). The study from Mauritania is a project evaluation report on



**Fig. 3.** Mean Sahel precipitation anomaly during the rain season (June–October). Averages over 20°–10N, 20W–10E. 1900–2010 climatology. NOAA NCDC Global Historical Climatology Network data. Source: Joint Institute for the Study of the Atmosphere and Ocean at the University of Washington, USA. <http://jisao.washington.edu/data/sahel/#analyses>.

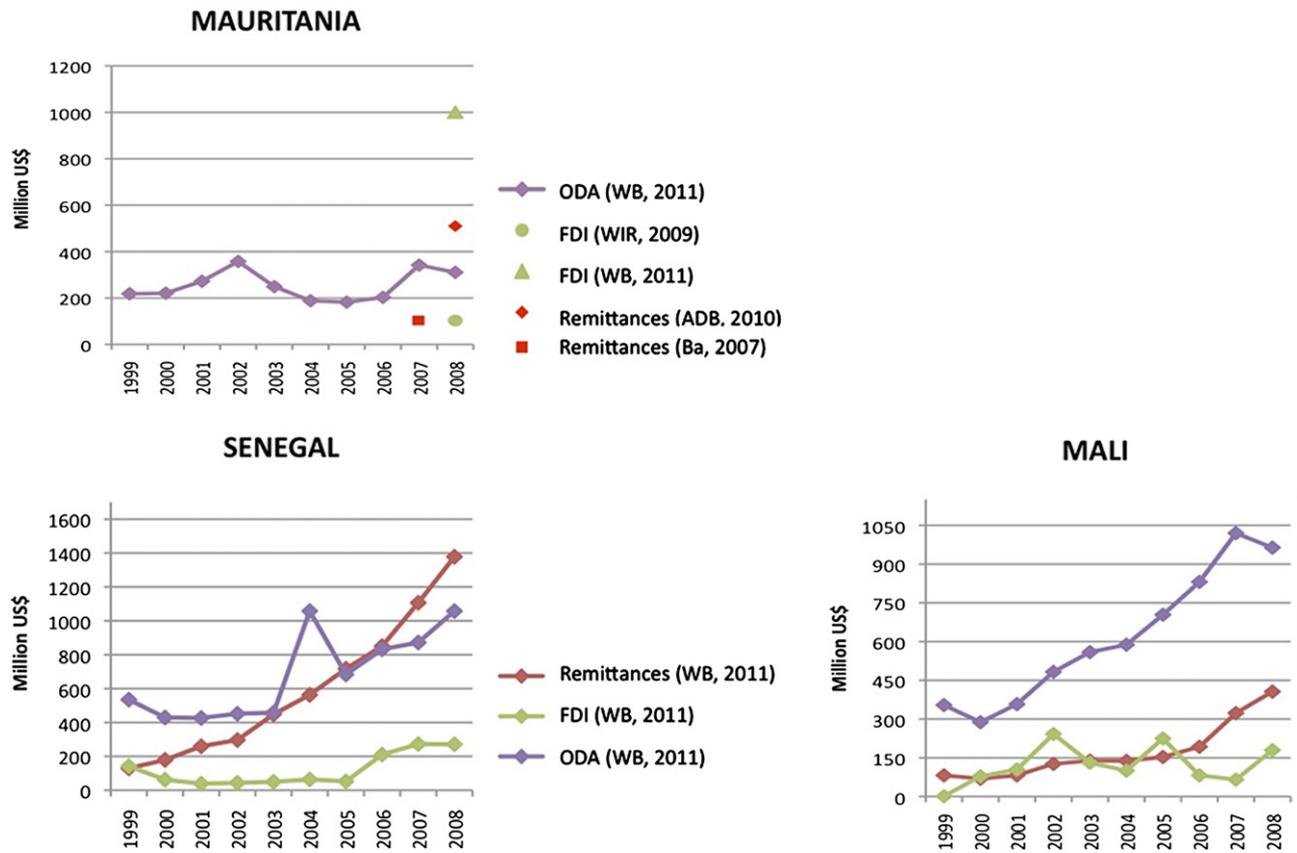


Fig. 4. Time series for Official Development Assistance (ODA), Foreign Direct Investment (FDI) and remittances in Mauritania, Senegal and Mali. Complete remittance data for Mauritania are not available (WB: World Bank) (WIR, 2009).

construction of a well initiated by a Spanish emigrant organization in their home village<sup>2</sup> (Avalua, 2008). The second is a longitudinal study assessing the involvement of Senegalese immigrant organizations in France in development projects in the water sector of 44 organizations representing over 70 villages (Drevet, 2000). The Malian case cites several studies on the contribution of emigrants of the Kayes region living in France (Galatowitsch, 2009). All migrant organisations are located in Western Europe, while the partnerships are located in the Senegal River valley (Fig. 3).

#### Mauritania

Estimates about the total number of international emigrants from Mauritania vary between 105,000 emigrants, or 3.2% of the population in 2005 (World Bank, 2011) and 250,000, equivalent to 8.1% of the population in 2004 (CARIM, 2010). Severe droughts in the 1970's seem to have fostered international emigration, initially mainly directed towards the neighbouring West-African countries. Since the late 1980s and after the Senegal-Mauritania conflict, emigrants increasingly settle in the Gulf countries and in Europe (CARIM, 2010). Today, most international emigrants (some 70%) move to the "South" (African and Gulf countries), while only about 30% settle in the countries of the "North". Estimates on annual remittances transferred to Mauritania by international emigrants vary significantly, between 2 million USD in 2010 (World Bank, 2011) and 360 million Euro in 2008 (ADB, 2010), or 10% of gross

national income (GNI), with 100 million USD estimated by Ba (2007) in between (Fig. 4).

Mauritanian emigrants cooperate with NGOs in the host countries, such as the Research Group and Realizations for Rural Development (GRDR) in France<sup>3</sup> to support development initiatives in their home locations, invest in infrastructure, health care and water supply. Migrant associations, professional and student transnational networks support Mauritians abroad and keep maintaining links to their home communities.<sup>4</sup>

The Mauritanian government has consolidated temporary economic migration frameworks with the EU member states and the Gulf countries. Governmental institutions do not offer significant support to embed Diaspora in the context of development; neither strong institutional links with Diaspora nor policy frameworks concerning Diaspora investments have been developed (CARIM, 2010).

#### Well construction project in Bouanze, region of Guidimakha, Mauritania

The mountainous Guidimakha region in Southern Mauritania, on the border with Senegal and Mali, hosts 10% of the country's total population (3.3 million) and is the center of Mauritania's agricultural production. However, it is considered to be the most neglected region by the State, with significant emigration; most of the male population over 25 years of age leaves the region to contribute to

<sup>2</sup> Project assessment and evaluation with participation of P. Sow.

<sup>3</sup> [http://www.grdr.org/spip.php?page=sommaire&id\\_rubrique=107](http://www.grdr.org/spip.php?page=sommaire&id_rubrique=107).

<sup>4</sup> For example, the students association ACEM (*L'Association Culturelle des Etudiants Mauritaniens*) <http://asso.acem.free.fr/>.

**Table 2**  
Summary of case studies.

Country	Region	Sector	Actors	Innovation
Mauritania	Guidimaka, Bouanze	Water	Emigrant organization in Spain, Spanish governmental organizations and NGOs	Social, financial and cultural capital of emigrants
Senegal	Podor, Matam, Bakel	Water	Emigrant organizations in France, private companies, governmental organizations and NGOs in Senegal, African & European countries	Social, financial and cultural capital of emigrants
Mali	Kayes	Renewable energy Electrification	Emigrant organizations in France, NGOs in Mali and France Emigrant Federation in France, private companies in France	Technological innovation, social and financial capital of emigrants Partnership between emigrants and private businesses

their families' income. The money transferred by the international Diaspora provides a strong basis for the local economy (Avalua, 2008). The region of Guidimakha is predominantly populated by Soninke. Economic migratory activities as traders or labourers are an integrative part of their lifestyle. Young men are expected to migrate at the age of eighteen in order to attain majority status (Smale, 1980). Since the 1970s drought, the duration, direction and composition of migration shifted significantly (Smale, 1980).

Bouanze, a village in Guidimakha with some 10,000 inhabitants, was severely affected by the drought in the 1970s, causing a massive emigration to cities and across the borders. The diaspora organization AFUB (*Association des Feres Unis of Bouanze*) was founded in 1975 by emigrants of Bouanze in France and in 1996, it established a branch in Spain. AFUB currently consists of 400 members in both European countries. It aims to foster development in the home region, support the remaining families and inhibit the emigration of young men by improving opportunities at home. In cooperation with local authorities, NGOs and aid organizations, AFUB has initiated several development projects in water supply and waste management. During 2004–2006, a well supplying drinking water to individuals and institutions (mosque, hospital and dispensary) was constructed in cooperation with a Spanish NGO, SPS (*Santa Perpetua Solidaria*<sup>5</sup>) involving a major contribution from the Catalan Cooperation Fund for Development. Drinking water supply in Bouanze had been provided from traditional wells located some 10 km outside the village. Beside the long distance that had to be covered, mostly by women, to access the water, its quality was low, frequently contaminated and a cause of health problems. AFUB is also running an agricultural co-operative for women. The irrigated land produces fruits and vegetables during the dry season, so these products do not have to be imported (Avalua, 2008).

For these activities, the emigrants pulled together all resources available to them. They contributed *financial capital* of over 13,000 EUR to the construction and maintenance of the well and made use of the *social capital* in the origin and destination countries. Close links to their home community enabled them to identify the population's needs. Networking with Spanish organizations and authorities provided financial support for the project. Some of the AFUB members are simultaneously members of the SPS. In terms of *cultural capital*, emigrants from Bouanze have been active in contracting and supervising hydro-geological and geophysical studies, coordinated the project management and maintenance and organized training for the employees. AFUB is still involved in the everyday monitoring of water supply, maintenance and the purchase of spare parts and contributed to the installation of solar panels to increase energy supply for the pump. The well construction

created employment of two technicians and fifteen people working at the distribution points (Avalua, 2008).

### Senegal

Because of its political stability and the strategic location it presents for transit migration, Senegal attracts immigrants from the neighbouring West-African countries and is home to over 25,000 refugees from Mauritania who arrived after the Senegal-Mauritania conflict in the 1980s (CARIM, 2010). Lately, the country has solidly become a country of emigration. Up to the 1990s, it was predominantly directed towards Sub-Saharan African countries but in the last 20 years, North Africa, Europe and the USA began to attract a significant fraction of Senegalese emigrants (CARIM, 2010; de Haas, 2007). In 2003–2004, some 650,000 Senegalese were residing abroad, consisting of 12% of the total population, two thirds of them without a regular legal status. This could probably explain why other sources indicate a smaller number of 480,000 (MDRC, 2007). In Europe, most Senegalese settle in France; in recent decades Italy and Spain also became important host countries (CARIM, 2010; de Haas, 2007). Out of the three Sahelian countries, Senegal has the highest percentage (over 40%) of emigrants moving to countries of the "North". Senegal is also receiving the highest amount of remittances relative to the GNI, around 1.16 billion USD in 2010 (Fig. 4).

Emigration is an important form of household strategy in Senegal (de Haas, 2007; Sow, 2002). A recent survey showed, that 2/3 of the surveyed households had at least one migrant; equally national and international (Plaza, Navarrete, & Ratha, 2011). The inflow of remittances from international emigrants is higher than foreign aid and a corner stone of the national economy (Tall, 2002). The Senegalese Diaspora is strongly organized supporting local communities in the countries of destination and fostering developmental projects back home (Grillo & Riccio, 2004).

Senegalese migration policy encourages co-development through remittances, investment and return of emigrants. Governmental agencies are promoting Diaspora investments in government-run infrastructure projects and utilizing business contacts and professional networks established by Senegalese emigrants abroad (Panizzon, 2008). The Senegalese government offers loans for migration-related craft development projects (Panizzon, 2008) and tax exemptions. Since 2008, the NGO FES (*La Fondation des émigrés sénégalais*)<sup>6</sup> with support by the Ministry of Senegalese Abroad and by Spain, aims at channelling diaspora investments into Senegal. Another government program, Agrobiotech, a part of the Return to Agriculture Program REVA (*Retours vers l'agriculture*), seeks to "reintegrate" return migrants by involving them in modernization of agricultural activities. The

<sup>5</sup> <http://www.spsolidaria.pangea.org/index.php>.

<sup>6</sup> <http://www.la-fes.org/>.

program is addressing highly skilled Senegalese professionals in the diaspora offering them options to return. This and other returnee programs are co-founded by the EU, France and Spain (Panizzon, 2008).

Spain and Italy actively participate in co-development projects with Senegalese diaspora organizations, for example through the MIDA programmes of the International Organization for Migration (IOM)<sup>7</sup>. The French Priority Solidarity Funding (FSP), a part of the French-Senegalese co-development convention signed in 2000, co-finances 25% of migrant-led projects.<sup>8</sup>

#### *Involvement of diaspora organizations in water development in Senegal*

The regions of Podor, Matam (North) and Bakel (South-East) in the Senegal River Valley have been characterized by strong emigration since the 1970s drought (CARIM, 2010): “The drought has reduced rain-fed agriculture, decreased the seasonal flooding of wetlands, limited economic development, and in the overall, enhanced poverty” (Oyebande & Odunuga, 2010). Developments in water management, collection and supply are essential measures to adapt to climate change. Forty migrant organizations from these regions in France (5800 members) were surveyed to assess their contribution in water development. Each represented one or several villages, with the total population of over 400,000 (Drevet, 2000). Most of the organizations were founded in the 1960s and the 1970s.

In addition to the monthly membership fees, some organizations regularly collected extra fees for the “water fund”. The project budgets ranged from 3000 to 136,000 EUR (Drevet, 2000). 70% of all water projects were fully financed by the migrant organizations; only 30% were co-financed. For larger projects, co-financing was sought by governmental and non-governmental organizations and businesses in Senegal and other African countries, in Europe and in the US. In the years 1996–2000, nearly 70% of all organizations initiated at least one water project (Drevet, 2000). Other activities were mainly directed towards education and health services, and to a lesser extent, to construction of mosques and agriculture.

Most of the organizations have been involved in the management of the water service in their home villages. One fourth of the surveyed organizations were not involved in the water management, because they claimed that either the water was well-managed locally and their contribution was not needed, or that the water was locally mismanaged leading to a conflict between migrants and local population (Drevet, 2000).

#### *Mali*

Mali is a landlocked country where only 3.8% of the land is arable and 80% of the population is dependent on the agriculture that contributes 40% of the GNI (Findley, 2004). Migration is deeply rooted in Malian society, initially due to the millennial Trans-Saharan trade, the vulnerable environment, and wars, in recent history followed by the labour demand in the Malian gold mines, in the plantations in Senegambia and Ivory Coast and in the automobile sector in France. Most of the population movement occurs within the country: a survey conducted in 1992–93 found that by age 25, citizens have migrated at least once to another district, but by age 35 most men had moved again (Findley, 2004). International migration is mainly directed towards other African countries, less than 10% of emigrants move to the “North” (Table 1). In Europe,

most Malians reside in France and Spain, an increasing number emigrates to North America (Findley, 2004). Officially recorded remittances transferred to Mali are higher than FDI (Fig. 4). Gubert (2009) found that Malian remittances reduce the poverty rate and the Gini coefficient<sup>9</sup> by 5%.

Malian emigrants organized themselves since the early 1960s. The organizations became popular and the participation in them steadily grew; by 1985 they covered nearly 70% of all Malians living in France (Daum, 1995). A study conducted in 2004 (FSP, 2004) sampled 42 migrant organizations with 11,000 members, representing 31 villages in Mali with a total population of 135,000. The sampled organizations have implemented 250 developmental projects most commonly directed towards education.

The government of Mali pursues a strategy “to ensure and coordinate ... the participation (of emigrants) in local development, ... favour investments from Malian expatriates, ... and organise relations with the Diaspora”. The High Council of Malians Abroad is represented in 62 countries (CARIM, 2010). In 2002, in a bilateral program with France (Priority Solidarity Fund Co-development Mali), the Malian government started a program to actively support co-development activities. However, in 2009, France discontinued its support of the program, as Mali refused to sign the agreement with France accepting repatriation of “irregular” Malian immigrants. The program continues running with the support of the Malian government and NGOs. Projects funded are required to be at least 30% co-financed by immigrants (Galatowitsch, 2009).

#### *The case of the Kayes region, Mali*

The region of Kayes, the Malian part of the Senegal River Valley, is mostly populated by Soninke, who have a long tradition of journey, commerce and migration (Azama & Gubert, 2006). In Mali, Kayes has the highest rate of emigration, historically motivated by high vulnerability of the region to desertification and drought, and by the extended trade. After independence, France promoted temporary migration to fill the labour gaps in its automobile industry, which attracted wealthier Soninke because migration was seen as prestigious (Azama & Gubert, 2006). Remittances were found to make up 80% of household resources in Kayes (Ammarrasi, 2005) and collective projects have contributed to 60% of infrastructure (World Bank, 2005).

Today, migrant organizations co-finance the majority of development projects in the region of Kayes, investing in water systems, dikes, health centers, schools, cooperatives, grain mills, transportation and other projects (Galatowitsch, 2009). Between 2000 and 2004, some 7.8 Million USD were contributed by immigrants to developmental projects in Kayes (FSP, 2005).

According to Daum (2007), migrants quadruplicated the health care facilities between 1980 and 1995. While in the late 1980s school facilities were quite inadequate, nearly every village in the region had its own school by 2005 largely financed by emigrants (Daum, 2007). Migrants commit financial resources and play an important role in the project implementation and management.

The access to electricity in rural Mali is exceptionally low. Diaspora organizations in Kayes participate in electrification projects in their region. Together with the Malian NGO “AND DEFAR” and the associated French NGO “ADER”<sup>10</sup> Diaspora organizations are running several projects involving the use of solar energy often providing first electrification for private households and public facilities. Solar panels have been already installed in over 8000 private households; 30,000 people benefit from the

<sup>7</sup> <http://www.iom.int/jahia/jahia/activities/africa-and-middle-east/west-africa/senegal#md>.

<sup>8</sup> <http://www.pseau.org/cms/index.php?id=codevsenegal>.

<sup>9</sup> The Gini coefficient is a measure of the inequality of a distribution (Gini, 1912).

<sup>10</sup> <http://www.ader.eu/english/ader.html>.

electrification of public facilities. Immigrants in France set up a company providing the solar hardware, in which local technical and financial operators work together under contractual agreements with “AND DEFAR”. The program carries out training for local technical support teams and organizes credits for the emigrants to finance the projects.

A different electrification project in the region was initiated in 1999 by migrants residing in Paris and federated within the Sahel Development Immigration Organization (IDS) in cooperation with the Rural Energy Services Company (RESCO), funded by the French energy companies EDF (70%) and TOTAL (30%). The migrants contribute 70% of the connection and the monthly fees for the clients in Mali. The electricity provision is based on solar home systems (10%) and small low-voltage village micro-networks supplied by diesel generators (90%). Research studies are conducted with the view to replace diesel by biofuels (UNDP, 2007). From 1999–2005 RESCO provided electricity to 510 private households (10,200 people) in four villages and their public facilities (UNDP, 2007).

### Conclusions and final remarks

Climate change may undermine the living conditions of people in many parts of the world and force them to leave their home if life becomes unbearable. On the other hand, migration is an adaptation measure that reduces pressure and offers potential opportunities in climate hot spots. With these resources, migrant networks can strengthen the social capital, livelihood and resilience of their origin communities and develop innovative approaches for climate adaptation. As the case studies in Mauritania, Senegal and Mali demonstrate, co-development projects initiated and run by migrant organizations in water, food and energy can be successful if jointly supported by institutional frameworks, involving governmental and non-governmental organizations and companies in countries of origin and destination.

The United Nations can play an important role in supporting such an institutionalization process. The 2010 Cancun Accord provides a first step towards addressing climate change-induced migration on the international agenda. With this new framework, the foundations have been laid for accepting migration as a legitimate adaptation option which, when taken seriously, would also require financial and institutional mechanisms to facilitate the migration-as-adaptation pathway.

For the time being, adaptation for preventing migration remains the dominant concept to avoid climate change from becoming a threat to human livelihood that forces people to flee. With growing relevance of climate change, the migration-for-adaptation path may gain importance, in particular in the Sahel. In all three case regions, the pressure to migrate significantly increased since the 1970s possibly as a response to the onset of the persistent droughts. For those who take this step the international community needs to take supportive measures that move beyond the threat-victim dichotomy and treats migrants as active agents who develop their livelihood options.

Migration was found to be an integral part of livelihood for all described societies for centuries, as it is true for human mobility in many other societies and parts of the world. In view of this fact adaptation strategies should be de-linked from measures to stop migration. Instead developing adaptation can be useful to decrease the pressure on young people to migrate by preserving and improving their livelihood options. New ground can be entered by developing the migration-for-adaptation pathway that improves resilience to climate change and strengthens the links between migrants in host regions and their home communities.

### Acknowledgements

Research for this study was funded in parts by the German Science Foundation (DFG) through the Cluster of Excellence ‘CiSAP’ (EXC177).

### References

- ADB. (2007). *Migrant remittances: A development challenge*. African Development Bank. <http://www.co-developpement.org/?p=309>.
- ADB. (2010). *Transferts de Fonds des Migrants au Maghreb et en Zone Franc*. Casablanca-Bamako: African Development Bank. 16–19 November, 2009. Final report.
- Adger, W. N., Kelly, P. M., Winkels, A., Huy, L. Q., & Locke, C. (2002). Migration, remittances, livelihood trajectories, and social resilience. *Journal of the Human Environment*, 31(4), 358–366.
- Adger, W. N., Lorenzoni, I., & O'Brien, K. (Eds.). (2009). *Adapting to climate change: Thresholds, values, governance*. Cambridge: Cambridge University Press.
- Agrawal, A. (2009). Local institutions and adaptation to climate change. In R. Mearns, & A. Norton (Eds.), *Social dimensions of climate change* (pp. 173–197). Washington, DC: World Bank.
- Ammarrasi, S. (2005). *Gestion des migrations et politiques de développement: Optimiser les bénéfices de la migration internationale en Afrique de l'Ouest*. Geneva: International Labour Office.
- Avalua. (2008). *Bones Pràctiques de la Cooperació Catalana. Construcció d'un pou per a l'abastiment d'aigua a Bouanze, Mauritània*. [http://avalua.cat/cat/06\\_publicacions/bp1.pdf](http://avalua.cat/cat/06_publicacions/bp1.pdf).
- Azama, J. P., & Gubert, F. (2006). Migrants' remittances and the household in Africa: a review of evidence. *Journal of African Economies*, 15, 426–462.
- Ba, I. (2007). *Mauritaniens Résidents à l'Etranger*. [www.carim.org/public/polsocetexts/PO3MAU1092\\_916.pdf](http://www.carim.org/public/polsocetexts/PO3MAU1092_916.pdf).
- Babu, S. C., & Asenso-Okyere, K. (2010). Making innovation and innovation systems work for the poor. *Rural* 21, 44(2), 8–9.
- Bates, B. C., Kundzewicz, Z. W., Wu, S., & Palutikof, J. P. (2008). In *Climate change and water. Technical paper of the Intergovernmental Panel on Climate Change*. Geneva: IPCC Secretariat.
- Bollard, A., McKenzie, D., & Morten, M. (2010). The remitting patterns of African migrants in the OECD. *Journal of African Economies*, 19(5), 605–634.
- CARIM. (2010). *Migration profiles. Consortium for applied research on international migration report*. <http://www.carim.org>.
- Christoplos, I. (2010). Understanding climate change adaptation: lessons from community-based approaches. *Climate and Development*, 2(1), 73–74.
- Conway, D., & Cohen, J. (1998). Consequences of migration and remittances for Mexican transnational communities. *Economic Geography*, 74, 26–44.
- Daum, C. (1995). *Les migrants, Partenaires de la coopération internationale: Le Cas des Maliens de France*. Document Technique No. 107. Paris: OECD.
- Daum, C. (2007). Migration, retour, non-retour et changement social dans le pays d'origine. In V. Petit (Ed.), *Migrations internationales de retour et pays d'origine* (pp. 157–169). Nogent-sur-Marne: CEPED.
- Drevet, O. (2000). *L'implication des associations de migrants dans le domaine de l'hydraulique au Sénégal*. Document réalisé par Séverine Champetier pS-Eau.
- EACH-FOR. (2009). *Environmental change and forced migration scenarios*. Synthesis Report, 14.05.2009.
- Findley, S. E. (2004). *Mali: Seeking opportunity abroad*. Washington, DC: Migration Policy Institute. <http://www.migrationinformation.org/Feature/print.cfm?ID=247>.
- Findley, S. E., & Sow, S. (1998). From season to season: agriculture, poverty and migration in the Senegal River Valley, Mali. In R. Appleyard (Ed.), *Emigration dynamics in developing countries. Sub-Saharan Africa, Vol. 1*. Brookfield, VT: Ashgate.
- FSP. (2004). *Les Migrants au cœur de la coopération*. Pamphlet, Paris: FSP Codéveloppement Mali.
- FSP. (2005). *Migrants: Quelle place dans le développement*. Report. Paris: FSP Codéveloppement Mali.
- Galatowitsch, D. (2009). *Co-development in Mali*. ISP collection. Paper 737. [http://digitalcollections.sit.edu/isp\\_collection/737](http://digitalcollections.sit.edu/isp_collection/737).
- Gemenne, F. (2011). Climate-induced population displacements in a 4 °C+ world. *Philosophical Transactions of the Royal Society A*, 369, 182–195.
- Gini, C. (1912). *Variabilità e mutabilità*. C. Cuppini, Bologna.
- Gonin, P. (2001). *Les migrations venant du bassin du fleuve Senegal vers l'Union Européenne*. Lecture for the symposium “L'état des migrations vers l'Europe.”. Brussels, 21.03.2001.
- Granovetter, M. S. (1973). The strength of weak ties. *American Journal of Sociology*, 78(6), 1360–1380.
- Grillo, R., & Riccio, B. (2004). Translocal development: Italy–Senegal. *Population Space and Place*, 10, 99–111.
- Gubert, F. (2009). Do remittances affect poverty and inequality? Evidence from Mali. *Africa*, 1–21.
- de Haas, H. (2006). Migration, remittances and regional development in Southern Morocco. *Geoforum*, 37, 565–580.
- de Haas, H. (2007). *The myth of invasion. Irregular migration from West Africa to the Maghreb and the European Union*. IMI research report. UK: University of Oxford.
- de Haas, H. (2010). Migration and development: a theoretical perspective. *International Migration Review*, 44, 227–264.

- de Haan, A., Brock, K., Carswell, G., Coulibaly, N., Seba, H., & Toufique, K. A. (2000). *Migration and livelihoods: Case studies in Bangladesh*. Brighton, Sussex: Ethiopia and Mali, IDS.
- IPCC. (2007). *Climate change 2007. Climate change impacts, adaptation and vulnerability*. Geneva: Intergovernmental Panel on Climate Change.
- Jakobeit, C., Methmann, C. (2011). "Climate refugees" as dawning catastrophe? Acritique of the dominant quest for numbers. In: Scheffran, J., Brzoska, M., Brauch, H. G., Link, M. L., Schilling, J. (Eds.), *Climate change, human security and violent conflict*. Berlin: Springer.
- Laczko, M., & Aghazarm, C. (2009). In *Migration, environment and climate change*. Geneva: International Organization for Migration.
- McDowell, C., & de Haan, A. (1997). *Migration and sustainable livelihoods: A critical review of the literature*. Sussex: IDS.
- MDRC. (2007). *Migration Development Research Centre*. UK: University of Sussex. Database available at [http://www.migrationdrc.org/contact/contact\\_us.html](http://www.migrationdrc.org/contact/contact_us.html).
- Mearns, R., & Norton, A. (2009). *Social dimensions of climate change: Equity and vulnerability in a warming world*. Washington, DC: World Bank.
- Myers, N. (2002). Environmental refugees: a growing phenomenon of the 21st century. *Philosophical Transactions of the Royal Society of London Series B*, 357, 609–613.
- Nordás, R., & Gleditsch, N. P. (Eds.). (2007). *Climate change and conflict*. Special Issue of *Political Geography* 26(6).
- Oels, A. (2011). Comparing three theoretical perspectives on climate change as a security issue: from the "securitisation" of climate change to the "climatisation" of the security field. In: Scheffran, J., Brzoska, M., Brauch, H. G., Link, M. L., Schilling, J. (Eds.), *Climate change, human security and violent conflict*. Berlin: Springer.
- Østergaard-Nielsen, E. (2010). Codevelopment and citizenship: the nexus between policies on local migrant incorporation and migrant transnational practices in Spain. *Ethnic and Racial Studies*, 34(1), 20–39.
- Oyebande, L., & Odunuga, S. (2010). Climate change impact on water resources at the transboundary level in West Africa: the cases of the Senegal, Niger and Volta Basins. *The Open Hydrology Journal*, 4, 163–172.
- Page, J., & Plaza, S. (2005). Migration remittances and development: a review of global evidence. *Journal of African Economies*, 15(2), 245–336.
- Panizzon, M. (24–25 April, 2008). *Labour mobility: A win-win-win model for trade and development. The case of Senegal*. Geneva Trade and Development Forum.
- Plaza, S., Navarrete, M., & Ratha, D. (2011). *Migration and remittances household surveys in sub-Saharan Africa*. Methodological Aspects and Main Findings.
- Portes, A. (1998). Social capital: its origins and applications in modern sociology. *Annual Review of Sociology*, 24, 1–24.
- Rain, D. (1999). *Eaters of the dry season*. Oxford: Westview Press.
- Sall, B. (2005). Remittances and economic initiatives in sub-Saharan Africa. In *Migration, remittances and development*. Paris: OECD.
- Scheffran, J., & Battaglini, A. (2011). Climate and conflicts - the security risks of global warming. *Regional Environmental Change*, 11(s1), 27–39.
- Sen, A. (1985). *Commodities and capabilities*. Amsterdam: North-Holland.
- Smale, M. (1980). *Women in Mauritania: The effects of drought and migration on their economic status and implications for development programs*. Washington DC: Agency for International Development (IDCA).
- Sow, P. (2002). Les récolteuses de sel du lac Rose (Sénégal): Histoire d'une innovation sociale féminine. *Géographie et cultures*, 41, 93–113.
- Sow, P., & Alissoutin, R. L. (2010). *ICT and codevelopment in Senegal and Catalonia*. IN3 Spain: Mireia Fernandez-Ardevol et Ros Adela éditions.
- Tall, S. M. (2002). L'emigration internationale sénégalaise d'hier à demain. In M. C. Diop (Ed.), *La Société Sénégalaise entre le local et le global* (pp. 549–578). Paris: Karthala.
- Taylor, J. E. (1999). The new economics of labour migration and the role of remittances in the migration process. *International Migration*, 37, 63–88.
- Tschakert, P., & Dietrich, K. A. (2010). Anticipatory learning for climate change adaptation and resilience. *Ecology and Society*, 15(2), Article No. 11.
- UNDP. (2007). *Gaye, M. Rural electrification in Mali: Improving energy accessibility to the rural poor*. Report.
- Valdes-Rodriguez, & Perez-Vazquez. (2011). Sustainable livelihoods: an analysis of the methodology. *Tropical and Subtropical Agroecosystems*, 14(1), 91–99.
- Warner, K., & Afifi, T. (Eds.). (2011). *Environmentally induced migration in the context of social vulnerability*. *International migration*, 49 (S1).
- WBGU. (2007). *World in transition - Climate change as a security risk*. (London: Earthscan); at [http://www.wbgu.de/wbgu\\_jg2007\\_engl.html](http://www.wbgu.de/wbgu_jg2007_engl.html).
- WIR. (2009). *World investment report 2009*. New York/Geneva: UNCTAD.
- Woodruff, C., & Zenteno, R. (2007). Migration networks and microenterprises in Mexico. *Journal of Development Economics*, 82(2), 509–528.
- World Bank. (2005). *Global development finance: Mobilizing finance and managing vulnerability*. Washington, D.C: World Bank.
- World Bank. (2011). *Migration and remittances handbook* (2nd ed.). <http://siteresources.worldbank.org/INTLAC/Resources/Factbook2011-Ebook.pdf>.