



**USAID**  
FROM THE AMERICAN PEOPLE

# CLIMATE CHANGE, WATER AND CONFLICT IN THE NIGER RIVER BASIN

MARISA GOULDEN AND ROGER FEW

DECEMBER 2011



This report is written by Marisa Goulden and Roger Few, with contributions from the people listed below as part of a project led by International Alert in partnership with the School of International Development at the University of East Anglia (UEA), the Tyndall Centre for Climate Change Research and research partners in Mali, Nigeria and Niger. This project and report have been made possible by the generous support of the American people through the United States Agency for International Development (USAID). The report has been reviewed.<sup>1</sup> The contents of this report are the sole responsibility of the authors and do not necessarily reflect the views of USAID or the United States Government, or researchers within the wider Tyndall Centre or School of International Development, UEA.

**Contributors:** Lulsegged Abebe, Nick Brooks, Mona Daoud, Mamadou Kani Konaté, Elizabeth Sarney, Dan Smith, Boniface Umoh, Phil Vernon, Julia Weiner and Boubacar Yamba.

---

<sup>1</sup> The reviewers included one external reviewer, two reviewers from International Alert not directly involved in the research and a representative of the funding agency.

# CLIMATE CHANGE, WATER AND CONFLICT IN THE NIGER RIVER BASIN

MARISA GOULDEN AND ROGER FEW

## ABOUT THE LEAD AUTHORS

**Marisa Goulden** is a Lecturer in Climate Change at the Tyndall Centre for Climate Change Research and the School of International Development, UEA. She conducts research and teaching on topics related to adaptation to environmental change and international development, water security and management of water resources, human security, livelihoods and resilience.

**Roger Few** has a background in human geography, political ecology, and environment and health in developing countries. His current research focuses on vulnerability and adaptation to natural hazards/disasters and climate change, with special interest in how households, communities and institutions respond to the health risks associated with climatic and environmental hazards. He is a Senior Research Fellow at the School of International Development, UEA, and is also a member of the Tyndall Centre for Climate Change Research.

## ABOUT INTERNATIONAL ALERT

International Alert is a 25-year old independent peacebuilding organisation. We work with people who are directly affected by violent conflict to improve their prospects of peace. And we seek to influence the policies and ways of working of governments, international organisations like the UN and multinational companies, to reduce conflict risk and increase the prospects of peace.

We work in Africa, several parts of Asia, the South Caucasus, the Middle East and Latin America and have recently started work in the UK. Our policy work focuses on several key themes that influence prospects for peace and security – the economy, climate change, gender, the role of international institutions, the impact of development aid, and the effect of good and bad governance.

We are one of the world's leading peacebuilding NGOs with more than 155 staff based in London and 15 field offices. To learn more about how and where we work, visit [www.international-alert.org](http://www.international-alert.org).

## ABOUT THE TYNDALL CENTRE FOR CLIMATE CHANGE RESEARCH

Established in 2000, the Tyndall Centre for Climate Change Research has pioneered interdisciplinary research on the multiple dimensions of climate change. Among its notable achievements are: establishing strategies for managing urban environments and dynamic coastlines in a changing climate; identifying the importance of aviation, shipping, public perceptions and non-state actors for climate change mitigation; advancing the theory for climate change adaptation and resilience; and creating narratives for limiting global warming to two degrees while preparing for four degrees Celsius. The Tyndall Centre for Climate Change Research is a partnership of the University of East Anglia and the Universities of Cambridge, Cardiff, Manchester, Newcastle, Oxford, Southampton and Sussex. The Fudan Tyndall Centre has recently been launched at Fudan University in Shanghai, China.

## ABOUT THE SCHOOL OF INTERNATIONAL DEVELOPMENT, UEA

The School of International Development (DEV) has a global reputation as a centre of research excellence, including policy work with international and national organisations. DEV research addresses contemporary challenges in developing and transition economies through methodological and theoretical innovation, interdisciplinary collaboration and a commitment that its research should make a difference. It works closely with individuals and communities, often taking a long-term approach. DEV also hosts a number of research groups, which are organised along three broad research areas: economic development, social development and sustainable development.

## ACKNOWLEDGEMENTS

We would like to thank the communities in Mali and Nigeria who took part in this study, as well as the local and federal government officials, local and international civil society organisations and academics who have shared their insights in interviews and workshops.

This report would not have been possible without the valuable assistance provided by the members of the project team: Lulsegged Abebe, Project Manager, and Julia Weiner, Project Officer at International Alert; Mamadou Kani Konaté and colleagues at Centre d'Appui à la Recherche et à la Formation (CAREF) in Mali; Boniface Umoh at the Institute of Developmental Studies, University of Nigeria, Nsukka; Professor Boubacar Yamba at the University Abdou Moumouni Dioffo in Niger. We are also grateful for the support of the West Africa Civil Society Forum (WACSOF) for facilitating the research teamwork in Nigeria.

We would like to extend our thanks to the report reviewers for their constructive comments and to Cynthia Brady (USAID), Dan Smith, Lisa Renard, Janani Vivekananda, Phil Vernon, Chitra Nagarajan, Judy El-Bushra and Aurelien Tobie (International Alert), Colette Harris (UEA), and colleagues at DEV and the Tyndall Centre for Climate Change Research, UEA for helpful contributions in various stages of the research.

Finally, we would like to sincerely thank USAID for funding this initiative; in particular, USAID Mali and USAID Nigeria for their support in country.

# CONTENTS

|   |    |
|---|----|
| EXECUTIVE SUMMARY   | 5  |
| ACRONYMS  | 9  |
| 1. INTRODUCTION   | 10 |
| Purpose of the study  | 10 |
| Climate, resources and conflict: research scope and concepts                      | 10 |
| Gender, conflict and climate change   | 13 |
| Methodology   | 14 |
| Structure of report   | 15 |
| 2. CURRENT AND FUTURE CLIMATE OF THE NIGER RIVER BASIN                            | 16 |
| Description of the Niger River Basin and climatological context                   | 16 |
| Historical changes in climate and river flows in the Niger Basin                  | 16 |
| Future climate change in the Niger Basin  | 19 |
| 3. REGIONAL AND NATIONAL WATER MANAGEMENT AND ADAPTATION                          | 20 |
| Water resources management  | 20 |
| Adaptation and future development in the Niger Basin                              | 21 |
| 4. REGIONAL SCALE – CONFLICT ISSUES   | 25 |
| The role of climate and environmental change in conflict                          | 25 |
| Other drivers of conflict in the Niger Basin region                               | 25 |
| 5. CASE STUDY 1 – SÉLINGUÉ, MALI  | 28 |
| Context and description   | 28 |
| River management  | 28 |
| Extreme events and variability  | 30 |
| Access to pasture (land and water)  | 31 |
| 6. CASE STUDY 2 – SÉGOU, MALI   | 33 |
| Context and description   | 33 |
| Water management for irrigation and population displacement                       | 33 |
| Extreme events and variability  | 35 |
| Access to pasture (land and water)  | 36 |
| 7. CASE STUDY 3 – LOKOJA, NIGERIA   | 38 |
| Context and description   | 38 |
| Extreme events and variability  | 38 |
| River management  | 40 |
| Access to pasture (land and water)  | 42 |
| 8. CLIMATE-CONFLICT LINKS AND PROSPECTS FOR ADAPTATION AND RESILIENCE             | 45 |
| Environment-climate stresses  | 45 |
| Climate-conflict linkages   | 47 |
| Responses: the role of adaptation and conflict resolution in providing resilience | 48 |
| 9. CONCLUSIONS  | 54 |
| 10. POLICY GUIDELINES   | 56 |
| REFERENCES  | 58 |
| ANNEX: NUMBER OF INTERVIEWS AND GROUP DISCUSSIONS BY CASE STUDIES                 | 66 |

# EXECUTIVE SUMMARY

## NIGER RIVER BASIN CONTEXT AND CASE STUDIES

The Niger River is the third longest river in Africa, flowing for 4,200 km from its source in the Guinea highlands, within the humid tropics, through Mali and Niger with their semi-arid Sahelian climates, to the Niger delta in Nigeria. The drainage basin covers a surface area of just over 2.2 million km<sup>2</sup>, extending into 10 countries. Seventy-six percent of the basin area is located within Mali, Niger and Nigeria. The Niger River and its tributaries are a key source of water for the estimated 100 million people living in the basin, especially for the drier regions within the western Sahel zone.

This report examines the links between environmental stress, climate change, human security, conflict and adaptation at different scales and localities along the Niger River. Despite a growing interest in the possible linkages between climate and conflict, limited evidence on these linkages exists, much of which is contradictory. The Niger Basin has experienced significant climate variability during the 20th century, making it suitable for studying the links between climate and conflict.

This report explores a number of issues. Firstly, it examines how climatic and environmental stresses influence water resources and human security in the Niger Basin. Secondly, the report examines whether climate stress on water resources increases the risk of conflict. Thirdly, it asks what types of adaptations, conflict resolution and governance mechanisms provide resilience to climate stresses and reduce the risk of conflict.

We examine the impact of climate extremes, issues of river management, and access to land and water for pasture and agriculture for two cases studies located in Mali and one case study in Nigeria. The research draws on a review of published literature for the Niger Basin and Sahel region, and interviews with members of nine communities in the case study locations as well as national and local government institutions, non-governmental organisations (NGOs) and academics in Mali and Nigeria.

The first case study – the Sélingué case study – focuses on the issues faced by the population settled near the Sélingué Dam in Mali. In 2001, to avoid damage to the dam, the gates were opened with little warning to downstream farmers and communities, as upstream flood waters entered an already full reservoir. This resulted in extensive flood damage to downstream irrigated rice fields, crops and settlements, prompting responses from the national and local government and those affected. This case study also examines the effects of ongoing stresses related to climate extremes and variability, competition over access to land and water, and efforts to resolve conflicts between farmers and pastoralists.

The second case study examines an area within the Office du Niger (ODN) zone in the Ségou region, Mali. The focus is on the impacts of heavy rain and flooding in 2010 and land and water management decisions associated with the expansion of irrigation in the region. A planned 14,000-hectare sugarcane project requires the relocation of a number of communities and landuse change away from rainfed agriculture and grazing. The case study also examines ongoing conflict between farmers and pastoralists and how this relates to climatic stresses, land and water management.

A third case study in Lokoja, Kogi State, Nigeria examines the impacts of climate variability, flooding, and natural and human induced changes in the river channel on communities engaged in crop farming and cattle herding close to Lokoja. Changes in rainfall seasons, flooding of crops and homes, and erosion of the river banks are significant problems for the riverside communities. Other changes to the river include the dredging of the river by the National Inland Waterways Authority (NIWA).

## HOW DO CLIMATIC AND ENVIRONMENTAL STRESSES INFLUENCE WATER RESOURCES AND HUMAN SECURITY IN THE NIGER RIVER BASIN?

Much of the Niger Basin is in a region of low rainfall, with high natural variability in rainfall and stream flows. This affects land and water resources and the livelihoods on which people depend. Climate-environment links require careful scrutiny: we show how a systematic process of desertification and degradation in the Sahel is questioned by critical literature. There is a growing argument that the fluctuation of the desert boundary is a normal outcome of long-term climate variability. Climate variability is manifested both in seasonal variations in rainfall over the basin and year-to-year variability in rainfall and extremes.

Extreme events include droughts, which are recurrent in many parts of the basin, but also severe flood events with major impacts on lives, livelihoods, wellbeing and the productivity of sectors. The rural populations in the three case studies have all experienced significant losses and threats to their human security due to climate extremes and other environmental changes, despite varied coping strategies. There is a gendered dimension to the impacts and ability to cope.

The climatic future of the Niger Basin remains uncertain, but climate change is expected to have a key influence on water resources and human security through its impact on climate variability and extremes. There may be other indirect influences of climate change, for example higher temperatures leading to greater demand for water. Disagreement between climate models means that nothing can be said with certainty about the future evolution of rainfall in the basin. A very high degree of climatic variability is expected to continue and may well become more pronounced on seasonal, annual and decadal timescales.

Complex factors are likely to have an influence on the observed ongoing changes in the river and its flow. These factors include variations in rainfall over the river basin, the effect of dams on the timing and quantity of flows, small-scale water abstraction, and deforestation in the basin.

## DOES CLIMATE STRESS ON WATER RESOURCES INCREASE THE RISK OF CONFLICT?

Links between climate stresses and manifest or overt conflict are highly controversial and often challenged. Decades of research on wider issues of conflict underline the complexity of conflict generation and provide a clear warning against making environmentally-deterministic assumptions. Climate variations may be a contributory factor or a trigger, but are unlikely to explain fully the presence of conflict. Climatic change (and variability), in combination with other environmental change and wider dynamics in society, places stresses on people and their livelihoods. This has the potential to sow (or at least water) the seeds of conflict at different scales. Such conflict might be latent in terms of distrust and frustration, or become increasingly manifest.

Conflicts as a result of farmers encroaching on pastoral lands and routes, pastoralists encroaching on farmland, and the cutting of trees for fodder are sometimes violent but often not. Conflict resolution mechanisms appear to be very important in reducing the risk of violence, with different types of mechanism working well or not so well in different locations. Although the degree of climate influence on these types of conflicts is unclear, they are likely to be exacerbated if a change in rainfall, especially drying, forces changes in routes and grazing areas. However, the context in which this occurs – in terms of governance, agricultural or rural policy, changes in cattle population and other influences such as expansion of irrigation and rainfed agriculture or the displacement of grazing and agricultural land by dam reservoirs – will have a large influence. Perceptions of fairness associated with responses to problems are likely to influence whether conflict will increase or not.

Extreme events related to water management can raise latent or manifest conflict between the people exposed and “governors” (i.e. between citizen and state). This is particularly the case if there is minimal warning and an

insufficient emergency response on the part of government. Similarly, water-related developments can be a source of tension between citizens and the state or other actors. A lack of accurate information on or understanding of the nature of benefits and disadvantages of water-related developments, and perceptions of uneven benefits, can lead to distrust and frustration – an indicator of latent conflict.

## **WHAT TYPE OF ADAPTATIONS, CONFLICT RESOLUTION AND GOVERNANCE MECHANISMS PROVIDE RESILIENCE TO CLIMATE STRESSES AND REDUCE THE RISK OF CONFLICT?**

The report offers examples of both good and deficient adaptation occurring at a range of scales from local to national. Community level responses – such as the use of social networks, conflict resolution mechanisms and diversification of livelihood activities, some of which are gender sensitive – provide people with some resilience to climate impacts. However, these are clearly not sufficient, under present climate conditions and stresses, to avoid the losses that contribute to human insecurity.

Existing local mechanisms and citizen-state mechanisms for resolving conflict over environmental resources and water management have had mixed success. Formal and informal local scale institutions, such as community groups, appear to have more ability to respond and more trust than the formal institutions of the state, such as courts of law. Although there were some positive exceptions, where state-led governance mechanisms were able to resolve conflict experienced at the local level, not all groups in society were able to benefit equally. Those adaptations and conflict responses which do improve resilience need to be supported by governance structures and processes. At the same time, planned adaptations should be designed to work in synergy with people's own capabilities.

Peaceful adaptation to the effects of climate variability and climate change is dependent on a reasonable standard of governance, at least to ensure that state authorities are not an obstacle to adaptation. Fair processes of adaptation, where people's views and concerns are taken into account and accurate information is given, are as important as fair outcomes of adaptation, where existing inequalities are reduced rather than increased. Attempts to improve participatory and stakeholder inclusive policy processes in water management initiatives will be important for achieving fair processes and outcomes and reducing risks of tensions between stakeholders, but only if the concerns of communities are adequately addressed.

While many of the determinants of resilience are to be found at the local scale, national and international government institutions and policies are also key to successful adaptation. Policy processes and structures emerging to address climate change show that thinking and planning for adaptation to climate change are beginning in the region. Existing activities not designed explicitly for climate change adaptation, such as early warning and disaster response activities, have only had limited effectiveness, since the capacities to respond at the local government level are limited.

Climate stresses have an impact in combination with other features of the environmental, social, economic and political landscape. Therefore, approaches to adaptation and development are closely linked, and initiatives to support adaptation cannot afford to address climate-related problems alone. Environmental management and development policies must be flexible enough to cope with uncertainty and growing climate variability on long-term timescales. Future development must avoid maladaptation through "lock-in" to unsustainable practices in a changing and variable climate; for example, by maximising irrigated production when times are favourable, but risking collapse when conditions become drier. Building peace through resolving conflicts, adapting to the consequences of climate variability and climate change, and pursuing equitable and sustainable development are linked elements of enhancing human security and building resilience.

## POLICY GUIDELINES

The complexity of the environmental, social and political context of the Niger Basin and the specific nature of many of the case study findings do not lend themselves to simple policy recommendations. Nevertheless, the findings support the following set of policy guidelines.

**1. A focus on building resilience and supporting the ability of the population to adapt is often more appropriate than seeking to promote specific adaptation strategies at the local level.**

Both outside actors and community participants should seek to understand the factors that enable and inhibit resilience, to build on the former and diminish the latter. This goal should be based on knowledge of the local circumstances and achieved by working together. This requires flexibility and attention to the different contexts in which adaptation is occurring, rather than promoting specific planned adaptations.

**2. Equitable, participatory and transparent forms of governance are all important for reducing the risk of conflict and increasing the ability to adapt.**

Engagement within and between communities, government institutions and other outside organisations can be improved by better consultation with and participation of those communities. This can be done through efforts to improve the communication of accurate information about development projects, and through establishing better channels of communication between the state and its citizens.

**3. Multiple scales of action are relevant for responding to climate stresses and reducing the risk of conflict.**

In addition to building resilience locally, the influence of national policies on local abilities to adapt and on tensions between different groups needs to be recognised. Steps should be taken to reduce the negative impacts and increase the positive impacts of policies. Water resource developments often create winners and losers, so principles of good governance and engagement between national and local level institutions are needed to protect and promote the resilience of different social groups.

**4. An increased recognition of the interconnections between development and adaptation will facilitate resilience building.**

A resilience-building approach requires adaptation to be built into development and peacebuilding policies. Incentives to keep adaptation and development efforts separate, resulting from the international financing of adaptation and development, pose a risk of incoherent policies and programmes. Those responsible for adaptation and development programming must work closely together, recognising the substantial overlap between their mandates. Environmental management and development policies need to be flexible enough to adapt to uncertainty and growing climate variability on long-term timescales.

## ACRONYMS

|               |   |
|---------------|---|
| <b>AMUMA</b>  | Amicale des Municipalités du Mandé (Association of Municipalities in Mandé)                               |
| <b>CAREF</b>  | Centre d'Appui à la Recherche et à la Formation (Centre for Research and Training Support)                |
| <b>CGE</b>    | Commission Gestion des Eaux (Water Management Committee)  |
| <b>CIDA</b>   | Canadian International Development Agency   |
| <b>DEV</b>    | School of International Development   |
| <b>DNA</b>    | Direction Nationale de l'Agriculture (National Department for Agriculture, Mali)                          |
| <b>DNH</b>    | Direction Nationale de l'Hydraulique (National Directorate of Water, Ministry of Energy and Water, Mali)  |
| <b>DNM</b>    | Direction Nationale de la Météorologie (National Directorate of Meteorology, Ministry of Transport, Mali) |
| <b>EDM</b>    | Energie du Mali (Mali Energy)   |
| <b>EIA</b>    | Environmental Impact Assessment   |
| <b>FAO</b>    | Food and Agriculture Organization (United Nations)  |
| <b>GEF</b>    | Global Environment Facility   |
| <b>GIRE</b>   | Gestion Intégrée des Ressources en Eau (Integrated Management of Water Resources)                         |
| <b>GTZ</b>    | Deutsche Gesellschaft für Technische Zusammenarbeit (German Society for Technical Cooperation – now GIZ)  |
| <b>IPCC</b>   | Intergovernmental Panel on Climate Change   |
| <b>IWRM</b>   | Integrated Water Resources Management   |
| <b>NAPAs</b>  | National Adaptation Programmes of Action  |
| <b>NASPA</b>  | National Adaptation Strategy and Plan of Action   |
| <b>NBA</b>    | Niger Basin Authority   |
| <b>NCAR</b>   | National Center for Atmospheric Research (USA)  |
| <b>NGO</b>    | Non-Governmental Organisation   |
| <b>NIWA</b>   | National Inland Waterways Authority (Nigeria)   |
| <b>ODN</b>    | Office du Niger (Niger Agency)  |
| <b>ODRS</b>   | Office de Développement Rural de Sélingué (Rural Development Agency in Sélingué)                          |
| <b>PACT</b>   | Programme d'Appui aux Collectivités Territoriales (Regional Authority Support Programme)                  |
| <b>SEMA</b>   | State Emergency Management Agency (Nigeria)   |
| <b>UEA</b>    | University of East Anglia   |
| <b>UNDP</b>   | United Nations Development Programme  |
| <b>UNEP</b>   | United Nations Environment Programme  |
| <b>UNFCCC</b> | United Nations Framework Convention on Climate Change   |
| <b>USAID</b>  | United States Agency for International Development  |
| <b>WACSOF</b> | West Africa Civil Society Forum   |
| <b>WAM</b>    | West African Monsoon  |

# I. INTRODUCTION

This report explores the consequences of climate change and climate variability in the Niger River Basin for human security and the risk of conflict. It presents the findings of a USAID-funded research project led by International Alert, the Tyndall Centre for Climate Change Research and the School of International Development at the University of East Anglia (UEA). The team worked in partnership with local universities and research centres – Centre d'Appui à la Recherche et à la Formation in Mali, the University Abdou Moumouni Dioffo in Niger and the University of Nigeria, Nsukka, in Nigeria.

## PURPOSE OF THE STUDY

The aim of the research was to examine the links between environmental stress, climate change, human security, conflict and adaptation at different scales and localities along the Niger River. The research objectives sought to understand how, in specific locations, the consequences of climate change and climate variability are interacting with societal, economic, political and other contextual factors to increase human insecurity and the risk of conflict. At the same time, the research sought to identify ways in which adaptation and conflict resolution can reduce this risk and build resilience.

The research addressed three specific research questions:

- How do climatic and environmental stresses influence water resources and human security in the Niger River Basin?
- Does climate stress on water resources increase the risk of conflict?
- What types of adaptations, conflict-resolution and governance mechanisms provide resilience to climate stresses and reduce the risk of conflict?

The findings of the research are relevant at local, national, regional and international levels. It is hoped that the findings will: catalyse debate about the understanding of the links between climate and conflict in the context of the Niger River Basin countries; inform relevant policies related to adaptation, water resource management and conflict prevention; contribute to improved governance by informing on-the-ground interventions by key actors (government, donors, and local and international non-governmental organisations (NGOs)).

## CLIMATE, RESOURCES AND CONFLICT: RESEARCH SCOPE AND CONCEPTS

There is growing international interest in the linkages between climate variability/change and conflict. However, only a relatively limited body of research evidence exists to date on this theme. Barnett and Adger (2007) suggest that climate change may lead to increased risks of violent conflict because of reductions in human security either due to the direct impact of climate change on the ability of states to secure a population's livelihoods and human security, or indirectly due to reduced access to natural resources on which livelihoods depend. However, empirical evidence is limited (Nordas and Gleditsch, 2007) and recent global scale studies are contradictory about the links between climate and conflict; in particular, where conflict is defined in terms of violence and war (Buhaug, 2010; Burke et al., 2009).

Decades of research on wider issues of conflict underline the complexity of conflict generation and provide a clear warning against making environmentally-deterministic assumptions. Many contextual factors are important for situations of conflict to develop, such as policy bias in favour of one group over another, changing political and governance structures during governance reform and decentralisation processes, political uncertainty,

opportunism and corruption (Benjaminsen and Ba, 2009). Hendrix and Salehyan (2010) propose that it is the interaction of environmental stress with social and political factors which is key to whether resource-related conflict develops or not. Similarly, Raleigh and Kniveton (2010) emphasise that conflict is complex, sometimes linked to resources but often fundamentally rooted in other factors.

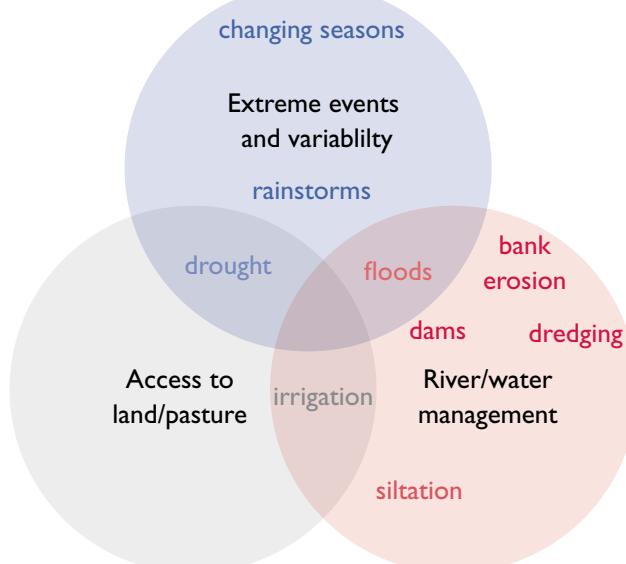
This research considers how climate change and environmental stress, with a particular focus on water resources, will interact with other contextual factors. Such factors include socio-economic and political stresses and the impact these interactions will have on human security and the risk of conflict, as well as on adaptation needs to reduce the risk of associated violent conflict within the Niger River Basin. Human security is a concept that refers to the protection of individuals from chronic threats and harmful disruption to their lives (UNDP, 1994) as well as to notions of freedom from fear and the provision of basic needs (Gasper, 2005). By broadening our research focus to examine human security as well as conflict, we are also interested in those threats which might lead to insecure situations for populations that might include, but not be limited to, conflict.

By environmental stress, we refer to stresses related to climate as a result of climate change and climate variability, and other related environmental stresses. Such stresses include changes in river flow, vegetation and soils which may be partially related to climate stresses. It is important to distinguish between climate change and climate variability. In this report, we adopt the Intergovernmental Panel on Climate Change (IPCC) definitions of the terms. Accordingly, we refer to “climate change” as long-term changes in the climate conditions observable over several decades or longer. “Climate variability”, on the other hand, refers to short-term variations in the climate over periods of days, month, years and decades (Watson, 2001). Climate change will have a key influence on water resources and human security through its impact on climate variability and extremes. However, there may be other indirect influences of climate change; for example, higher temperatures leading to greater demand for water.

Drawing from literature and field research, three broad but overlapping issues related to environmental and climate stresses along with human management of resources are apparent in the Niger River Basin (see Figure 1). The first issue is the impact of climate extremes (heavy rainfall and flooding, drought, storms) and variability (changes in rainfall seasons and year-to-year variability in rainfall and temperature). The second is the issue of river management. The third issue relates to access to land and water for pasture and agriculture.

Figure 1 maps out these issues and explores some of the overlaps and interactions between them. For example, the severity of floods is affected both by the nature of climate variability and how extreme a high rainfall event is, as well as by river management practices, as illustrated by a case study of the Sélingué Dam (see Chapter 5).

**FIGURE 1: LINKAGES BETWEEN CLIMATE-ENVIRONMENT STRESSES IN THE NIGER BASIN**



Conflict occurs at different levels of intensity and at different scales within a river basin. In order to examine the risk of conflict, we used a simple typology of conflict adapted from Lund (2009). This typology distinguishes between three types of conflict:

- Latent conflict – strains among social groups due to internal or external changes that are underlying but not acknowledged or expressed;
- Manifest conflict – where groups are aware of conflicting interests and voice their diverging positions;
- Violent conflict – where major hostilities are imminent or realised.

Table 1 shows the types of conflict and scales of interest for this research. Empirically, the research focused on latent and manifest conflict principally at the local and national scale (including cross-scale interactions). However, the desk study element covered all three categories of intensity and scale.

**TABLE 1: HYPOTHESISED MANIFESTATIONS OF CONFLICT AT DIFFERENT INTENSITIES OF CONFLICT AND SPATIAL SCALES**

| Scale<br>Intensity   | Community/<br>Localised  | Cross-scale<br>(Regional origin, local<br>impact e.g. due to<br>displacement of people)   | International  |
|--|--|---|--|
| <b>Latent conflict</b><br><i>(underlying, unexpressed strains due to change causing difference and contradictions between individuals/groups)</i>                            | Changes or tensions which have the potential to lead to manifest conflict; e.g. changing livelihood patterns and resource availability, competition over land/water or other interests | Changes or tensions that have the potential to lead to manifest conflict; e.g. migration of people causing changing livelihood patterns and resource availability, competition over land/water or other interests | Neutral or unilateral plans or actions that may have an influence on another riparian nation; e.g. incompatible water development plans of upstream and downstream nations |
| <b>Non-violent manifest conflict</b><br><i>(diverging positions are voiced, escalation of conflict as difference and contradictions lead to polarisation between groups)</i> | Disputes (including those formalised through courts, village institutions, political allegiances)  | Disputes (including those formalised through courts, village institutions, political allegiances)   | Hostile diplomatic or economic interactions and barriers to cooperation; e.g. politicised/ securitised statements from ministers/heads of state                            |
| <b>Violent conflict</b><br><i>(escalating violence or organised violence)</i>  | Violence within and between social groups  | Violence between social groups  | Political-military hostile acts, military occupation, war  |

The study was not restricted to analysing the processes of conflict generation related to climate. It also examined more positive aspects of managing conflict and change. One crucial aspect here is the potential linkage to be made between processes of adaptation and the resolution or prevention of conflict. Adaptation refers to 'an active set of strategies and actions taken in reaction to or in anticipation of change by people in order to enhance or maintain

their wellbeing' (Goulden et al., 2009b, p. 449). Adaptation can also refer to adjustments in systems or processes made by different social actors – including communities and organisations, both public and private – to reduce the harmful effects of change and benefit from opportunities (Adger, 2003; Füssel, 2007; Smit and Wandel, 2006).

In the past, societies exposed to climate variability have adapted their livelihoods to fluctuating natural resources (Davies, 1996; Mortimore and Adams, 2001). Adaptations based on livelihood diversification, local knowledge and social networks are able to increase the resilience to climate impacts. However, the most vulnerable, often the poorest and most marginalised, commonly remain vulnerable (Goulden et al., 2009b).

Where climatic and other stresses lead to increased tensions and risk of conflict, adaptation strategies will need to be sensitive to the causes and processes of conflict. In particular, they will need to remain aware of potential pathways which might lead to conflict escalating into violent conflict, referred to by Smith and Vivekananda (2007) as "conflict-sensitive adaptation". Otherwise, adaptations which create winners and losers may increase the risk of conflict. Governance has been described as 'the set of decisions, actors, processes, institutional structures and mechanisms, including the division of authority and underlying norms, involved in determining a course of action' (Moser, 2009, p. 315). Governance structures and processes which support adaptation and conflict resolution are likely to have a role to play in resolving conflict and reducing the risk that conflict becomes violent. However, there has been little research into the links between adaptation to climate change and conflict resolution or conflict prevention. Drawing from Moser (2009), relevant questions to ask of governance structures and processes include the following: In what ways do they matter for enhancement of resilience? To what extent are they functional and effective in supporting adaptation and conflict resolution? When and how do they enable or constrain adaptation and conflict resolution?

## GENDER, CONFLICT AND CLIMATE CHANGE

Based on growing evidence of gender-specific vulnerability and adaptive capacity to climate stresses (Dankelman, 2010; Vincent et al., 2010) and conflict (El-Bushra, 2003), the need to address gender in adaptation to climate change and conflict resolution is increasingly recognised.<sup>2</sup> It is important to recognise the different context-specific priorities, needs and roles of women and men in order to identify positive solutions for them. Women and men experience conflict differently, and gender relations are subject to critical change during traumatic events (El-Bushra, 2003). While conflict may put pressure on the traditional division of labour (Makerere University, 2005), leading women to take on heavier responsibilities and tending to reduce those of men (El-Bushra, 2003; Harcourt, 2009), it can also open space for women's participation in the political sphere. This can in turn create opportunities for social transformation and equality (Sow, in International Alert, 2011, p. 17).

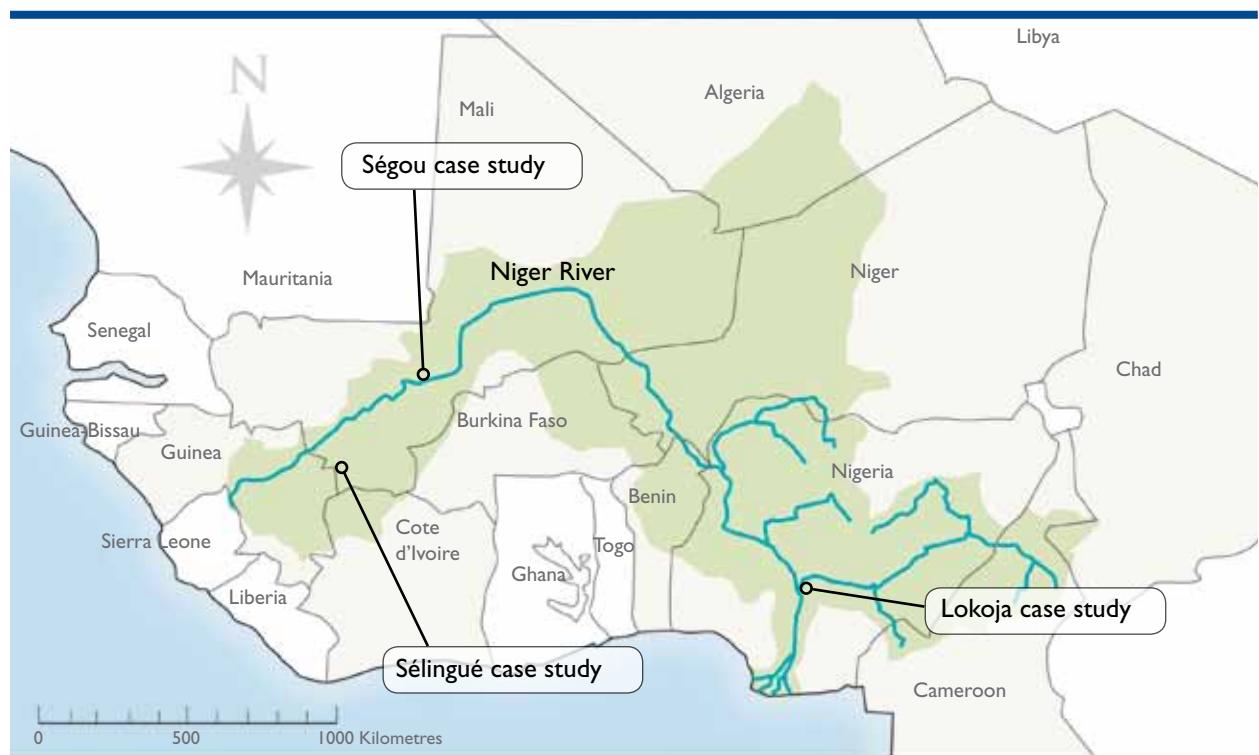
Gender inequalities with regard to women's limited access to resources, restricted rights and muted voice in shaping decisions make them highly vulnerable to climate impacts and hinders their adaptive capacity (Neumayer and Plümper, 2007; UNDP, 2009b). Furthermore, women's roles as the primary users and managers of natural resources in marginalised rural communities make them dependent on the resources most at risk from climate stresses and increase their vulnerability to climate impacts (Rossi and Lambrou, 2008). Adaptation strategies are more likely to be successful when there is an understanding of gendered roles. Such an understanding can greatly assist in securing and improving livelihoods and making use of gendered traditional knowledge and community networking to reduce societies' vulnerability and enhance their adaptive capacity (Aguilar, 2009). For this reason, this report attempts to draw out the gender dimensions of the linkages between climate and conflict, based on the field research – in particular, in the case study chapters and the discussion in Chapter 8. However, several challenges were encountered which impeded a detailed gender analysis. These challenges included the short duration of field visits, the lack of access to female translators in some locations, the cultural norms and sensitivities of the communities we visited, and the reluctance among some women to take part in the research.

2 Gender refers to the socially constructed roles and expectations that are attributed to men, women, girls and boys on the basis of their sex. "Gender relations" refers to a combination of roles, identities, institutions and ideologies, which have enabled societies to allocate the different functions of production and reproduction to different sexes and to uphold a specific social order (International Alert, 2010).

## METHODOLOGY

The study gathered evidence for links between climate and environmental stress, human insecurity, conflict and adaptation in the Niger River Basin through a combination of desk review and empirical research, using a mix of methods at different scales. The methodology comprised desk review of secondary materials, and primary research involving national and regional level interviews and local level case studies. We conducted three cases studies, chosen for the contrasting types of livelihood, environmental stress or resource situation. Two of these studies were carried out in Mali (Sélingué and Ségou) and one in Nigeria (Lokoja). The locations of the case studies within the Niger River Basin are shown in Figure 2.

**FIGURE 2: MAP OF THE NIGER RIVER BASIN AND CASES STUDY LOCATIONS**



The desk study drew on secondary data sources such as available media reports, databases, policy reports and academic literature. Key informant interviews were used with national and local government officials, academics, donors, social activists, local leaders, the private sector and media, etc., to explore links between climate, water, human security and conflict at sub-national, national and international scales. Local level field research for case studies involved interviews with individuals and groups as well as observation. Attempts were made to conduct the interviews in a way which was sensitive to gender differences and to draw out the gender dimensions of vulnerability and coping strategies. The Annex contains a table indicating the sampling by country and case study for the interviews and group discussions.

Three stakeholder workshops – where preliminary results were presented, feedback was received from participants and breakout group discussions were held – were also used to inform this report. Field research in Mali was carried out in February and March 2011, in Nigeria in May 2011, and the stakeholder workshops were held in July 2011. This research received ethical clearance from the University of East Anglia and was compliant with the University's ethics policy for research.

## STRUCTURE OF REPORT

The next three chapters tackle the research topic at the regional scale and discuss current and future climate in the basin, environmental and water management issues, along with conflict issues. The research draws both on published literature and on information from field research. This is followed by three chapters which examine research questions at the local scale by presenting evidence from the three case studies, organised around the themes identified in Figure 1. There then follows a discussion of lessons learned from the material presented in the previous chapters. This discussion focuses first on the nature of environment-climate stresses in the basin, then on conflict-climate linkages, followed by a discussion of responses in terms of actions and governance mechanisms to build resilience and reduce conflict. The report culminates in a set of key policy guidelines for resilience building, adaptation and reducing conflict, as supported by the study's findings.

# 2. CURRENT AND FUTURE CLIMATE OF THE NIGER RIVER BASIN

## DESCRIPTION OF THE NIGER RIVER BASIN AND CLIMATOLOGICAL CONTEXT

The Niger River flows for 4,200 km, making it the third longest river in Africa. Its drainage basin covers a surface area of just over 2.2 million km<sup>2</sup> (FAO, 1997), although the hydrologically active area has been estimated at 1.5 million km<sup>2</sup> (Andersen et al., 2005). The basin extends into 10 different countries,<sup>3</sup> with 76 percent of its area located in just three: Mali, Niger and Nigeria (FAO, 1997). The Niger River extends from its source in the humid sub-Saharan environment of Guinea through the semi-arid Sahelian regions of southern and central Mali, southwestern Niger and northeastern Nigeria. It continues on to the humid tropical environment of western and southern Nigeria, before terminating in the Niger Delta, where it flows into the Gulf of Guinea (see Figure 2). The Niger River is thus a key source of water, especially for the western regions of the Sahel.

An estimated 100 million people live within the basin, with the population growing at approximately three percent a year on average (Andersen et al., 2005). Mali and Niger depend on the Niger River and its tributaries for the majority of their water resources. Niger, in particular, is highly dependent on river flow from upstream countries. At the same time, Nigeria contributes a large amount of flow to the river from rainfall within Nigeria (FAO, 1997).

Since the majority of the basin lies in the Sahel zone (between 10° N and 20° N, and 20° W and 10° E), the description of the historical climate and future projections of climate change for the basin in this section draws heavily on literature on the Sahel climate, which is well researched. Less published information is available for the more humid portions of the basin. However, this chapter draws some information from country-specific studies of climate change.

The Niger River is fed by rains generated by the West African Monsoon (WAM) system, which dominates the climate of the region. Rainfall in the Sahel is strongly seasonal, with almost all rainfall occurring in the boreal summer, during which most rainfall typically occurs in the months of July to September (Nicholson, 1978; Rowell and Milford, 1993). As in all arid and semi-arid regions, rainfall is highly variable in both space and time, and drought is a common feature of the region. The strong south-north rainfall gradient and the high sensitivity of the WAM system to external forcing factors (e.g. sea-surface temperature patterns) mean that rainfall can vary greatly from year to year and also on timescales of decades or longer.

## HISTORICAL CHANGES IN CLIMATE AND RIVER FLOWS IN THE NIGER BASIN

### CHANGES IN RAINFALL, TEMPERATURE AND RIVER FLOW IN THE BASIN

It is important to understand historical patterns of climate variability and change in order to contextualise projections of climate change for the future and claims that are being made about the current impact of climate change. Historical records indicate that high variability in climate is the norm for the Niger River Basin and the

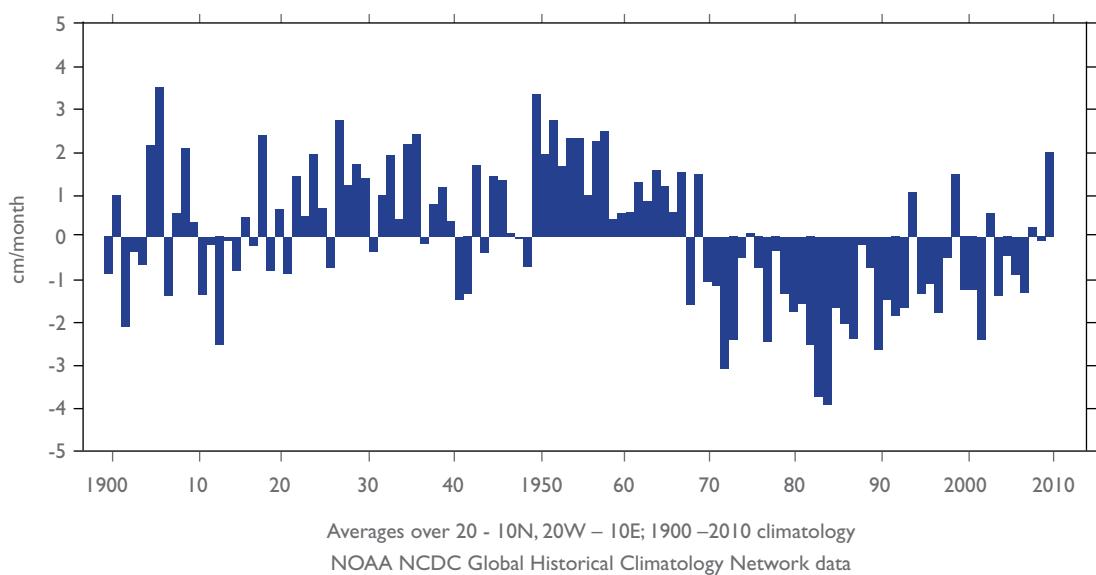
<sup>3</sup> The 10 countries are: Guinea, Côte d'Ivoire, Mali, Burkina Faso, Algeria, Benin, Niger, Chad, Cameroon and Nigeria (FAO, 1997).

Sahel, with alternating wetter and drier periods. Going back to pre-historic time periods, palaeoclimatic records demonstrate that the region has been affected by the expansion and contraction of the Sahara Desert in response to large-scale changes in global climatic conditions on timescales of thousands of years.

Instrumental rainfall records in the Sahel clearly illustrate the strong variability of rainfall in the region (Figure 3), as well as the well-documented decline in rainfall since the late 1960s (Hulme, 2001). The rainfall record also reveals a shift in climate around 1950, changing from predominantly year-to-year variability to variability visible over longer periods of decades. The 1950s and 1960s were consistently well above the long-term mean, while the 1970s, 1980s and 1990s were consistently well below the long-term mean in most years (Figure 3).

Since the mid-1990s, rainfall has recovered somewhat in the Sahel, with rainfall in a number of years being above the long-term mean. This was accompanied by an increase in vegetation in some areas, in part due to rainfall increases (Olsson et al., 2005). However, the “recovery” of the Sahel has been uneven, with dry conditions persisting in the western Sahel where the Guinea portion of the Niger Basin is located, which is of key importance to Niger flows. In contrast, rainfall has increased progressively since the late 1990s in central Sahel, the portion of the basin within Niger, which is less important to overall Niger flows (Lebel and Ali, 2009).

**FIGURE 3: SAHEL ANNUAL RAINFALL ANOMALIES FROM 1900 TO 2010**



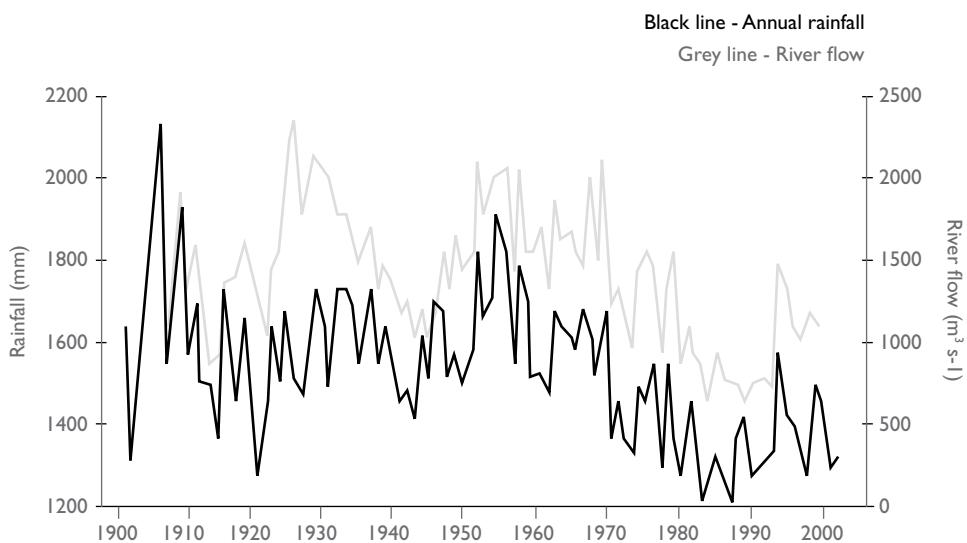
Note: The rainfall anomalies are expressed as standard deviations from the mean over the same period.

Source: Data and graphic from the NOAA Global Historical Climatology Network, analysed and provided by Todd Mitchell, University of Washington. See <http://jisao.washington.edu/data/sahel/>.

It has been claimed that the impact of climate change is already being felt in Mali (UNDP, 2009a). Over the last 40 years, Mali has been experiencing an increasingly harsh climate, accompanied by an increase in the frequency of phenomena such as drought and flooding (République du Mali, 2000). Mali has seen a decrease in annual five-day rainfall maxima of approximately 4.0 mm per decade since 1960. The rate of decrease varies between seasons, with the largest decadal decrease recorded occurring during the wet season (McSweeney et al., 2008). Such changes in the seasonality of rainfall are important for impacts on livelihoods. However, given the high variability of climate in the region, it is not clear whether these observed trends in rainfall and extreme events are a long-term trend in climate that will persist for more than a few decades. Temperature increases, however, are less ambiguous than rainfall changes. The current mean temperature for Mali constitutes an increase of approximately 0.7°C since 1960 (0.15°C per decade on average), with the rate of temperature increase varying between seasons (McSweeney et al., 2008).

Figure 4 shows how river flow fluctuations largely mirror fluctuations in annual rainfall for the Niger River at Koulikoro in southwestern Mali from 1900 to 2002. The graphs show high year-to-year variability in rainfall and river flow and evidence of decadal scale trends. There is a noticeable decline in flows in the 1970s and 1980s, reaching the lowest flows in the mid-1980s, but with a partial recovery since the early 1990s (Conway et al., 2009). Olomoda (2006) found that average flows at Koulikoro in Mali, Niamey in Niger and Lokoja in Nigeria all reduced during the period 1970 to 1990. The largest flow reduction from the 1950 to 2000 mean occurred in the decade 1981 to 1990 at Niamey (72 percent), compared with a 42 percent decline at Koulikoro and 24 percent for Lokoja for the same time period. Some of the observed change in river flow is likely to be attributable to changes in land use, land cover and water abstraction, rather than solely to rainfall variability (Conway et al., 2009; Ferry et al., 2011a).

**FIGURE 4: ANNUAL RAINFALL AND RIVER FLOW OF THE NIGER RIVER AT KOULIKORO IN MALI**



SOURCE: Conway, D., Persechino, A., Ardooin-Bardin, S., Hamandawana, H., Dieulin, C. and Mahe, G. (2008). *Rainfall and water resources variability in sub-Saharan Africa during the 20th century*, Tyndall Centre Working Paper 119, Norwich, UK: Tyndall Centre for Climate Change Research

## CLIMATIC EXTREMES

Decades of intensive academic research into climatic and environmental change in the Sahel was stimulated by the severe drought of 1972–1973, during which it is estimated that over 100,000 people died and millions of livestock were lost. The earliest explanations for the cause of drought focused on land degradation and desertification caused by local anthropogenic phenomena such as overgrazing (e.g. Charney et al., 1975; Lamprey, 1975). However, a vast body of subsequent research has demonstrated that the principal drivers of drought in the Sahel are large-scale changes in patterns of ocean surface temperatures (e.g. Folland et al., 1986; Giannini et al., 2003). These in turn may have been partly driven by short-lived atmospheric aerosols associated with northern hemisphere industrial emissions from outside of the Sahel region (e.g. Held et al., 2005; Evan et al., 2009). Furthermore, the notion that the Sahel has experienced, and is continuing to experience, systematic degradation and desertification on a regional scale has been strongly challenged in light of evidence of a recent “greening” of much of the region (Brooks, 2004; Olsson et al., 2005). What was interpreted as systematic desertification and degradation of the region is more accurately seen as a transient manifestation of large-scale climatic variability associated with decadal scale oscillations in monsoon behaviour and the position of the “desert boundary” (Brooks, 2004). Nonetheless, the Sahelian climate is influenced by many complex,

interacting processes, and it is likely that land surface conditions and other factors such as desert dust aerosols play some role in mediating rainfall and reinforcing drought conditions, even if they cannot explain the onset and longevity of drought (Nicholson, 2000; Yoshioka et al., 2007; Hiu et al., 2008).

While most research and action has focused on drought and its impacts in the Sahel, the region also experiences periodic flooding. In 1953, heavy rainfall destroyed crops and resulted in famine (the “Muda”) that persisted for the first nine months of 1954. This affected some five million people in western and south-central Niger, northern Nigeria and northern Cameroon (Grolle, 1997). The high impact of these heavy rains resulted not just from their intensity but also from the timing, occurring early in the season and destroying young crops.

The heavy rains of 1953 occurred during a period of above average rainfall in the Sahel region at large. During the dry period – spanning most of the final three decades of the 20th century – the intensity of the heaviest rainfall is reported to have declined (Easterling et al., 2000). However, since the “recovery” of Sahel rainfall in the mid-1990s, floods associated with intense rainfall have again become more common, most notably in 1995, 1998, 1999, 2002, 2003, 2005, 2006, 2007 and 2010 (Cook et al., 2011; Tschakert et al., 2010). Paeth et al. (2009) analyse the conditions associated with widespread flooding in the region in 2007 and associated this phenomenon with a number of factors, including anomalous heating in the tropical Atlantic and a La Niña event in the tropical Pacific. Tarhule (2005) points out that cumulative rainfall in the days prior to a heavy rain event is an important factor in determining whether such rainfall results in flooding. Other climate-related hazards of significance in the region include extreme temperatures, sandstorms and dust storms, strong winds, brush fires and locust swarms. Within Nigeria, the part of the basin extending south of the Sahel zone, an increase in the severity of weather across the country has been documented, with a greater number of torrential rains and storms being experienced (Odjugo, 2009).

## FUTURE CLIMATE CHANGE IN THE NIGER BASIN

Global climate models do not agree on whether the Sahel region is likely to become wetter or drier over the course of the 21st century. Around half of the models used by the IPCC (Christensen et al., 2007) predict increased rainfall, while the other half predict decreased rainfall. Nonetheless, predictions of wetter conditions in the central and eastern Sahel (including the portion of the Niger Basin within Niger) and drier conditions in the western Sahel (the Guinea highlands and source of the Upper Niger) are compatible with recent observations. The climate model that most closely captures the late 20th century Sahel drought suggests a drier future for the region (Cook, 2008). On the other hand, many regional models forced with moderate increases in atmospheric greenhouse gas concentrations suggest an intensification of the monsoon and a greening of the Sahel and parts of the southern Sahara (see Brooks, 2004, for a review). As well as changes in mean annual rainfall, the Sahel is likely to continue to experience changes in the seasonal distribution of rainfall, with modelling studies suggesting drier conditions in July and August, offset by wetter conditions in September (Patricola and Cook, 2010). Projections of a later start and shortening of the wet season are consistent across different climate models (Biasutti and Sobel, 2009).

The major portion of the Niger Basin that is outside of the Sahelian zone is in the humid tropical zone of southern Nigeria, a region already facing high temperatures and levels of precipitation. While climate models differ, some projections suggest that Nigeria may experience an increase in both rainfall and temperature (Podesta and Ogden, 2008) as well as a rise in the frequency and intensity of extreme weather events, such as floods and droughts (Ministry of Environment of the Federal Republic of Nigeria, 2003). The extreme variability of the basin’s climate, and the likely long-term evolution of the warming effect of increases in global greenhouse gases<sup>4</sup>, means that one single climatic future for the basin is unlikely. Moreover, any shift to drier or wetter conditions is likely to be reversed at some point in the future.

<sup>4</sup> Gases in the atmosphere that absorb and emit radiation, including but not limited to: water vapour; carbon dioxide; nitrous oxide; methane and ozone (Watson, 2001).

# 3. REGIONAL AND NATIONAL WATER MANAGEMENT AND ADAPTATION

## WATER RESOURCES MANAGEMENT

A reduction in water levels in the Niger River and the inland delta in Mali has been blamed on changes in rainfall, for which there is some evidence (see Figure 4). However, rainfall variability is unlikely to be the only influence on river water levels. A study by Ferry et al. (2011a) highlights several factors which influence river levels. These include the high variability in river flows over the 20th century, the impact of large dams and the important, but neglected, impact of small-scale water abstractions.

Siltation of the river channel was mentioned by many interview participants in Mali and Nigeria as a problem for water resources management. This was linked to a perceived reduction in vegetation because of drought, as well as deforestation and vegetation clearance by people, along with heavy rain causing erosion and deposition of sediment in the river. These processes are thought by some to be responsible for a widening and shallowing of the river, also leading to other impacts such as a reduction in fish catches. However, these widely held perceptions of siltation of the river are challenged by research which has shown that the upper parts of the Niger River are deepening, rather than becoming shallower. This is attributed to sand extraction activities (for the construction industry) and a reduced sediment supply due to the presence of the Sélingué Dam trapping sediment from nearly one quarter of the drainage basin (Ferry et al., 2011b). There are also narratives of wind erosion causing siltation, as sand from the dryer areas in the northeast of Mali is blown into the river.

Other changes in the river mentioned in interviews in Mali include: the reduction in fish catches, particularly large species; the pollution of the river by gold mining and textiles dye activities; sand extraction from the river. Few interview participants mentioned the impact of the dams on the river depth and volume. In response to the disputed problem of siltation of the river, the Malian government has a programme to dredge the river bed, funded by the Spanish. The Nigerian government, through its National Inland Waterways Authority (NIWA), is also dredging the river in the southern part of the basin from the Niger Delta to Lokoja in central Nigeria.

Challenges for water management include: the allocation of water between different users and countries; the lack of knowledge of the river, including climate variability and climate change impacts; the implementation of Integrated Water Resources Management (IWRM). According to one interview participant, quantitative monitoring of the resource in the basin is quite good, but there is a lack of qualitative information. There are proposals to build a model to help with water allocation between different users in the upper Niger Basin within Mali (from Sélingué to the Office du Niger (ODN)) – such as farmers, pastoralists, fishers and Energie du Mali (EDM), which produces hydroelectricity.

Dams in the basin have various purposes. The Sélingué Dam in Mali, managed by the Commission Gestion des Eaux (CGE), is used to regulate and store water for hydroelectricity production and irrigation, and also to control floods. The Markala Dam in Mali regulates water flow for irrigation of the ODN zone. The presence of the dams has reduced peak flows of the river, but increased the minimum flow. This is seen as beneficial for

water management, according to one interview participant. However, flood recession agriculture<sup>5</sup> on the river banks has declined, since the land that is flooded has reduced in area.

Mali and Niger have shifted towards the concept of IWRM, an approach which aims to conserve and sustain water resources, increase agricultural output, satisfy increasing demand for all kinds of water usage, and respect the needs of ecosystems as part of environmental protection. In 2000, Niger revised its water resources master plan and produced a policy and strategy document for water usage and water treatment. Under IWRM, responsibility for the implementation of water resources management involves a range of actors: the state, collectives, non-governmental organisations (NGOs) and the technical service providers which oversee projects.

## TRANSBOUNDARY WATER MANAGEMENT

Since the Niger River Basin is shared by 10 countries, water resources management is coordinated at the international level by the Niger Basin Authority (NBA)<sup>6</sup>. One of the NBA's major initiatives was the adoption and implementation of a Sustainable Development Action Plan (Andersen et al., 2005), which most significantly involves managing several hydroelectric and agricultural dams built along the river. One interview participant described how if Mali wants to build a dam, it must take the plans to the NBA for a decision. Representatives from each of the Niger Basin countries form part of the NBA, so each country has a chance to comment on water resource development plans.

The existence of dams on the river, when combined with climate variability, has caused misunderstandings between countries sharing the river in the past. For example, one interview participant explained how the building of the Sélingué Dam in 1982 coincided with a period of drought, and downstream countries thought that Mali was retaining water, causing the low flows of the river. Such incidents can now be dealt with by the NBA, since data is collected and shared between countries. There are many collaborative projects under the NBA such as Niger Hycos, which collects and collates data from the 9 NBA member countries. There is also a project to protect the river banks. In addition, bilateral cooperative initiatives are underway between basin countries. For example, a collaborative project between Mali and Guinea aiming for IWRM of the upper Niger Basin<sup>7</sup> was started in response to a pollution incident from upstream Guinea which affected drinking water supplies in Bamako, Mali's capital.

## ADAPTATION AND FUTURE DEVELOPMENT IN THE NIGER BASIN

Development planning in the basin needs to accommodate a high degree of uncertainty in future climate, particularly rainfall, to be able to cope with a range of very different possible futures. Such uncertainty is hardly new in a region characterised by climatic conditions which are highly variable on multiple timescales and in which there is a high degree of spatial variability in rainfall. One of the reasons why the late 20th century Sahel drought was so devastating for the region was that it followed a period of particularly high rainfall during which large-scale economic development had been pursued, based on the implicit assumption that climatic conditions would remain more or less constant. During the very wet 1950s and 1960s, economic "modernisation" was pursued in order to generate economic growth in newly or soon-to-be independent countries. This process was based on the intensification and expansion of agriculture, and a transition from subsistence to commercial agriculture (Cooper, 1997). This involved the expansion of agriculture into "idle lands" which were viewed as under-utilised and potentially productive, but which were historically marginal and unsustainable for agriculture under the drier conditions which followed the anomalously wet 1950s and 1960s (Heyd and Brooks, 2009).

5 A system of cultivation making use of the natural irrigation and fertilisation of the flood plain which occurs when rivers seasonally overflow their banks.

6 Only nine of the ten countries which contribute to the area of the river basin are members of the Niger Basin Authority. Algeria is not a member.

7 The project is called GIRE (Gestion Intégrée des Ressources en Eau – Integrated Water Resources Management).

One of the consequences of this agricultural expansion was the marginalisation of pastoralists, who were pushed further into the desert fringes. This meant that they could not sustain their livelihoods when the wet conditions ended (Thébaud and Batterbury, 2001). The catastrophic famines of the 1970s (and the 1980s) in the Sahel may, therefore, be viewed as much as the result of “maladaptive” development as of drought. Although drought acted as a trigger for famine, poor development policies which failed to account for the highly variable nature of Sahelian climate had resulted in a significant increase in the vulnerability of Sahelian societies to drought.

Future development in the basin needs to avoid maladaptation through “lock-in” to practices and systems which seek to maximise or enhance agricultural and economic productivity when conditions are favourable, but which are unsustainable under conditions of protracted drought or long-term desiccation. Water-intensive activities such as cotton, rice and sugarcane production may need to be re-evaluated. At the same time, issues of sustainability under “pessimistic” but plausible projections may need to be addressed. Even if rainfall increases, anticipated increases in temperature will result in increased evapotranspiration, with potentially significant impacts on surface water resources and groundwater recharge.

Successful adaptation in some parts of the region, such as in northern Nigeria, has taken the form of a shift from global to regional markets, greater crop diversity, the substitution of animal dung for fertiliser, mixed cropping schemes, and greater use of soil and water conservation techniques. These measures have combined to maintain soil fertility in the face of declining rainfall and population growth (Mortimore, 1998; Mortimore and Adams, 2001). In some respects, the basin population is potentially well equipped to adapt to climate change; traditional livelihoods have evolved to cope with a highly variable and unpredictable climate. Examples include the widespread use of mobile pastoralism, which enables herders to move to areas where water and pasture are available. Although pastoralism has been systematically undermined by development policies in many areas, it remains widespread and provides a potential foundation for adaptation (Brooks, 2006).

Traditional agricultural systems have also developed mechanisms for coping with climatic variability and unpredictability. For example, in the semi-arid regions of Niger, farmers sow seeds in multiple fields which are kilometres apart as a risk-spreading strategy; this maximises the chances of benefitting from highly localised rainfall (Graef and Haigis, 2001). Other traditional methods for enhancing agricultural performance include the use of planting pits, micro-dams and catchments, along with the construction of soil ridges and stone lines to conserve both soil and moisture (e.g. Graef and Haigis, 2001).

Future adaptation to climate change in the basin is most likely to be effective if it combines traditional techniques and practices with appropriate technological and managerial interventions, rather than seeking to replace traditional systems with “modern” approaches. Examples might include the more widespread use of communications technologies (e.g. mobile phones) to help farmers assess environmental conditions in distant fields, to save time and labour in deciding when and where to plant seeds. Whatever adaptation approaches are taken, they will need to balance the desire for greater agricultural and economic productivity with the need to spread risk in a highly (and probably increasingly) variable and unpredictable environment.

## **NATIONAL ADAPTATION INITIATIVES**

Mali, Niger and Nigeria have all made steps at the national level to implement planning for adaptation to climate change. Mali and Niger have produced National Adaptation Programmes of Action (NAPAs), supported by the United Nations Development Programme (UNDP) and the Global Environment Facility (GEF). This is a requirement for Least Developed Countries that are signatories of the United Nations Framework Convention on Climate Change (UNFCCC).

Mali’s NAPA was completed in 2007 and led by the Ministry of Environment, supported by UNDP (République du Mali, 2007). Agriculture (farming, fishing and pastoralism) was identified as a key priority for adaptation, to be achieved mainly through planning activities to build resilience within the sector. GEF, UNDP and the Food

and Agriculture Organization (FAO) funded the first NAPA projects in Mali. In addition, the NAPA report is used by NGOs and others to plan related projects and activities. According to government representatives involved in the Mali NAPA process, the initiative brought several benefits, including an increased visibility of climate change issues within the government, raised awareness of climate change and existing adaptation measures among the population, and the creation of a planning tool. Challenges associated with NAPA, as identified by research participants, include the lack of financial means and staff capacity to implement projects. This has resulted in weak implementation of programmes at the local level.

Niger's NAPA was completed in 2006 and led by the National Environmental Council for Sustainable Development, with funding provided by GEF. It identified several adaptation measures which form part of Niger's overall national approach to poverty reduction and rural development. The highest priority adaptation projects identified in NAPA are to strengthen fodder provision for livestock production and to improve crop irrigation (Republic of Niger, 2006). Niger also has a National Technical Commission on Climate Change and Variability, which presented a national communication to the UNFCCC in 2000 along with a National Strategy and Action Plan for Climate Changes and Variability, which was adopted in March 2004.

Nigeria, since it is not classified as a Least Developed Country, was not required to produce a NAPA. Nonetheless, with the support of UNDP and the Canadian International Development Agency (CIDA), it began producing a similar document in 2010 which it has called its National Adaptation Strategy and Plan of Action (NASPA). This is currently in draft form and Nigeria is aiming to finalise it by the end of 2011. The country has also set up a Special Climate Change Unit, under the Ministry of Environment. This unit is coordinating the production of the NASPA and also a Climate Change Policy, which is currently in draft form after a national-level review took place in early 2011. Nigeria is also working on its second National Communication to the UNFCCC.

In addition to the specific climate change adaptation initiatives mentioned above, the Niger Basin countries are conducting other activities which are relevant to adaptation to climate change and climate variability. For example, in Mali, research is being carried out into different crop varieties for crops that are better adapted to rainfall variability, such as short season maize, millet and dryland rice.

The Ministry of Agriculture and the National Directorate of Meteorology (Direction Nationale de la Météorologie, DNM) of Mali have a longstanding programme of agro-meteorological assistance, which was initiated in 1982 in response to the drought of the 1970s. Rain gauges have been distributed to villages throughout the country and farmers have been trained to collect rainfall observations. These are used to provide advice to farmers in the form of planting calendars or sowing guides. This information is distributed by radio and TV and also directly as bulletins sent to the trained farmers, translated into five local languages. Ten-day and seasonal forecasts produced in Niamey are also distributed. The forecasts also give information on pasture and water points. There is some evidence for an increase in agricultural production in response to the programme (see Hellmuth et al., 2010). The programme faces some challenges, however, particularly in terms of supervision and gathering of data on impact, as there is a lack of funding for monitoring and evaluation.

The DNM also has a pilot programme of rain-seeding, which has been running since 2005. It claims to be successful, saving crops when rainfall is insufficient. The DNM coordinates with the National Directorate of Agriculture (Direction Nationale de l'Agriculture, DNA) to assess where additional rainfall might be needed. They are now evaluating the programme. There is reportedly some distrust of the programme among the population; for example, according to one interview participant, a similar programme in Senegal was stopped after floods because people were concerned that the rain-seeding had caused the floods.<sup>8</sup> The rain-seeding initiative is a high-cost programme, funded by the government of Mali, with technical support provided by the US-based National Center for Atmospheric Research (NCAR).<sup>9</sup> Mali also has a new rain and drought

<sup>8</sup> For information on Senegal rain-seeding, see [http://www.wmo.int/pages/prog/arep/wmp/documents/Sarr\\_Senegal.pdf](http://www.wmo.int/pages/prog/arep/wmp/documents/Sarr_Senegal.pdf) (357Kb)

<sup>9</sup> For further information, see <http://www.rap.ucar.edu/projects/westafrica/>

monitoring programme, to be implemented by the National Directorate of Water (Direction Nationale de l'Hydraulique, DNH). Under this programme, information on historic flooding incidents will be collected from farmers and assessed for correlation with rainfall data.

New efforts in Mali on climate change also include seminars for educating and gathering the perceptions of the wider public on climate change impacts, an initiative which is funded by the Spanish meteorological agency (see Hellmuth et al., 2010). Findings from the seminars have shown that traditional forecasting methods are no longer considered useful by the rural population, because they have noticed a change in the weather. During the seminars, the participants are informed about climate change, adaptation possibilities are discussed and rain gauges are distributed for the agro-meteorological assistance programme. In Nigeria, there are also efforts to raise awareness of climate change which are being carried out at the state level.

## **FLOOD MANAGEMENT**

In Mali, a national commission for responding to floods was created under the Ministry of Administration Territoriale. According to one interview participant, research has shown that the maximum flood intensity in the Malian portion of the basin has increased, but the overall quantities of water have decreased. Emergency response to flood victims often consists of food and basic household items but does not include helping people to rebuild their houses. In Mali, the CGE advises EDM, the operator of the Sélingué Dam, using data from upstream incoming floods to avoid coincidence of high flows on two branches of the river upstream from Bamako which would result in flooding. Water releases from the dam are governed by information about the incoming flood from Guinea and water levels in the reservoir. Chapter 5 contains more information about the role of the CGE.

Nigeria has a programme for flood forecasting, management and control, and erosion monitoring within the Ministry of Environment. A flood risk vulnerability study and mapping exercise was carried out by the Ministry of Environment with the support of UNDP. The programme is now trying to establish a flood early warning system in Nigeria, with a community-based component and an automated flood-monitoring component. However, the initiative is facing the challenge of insufficient financing.

# 4. REGIONAL SCALE – CONFLICT ISSUES

## THE ROLE OF CLIMATE AND ENVIRONMENTAL CHANGE IN CONFLICT

A number of authors have attempted to link climate change and environmental degradation with conflict at global, regional and local scales (e.g. Campbell et al., 2007; Mabey, 2008; Burke et al., 2009). These factors have also been invoked as drivers of conflict in the Sahel region, most notably in Darfur (e.g. UNEP, 2007), but also in the 1989 conflict between Mauritania and Senegal (Parker, 1991). Nonetheless, the links between climate change and conflict remain highly controversial, and studies purporting to demonstrate such links have been widely challenged (Maxwell and Reuveny, 2000; Gleditsch et al., 2007).

The example of the conflict in Darfur in western Sudan provides a number of lessons relating to the study of these links in the semi-arid Sahelian region in general. A widely-cited report by the United Nations Environment Programme (UNEP) (2007) linked the conflict in Darfur to climate change, desertification and land degradation, arguing that these factors had brought farmers and herders into conflict over dwindling resources. However, the conflict in Darfur followed several years of relatively abundant rainfall (Brown, 2010). While earlier droughts played some role in establishing the social, economic and political conditions in which the conflict originated, many other social, political and economic factors have been identified as drivers of conflict (Young and Osman, 2006).

Suhrke (1993) makes a distinction between climate change conflict minimalists, who see climate change as one of many interacting drivers of conflict, and maximalists, who see climate change-driven environmental deterioration as a direct cause of conflict over diminishing resources (often water resources or productive land). With respect to Africa, Burke et al. (2009) concluded that civil wars were more common in Africa in warmer years. They even went so far as to quantify the impacts of climate change on conflict, suggesting a climate-related increase in the incidence of armed conflict of 54 percent by 2030, resulting in an additional 393,000 deaths. The conclusions of Burke et al. (2009) regarding the link between temperature and conflict in Africa were widely criticised. For example, Buhaug (2010) provided a detailed critique, countering that economic conditions and governance were more significant as drivers of conflict.

In a global analysis at the sub-national scale, using georeferenced historical data relating to a number of factors assumed to be sensitive to climate, Raleigh and Urdal (2007) found that population growth and density were associated with increased risks of conflict. On the other hand, the effects of land degradation and water scarcity on conflict were weak, negligible or insignificant. With specific reference to transboundary water resources, Barnaby (2009) examined 1831 instances of interactions over international freshwater resources between 1948 and 1999. He found that 67 percent of these interactions were cooperative, 28 percent were conflictive and the remaining 5 percent were neutral or insignificant, with no formal declarations of war over water during this period.

## OTHER DRIVERS OF CONFLICT IN THE NIGER BASIN REGION

While environmental changes in the form of long-term variations in climate may play a role in “setting the stage” for conflict, the causal relationship is highly complex and the role of policy is crucial in the emergence of conflict. One of the key characteristics of development policy in the Sahel since the 1950s has been agricultural intensification, expansion and modernisation (Cooper, 1997; Bloch and Foltz, 1999). In the wet 1950s and

1960s, agriculture was intensified and expanded into areas that were seen as “underutilised”, but which were in fact historically marginal and which would have served as grazing areas for pastoralists in drought years. When dry conditions returned in the early 1970s, agriculture in these areas suffered and pastoralists either could no longer access them, losing their livelihoods or perishing, or came into conflict with settled farmers in areas recently converted to agriculture. Since the 1970s, land tenure reforms have tended to promote private ownership of land at the expense of common property rights. In particular, they have favoured agriculture over pastoralism, making pastoralists more vulnerable to drought and undermining reciprocal arrangements which previously allowed different groups access to common resources (Hill, 1989).

Bejaminsen et al. (2010) examine land use conflicts in the inland Niger Delta region of Mali in the Mopti region, based on court records, in order to assess the evidence for links with climate change and variability. They find a peak in land disputes in 1995 following an unusually wet year and relatively few land disputes in the early 2000s following a “relatively dry period”. The researchers reach the general conclusion that there is ‘little reason to suspect that short-term climatic anomalies are important drivers of land tenure disputes in the court system’ (Benjaminsen et al., 2010, p. 9). Instead, they conclude that a sharp increase in land disputes in the early 1990s, peaking in 1995 and then declining and stabilising, is probably related to the political reforms of 1991–1992, when multi-party democracy and decentralisation policies were introduced.

Turner et al. (2011) examine farmer-herder conflicts in West Africa through studies of four rural communities in Niger. In this instance, the most common cause of conflict (verbal, political or violent in their terminology) is crop damage by livestock, the risk of which is increased by the proximity of livestock to agricultural land. They conclude that the ‘increased proximity of grazing livestock to cropped fields results primarily from an expansion of the cropped areas in the four study areas’. Significantly, they report that in one of the study communities, farmer-herder conflict is reported to have declined ‘in large part due to recurrent drought leading to the reduced presence of outside herders in the village area during the cropping season, indicating further that the relationship between drought and conflict is far from simple’ (Turner et al., 2011, p. 197–200).

Djiré et al. (2010) studied causes of conflicts associated with water in three case studies in Douentza, southern Mali.<sup>10</sup> They found that, in dryer zones, some conflicts are related to water scarcity, but that, in more humid zones, conflicts occurred over the political benefits which control over access to water brings. Conflict also occurred in a third case study over access to land in the flood plain, rather than directly over water. The authors also recorded plentiful instances of cooperation associated with conflict and were of the view that problems mostly occurred where local rules and conventions were not adhered to.

In recent decades, a discourse has emerged in which conflict in the Sahel, particularly between farmers and herders, is seen as resulting from drought, desertification and land degradation. This has caused herders to migrate into agricultural areas, where they have come into conflict with farmers. This model presents conflict as generated by environmental trends, on the one hand, and the associated encroachment of mobile pastoralists into settled areas on the other. However, this is a highly simplistic and partial representation of the reality of the interaction between environmental change and conflict in the Sahel. In particular, it neglects the central role played by development policies in driving conflict.

Nonetheless, today, pastoralists are seen as highly vulnerable to climate change and indeed as “backward”, despite evidence that in the past they have adapted to deteriorating environmental conditions associated with severe and rapid climate change (Di Lernia, 2002, 2006; Jousse, 2004). As a result, development policies have tended to marginalise pastoralists and undermine their livelihoods, making them more vulnerable to drought through a restriction of their access to resources, principally water and grazing land, largely through land tenure reforms which favour agriculture at the expense of pastoralism (Bloch and Foltz, 1999).

<sup>10</sup> See also case study reports examining conflict over water (Djiré and Cissé, 2010; Cold-Ravnkilde, 2010).

All of the above factors – land tenure reforms, development policies and political reforms – increase the likelihood of conflict. While drought undoubtedly contributes to livelihood pressures and migration, resource-based conflicts in the Sahel may be viewed as much the result of development policies as of environmental degradation and climate change.

# 5. CASE STUDY I – SÉLINGUÉ, MALI

## CONTEXT AND DESCRIPTION

This case study examines interacting issues around climate variability, flooding and management of the River Niger, by focusing on the Sélingué Dam in Mali and issues faced by the population settled near the dam. We examine the impact of a flooding event in 2001 and the responses to it. We also examine the effects of ongoing stresses related to climate extremes and variability, competition over access to land and water, and efforts to resolve conflicts between farmers and pastoralists. The material we present here is based on interviews with local government officials,<sup>11</sup> key stakeholders and residents of three settlements close to the Sélingué Dam and reservoir, in the regions of Koulikoro and Sikasso in southern Mali.

The Sélingué Dam is located on the Sankarani River, a tributary of the Niger River. It was completed in 1981 for the purpose of hydropower production and irrigation. However, it also plays a role in flood control and navigation provision due to its modification of downstream flows (dry season flows have increased). The reservoir of the dam occupies a volume of 2,170,000m<sup>3</sup> and has become a major resource for fishing, with an estimated 80 percent of fish consumed in Bamako coming from Sélingué and approximately 6,000 fishermen recorded in the 2010 census. Many of these fishermen migrated from other regions of Mali, such as Mopti and Ségou in south-central Mali and Gao in eastern Mali. Estimates of the number of people displaced by the reservoir vary from 15,000 to 35,000 persons (Beukering et al., 2005; Skinner et al., 2009).

The first flooding event we examine occurred in September 2001, when the dam operators, EDM, had to release water quickly from the dam to make space for the incoming flood from upstream after a period of high rainfall in Guinea. Interview participants told how the dam reservoir was already at a high level because EDM had accumulated water in order to meet high electricity demand during the African Cup football tournament, which was to be hosted in Mali. EDM opened the dam gates with little warning to downstream farmers and communities in order to avoid damage to the dam. This resulted in extensive flooding and damage to downstream irrigated rice fields, croplands and settlements.

Flooding again caused damage to villages and crops in 2010, as a result of the heavy rainfall that was experienced across the Niger River Basin. Additional issues of concern raised by local government stakeholders include a perceived widening of the river, causing impacts on fishing, erosion of cropland and increasing flood risk, bank erosion by cattle and deforestation. There is a perception that the dam has brought many economic benefits to the area, but that the increase in human population and economic activities has also put pressure on natural resources. The area receives many migrating cattle herds and experiences ongoing issues between farmers and cattle herders.<sup>12</sup>

## RIVER MANAGEMENT

### COMMUNITY PERSPECTIVES

People in a village downstream from the dam perceived both benefits and disadvantages regarding the dam. They associated the development of the area with the presence of the dam; for example, a new road, a health centre, better access to water, access to chemicals for agriculture, expansion of vegetable growing, and markets

<sup>11</sup> Local government in Mali operates at the level of the “region”, “cercle” and “commune”.

<sup>12</sup> In Mali, cattle herders/pastoralists are often referred to by their ethnic group – “Peul”.

to sell their crops. Some members of the village grow rice in the irrigated plots, but many rely on rainfed agriculture and vegetable gardens close to the river.

They noticed the difference that the dam has made to the flow of the river, describing how there is no longer a period in the year when the river runs dry, as it did before. Now animals have to cross the river on Saturdays and Sundays, when the water level is low, presumably because of demand for electricity and, hence, low water releases on these days. Disadvantages that they perceived included an increase in mosquitoes. The villagers did not openly blame the dam for the flooding they experienced in 2001; however, when probed, some people recognised a link with the dam, explaining how the heavy rain meant that the dam was full and they had to open it, which caused the flood. Others did not know the cause of the flood or attributed it to God.

The 2001 flood was the worst they had known. Water swept through the village rapidly and remained in their homes for about a month. Impacts included the destruction of many homes, crops, food stores and small livestock (chickens, goats and sheep), as well as the contamination of the drinking water supply in shallow wells. The locals did not receive any warning regarding the water release. People observed more cases of sickness, particularly malaria and diarrhoea, among children and adults.

Women, men and children were all affected by the flooding, but men and women appeared to show different responses. From the topics discussed in the focus groups and interviews, it seemed that the women were more concerned with the loss of their small animals, finding shelter for the children and older people, accessing safe water, obtaining and preparing food communally, and caring for the sick. The men, on the other hand, were more concerned with helping people to move out of the flooded area and with the rebuilding of collapsed homes. One woman commented how stressful the flood situation was for her:

*I was very distressed, all the more so since the house had collapsed and our belongings were destroyed. I was emotionally shattered by the situation. (Interview 11)*

A range of coping strategies were used in response to the floods. Some people whose houses were flooded were able to stay in relatives' houses within the village until the water had receded and they had rebuilt their houses. Others made temporary plastic shelters, which increased their exposure to diseases. Some people obtained food by making and selling charcoal and buying food at the market. They also sold belongings such as cows to pay for bricks to rebuild houses. They received a few mats and blankets as emergency assistance from outside agencies, but little else. One person told how neighbouring villages were similarly affected and unable to assist them. However, there were sources of assistance within the village. One member of a village-based committee revealed how they helped relocate people and their belongings from flooded houses. Despite these coping strategies, people suffered significant losses. One man described how it took his family seven years to recover their losses after the flood.

Village residents expressed their desire to move the village further away from the river and towards the road to avoid flooding. People felt that the government did not listen to their various demands or provide assistance with the things they needed, especially after the flooding events:

*Nothing happens at our level. So there are no changes here. There is some assistance that never gets to us. Since for nine years they have given us nothing, we do not have hope. (Interview 6)*

## **INSTITUTIONAL PERSPECTIVES**

Irrigated plots were offered to those who were displaced by the reservoir as compensation and also to meet additional demand from locals and newcomers. Dam management was blamed for the 2001 flooding rather than an extreme climate event. One informant told how warnings of flood releases from reservoirs were usually given by radio and TV, but this time it was given very late. The rice farmers whose irrigated plots had been

destroyed asked EDM for compensation for their lost crops, but EDM refused to take responsibility. The rice farmers then sued EDM and won the case.<sup>13</sup> EDM appealed and eventually, with the intervention of the president, a settlement was agreed for CFA 200 million<sup>14</sup> (about €305,000). The trial led to the demand for the establishment of a managing committee for the dam, made by the rice farmers through the Union des Sociétés Coopératives of the zone Office de Développement Rural de Sélingué (ODRS), which manages irrigation in the area. The CGE was created in 2003 in order to have a management entity that would represent, in theory, all water users.

The CGE is a national entity, chaired by the Direction Nationale de l'Hydraulique. It comprises representatives of technical services, including the DNM, the ODN, the ODRS, EDM and Civil Protection. There is an assumption that the mayors of relevant localities are represented by the Mayor's Office of the District (the central Mayor of Bamako) and that ODN and ODRS represent the farmers. However, there is some question as to the effectiveness of local participation, since two mayors interviewed had not heard of it. One national government interview participant commented that participation was limited because of limited funding, but that the membership of the CGE was due for review.

The main mandate of the CGE is to ensure coordinated management of the Sélingué Dam.<sup>15</sup> The CGE meets every one to three months, or more often during extreme events. Decisions made by the CGE inform EDM's filling and release policy in order to manage water releases and water levels in the dam, and upstream and downstream of the dam. The CGE try to balance different criteria, including meeting irrigation needs at Sélingué and downstream at ODN, meeting electricity generation needs and avoiding flood damages. Different groups lobby for their interests to be taken into account. For example, during 2011 rice producers and fishermen lobbied for the dam to be closed to prevent an upstream drop in water level. Since the formation of the CGE, a repeat of the 2001 flooding incident has been avoided.

## EXTREME EVENTS AND VARIABILITY

### COMMUNITY PERSPECTIVES

Communities have been experiencing the impact of climate variability on their livelihoods. Farmers told us that from 1981 to 1989, the rains were poor and the harvests bad. They experienced a lack of food, empty food stores and malnutrition. They also recounted how animals invaded the fields and ate crops during that time. They described how the rains became more abundant following that period.

The most recent extreme climate event that people experienced was in 2010, when heavy rain caused damage to houses and crops. Similar problems were experienced across much of the Niger Basin in August 2010. Residents of one village close to the river described how the flooding that they experienced in 2010 was less severe than the 2001 flooding. Several houses collapsed, especially the older ones, and there was flooding in the village. However, it is not clear whether the river overtopped its banks in 2010 or whether the damage was more related to heavy rain and localised flooding. The impacts of and responses to the flooding in 2010 were similar to those described for the 2001 flood event, although the management of the dam did not appear to be a factor of concern for the 2010 flooding.

One person commented how the women suffered during the drought period (1981 to 1989), since they had to walk a long way to collect water from the river as all the village wells had dried up. Access to clean water is often difficult for the women with the shallow wells drying up in the dry season. The women explained that the

<sup>13</sup> After the first trial, EDM was to pay CFA 445 million (€78,400) for damages and CFA 500,000 (€62) for compensation for moral harm, according to one interview participant (translation of French legal terms based on <http://www.dictionnaire-juridique.com/definition/dommages-interets.php>).

<sup>14</sup> CFA refers to the West African Franc. € = CFA 656 as at 18th November 2011.

<sup>15</sup> See Ministère des Mines, de l'Energie et de l'Eau, Direction Nationale de l'Hydraulique (2004). Atelier Régional sur la Prévention des Catastrophes (ISESCO) Dakar – Mali report available in French at [http://www.preventionweb.net/files/913\\_Mali-report.pdf](http://www.preventionweb.net/files/913_Mali-report.pdf) (395Kb).

river water is dirty and difficult to access because the river banks were steep. The group of women interviewed expressed their desire for an alternative source of clean water.

## **INSTITUTIONAL PERSPECTIVES**

From the interviews, it appears that the flooding in 2010 was a result of heavy localised rainfall rather than the opening of the dam, although this could not be confirmed. One interview participant told how those farmers growing rice in the irrigated plots also suffered losses due to flooding in August 2010, in particular those who had spent money applying fertilisers. One interview participant estimated that the loss of crops due to flooding in one of the *cercles* was 40 percent. Another participant described how some loss of the rice crop due to flooding is considered a normal occurrence by rice farmers. Where villages are affected by flooding, there is an emergency response by government agencies, which provide items such as plastic sheets and food.

## **ACCESS TO PASTURE (LAND AND WATER)**

### **COMMUNITY PERSPECTIVES**

People in the village where the majority of village-level interviews were carried out practise mixed livelihoods based on agriculture. They keep animals as well as cultivate crops, with men keeping cows and women keeping small animals. They grow year-round fruit and vegetable crops beside the river and some pump water from the river to irrigate crops. The villagers explained that they grow much less cotton compared with five years ago, since the profitability of cotton has dropped. During the wet season, rainfed crops include maize and peanuts. Cultivated area has increased as the population and family sizes have grown. Some men cultivate rice in the irrigated fields but they described how the crop had been poor recently due to pest outbreaks. Some men fish as well as farm, although not everyone can afford the equipment. Fishing techniques have changed since the dam was built. They started cultivating vegetable gardens close to the river some years ago, which is when they really started to have problems with cattle eating crops, even those cattle belonging to people in the village.

A village elders committee is responsible for trying to find an agreement between community members if a farmer has a problem with animals eating his crops, avoiding the necessity of going to higher authorities. Farmers themselves may try to prevent problems by getting children to watch over the crops when animals are passing by. If crops do get eaten, the farmer and animal owner sometimes resolve the issue between themselves without referring to others. However, they are not always satisfied with the outcome, as one owner of some fruit trees destroyed by cattle explained:

*If I had harvested, I would have earned at least CFA 50,000 [€76] per month; now with these problems, I only got CFA 100,000 [€152] and I lost five years of work. (Interview 8)*

Most problems between migratory cattle herders and farmers occur in the dry season after the end of the rains. The herders migrate from the delta area (Djoliba, Segou, Mopti) to the southwest and pass the village. Some villagers feel that there is a limit to what they can do to resolve problems with herders. They believe that it is up to the government of Mali to deal with the problem, possibly because many of the animals are owned by those in government, as one interview participant from an NGO indicated:

*Cattle are owned by major political actors; therefore, it does not matter if they do not respect all the rules established by the conventions, as they are protected by the government anyway. (Interview 5a)*

Villagers described how the government, with the help of foreign assistance,<sup>16</sup> introduced a scheme for marking agreed cattle routes, following incidences of conflict between farmers and pastoralists in the area. The project was introduced to the village by the mayor and completed about two years ago. Villagers also described an agreement whereby pastoralists were not supposed to move with their animals before 31st January or return after 31st May, when the river level rises. Under this agreement, farmers are not to plant crops in the agreed routes. Two villagers have been trained and have participated in the marking out of the routes. Several villagers believe that the cattle routes appear to have been a success, since they have noted a reduction in problems between pastoralists and farmers. Others noted that this year there were many more animals in the area, since those that would normally go to Côte d'Ivoire have stayed in Mali because of conflict in Côte d'Ivoire. This has meant a shortage of fodder for their own animals.

## INSTITUTIONAL PERSPECTIVES

One local government interviewee described how pressure on land for agriculture had been exacerbated as a result of the dam reservoir displacing croplands. He also raised concerns about new pressures on land from land investments, such as a Libyan investment of 200 hectares for a tourist village close to the lake shore. Another local government participant commented how the region had become a zone of pastoralism.

In many cases, it is the mayor who deals with conflict between farmers and pastoralists. However, there are differences in conflict resolution measures between different  *cercles* and regions. In one area of our case study location, the mayors drew up a convention in 2002 under the banner of Amicale des Municipalités du Mandé (AMUMA),<sup>17</sup> which set up rules for the herders. These include specific routes and dates for entering and leaving the area, in order to avoid the destruction of forests and crops by cattle (see Figure 5). Under the convention, farmers are forbidden from growing crops within 50 metres of these routes. The convention also forbids herders from cutting tree leaves for fodder and establishes rules for tree felling and charcoal production. There is also a project for training people and setting up mediation structures for improved dispute management.

In the neighbouring region, there are no similar agreed cattle routes or conventions. However, one interview participant described how pastoralist communities work with a “lodger” – a sedentary *Peul* – who takes responsibility for the migratory herders and their cattle.

**FIGURE 5: IMAGE OF POSTER EXPLAINING CATTLE ROUTES**



**Note:** The text of the poster reads as follows: ‘Stop conflicts between farmers and herders! Let us respect the marked paths for animals and the terms of the local convention to prevent and manage conflicts linked to the access and use of resources for agro-pastoralism and forestry. Let us look after our paths and their management rules to reduce conflicts.’

<sup>16</sup> They referred to “Americans”, but in fact the donor for the project was the German development agency Deutschen Gesellschaft für Internationale Zusammenarbeit (GTZ) (Kundermann et al, 2004).

<sup>17</sup> Amicale des Municipalités du Mandé (AMUMA) is supported by the Programme d’Appui aux Collectivités Territoriales (PACT) of GTZ (see Figure 5).

# 6. CASE STUDY 2 – SÉGOU, MALI

## CONTEXT AND DESCRIPTION

This second case study examines an area within the ODN zone in the region of Ségou in south-central Mali. Here we look at the impacts on the population of climate variability (particularly heavy rain and flooding in 2010) and land and water management decisions associated with the expansion of irrigation. We also examine ongoing conflict between farmers and pastoralists and how this relates to the aforementioned issues. The material we present here is based on interviews with local government officials, key stakeholders and residents of three settlements within the *cercle* of Ségou in the Ségou Region.

The ODN was created in 1932 and the irrigation water is provided by the Markala Dam, constructed on the Niger River in 1943 and completed in 1947. The ODN is a commercial public establishment under the supervision of the Ministry of Agriculture, Livestock and Fisheries. It is responsible for managing and developing water and lands in the central zone of Mali around the Niger River and the inland delta.<sup>18</sup> Although there are 2,800,000 hectares of land demarcated in the ODN zone, only 100,000 hectares of irrigated land are currently managed by the ODN. The ODN is currently expanding the area of irrigated land in the zone by attracting investment. One of these investments is the planned Markala Sugar Project, a public-private partnership between the Malian state, a South African company and two other private companies. The initiative is being financed by the African Development Bank to grow and process sugar cane for sugar and biofuel production (African Development Bank, 2010). The project is due to start in 2012 with 14,000 hectares of irrigated area, mostly for sugarcane to be sold to a new factory; some 5,600 hectares of this area have been earmarked for “local production” of crops. The project will require the relocation of some communities and change in use of the lands, which are currently used by the population for rainfed agriculture and grazing. Our case study focused on one area affected by the Markala Sugar Project, but expansion of irrigation is also occurring elsewhere in the ODN zone. An example is the Malibya Agriculture Project, which plans to irrigate 100,000 hectares of land for rice and other crops in Masina (Diallo and Mushinzimana, 2009).

In addition to the increase in irrigated land area, rainfed agriculture has been expanding and there are ongoing conflicts over land and water between farmers and pastoralists. Insufficient rains and damage to crops and property from heavy rain and floods also cause problems for the population in this region.

Livelihood activities consist of rainfed agriculture, vegetable growing on the banks of the canals and river, and irrigated rice cultivation. Many farmers also keep livestock. In addition, pastoralists have settled in the area and land is used for grazing. Fishing is also an important livelihood activity. Many interview participants told how fish catches had diminished. More people have turned to fishing over the years and fishermen have adapted their techniques to increase their catches. Communal fishing is still practised in pools which are seasonally isolated from the main flow of the river.

## WATER MANAGEMENT FOR IRRIGATION AND POPULATION DISPLACEMENT

### COMMUNITY PERSPECTIVES

According to several interview participants, the new sugarcane project would have a large impact on the population. It is already a cause of uncertainty and concern as well as tensions between the state and the affected

<sup>18</sup> For more information about the ODN (in French), see [http://www.maliagriculture.org/services\\_tech/Office%20du%20Niger/page-ON.html](http://www.maliagriculture.org/services_tech/Office%20du%20Niger/page-ON.html).

village residents. As well as impacting on populations currently carrying out rainfed agriculture, the increase in irrigated land will reduce the land available for pasture and affect cattle migration routes. As one interviewee outlined:

*With the coming of the new project there are problems; farmers don't understand what is happening to their land. It has brought some conflict and poses a problem to the application of the existing convention (between farmers and pastoralists). (Interview 19)*

Farmers interviewed were unwilling to talk about the new sugarcane project, since it is a source of current disagreement within the community. Pastoralists described how they had seen people coming to do studies on their land but claimed that they had not been informed about the nature of the project. They knew very little about it and were worried:

*For the moment, we have not been informed about this situation [the sugarcane project] ... we have not been told but we are in a precarious situation. Last year, they came to take some measurements in our plots. (Interview 27)*

Nursery fields had already been established in early 2011, using plots of land leased from some of the communities, for which they had been compensated for their lost income.

## **INSTITUTIONAL PERSPECTIVES**

The Office du Riz du Ségou and the ODN are the two main institutions of irrigation in the zone. Farmers can apply for a plot for rice cultivation and pay a tax on the water used. The vision of the ODN is to increase the area of land irrigated to meet the nutritional needs of Mali and neighbouring countries. The ODN is attracting funding from different sources to expand irrigation. For example, the German government is funding new irrigation infrastructure for rice at Niono, at a cost of €5,000 per hectare.

It is thought likely that there will be a big influx of migrants to work on the plantations and that the displaced villagers will move to the towns. Some in local government have seen this as a good opportunity for the development of the area, but have acknowledged the misgivings of some community members. An Environmental Impact Assessment (EIA) of the project was carried out, which mentioned discussions with communities to gather their wishes and decide on the new pastoralist routes that the project was expected to fund. However, there was some criticism from one interview participant that the EIA did not consider the communities' interests sufficiently. It was observed that conflict arose because of poor communication in the way that the project was introduced and because communities did not welcome change and were given few options:

*The problem is the study was mainly about going to see the people and telling them 'you cannot use your land anymore as the government is taking it, because we are going to grow something else here, what do you think can be done for you, what alternative do you suggest?'. (Interview 19)*

One interview participant emphasised the strong influence of decentralisation and politics in the decisions being made over land and water use.

A decrease in river flows had been observed by interview participants which influences the water available for irrigation. The perception is that this is linked to lower rainfall and climate change. Figure 4 in Chapter 2 seems to support this, although climate variability might be a more accurate term to use rather than climate change. One interview participant acknowledged that reduced rainfall in the future might cause problems once larger areas were irrigated. However, others seemed to have fewer concerns about climate variability or climate change. For now, there is a strong perception that water quantity is not a limitation, at least in the wet season; rather, it is financial resources which are considered the limitation:

*The water that we have is largely sufficient to cultivate all the parcels of the Office du Niger. During the rainy season, even one million hectares can be irrigated and we don't even have to close the dam. But it's because we don't have the means that we don't irrigate all the land. It's a problem of money. The state has very limited capacity. This is why we can't irrigate more space. But there is enough water. (Interview 20)*

ODN claims to be trying to encourage more efficient water use by discouraging water-intensive crops such as rice and encouraging less water-intensive crops such as vegetables, through taxation. It is also starting training for farmers to reduce water consumption. However, it is not clear how expanding the area planted with sugarcane fits in with this policy, since sugarcane is very water intensive.

If the ODN needs to increase the water level at the Markala Dam for irrigation needs, it issues a request for water to be released from the Sélingué Dam, via the institution of the CGE. With respect to transboundary dimensions of water use, the ODN informs the NBA of its plans through the DNH. According to one interview participant, the ODN is the biggest water user in Mali and the perception is that, for now, upstream countries have not had a big impact on water use by the ODN. According to an interview participant, it does not appear that the NBA, or the transboundary concerns of other countries, pose any limitation to ODN activities:

*The NBA is here to respond to the development policy of the member states ... All the information is treated by them and we know whether the river has the capacity to serve all the countries. So if Mali has to irrigate lands, we go to the NBA Mali representative who treats the information with the NBA. (Interview 20)*

## EXTREME EVENTS AND VARIABILITY

One local government respondent described an increase in wind in recent years, as well as a shortening of the rainy season from four months to two months and a reduction in the quantity of rain. This has affected rainfed agriculture and reduced fodder for animals. Other environmental changes perceived by many respondents included a reduction in river water and an increase in sand in the river. Some linked this to erosion and vegetation clearance while others linked it to river management. A decrease in fish catches was linked by many to this phenomenon. The impact on fish catches on reduced river flows because of water abstraction and fishing pressure were rarely mentioned, unless directly probed. The heavy rains and resulting flooding problems experienced in 2010 appeared to have been unusually extreme across much of the Niger Basin and caused damage to homes and crops.

## COMMUNITY PERSPECTIVES

Many farmers and pastoralists noted changes in rainfall seasons and negative impacts on their livelihoods. Others noted that the rains were variable from year to year as before. Heavy rain has led to flooding problems, particularly in 2010 when many villages in the area experienced flooding, causing damage to houses and crops. Some villages closest to the river expressed a wish to be relocated.

*Last year there was a lot of rain, in 2010. It was too abundant. There were floods here. People said that they never saw it like that in 80 years. Houses fell down and fields were submerged so they couldn't harvest. There was a lot of rain and the fields produced little. (Interview 24)*

The heavy rains and flooding also destroyed irrigated rice crops. People described how they had made all their water payments, despite getting little or no crop at the end of the season. People were expecting some assistance from government but did not receive any, adding to their frustration:

*The authorities did a survey of the houses; they promised help but no one received even a single franc from them. (Interview 25)*

Floods were a problem in 2010 but a lack of rain was more often a problem:

*This year the flood destroyed our crops. Except for this year, every year our plots experienced difficulties linked to (insufficient) water given the low rainfall. (Interview 26)*

Some farmers obtained irrigated rice plots because of the difficulties they had experienced with unreliable rainfall. However, some told how the ODN closed the canals from time to time, threatening their crops. This indicates that, at least at some times of the year, water for irrigation is limited. Farmers sometimes respond to this by taking informal action themselves, by trying to reopen the water supply.

Pastoralists explained how in previous droughts, they were still able to obtain fodder for their animals nearby; for example, by cutting leaves from trees. They described how the vegetation was gone now and how this was no longer an option in case of drought, since they were prevented from cutting branches by the authorities. They said that selling off their animals was not something they would normally do as a response. Pastoralists listen to weather forecasts on radio and use the information to avoid areas where it has recently rained, since it is too difficult for the animals to move over the damp ground.

Contrary to scientific evidence that climate variability and water abstraction have had the biggest impact on the river (Ferry et al., 2011a), there is a strong perception in the community visited closest to the river that siltation of the river is responsible for a decrease in river flows and fish catches. Decreases in fish catches have meant that many fishermen have turned to extraction of sand from the river for use in the construction industry as a source of additional income in the last two years.

## **INSTITUTIONAL PERSPECTIVES**

One interview participant (an irrigation engineer) told us how flooding induced by heavy rainfall did not greatly influence the irrigated areas, since the drainage system was good and drought was more of a problem than flooding. Other interviews suggested that poor drainage in rainfed agricultural areas contributed to flooding. Another participant explained that there was a water users' committee – Committee Locale de l'Eau – which is under the DNH. The committee was created to carry out environmental projects, to reduce erosion and to improve water quality. However, it is not known how effective this committee is.

A census was carried out by local government of the damages caused to communities affected by the flooding in 2010. However, we have no information on any assistance provided to communities, other than the information offered by the community members to whom we spoke, who said that they had received nothing.

## **ACCESS TO PASTURE (LAND AND WATER)**

### **COMMUNITY PERSPECTIVES**

There appeared to be a lot of distrust and tensions between farmers and pastoralists in this region, as illustrated by these comments by a group of farmers:

*Pastoralists are just doing what they want and refuse to move away from the crops, saying that animals find more food here than in other places. They do it on purpose to destroy our crops. During this period, bush grass is becoming dry while cattle like fresh grass. But by trying to get closer to the fresh grass, you are likely to cause damages. (Interview 26)*

Farmers are driven to expand the area they cultivate, because of insufficient rains. This is possibly a similar strategy to that employed by farmers in Niger (Graef and Haigis, 2001), as explained by one farmer:

*I would like to talk about the rain; it's been a while that rain does not provide enough for our crops. This situation brought us to cultivate plots elsewhere. (Interview 26)*

The pastoralists interviewed described how they had observed a reduction in the rains and fodder available and often had problems finding sufficient food for their animals. They noted a large increase in people and cultivated fields. They also had problems accessing the river for their animals to drink, because of the increase in cultivation along the banks of the river and canals. They expressed a desire for water points with solar pumps in the grazing areas. They also complained that farmers had already encroached close to two existing water points and that tension between pastoralists and farmers would be inevitable. The pastoralists felt that they would be obliged to leave the area because of the expansion of agriculture:

*We won't have a place for animals if we don't find a solution to this situation. Even five years from now it will be difficult to water our cattle here. We will be obliged to leave this place because we don't feel at ease here. (Interview 27)*

In addition to their problems with farmers, pastoralists also resent paying a large amount of money to the authorities for the corrals in which they keep their animals.

Conflicts between farmers and pastoralists are usually dealt with by the communities themselves or by the local authorities. However, they sometimes go to court, as described by one group of farmers:

*Most often, we sit down to talk here. There is the Mairie (town council) for the discussions, but you have the stubborn people who prefer showing what they are capable of.*

*Question: Do you go to the court if you cannot reach a compromise in the Mairie?*

*Response: Yes, but for one case that has just been closed, we think it's not fair, because the farmers were condemned. (Interview 26)*

One participant observed that if cases of conflict go to trial, they can remain unresolved for years and the parties may not be satisfied with the outcome. This means that as soon as they have sufficient resources, they may appeal the case and the conflict would continue.

## **INSTITUTIONAL PERSPECTIVES**

In 2005, a convention for the management of agro-pastoral resources was created, with the support of the GTZ Programme d'Appui aux Collectivités Territoriales (PACT). This brought together farmers and pastoralists as well as communal authorities, technical services of the state and NGOs. The convention was initiated because of the conflict in the region between farmers and pastoralists. However, although the convention refers to agreed cattle routes, the research team did not see any panels or signs marking the routes as observed in the Sélingué case study. According to one interview participant, the convention was working for a while but no longer appears to be working. One problem was that pastoralists saw farmers letting their own animals onto the land at a time when pastoralists were forbidden by the convention.

It was acknowledged by one government interview participant that the increase in irrigation would reduce pasture zones in the region. Another view expressed by a regional government participant was that pastoralism should be modernised, so that it no longer required cattle keepers to be nomadic. One local government participant remarked that the arrival of the sugarcane project would create a new dynamic to the conflict between farmers and pastoralists. The view was expressed that the convention no longer applied because of the sugarcane project and therefore needed to be reviewed. As a result, a committee has been established to follow up on this.

# 7. CASE STUDY 3 – LOKOJA, NIGERIA

## CONTEXT AND DESCRIPTION

In this case study, we examine the impacts of climate variability, flooding and both natural and human induced changes in the river channel in two farming communities located on the banks of the Niger River close to Lokoja in Kogi State, central Nigeria. Since similar issues of tensions between farmers and pastoralists were observed as elsewhere in the river basin, the research team also visited a pastoralist settlement close to Lokoja to gain an insight into the perspective of the people there.

Lokoja is located at the confluence of the main Niger River and the Benue River in central Nigeria. The climate is more humid than that of the case study locations in Mali, but livelihood activities are similar. The communities along the banks of the river cultivate in the flood plain and surrounding land and do some fishing. They are affected by regular floods, which in some years cause considerable damage to their crops and houses. Erosion of the river banks is also a significant problem to these communities. In addition, heavy rainfall causes localised flooding and damage.

NIWA has begun dredging the river in order to allow for the increased transportation of goods on the river using barges. This is desired by national government in order to reduce the strain on the road network. The dredging operations pump sand from the river channel onto the banks and are thought to help strengthen the river banks. The erosion of the banks and a perceived shallowing and widening of the river channel is thought to cause increased problems of flooding for the communities along the river. There is also a problem with water hyacinth and other water weeds building up in the river channel, in particular in the delta creeks. One interview participant blamed the water hyacinth problem on climate change.

## EXTREME EVENTS AND VARIABILITY

### COMMUNITY PERSPECTIVES

Some interview participants noted that drought had been a problem for the past 20 years, with an absence of rain between November and April. One local government participant observed that because of drought, many people, mostly men, had left farming and migrated to the city to look for jobs. This has resulted in lower productivity in crop growing. Particular years of drought mentioned were 1991 and 1999.

Farmers observed that the rains came later than they used to and that this caused them to plant later and lose their crops when the annual flood arrived before they are ready to harvest:

*It is about 20 something years now, in those days we used to have rain by December. Yes, January, February we would go to farm, but now it is April before you have rain; it's just five months to August. Because of the rain delay, the floods are affecting the crops. (Interview 36)*

One interview participant explained how the river flood came in July or August every year and the river overflowed its banks until October. It is variable how much land is flooded from year to year, but the timing of the flood has not changed. The flood is helpful for fishermen as it fills the tributaries and lakes in the floodplain. However, it is difficult for the farmers. Particularly serious floods that were mentioned by different interview participants were those of 1994, 1996, 2005, 2006, 2007 and 2010.

In the communities most affected by flooding, it is an almost annual occurrence. The destruction of crops is nevertheless variable from year to year, with some sense that the situation has worsened, as these women commented:

*Some years there are no floods and we make some profit. But that was long ago. That was about nine years ago.*  
(Interview 40)

Despite these problems, farmers explained that they continued to cultivate in the flood plain. Because there is a shortage of land for farmers to plant, they need the water and they do not have an alternative. They hope that the current year will be a good one for them. There are differences in the crops which men and women grow. Men tend to plant those crops which need harder labour: yam and cassava. Women concentrate on rice, maize, beans and sweet potatoes.

Women meet together as a group to plan their food trading activities, which are an important part of their income, especially as they cannot rely on their own crops because of flood problems. Women play an important role when it comes to coping with the impacts of flooding destroying the crops. They go to villages which are further from the river, buy rice on credit, process it and then sell it at the market to make a profit. They use their family networks to help them obtain crops on credit. The women described how they help each other out when they are affected by the flooding:

*In the situation of flood, the women run to help the women, while the men run to any man whose farm is destroyed to aid them. And at the end of the day, if we find out that someone has lost everything totally, we contribute things to help them, whether foodstuffs and other things. And if a house collapses, the men prepare the frame of the house from poles; then women will make the wall with the mud and help them to replace the house.* (Interview 40)

Another woman described how they stayed in their houses when flood water entered the village, but built platforms to sleep on and hung up their belongings to keep them dry. The water can stay in the village for up to two months. In a second village, some women described how those who were widows had more difficulty rescuing their children and belongings from the flood.

One man described how his family cultivated several different crops in various locations to reduce the risk of losing all their crops in the flood. In addition, he has worked as a day labourer on private farms in order to recover from the flood. Although people sometimes hear forecasts and warnings on the radio about an impending flood, this does not always help them:

*Even when we hear that there will be a flood, and it is like that we cannot help, we have no other place to go.*  
(Interview 38)

The communities have various arrangements of leaders and committees which are involved in responding to problems. For instance, in one village the chief and his deputies meet with household heads to hear cases of disputes between community members every eight days. In the same village, there is a youth committee which carries out work on behalf of the village, including responding to floods. For matters with which the community requires assistance, they send the Gago<sup>19</sup> to speak to local government, but do not always receive the results for which they would wish:

*The government promised to do something (in response to a request for help with the floods). Early this year, the government sent 25 kilograms of corn to the entire village, and they promised to give money. We have not seen the money promised.* (Interview 39)

<sup>19</sup> Gago is a term used to describe a person in the village whose role is to assist the chief as a messenger. They are the main person communicating with the authorities. It is usually someone who speaks English.

## INSTITUTIONAL PERSPECTIVES

State government officials commented on the unusually high temperatures they were now experiencing, problems of desertification and change in the local vegetation, excessive deforestation, erosion and siltation of the river leading to reduced fish catches, problems for navigation and shortages of water supply to the town of Lokoja. Other problems mentioned included price inflation, dwindling natural resources and the population problem. Officials believed that farmers had moved closer to the river because of climate changes, resulting in an increase in siltation of the river and flooding now being an annual problem.

Severe rain storms were also noted as a problem. For example, one storm was experienced in Kogi State in May 2011 which caused damage to buildings in Lokoja town. The state is trying to put in place some measures to respond by setting up a committee to look at risks from natural hazards.

One local government interviewee acknowledged that the compensation they were able to provide to flood victims was too small because local government had very little funding to assist and the State Emergency Management Agency (SEMA) provided only limited assistance. They have 70,000 farmers in their area and cannot help them all.

Understanding of climate change is thought to be weak among people in the state. One person linked landslides on the river to climate change. Others in the state government linked it to local deforestation:

*Climate change, the destruction of the forest is a major source of climate change. Where you have forest, the rains are more regular than where you have open land. (Interview 28)*

Another participant was one of the few interviewees who referred to global causes:

*It is a result of industrialisation. It is affecting the regions. (Interview 37)*

## RIVER MANAGEMENT

### COMMUNITY PERSPECTIVES

For the communities closest to the river, flooding is an annual problem and some villages experience severe problems with bank erosion, which displaces people. People from one village remembered the years 1980, 1990, 2000–2001 and 2010 for the particularly severe floods which caused erosion and loss of houses and farmland. In one of the villages we visited, households had moved their homes three or four times in the last 30 to 50 years because of the erosion of the land by the river. Bank erosion was an issue of great concern. Landslides are said to occur every few years, four years ago being the last major one. However, some participants said that erosion was a problem every year and caused considerable hardship:

*When you continue to shift as a result of flooding and landslide every year, you are impoverished, you cannot plan, you cannot have anything. Shifting has affected our farmlands. We are now short of land to farm because we shift and erect houses on the farmlands. (Interview 38)*

In one village, people told us how they responded to bank erosion by building new houses and moving to them as they are about to collapse, using existing community land further away from the river to build new houses. In another village, several people had been displaced entirely from their communities by erosion and over 250 households had lost their homes. They found new locations to build their houses in other villages and had to rent land to farm. This led to fears of the disintegration of the community and conflict, since many communities are afraid to receive too many displaced families because of competition over land:

*We have not experienced conflict among ourselves. However, since most of us are farmers, the flooding could increase tension and even trigger conflict as the arable land continues to be covered by flooding. As our village continues to be flooded, members of the community move to other places, leaving their ancestral land; therefore, we are dispersed in different villages. If this trend continues, there is a fair chance that the (village) people will disappear, we will lose our heritage, values and group identity ... We have been consulting the other communities for plots of land for us to settle, but they do not give us, for fear of losing their farmlands. (Interview 43)*

There was an expectation that the dredging of the river might resolve flooding and bank erosion problems, because those responsible for the dredging had indicated this would be the case. Nonetheless, when the large flood of 2010 followed the dredging in 2009, many residents concluded that the dredging had worsened the flooding. One farmer even described how he had planted cassava and yam close to the river, because he assumed that the flooding would not be a problem after the dredging. In another village, people mentioned that the sand was deposited on their farmland when the dredging occurred, destroying their crops. One fisherman described how the fish were scared off by the noise of the machinery and the sand movement during the dredging, but he did not indicate how long term this effect had been.

Some people associated the flooding of 2010 with the opening of the Kainji Dam upstream, but said that they had not received any warning of the impending flood. In the second village we visited, which is upstream of the confluence of the Niger and Benue rivers at Lokoja, several interview participants said that the flooding occurred when they opened the Kainji Dam. They described how they heard warnings on the radio that a flood was coming and prepared as best they could. A group of women in the same village described the limits to the flood warning:

*By the time you get the information, it is always too late. Floods come at different times – it can come in the morning, afternoon or night. The last flood that came was in the night. It took us by surprise. (Interview 53)*

In the same community, they also mentioned that they had started building houses using cement blocks, since they withstood flooding better than mud houses.

## **INSTITUTIONAL PERSPECTIVES**

NIWA, the agency responsible for the river dredging, is involved in a study on bank protection. It is looking into ways of slowing erosion by changing irrigation channel alignment and by planting trees. Interview participants described how moving communities away from the river banks was costly for the government. Some interview participants associated reduced river flows and bank erosion with the presence of dams on the river.

With respect to the dredging, one local government official felt that they had not been properly informed of the impacts:

*The contractors tried to explain that there is dredging and they want the people to cooperate with them ... But they didn't explain for us to understand what dredging really means ... What is the disadvantage? We want to know what it entails. How will it affect the lives of the people? Is this to the benefit of the people or to the government alone? (Interview 36)*

Local government gives assistance of food and money in instances of flooding as compensation for lost crops. SEMA sometimes also provides funds. However, there are insufficient funds to help with relocating people. One local government official described how he tried to help relocate displaced people affected by the bank erosion by talking with the local chiefs and *Gagos* of neighbouring communities to persuade them to receive displaced people. However, he claimed that this took place more on a personal basis, rather than as part of an official government role. Sometimes, disputes arise between communities as a result of displacement and local government responds:

*We call them to order and settle that. We use the police and other government security agencies, at least to ensure there will be peace between the two communities. Even the state will assist – the State Emergency Management Agency (SEMA). They send guinea corn and rice. But what quantity? It can't be enough, there are so many farmers affected. (Interview 36)*

One participant explained how the impact of government in this area was not being felt:

*We are far behind in everything, development ... We are not feeling the impact of government here. Our people are suffering ... there is no water treatment, the water is not good for drinking. (Interview 36)*

## **ACCESS TO PASTURE (LAND AND WATER)**

### **COMMUNITY PERSPECTIVES**

Fulani cattle herders move north in the wet season, but then come back to the southern areas including Kogi State during the dry season. They arrive in the Lokoja area from December or January and stay four to five months in the area, up until May. Disputes between farmers and pastoralists occur when the animals stray onto farmland and eat crops. In some parts of Kogi State, deaths occur because of tensions, as identified by a state government official:

*Last week a Fulani's herd went to someone's farm and ate up his cassava. When the farmer demanded why, the Fulani killed the farmer. That was about two weeks ago. The clash is almost always like that. (Interview 28)*

Pressure on land is an important issue in this area and appears to have several causes; for example, according to one participant, a decrease in fish catches had resulted in fishermen resorting to farming. Failure of crops due to poor rains has also encouraged farmers to diversify their crop production. Land available to the riverside communities has also shrunk because of river bank erosion. This has all resulted in less available grazing land for pastoralists:

*We do not have enough land now. The river takes a sizeable portion of our land. Because of shortage of land, we use every available land for farming, including the ones with the pasture that the Fulani were using. In the past, we had more land than the Fulanis used. (Interview 41)*

For the villages visited for this study, local government officials and village residents described how conflict with the herders had declined in recent years, despite large numbers of pastoralists and cattle still visiting the area. People attributed this to a mediation and compensation process:

*Fulanis do not restrict where they go. At times, they destroy your crops yet they will be hostile; then we the farmers will have to defend ourselves.*

*Question: When was the last open hostility?*

*Response: Some 15 to 16 years back. The presence of the local government mediator has reduced the problem. Some years ago, we had no local government mediator. (Interview 38)*

It appears that the mediation process has allowed for some compromise between the demands of the farmer and the interests of the herder, as this comment by a farmer reveals:

*When the government comes, the Fulani will start begging and so the amount paid is often not enough for the damage. The representative of the government decides the amount to be paid. (Interview 39)*

In the second village we visited, they established a dispute resolution association of 15 members of the village to deal with conflicts between farmers and pastoralists. They found this preferable to trying to solve the dispute on their own or going to the authorities:

*Fulanis are too aggressive; if you are alone you cannot just ask and get compensation, so you involve the association for dispute resolution ... this arrangement is good, because the amount you spent in the farm, you will recover. When you report to the police, they will eat the money, and at the end the problem is not resolved. (Interview 52)*

The level of tolerance between the two groups appears to be higher than in the second case study in Mali. For example, one farmer described the interdependence of the farmers and pastoralists and offered some solutions to the problems between them:

*You see, we are one people and we need the Fulanis and they need us. We buy cattle from them and they also buy agricultural produce from us. We also benefit from the droppings of the animals; it is an excellent fertiliser. From my perspective, there are two possible solutions: either the Fulanis have to wait until we have harvested our crop; or the Local Government Authority in consultation with the traditional leaders mark the route the Fulanis can use. (Interview 49)*

Women are often not involved directly in conflict resolution, but sometimes they are victims of revenge attacks. In one village, the women believe it is the men's role to solve the conflict:

*Even the men find it difficult to solve this problem, so for us as women to go into it, it is like nothing is happening. (Interview 40)*

Interviews with men and women in a pastoralist settlement near Lokoja revealed some of the difficulties they are facing. The land on which they are settled has become surrounded by farms after a new road was developed and greater numbers of farmers settled in the area. They were unable to buy additional land to house their animals. As a result, they are contemplating leaving the small piece of land they bought and settled on 30 years ago:

*The reason for us leaving this place in the future is that all the people who bought the land around are farmers. And us, we are Fulani. Those people will grow crops now, and the cows will see those crops, there will not be peace. That's the reason why we are going to leave. (Interview 50)*

The men described how a new road development was a problem for them:

*When we cross the road and motorists – instead of waiting for the animals to cross – run into the cows and have their vehicle damaged, they will demand that we pay for the damage. They don't care about the death of our animals in the case. (Interview 50)*

The women also complained that the road development had caused problems for them, because it had cut off the stream from which they used to collect water. As a consequence, they now have to walk further and collect dirty water. The women also suffer because the lack of grazing land nearby means that their children are absent for long periods:

*Because of the problem of grazing, our children move far, looking for grazing. We are upset because we don't see our children. It's about eight months now that some of our children left. We don't even know when they are coming back. (Interview 51)*

## INSTITUTIONAL PERSPECTIVES

In the case study village areas, the local government officials described how conflict between farmers and pastoralists used to be serious in the 1970s. Today, there is reportedly less conflict because of the system of negotiation and compensation. However, one local government official's description of this process differed to that given in the villages:

*Before the Fulani come, the Gago and the chief and the members of the community will agree with a representative of the Fulani, before they encroach onto the land....Now if the Fulani cattle destroy crops the Gago goes to the Fulani and they have to compensate the farmer. They arrange it by themselves. That is why there is not much conflict now. ...If anybody happens to cost the Fulani a cow then they have to pay. They begin to understand between themselves. (Interview 36)*

However, village members in the same local government area described how mediation between farmers and pastoralists was led by representatives of local government, rather than being something they organised themselves:

*We report it to the staff at the local government office. He mediates between us and the Fulanis. (Interview 38)*

Kogi State officials described how negotiations between farmers and pastoralists were very temporary, since the pastoralists were always on the move and different groups might be passing through a cultivated area. They expressed a belief that grazing should be controlled by having grazing reserves to grow grass, but added that the Fulani did not like to follow rules. This is a similar argument in favour of modernisation of animal rearing that has often been repeated elsewhere in the Niger Basin, revealing a lack of recognition of herding rights (Bloch and Foltz, 1999; Thébaud and Batterbury, 2001).

# 8. CLIMATE-CONFLICT LINKS AND PROSPECTS FOR ADAPTATION AND RESILIENCE

This chapter is divided into three sections, each one addressing one of the three research questions outlined in Chapter 1. First, we examine how climatic and environmental stresses influence water resources and human security in the Niger River Basin. We then look at the question of whether climate stress on water resources increases the risk of conflict and, if so, then how. We follow this with an examination of the types of adaptations, conflict-resolution and governance mechanisms which can provide resilience to climate stresses and reduce the risk of conflict.

## ENVIRONMENT-CLIMATE STRESSES

Much of the Niger Basin is in a region of low rainfall, with high natural variability in rainfall and stream flows that affect land and water resources and people's livelihoods. Climate variability is manifested both in seasonal variations in rainfall over the basin and year-to-year variability in rainfall. In some years, this variability is manifested as extreme events. Extreme events include droughts, which are recurrent in many parts of the basin, but also severe flood events with major impacts on lives, livelihoods, wellbeing and the productivity of sectors.

The Niger River and its tributaries are an important water resource for multiple uses, including flood plain agriculture, irrigated agriculture, livestock wetland grazing and watering, production of hydropower, and domestic and industrial uses of water. Several dams along the Niger River have reduced the variability in river flows to a small extent. However, seasonal variation and flooding remain an important part of the annual cycle in the river flood plain and also bring many benefits to human exploitation of ecosystems. An example is the Niger delta, where the productivity of fisheries and pasture are dependent on the size of the annual flood.

The rural populations in the three case studies have all experienced significant losses and threats to their human security due to climate extremes and other environmental changes, despite varied coping strategies. There is a gendered dimension to the impacts and ability to cope; for example, women were vulnerable to flood impacts in terms of livelihoods (such as loss of small animals) and their social role, because of their responsibility to care for children, the elderly and the sick. Specific vulnerabilities of women to droughts (both seasonal and longer-term droughts) included the additional burden of water collection when nearby water sources dry up. Pastoralist women were vulnerable to difficulties experienced indirectly as a result of changing pasture resources, which may or may not be climate related; for example, in the Nigerian case study, pastoralist women whose children had to travel further and stay away for longer with the cattle experienced a sense of emotional loss and a lack of practical help at home.

Ongoing changes in the river and its flow are complicated, and causes and effects are the subject of much discussion but perhaps poorly understood. An example is the question of whether the upper Niger River channel in Mali is experiencing siltation or is deepening (Ferry et al., 2011b). Clearly complex factors that are likely to have an influence include variations in rainfall over the river basin, the effect of dams on the timing and quantity of flows, smaller-scale water abstraction and deforestation in the basin.

The climate-environment link has to be carefully scrutinised. In this report, we have questioned the prevailing assumptions and perspectives among many of those interviewed and much of the earlier literature. In particular, those narratives linking degradation of the environment to trends towards a less favourable climate and recurrent drought have been questioned, since they disregard natural variability and global causes of climate variability and change. A systematic process of desertification and degradation in the Sahel is questioned by critical literature. There is a growing argument that the fluctuation of the desert boundary is a normal outcome of long-term climate variability.

As the narrative of global climate change gains traction in policy circles, there is also a need to question proposed linkages between climate change and environmental degradation. There is a risk that stresses and changes resulting from complex human-environment interactions are inappropriately blamed on “climate change” without examining the evidence for such linkages. This research emphasises that not all changes in natural resources are due to climate variability or climate change; for example, human exploitation of the Niger Basin’s water resources is likely to have had a large effect on the flows in the Niger River (Ferry et al., 2011a).

Although there are claims that evidence for climate change in the basin is already being detected, we would describe much of this as climate variability or the interaction of climate with other drivers of change. Some of this disagreement about claims of observed climate change impacts may result from different uses of the terms “climate change” and “climate variability” (Watson, 2001). It is open to debate whether the drying trend seen in the Sahel climate in the second half of the 20th century should be referred to as climate variability or climate change.

The climatic future of the Niger Basin remains uncertain. Anthropogenic climate change may well result in adverse impacts on the region that reduce resource availability through more severe and protracted droughts and long-term desiccation, particularly in the western and central parts of the Niger Basin, within the western Sahel region (Christensen et al., 2007). However, widespread disagreement between models means that nothing can be said with certainty about the future evolution of climate in the Sahel (Christensen et al., 2007). To a certain extent, it might even be argued that whether climate change is likely to make the region drier or wetter is irrelevant in the longer term. The region will almost certainly continue to experience a very high degree of climatic variability, and this variability may well become more pronounced on seasonal, annual and decadal timescales as a result of climate change. Given the climatic history of the region, it cannot be assumed that rainfall will simply change in one direction or the other; any further “greening” of the Sahel is likely to be followed at some point in the future by a return to aridity, and vice versa, as the region responds to large-scale climatic variability and to long-term changes in climate associated with accumulating atmospheric greenhouse gases (Brooks, 2004).

In addition to the high uncertainty of climate model projections for the region, there are also few published climate impacts studies. However, even if more climate impacts modelling studies are carried out, these are unlikely to reduce the uncertainties associated with such a highly variable climate.

Climate change might relieve some stresses; for example, if higher average rainfall translates into reduced water scarcity. Nevertheless, the effects are again complex; for instance, such effects may be short lived and higher temperatures may increase evapotranspiration rates to a level which counteracts any increase in rainfall. Interactions of climate with other factors will remain important in the future for determining the vulnerability or resilience of the population. Key dynamic factors include increasing demand for water, pollution, population movements and growth, consumption of resources, changes in livelihoods and lifestyles, a change in demand for products and resources, land use change and environmental impacts of development projects.

## CLIMATE-CONFLICT LINKAGES

Links between climate stresses and manifest or overt conflict are highly controversial and often challenged. Climate variations may be a contributory factor or a trigger, but they are unlikely to explain the presence of conflict. Recent research in the region, such as that of Djiré et al. (2010), has suggested links between conflict and water scarcity or access to water. However, they also observed cooperative responses to scarcity. Climatic change (and variability), in combination with other environmental change and wider dynamics in society, places stresses on people and their livelihoods, potentially sowing (or at least watering) the seeds of conflict at different scales. That conflict might be latent in terms of distrust and frustration, or become increasingly manifest. We did not have the opportunity to explore the influences on whether climate-influenced conflict becomes violent or not in this research.<sup>20</sup> Nonetheless, evidence from analysis of conflict between farmers and pastoralists indicates the important role of conflict-resolution mechanisms and adaptations in reducing the risk of conflict between individuals becoming violent. However, other forces are also likely to influence whether conflict becomes violent or not, such as the history of tensions between groups, political manipulation and ethnic or religious differences.

Again, there are complex linkages between climate stresses and conflict; for example, the impact of drought in the Sahel is not just related to the existence of drought hazard, but also to development policies that raise societal vulnerability to its effects – that is, if they do not take into account the variable nature of the climate and environment.

Our research has not shown a direct link between climate and conflict between farmers and pastoralists, although in some of the case studies the expansion of agriculture into pastoral zones has been explained as a response to climate stresses. Conflicts as a result of farmers encroaching on pastoral lands and routes, pastoralists encroaching on farmland and the cutting of trees for fodder are sometimes, but often not, violent. We found varying degrees of tolerance between the two groups in our three case studies. Conflict resolution mechanisms appeared to be very important in reducing the risk of violence, with different types of mechanisms working well or not so well in different locations. Although the degree of climate influence on these types of conflicts is unclear, they are likely to be exacerbated if change in rainfall, especially drying, forces changes in routes and grazing areas. However, the context in which this occurs – in terms of agricultural or rural policy, changes in cattle population, and other influences such as expansion of irrigation and rainfed agriculture, along with displacement of grazing and agricultural land by dam reservoirs – will have a large influence.

Perceptions of fairness associated with responses to problems are also likely to influence whether conflict will increase or not; for example, while farmers might be compensated to some extent for crops lost to cattle, pastoralists continue to lose access to grazing land as it is taken over by agriculture, with little or no compensation. Both pastoralists and farmers expressed dissatisfaction at the outcomes of processes to resolve conflict between them. If the area around the Sélingué Dam becomes a major pastoralism zone in Mali because of changing climate, as one participant indicated, this will be a major dynamic that will likely have repercussions in terms of farmer-pastoralist tensions.

Extreme events related to water flow management can raise latent or manifest conflict between the people exposed and “managers” (citizen and state). This is particularly the case if there is minimal warning and an insufficient emergency response on the part of government. An example of this was the 2001 flooding of villages and irrigation plots downstream of the Sélingué Dam which had major impacts on property, crops and drinking water. The court case which ensued was an indicator of manifest conflict, but also an example where conflict engendered a positive response or resolution (the formation of the CGE) which has a role to play in adaptation

<sup>20</sup> The majority of evidence of conflict gathered in the field research which appeared to have some link to fluctuating water resources and climate stresses could be classified as manifest or latent rather than violent conflict. Researching violent conflict involves considerably higher sensitivities and risks to participants and researchers. Therefore, it would have necessitated long-term engagement of the researchers with the research participants in order to build trust. This was not possible within the timeframe and resources available for this study.

to climate change. Not all victims of such events are able to express their grievances in terms of court cases, so some grievances may remain unexpressed and ignored; for instance, rice farmers at Sélingué were compensated for their lost crops, but downstream village residents whom we visited during the field research were not.

Similarly, water-related developments can be a source of tension between citizens and the state or other actors. Perceptions of neglect, that development has passed an area by, can be a cause of frustration with or distrust in government. Equally, a lack of accurate information on or understanding of the nature of benefits and disadvantages of water-related developments, and perceptions of uneven benefits, can lead to distrust and frustration; an indicator of latent conflict. In most of the case study villages, we encountered a strong expectation on the part of the population that government should help them and had the resources to do so, but chose to ignore their needs.

As an example of water resource developments, the expansion of irrigated lands clearly has ramifications for rainfed farmers and for pastoralists in terms of current livelihoods, but also may exacerbate vulnerability to climate variability and change; for example, if water availability declines in the future, where will the available water be routed from and who will benefit from the dwindling resource? Indeed, what would happen if the land converted to irrigation had to be abandoned? By its impact on access to land and water resources, the expansion of irrigation brings a new dynamic to pastoralist/farmer tensions, invalidating existing conventions or agreements between the two groups.

With respect to transboundary relations between riparian countries sharing the Niger, increasing development and abstraction of river water, both at a large and small scale, could interact with climate variability to exacerbate existing latent tensions between countries. The extent to which this tension develops depends in part on the effectiveness of cooperation between countries, in particular through the NBA. It has been suggested that cooperation in transboundary river basins has the potential to contribute positively to adaptation to climate change (Goulden et al., 2009a). There is an opportunity for further research on the role of the NBA and transboundary cooperation between national institutions for building resilience to climate stresses and resolving potential associated conflicts. Lessons from other river basins around the world have shown that violent conflict between riparian nations is unlikely (Wolf, 1998), although there are arguments that even lesser forms of conflict can be disadvantageous for weaker riparian states (Zeitoun and Warner, 2006).

## **RESPONSES: THE ROLE OF ADAPTATION AND CONFLICT RESOLUTION IN PROVIDING RESILIENCE**

Responses to climate stress, broadly referred to as adaptation, include coping strategies of affected populations and reactive or planned adaptation by individuals or communities, organisations, sectors, government, etc. (Füssel, 2007; Smit and Wandel, 2006). Conflict-resolution strategies are attempts at positive responses to conflict. If we think of climate stress as a potential cause of conflict, then the two concepts of adaptation and conflict resolution conflate to some extent, as indicated by the term “conflict-sensitive adaptation” used by Smith and Vivekananda (2007). Good adaptation which is equitable has the potential to avoid conflict. In some cases, however, adaptations may contribute to conflict, as there are often winners and losers associated with adaptation actions (O’Brien and Leichenko, 2003). This is particularly true in relation to large-scale planned adaptations, such as water resource infrastructure and its management.

### **RESPONDING TO UNCERTAINTY**

Given the uncertainty over future climate in the Niger Basin, planning for one particular climatic outcome (e.g. wetter or drier weather) is a high-risk strategy. In the face of such uncertainty, addressing extreme climatic variability such as that which the region has experienced in the past 50 to 100 years provides a reasonable entry point for development and adaptation planning. Development in the region needs to be based on flexible systems which can accommodate

climatic oscillations between periods of relative humidity and aridity, perhaps lasting decades. Land tenure systems that lock development into particular patterns of land use are likely to be maladaptive in the medium to long term. Systems that allow any given area to be subject to different patterns of exploitation depending on the extant climatic conditions are more suitable for sustainable development. This will require the rehabilitation of traditional, and the introduction of new, reciprocal arrangements between farmers and herders, along with flexible tenure systems which recognise and accommodate the highly dynamic nature of the environment. In addition, mechanisms will need to be put in place to assist different groups in the event of severe and intense droughts, such as those seen in the early 1970s and 1980s. Development needs to move away from “steady-state” approaches which assume climatic stationarity and simply seek to maximise production under current conditions, without consideration of how conditions might change in the future. Crucially, the role of mobile pastoralism as an effective means of securing livelihoods in the highly variable, marginal and uncertain Sahelian portion of the basin needs to be recognised, and the rights of agriculturalists balanced with those of pastoralists. Only then will the conditions be right to address and reduce conflict in the region.

### **STAKEHOLDER PERCEPTIONS OF SOURCES OF RESILIENCE**

For this project, the research team held three stakeholder workshops in Bamako, Lokoja and Abuja in July 2011 after the fieldwork had been completed. The aim of the workshops was to present and gain feedback on preliminary results. Many of the participants were individuals who had been interviewed during fieldwork, along with additional representatives of government departments, civil society organisations and representatives of some of the communities in which we carried out research. During these workshops, we proposed the hypothesis that climate change may lead to additional risk of conflict. We asked stakeholders to divide into groups and identify factors which they thought might lead to improved resilience to the impacts of climate stresses and a reduced risk of conflict, which we referred to as “stabilising factors”. We also asked them to identify “destabilising factors”, factors which might lead to increased conflict associated with climate stresses. This framing of stabilising and destabilising factors draws on USAID’s thinking on climate change and conflict (USAID, forthcoming). The combined results of the discussions of the six breakout groups (two from each workshop) are shown in Table 2.

**TABLE 2: SUMMARY TABLE OF STAKEHOLDER PERCEPTIONS OF POSSIBLE SOURCES OF RESILIENCE AND CONFLICT WITH RESPECT TO CLIMATE CHANGE AND WATER RESOURCE MANAGEMENT<sup>21</sup>**

| Stabilising factors: sources of resilience  | Destabilising factors: sources of conflict   |
|---|--|
| <b>Information and communication</b>  |  |
| <ul style="list-style-type: none"> <li>Sensitisation and training activities to help communities prepare for and cope with climate impacts, by state agencies, NGOs, technical agents</li> <li>Efficient data management systems and dissemination strategies</li> </ul>  | <ul style="list-style-type: none"> <li>Lack of awareness among communities; not prepared for climate variability</li> <li>Communities are not informed about development projects and do not have the capacity and resources to engage and deal with authorities</li> </ul>  |
| <b>Early warning and disaster management mechanisms</b>   |  |
| <ul style="list-style-type: none"> <li>Identification of local stakeholders who know what the community needs</li> <li>Contingency plans and local monitoring committees to communicate risks</li> <li>Clarification of responsibilities for disaster response</li> <li>Use of community radio to inform and warn members of the community</li> <li>Provision of alternative means of livelihood to support disaster victims during recovery periods</li> </ul> | <ul style="list-style-type: none"> <li>Lack of decentralised early warning systems</li> <li>Adaptation strategies for climate variability which are not community orientated</li> <li>Lack of clarity on the roles and responsibilities of various government institutions in the event of disasters or during times of crisis</li> </ul>    |
| <b>Water and infrastructure management systems</b>  |  |
| <ul style="list-style-type: none"> <li>Design of water management infrastructure to take into account water users' differing needs</li> <li>Establishment of a committee to manage water use for irrigation, etc.</li> <li>Developments which create economic opportunities</li> </ul>  | <ul style="list-style-type: none"> <li>Failure to inform communities about the negative impacts of water-related infrastructure</li> <li>Lack of ownership by communities and beneficiaries</li> <li>Unexpected release of water from dams</li> </ul>  |
| <b>Decision-making processes</b>  |  |
| <ul style="list-style-type: none"> <li>Application of a gender lens in the analysis</li> <li>Coordination among government agencies, ministries, NGOs and communities</li> <li>Processes which take into account the concerns and needs of stakeholders during resource allocation</li> </ul>   | <ul style="list-style-type: none"> <li>Lack of engagement with youth and women</li> <li>Insensitivity to religious practices and customs related to the utilisation of water</li> <li>Poor accountability and inadequate funding</li> <li>Lack of sustainability of policies and interventions</li> </ul>                                    |
| <b>Legal and social issues, access to resources</b>   |  |
| <ul style="list-style-type: none"> <li>Commitment to the rule of law</li> <li>Understanding context, culture and religion</li> <li>Mobilisation of traditional leaders to respond to the needs of displaced people; e.g. providing land</li> <li>Increased awareness and tolerance among different groups</li> </ul>  | <ul style="list-style-type: none"> <li>Laws are not respected</li> <li>Gap between customary law and modern law</li> <li>Disrespect for traditional knowledge</li> <li>Population pressure and an increase in farming and settlement along the river</li> <li>Alteration of herding routes owing to changes in water availability</li> </ul> |

<sup>21</sup> Table contents are compiled from the results of breakout discussion groups held with stakeholders in meetings in Bamako, Abuja and Lokoja in July 2011.

As Table 2 shows, participants identified issues related to information and communication, early warning and disaster management, water and infrastructure management, decision-making processes, and legal and social issues, as well as access to resources. The stabilising factors – or sources of resilience – identified by stakeholders include responses which are already underway and those which are missing or need strengthening, whose absence might lead to heightened risks of conflict. The responses identified by stakeholders and through the case study research and national interviews fall into two broad categories of scale: village- or community-level responses and regional or national responses. We will first examine these responses and then look at the implications for governance of adaptation and conflict resolution.

## COMMUNITY-LEVEL RESPONSES

Community-level responses provide people with some resilience to climate impacts. However, these responses are clearly not sufficient, under present climate conditions and stresses, to avoid the losses which contribute to human insecurity. Community level responses observed in the case studies which provide resilience include the use of social networks to provide food, shelter and credit, along with access to conflict-resolution mechanisms. Diversification of livelihood activities also provides resilience; for example, growing different crop types in different locations such as close to the river and further away, trading activities and wage labour. Diversification and extensification of crops appear to be responses to risks and means of improving income, as well as flood plain recession agriculture, vegetable gardens on the banks of rivers and canals, and the use of hand irrigation (or small pumps). Some of these responses improve resilience to drought but increase vulnerability to flooding. Responses at the village level are also gender sensitive. Some strategies are taken up more frequently by men, such as migration to look for economic opportunities. Others are developed by women; for example, the rice trading association in the Nigerian case study. Some responses are only available to those with higher levels of assets; for instance, those who can afford it can build houses from concrete blocks which are more resistant to floods.

The case studies revealed opportunities for government support for improved adaptation to flooding risks in communities, such as growing different crop varieties which mature more quickly. Our research recorded the desire of some villages in flood zones to move further inland. Nevertheless, there are restrictions and limitations on their capacity to do so and also some reluctance to abandon ancestral land, revealing values attached to place and concerns over loss of identity and community cohesion. Government support for training and promotion of water use efficiency for farmers has a role to play in response to climate variability and increasing water scarcity as demand increases. However, questions arise over the fairness of requiring farmers to economise on water use while new plantations of high water-demanding crops are being established, for example the Markala sugar project in Mali (case study 2).

Agreements on pastoral routes were described as a conflict-resolution mechanism. Moreover, in some of the case studies, additional arrangements appeared to be in operation, such as gaining permission from village elders, introducing the role of a local guide or “lodger” and establishing a dispute-resolution association. Although it appears that often neither side is satisfied with the outcome, such measures appear to play an important role in reducing violent conflict: conflict remains latent or sometimes manifest. However, these mechanisms may not always be equitable or effective and it is important to be aware that power relations are at play, sometimes to the disadvantage of one or other group. We noted a distrust of formal conflict-resolution mechanisms, such as the police and courts. There is also a potentially positive role for the provision of training in conflict resolution for different stakeholders.

## REGIONAL AND NATIONAL LEVEL RESPONSES

National responses include those targeted specifically at climate change adaptation, such as Mali’s and Niger’s NAPAs and Nigeria’s NASPA. Many of the proposed projects in these are broadly within the remit of improved natural resource management. However, funding for initiatives is currently limited. Other relevant responses

of national and state/regional governments include those aimed at improved water management (for example, IWRM approaches and the creation of the CGE), erosion and flood control, early warning systems and emergency responses. Additional technical responses to climate stresses funded by the state include research on crops which are better adapted to rainfall variability, providing forecasting and planting advice to farmers, and cloud seeding in Mali.

The case study research highlighted a role for early warning systems for floods and storms and for improved communication of information between the state and the citizen: for example, in the Nigeria case study, more complete information about dredging may have avoided expectations being raised that it would provide flood protection; it would have prevented the distrust and frustration which arose after the floods of 2010, from which the dredging, not surprisingly, failed to provide protection. Early warning systems are already in place in some areas; for instance, Nigeria has a flood early warning system. However, the ability of state and local government to implement suggested action to reduce risks of damages is limited (IRIN, 2011). Similarly, emergency preparedness and emergency-response structures do exist, such as SEMA in Nigeria, but are not able to satisfy the needs or expectations of assistance of the population. Local governments, for example, seldom have the powers or resources to relocate settlements. Communities themselves make decisions about how to act in the face of flood warnings and have their own strategies to save lives and property, although significant losses do occur, particularly of crops and food stores.

National and state/regional efforts to raise awareness of climate change among the population are unlikely, in themselves, to influence people's actual coping abilities. As previously mentioned, there is also a risk that efforts to emphasise awareness of climate change will create the impression that climate change is responsible for a host of problems which, in reality, have complex interacting causes, only some of which may be climate related. Efforts such as research on crop varieties and support for adaptations to cope with current stresses may be just as important as awareness raising, since they may be more likely to be adopted by farmers than adaptations to future risks. Climate change discourses may strengthen the case for certain types of developments as adaptations; for example, flood protection and water storage infrastructure. However, these large-scale responses may have uneven benefits and impacts on the more vulnerable. To avoid maladaptation, such planned strategies will need to take into consideration uncertainty over the future climate.

## THE ROLE OF GOVERNANCE IN RESILIENCE BUILDING

The importance of governance in building resilience to climate variability and climate change can be deduced from many of the examples of responses discussed in the preceding sections. A number of different actors and institutions are involved in the responses described above, working across different scales, from the family or community to different agencies of local, regional and national government and other actors including donors and non-governmental agencies. Adaptations to current stresses are principally occurring at the local scale, with measures being taken by individuals, households and communities. At the same time, government institutions are now beginning to plan structures and processes to raise adaptive capacity and implement future adaptations to climate change.

Local scale institutions which are both formal and informal – and involve community leaders and community groups – appear to have some degree of effectiveness and greater trust than those of the state when it comes to coping strategies and conflict resolution. To a large extent, the case studies revealed that state institutions are less trusted and deemed less effective by the affected populations than village-based governance structures and processes. However, there are some positive exceptions where state-led governance mechanisms were able to resolve conflict experienced at the local level. An example of this is the court case brought by the rice farmers at Sélingué which led to the formation of the CGE in Mali. However, not all groups in society are able to benefit equally from such processes, as shown by the exclusion of the interests of downstream communities in this process. The CGE has the potential to manage conflicts of interests between different stakeholders and, therefore, has a role to play in adapting to the additional stresses on water resources resulting from climate variability and

climate change. However, there are questions over the appropriate level of participation in decision making and how to include underrepresented groups, such as the communities living close to the river.

New policy processes and governance structures emerging to address climate change show that thinking and planning for adaptation to climate change are beginning in the region. Existing activities not designed explicitly for climate change adaptation – such as early warning and disaster response activities by state and non-governmental agencies – have only limited effectiveness at the local scale since the capacities to respond are limited at the local level. Opportunities for government initiatives to complement the adaptation and conflict-resolution strategies of communities can be improved by increased engagement between communities and government institutions.

Governance processes have an important influence on the ability of vulnerable populations to engage with government. The communities visited displayed varying degrees of confidence in their ability to seek assistance from, and to achieve dialogue with, state institutions. In particular, the pastoralist communities appeared to have weaker links with state governance institutions. Processes of local government and community engagement in planned development activities, for example through the EIA, appear to be weak. This has intensified misunderstandings or concern over the impacts of development projects and distrust of the agencies responsible for them. Attempts to improve participatory and stakeholder inclusive policy processes in water management initiatives will be important for achieving fair processes and outcomes and for reducing risks of tensions arising between different stakeholders, but only if the concerns of communities are adequately addressed.

Attempts to formulate agreements to reduce conflict between farmers and pastoralists, with the support of international donor organisations, appear to have been successful in some cases but less successful in others. Further research is required to understand the factors influencing the success or failure of these initiatives. This research suggests that carefully negotiated conventions can fail if certain factors are ignored, such as the perceptions of justice or injustice of different groups and large changes in local land use associated with the expansion of agricultural and irrigation activities. The influence of climate variability and the resulting fluctuations in water and grazing resources should also be considered in such agreements. If flexibility can be built into governance structures and processes for managing land and water, such as land tenure systems, they will be more resilient to climate variability and climate change.

# 9. CONCLUSIONS

The effects of variations in climate are, and have long been, part of the reality of life in the Niger River Basin, mingling with other elements of the social and economic reality. As a result, there is a wealth of experience of responding and adapting to these changes, from which lessons on how to support adaptation can be taken. However, dissociating the climate-related variables causing change in environmental, social, economic and political realities from other multiple variables which shape and influence local life remains a challenge. This reflects the underlying analysis that climate stresses have an impact in combination with other features of the environmental, social, economic and political landscape. Therefore, initiatives to support adaptation cannot afford to address climate-related problems alone. In addition, due to high uncertainty surrounding future climate conditions in the basin, adaptation goals, targets and modes of implementation need to be flexible, rather than being locked into one particular view of what is happening with the climate, whether locally, nationally or sub-regionally.

Whatever the causation of problems, issues linked to climate around extreme events, land use competition and water management are real issues to people; issues which can threaten their wellbeing and which are likely to lead to or exacerbate human insecurity and the tensions which can generate conflict. In the Niger Basin, as elsewhere, we do not find a traceable, direct impact of climate stresses alone causing conflict to escalate. Low-level conflicts could escalate, and historically have escalated, partly as a result of pressure on basic resources such as land, water and, therefore, food. However, the role of other social, political and economic factors, such as past development policies, may have significantly influenced the vulnerability of some social groups to such pressures. As in other regions of the world, therefore, building peace through resolving conflicts, adapting to the consequences of climate variability and climate change, and pursuing equitable and sustainable development are linked elements of enhancing human security and building resilience.

This report offers examples of both good and deficient adaptation occurring at a range of scales, from local to national. At the village level, farmers, fishers and pastoralists have varying abilities to respond to climate stresses. Many households are able to deploy considerable flexibility and diversity in their livelihoods as well as to make use of social networks for adaptation responses which contribute to resilience. There are examples of adaptation which is peace positive and also adaptation which is conflict insensitive. Existing local mechanisms and citizen-state mechanisms for resolving conflict over environmental resources and water management have had mixed success in the case studies. Village-level institutions often seem to work for local communities and gain trust in ways that local and national governmental institutions often do not. Formal mechanisms of dispute resolution and conflict management, such as the police and the court system, seem from the case studies to generate less trust than informal modes. Informal institutions which mediate relations between herders and farmers can often work well, while formal conventions have not always been successful. Agreed pastoral routes can be adaptive in terms of managing different needs in a dynamic environment. However, they will need to be flexible to changing conditions and updatable with consensus.

There are examples of failures of governance which hamper attempts both at adaptation and conflict resolution. Thus, as in other regions of the world, the questions of adaptation, conflict resolution and development are linked not only with each other, but also to fundamental issues of governance. Peaceful adaptation to the effects of climate variability and climate change is dependent on a reasonable standard of governance, at least to ensure that state authorities are not an obstacle to adaptation. The issue of justice in adaptation is important for avoidance of conflict, both in terms of fair processes and fair outcomes of adaptation (Adger et al., 2006). Procedural justice in adaptation and development is related to governance. It occurs where people's views and concerns are taken into account, accurate information is given, and processes such as the EIA which are designed to address the needs and concerns of different groups in society are respected. Examples from the cases studies show that such processes are often neglected or inadequate.

In terms of fair outcomes, distributive justice in adaptation would require that existing inequalities be reduced rather than increased by adaptation.

Many of the determinants of resilience are to be found at the local scale. However, the case studies also show that it is important to take account of the context in which communities live. This context is not defined simply by purely local concerns. Local and national government institutions and policies are also key to successful adaptation. Therefore, when it comes to issues such as management of international rivers, for example, such institutions include inter-governmental bodies and their politics.

At the regional and national level, water resources management and other related government policies do not sufficiently consider the uncertainty and growing climate variability on long-term timescales. This risks maladaptation through “lock-in” to unsustainable practices in a changing and variable climate; for example, by maximising irrigated production when times are favourable, but risking collapse when conditions become drier. This again implies a close relationship between adaptation and development activities. Protecting and improving the ability of societies to adapt, pursuing equitable and sustainable development at multiple scales, and supporting mechanisms for conflict resolution and peacebuilding can all contribute to resilience to climate change.

# 10. POLICY GUIDELINES

Chapters 8 and 9 highlight the many policy relevant findings emerging from this research. The complexity of the environmental, social and political context of the Niger River Basin and the specific nature of many of the case study findings do not lend themselves to simple policy recommendations. Nevertheless, we offer the following set of policy guidelines, supported by the study's findings. There are clear linkages between these guidelines.

## **1. A focus on building resilience and supporting the ability of the population to adapt is often more appropriate than seeking to promote specific adaptation strategies at the local level.**

Outside actors should acknowledge the adaptations and responses already providing resilience within communities and aim to support the ability of societies to adapt. The principle of "do no harm" should be followed, to avoid weakening community resilience. Both outside actors and community participants should seek to understand the factors which enable and inhibit resilience, to build on the former and diminish the latter, based on knowledge of the local circumstances and on working together. This requires flexibility and attention to the different contexts in which adaptation is occurring, rather than relying on promoting specific planned adaptations or using templates or models for how to build resilience. Therefore, those adaptations and conflict responses which do improve resilience need to be supported by governance structures and processes. At the same time, planned adaptations should be designed to work in synergy with people's own capabilities.

One element of ensuring that local communities are engaged is to bring together formal and informal institutions and mechanisms; for example, to work together with trusted individuals, village-level institutions and women's groups, as well as government and NGOs. Local institutions are where adaptation, conflict resolution and conflict management may be seen in practice. Formal institutions, on the other hand, can play a complementary and supporting role.

## **2. Equitable, participatory and transparent forms of governance are all important for reducing the risk of conflict and increasing the ability to adapt.**

Opportunities for government and donor initiatives to complement the adaptation and conflict resolution strategies at community level can be improved by increased engagement between communities, government institutions and other outside organisations. Engagement can be improved by better consultation and participation of community members, by efforts to improve communication of accurate information about development projects to affected communities, and by establishing better channels of communication between the state and its citizens. In particular, efforts could be focused on community members, such as women and landless households, who are often marginalised. Efforts could also be focused on particular communities, such as pastoralist groups, which can lack the confidence and trust to engage directly with government institutions. It is vital to ensure that mechanisms for resolving conflict – both within and between communities and between state institutions and citizens – are equitable and participatory, through training and support.

To support community resilience (guideline 1), it is important that people are actively involved in making the decisions which affect them. The approach of outsiders must therefore be inclusive, rich in communication and patient. It must be able to engage with and enrich local communities' own awareness of climate variability and its environmental impacts. Such an approach can reduce the risk of there being outliers who, by not being involved in consultation and decision making, could become spoilers both of peace and resilience.

There is an increasing role for participatory water management mechanisms to reduce risks from extreme events. Attempts to improve participatory and stakeholder-inclusive policy processes in water management

initiatives will be important for achieving fair processes and outcomes and for reducing risks of tensions arising between different stakeholders, but only if the concerns of community members are adequately addressed.

### **3. Multiple scales of action are relevant for responding to climate stresses and reducing the risk of conflict.**

In the first guideline, we emphasised the importance of resilience building at the local scale. For governments, donors and international organisations, this means taking the very local context as the starting point. However, the broader context will be equally important for successful responses. The case studies offer evidence of the inadequacy of national and regional government responses to climate and water issues at the local scale, through being unresponsive, under-resourced or poorly thought through and communicated. Although the evidence from the case studies supports a preference for local solutions, it is misleading to think that all local solutions will work for everyone. They may be inadequate, particularly for more vulnerable members of society. Moreover, if externally resourced, they may suffer through inadequate follow-up.

The influence of national policies on local abilities to adapt and on tensions between different groups, such as farmers and pastoralists, also needs to be recognised. Steps should be taken to reduce the negative impacts and increase the positive impacts of policies. There are opportunities for the newly-emerging national climate change-adaptation institutions and policies to foster closer links with development and water management institutions, policies and programmes, including inter-governmental institutions such as the NBA. This can help to ensure that planned infrastructure and water management decisions consider adaptation to climate change. Since water resource developments often create winners and losers, principles of good governance and engagement between national and local level institutions (guideline 2) can be used to ensure that resilience of different social groups is not compromised. A useful way for those involved in supporting adaptation to view this issue of multiple scales of action is through the concept of subsidiarity. In this approach, decisions and actions should be taken at the lowest appropriate level, with successively higher levels adding value to and enabling the actions which are undertaken at a more local level.

### **4. An increased recognition of the interconnections between development and adaptation will facilitate resilience building.**

In a resilience-building approach to adaptation (guideline 1), keeping adaptation and development efforts separate makes no practical sense. There may be political reasons for a separation related to the international financing of adaptation and development. However, on the ground, this risks incoherent policies and programmes, as the same donor governments support activities of separate state institutions with their own separate priorities and strategies which would benefit from integration. It is therefore incumbent on those responsible for adaptation and development funding to work closely together in recognition of the substantial overlap between their mandates.

Adaptation can be facilitated by ensuring that environmental management and development policies are flexible enough to cope with uncertainty and growing climate variability on long-term timescales. Future development must avoid maladaptation through “lock-in” to unsustainable practices of water and land use in a changing and variable climate. If flexibility can be built into governance structures and processes for managing land and water, such as land tenure systems, they will be more resilient to climate variability and climate change.

While it is both possible and necessary to build adaptation into development and peacebuilding policies, some tensions between different approaches may arise; for example, adaptation is seen as being urgent. However, building resilience is not something which can be achieved quickly. Its components include key elements of development including education, good governance, jobs, household asset accumulation and protection, gender equality, and the qualities of trust and self-esteem which grow from these. These elements take decades to build.

# REFERENCES

Adger, W.N. (2003). 'Social capital, collective action and adaptation to climate change', *Economic Geography*, 79 (4), pp. 387–404.

Adger, W.N., Paavola, J. and Huq, S. (2006). 'Towards justice in adaptation to climate change' in Adger, W.N., Paavola, J., Huq, S. and Mace, M.J. (Eds.) *Fairness in adaptation to climate change*. Cambridge, Massachusetts: MIT Press, pp. 1–19.

African Development Bank (2010). *Markala Sugar Project – Agricultural Component – Appraisal Report*, November 2010. Available at <http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/MALI%20-%20AR%20Agricultural%20Component%20Markala%20Project.pdf> (1.3Mb).

Aguilar, L. (2009). *Women and Climate Change: Vulnerabilities and Adaptive Capacities*. Washington DC, US: World Watch Institute.

Andersen, I., Dione, O., Jarosewich-Holder, M. and Olivry, J-C. (2005). *The Niger River Basin: A vision for sustainable management*. Washington DC, US: The World Bank.

Barnaby, W. (2009). 'Do nations go to war over water?', *Nature*, 458, pp. 282–283.

Barnett, J. and Adger, W.N. (2007). 'Climate change, human security and violent conflict', *Political Geography*, 26, pp. 639–655.

Benjaminsen, T.A., Alinon, K., Buhaug, H. and Tove Busetha, J. (2010). 'Land Use Conflicts in the Inner Niger Delta of Mali: Does Climate Change Play a Role?', Paper presented at the conference "Climate Change and Security", Trondheim, Norway, 21st–24th June 2010.

Benjaminsen, T.A. and Ba, B. (2009). 'Farmer-herder conflicts, pastoral marginalisation and corruption: A case study from the inland Niger Delta of Mali', *The Geographical Journal*, 175, pp. 71–81.

Beukering, P.J.H. van, Kone, B., Goosen, H. and Zwarts, L. (2005). *The impact of water management on poverty and the environment in the Upper Niger River Basin (Mali)*, Poverty Reduction and Environmental Management (PREM) Working Paper 05/08, 6th March 2005. Available at <http://www.prem-online.org/archive/11/doc/PREMWP05-08.pdf> (668Kb).

Biasutti, M. and Sobel, A.H. (2009). 'Delayed Sahel rainfall and global seasonal cycle in a warmer climate', *Geophysical Research Letters*, Vol. 36, L23707, doi:10.1029/2009GL041303.

Bloch, P. and Foltz, J. (1999). *Recent Land Tenure Reforms in the Sahel: Assessment and Suggestions for Redirection*. Madison, US: BASIS/Land Tenure Center.

Brooks, N. (2004). *Drought in the African Sahel: Long-term perspectives and future prospects*, Tyndall Working Paper No. 61. Norwich, UK: Tyndall Centre for Climate Change Research.

Brooks, N. (2006). 'Cultural responses to aridity in the Middle Holocene and increased social complexity', *Quaternary International*, Vol. 151, pp. 29–49.

Brown, I.A. (2010). 'Assessing eco-scarcity as a cause of the outbreak of conflict in Darfur: a remote sensing approach', *International Journal of Remote Sensing*, 31, pp. 2513–2520.

Buhaug, H. (2010). 'Climate not to blame for African civil wars', *Proceedings of the National Academy of Sciences (PNAS)*, Vol. 107, pp. 16477–16482.

Burke, M.B., Miguel, E., Satyanath, S., Dykema, J.A. and Lobell, D.B. (2009). 'Warming increases the risk of civil war in Africa', *Proceedings of the National Academy of Sciences (PNAS)*, Vol. 106, pp. 20670–20674.

Campbell, K.M., Gulette, J., McNeill, J.R. et al. (2007). *The Age of Consequences: The Foreign Policy and National Security Implications of Global Climate Change*. Washington DC: Center for Strategic & International Studies (CSIS) and Center for a New American Security (CNAS).

Charney, J., Stone, P.H. and Quirk, W.J. (1975). 'Drought in the Sahara: A biogeophysical feedback mechanism', *Science*, Vol. 187, pp. 434–435.

Christensen, J.H., Hewitson, B., Busuioc, A., Chen, A., Gao, X., Held, I., Jones, R., Kiolli, R.K., Kwon, W.-T., Laprise, R., Magaña Rueda, V., Mearns, L., Menéndez, C.G., Räisänen, J., Rinke, A., Sarr, A. and Whetton, P. (2007). 'Regional climate projections' in Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M. and Miller, H.L. (Eds.) *Climate Change 2007: The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK and New York, US: Cambridge University Press.

Cold-Ravnkilde, S. M. (2010). *Case studies on conflict and cooperation in local water governance. Report No. 3. The case of Lake Agofou, Douentza, Mali*. Copenhagen, Denmark: Danish Institute for International Studies.

Conway, D., Persechino, A., Ardoine-Bardin, S., Hamandawana, H., Dieulin, C. and Mahe, G. (2008). *Rainfall and water resources variability in sub-Saharan Africa during the 20th century*, Tyndall Centre Working Paper 119, Norwich, UK: Tyndall Centre for Climate Change Research.

Conway, D., Persechino, A., Ardoine-Bardin, S., Hamandawana, H., Dieulin, C. and Mahe, G. (2009). 'Rainfall and river flow variability in Sub-Saharan Africa during the twentieth century', *Journal of Hydrometeorology*, Vol. 10, pp. 41–59.

Cook, K.H. (2008). 'The mysteries of Sahel droughts', *Nature Geoscience*, Vol. 1, pp. 647–648.

Cook, S., Fisher, M., Tiemann, T. and Vidal, A. (2011). 'Water, food and poverty: Global- and basin-scale analysis', *Water International*, Vol. 36, pp. 1–16.

Cooper, F. (1997). 'Modernizing bureaucrats, backward Africans, and the development concept' in Cooper, F. and Packard, R. (Eds.) *International Development and the Social Sciences*, pp. 64–92. Berkeley: University of California Press.

Dankelman, I. (Ed.) (2010). *Gender and climate change: An introduction*. London: Earthscan.

Davies, S. (1996). *Adaptable livelihoods: Coping with food insecurity in the Malian Sahel*. London: Macmillan.

Diallo, A. and Mushinzimana, G. (2009). *Foreign Direct Investment (FDI) in Land in Mali*. Eschborn, Germany: GTZ. Available at <http://www2.gtz.de/wbf/4tDx9kw63gma/gtz2010-0064en-foreign-direct-investment-mali.pdf> (832Kb).

Di Lernia, S. (2002). 'Dry Climatic Events and Cultural Trajectories: Adjusting Middle Holocene Pastoral Economy of the Libyan Sahara' in Hassan, F.A. (Ed.) *Droughts, Food and Culture*. New York: Kluwer Academic/Plenum Publishers.

Di Lernia, S. (2006). 'Building Monuments, Creating Identity: Cattle Cult as a Social Response to Rapid Environmental Changes in the Holocene Sahara', *Quaternary International*, Vol. 151, pp. 50–62.

Djiré, M. and Cissé, A.O. (2010). *Case studies on conflict and cooperation in local water governance. Report No. 5. The case of the Hombori water supply projects, Douentza, Mali*. Copenhagen, Denmark: Danish Institute for International Studies.

Djiré, M., Cissé, A.O., Cold-Ravnkilde, S.M., Keita, A. and Traore, A. (2010). *Conflict and cooperation in local water governance – inventory of local water-related events in Douentza District, Mali*, DIIS Working Paper 2010:12. Copenhagen, Denmark: Danish Institute for International Studies.

Easterling, D.R., Meehl, G.A., Parmesan, C., Changnon, S.A., Karl, T.R. and Mearns, L.O. (2000). 'Climate Extremes: Observations, Modeling, and Impacts', *Science*, Vol. 289, pp. 2068–2074.

El-Bushra, J. (2003). 'Fused in Combat: Gender Relations and Armed Conflict', *Development in Practice*, Vol. 13 (2&3).

Evan, A.T., Vimont, D.J., Heidinger, A.K., Kossin, J.P. and Bennartz, R. (2009). 'The role of aerosols in the evolution of tropical North Atlantic ocean temperature anomalies', *Science*, Vol. 324, pp. 778–781, doi:10.1126/science.1167404.

FAO (Food and Agriculture Organization) (1997). *Irrigation potential in Africa: A basin approach*, Land and Water Bulletin 4. Rome: Food and Agriculture Organization of the United Nations. Available at <http://www.fao.org/docrep/W4347E/w4347e00.htm#Contents>.

Ferry, L., Martin, D., Muther, N., Mietton, M., Coulibaly, N., Le Bars, M., Cissé Coulibaly, Y., Paturel, J.-E., Vauchel, P., Olivry, J.-C., Barry, M.A., Laval, M., Basselot, F.X. and Bachelot, N. (2011a). *Niger supérieur – Quelques résultats de recherche sur les ressources et usages de l'eau*. DNH-Mali, DNH-Guinée, IRD, UMR G-EAU, Université Jean Moulin (Lyon 3), UMR HSM, UNESCO, CE, ANR, 12 p.

Ferry, L., Mietton, M. and Cissé Coulibaly, Y. (2011b). 'L'équilibre du fleuve Niger perturbé par les "pêcheurs de sable"', *Actualité Scientifique*, Vol. 376, June 2011. Marseille, France: Institut de Recherche pour le Développement (IRD).

Folland, C.K., Palmer, T.N. and Parker, D.E. (1986). 'Sahel rainfall variability and worldwide sea temperatures, 1901–85', *Nature*, Vol. 320, pp. 602–606.

Füssel, H.M. (2007). 'Adaptation planning for climate change: Concepts, assessment approaches, and key lessons', *Sustainability Science*, Vol. 2, pp. 265–275.

Gasper, D. (2005). 'Securing Humanity: Situating "Human Security" as Concept and Discourse', *Journal of Human Development*, Vol. 6, pp. 221–245.

Giannini, A., Saravanan, R. and Chang, P. (2003). 'Oceanic forcing of Sahel rainfall on interannual to interdecadal timescales', *Science*, Vol. 302, pp. 1027–1030.

Gleditsch, N.P., Nordas, R. and Salehyan, I. (2007). *Climate Change and Conflict: The Migration Link*, Coping with Crisis Working Paper Series, International Peace Academy.

Goulden, M., Conway, D. and Persechino, A. (2009a). 'Adaptation to climate change in international river basins in Africa: A review', *Hydrological Sciences Journal—Journal Des Sciences Hydrologiques*, Vol. 54, pp. 805–828.

Goulden, M., Næss, L.O., Vincent, K. and Adger, N. (2009b). 'Accessing diversification, networks and traditional resource management as adaptations to climate extremes' in Adger, W.N., Lorenzoni, I. and O'Brien, K. (Eds.) *Adapting to Climate Change: Thresholds, Values, Governance*. Cambridge: Cambridge University Press, pp. 448–464.

Graef, F. and Haigis, J. (2001). 'Spatial and temporal rainfall variability in the Sahel and its effects on farmers' management strategies', *Journal of Arid Environments*, Vol. 48, pp. 221–231.

Grolle, J. (1997). 'Heavy rainfall, famine, and cultural response in the West African Sahel: the "Muda" of 1953–54', *GeoJournal*, Vol. 43, No. 3, pp. 205–214.

Harcourt, W. (2009). *Literature Review on Gender and Fragility*. Available at <http://erd.eui.eu/media/review-by-w-harcourt.pdf> (270Kb).

Held, I.M., Delworth, T.L., Lu, J., Findell, K.L. and Knutson, T.R. (2005). 'Simulation of Sahel drought in the 20th and 21st centuries', *Proceedings of the National Academy of Sciences (PNAS)*, Vol. 102, pp. 17891–17896.

Hellmuth, M.E., Diarra, D.Z., Vaughan, C. and Cousin, R. (2010). *Increasing Food Security with Agrometeorological Information: Mali's National Meteorological Service Helps Farmers Manage Climate Risk*. World Resources Report Case Study. Washington, DC. Available at [http://www.worldresourcesreport.org/files/wrr/papers/wrr\\_case\\_study\\_increasing\\_food\\_security\\_mali.pdf](http://www.worldresourcesreport.org/files/wrr/papers/wrr_case_study_increasing_food_security_mali.pdf) (319Kb).

Hendrix, C. and Salehyan, I. (2010). 'After the Rain: Rainfall Variability, Hydro-Meteorological Disasters, and Social Conflict in Africa', Paper presented at the conference "Climate Change and Security", Trondheim, Norway, 21st–24th June 2010.

Heyd, T. and Brooks, N. (2009). 'Exploring cultural dimensions to climate change' in Adger, W.N., Lorenzoni, I. and O'Brien, K. (Eds.) *Adapting to Climate Change: Thresholds, Values and Governance*. Cambridge: Cambridge University Press, pp. 269–282.

Hill, A.G. (1989). 'Demographic responses to food shortages in the Sahel', *Population and Development Review*, Vol. 15, Supplement: *Rural Development and Population: Institutions and Policy*, pp. 168–192.

Hiu, W.J., Cook, B.I., Ravi, S., Fuentes, J.D. and D'Odorico, P. (2008). 'Dust-rainfall feedbacks in the West African Sahel', *Water Resources Research*, Vol. 44, doi:10.1029/2008WR006885.

Hulme, M. (2001). 'Climatic perspectives on Sahelian desiccation: 1973–1998', *Global Environmental Change*, Vol. 11, pp. 19–29.

International Alert (2010). *Programming Framework for International Alert. Design, Monitoring and Evaluation*. London, UK. Available at <http://www.international alert.org/sites/default/files/library/012010ProgrammingFrameworkForAlert.pdf> (831Kb).

International Alert (2011). *Peace is a Marathon. Impact Report 2010*. London, UK. Available at <http://www.international-alert.org/sites/default/files/publications/082011ImpactReport2010.pdf> (2.6Mb).

IRIN (Integrated Regional Information Networks) (2011). ‘Nigeria fails to heed flood early warning messages’, *The Guardian*, 16th September 2011. Available at <http://www.guardian.co.uk/global-development/2011/sep/16/nigeria-ignored-flood-warnings>.

Jousse, H. (2004). ‘A new contribution to the history of pastoralism in West Africa’, *Journal of African Archaeology*, Vol. 2, pp. 187–201.

Kundermann, B., Diarrassouba, M., Garrido, D., Nett, D., Triemer de Cruzate, S. and Ulbrich, A. (2004). ‘Orientation vers les effets et contribution à la lutte contre la pauvreté du Programme d’Appui aux Collectivités Territoriales (PACT) au Mali’. Seminar für Ländliche Entwicklung, Berlin, December 2004. Available at <http://edoc.hu-berlin.de/series/sle/212/PDF/212.pdf> (2.4Mb).

Lamprey, H.F. (1975). *Report on the desert encroachment reconnaissance in northern Sudan: 21st October to 10th November 1975*. Paris and Nairobi: UNESCO/UN Environment Programme.

Lebel, T. and Ali, A. (2009). ‘Recent trends in the Central and Western Sahel rainfall regime (1990–2007)’, *Journal of Hydrology*, Vol. 375, pp. 52–64.

Lund, M.S. (2009). ‘Conflict Prevention: Theory in Pursuit of Policy and Practice’ in Bercovitch, J., Kremenyuk, V. and Zartman, I.W. (Eds.) *The SAGE Handbook of Conflict Resolution*. London: SAGE, pp. 287–308.

Mabey, N. (2008). *Delivering Climate Security: International Security Responses to a Climate Changed World*. Whitehall Paper 69, Royal United Services Institute. London: Routledge.

Makerere University, Department of Women and Gender Studies and Faculty of Arts, Peace and Conflict Programme (2005). *Gender Dimensions of Conflict: Strategies for Sustainable Peace*. Report submitted to Friedrich Ebert Stiftung. Available at [http://www.fes.de/aktuell/focus/3/Docs/Uganda\\_Gender%20Dimensions%20of%20Conflict.pdf](http://www.fes.de/aktuell/focus/3/Docs/Uganda_Gender%20Dimensions%20of%20Conflict.pdf) (477Kb).

Maxwell, J.W. and Reuveny, R. (2000). ‘Resource scarcity and conflict in developing countries’, *Journal of Peace Research*, Vol. 37, pp. 301–322.

McSweeney, C., New, M. and Lizcano, G. (2008). *UNDP Climate Change Country Profiles: Mali*. Oxford: School of Geography and the Environment, University of Oxford. Available at <http://ncsp.undp.org/sites/default/files/Mali.oxford.report.pdf> (3.7Mb).

Ministry of Environment of the Federal Republic of Nigeria (2003). *Nigeria’s First National Communication: Under the United Nations Framework Convention on Climate Change*. Abuja. Available at <http://unfccc.int/resource/docs/natc/nignc1.pdf> (1.5Mb).

Mortimore, M. (1998). *Roots in the African Dust*. Cambridge, UK: Cambridge University Press.

Mortimore, M.J. and Adams, W.M. (2001). ‘Farmer adaptation, change and “crisis” in the Sahel’, *Global Environmental Change – Human and Policy Dimensions*, 11, 49–57.

Moser, S.C. (2009). ‘Are our levers long and our fulcra strong enough? Exploring the soft underbelly of adaptation decisions and actions’ in Adger, W.N., Lorenzoni, I. and O’Brien, K. (Eds.) *Adapting to Climate Change: Thresholds, Values, Governance*. Cambridge, UK: Cambridge University Press, pp. 313–334.

Neumayer, E. and Plümper, T. (2007). 'The gendered nature of natural disasters: the impact of catastrophic events on the gender gap in life expectancy, 1981–2002', *Annals of the American Association of Geographers*, Vol. 97, No. 3, pp. 551–566.

Nicholson, S.E. (1978). 'Climatic variations in the Sahel and other African regions during the past five centuries', *Journal of Arid Environments*, Vol. 1, pp. 3–24.

Nicholson, S.E. (2000). 'Land surface processes and Sahel climate', *Reviews of Geophysics*, Vol. 38, No. 1, pp. 117–139.

Nordas, R. and Gleditsch, N.P. (2007). 'Climate change and conflict', *Political Geography*, Vol. 26, Issue 6, pp. 627–638.

O'Brien, K.L. and Leichenko, R.M. (2003). 'Winners and Losers in the Context of Global Change', *Annals of the Association of American Geographers*, Vol. 93, Issue 1, pp. 89–103.

Odjugo, P. (2009). 'Quantifying the Cost of Climate Change Impact in Nigeria: Emphasis on Wind and Rainstorms', *Journal of Human Ecology*, Vol. 28, No. 2, pp. 93–101.

Olomoda, I.A. (2006). 'Impact of climatic change on River Niger hydrology', Paper presented at the 9th International Rivers Symposium, Brisbane, Australia, 3rd–6th September 2006. Available at <http://www.riversymposium.com/2005/index.php?element=06OLOMODAIBraheem>.

Olsson, L., Eklundh, L. and Ardo, J. (2005). 'A recent greening of the Sahel – trends, patterns and potential causes', *Journal of Arid Environments*, Vol. 63, pp. 556–566.

Paeth, H., Fink, A. and Samimi, C. (2009). 'The 2007 flood in sub-Saharan Africa: Spatio-temporal characteristics, potential causes, and future perspective', *EMS Annual Meeting Abstracts*, Vol. 6, EMS2009-103.

Parker, R. (1991). 'The Senegal-Mauritania conflict of 1989: A fragile equilibrium', *The Journal of Modern African Studies*, Vol. 29, pp. 155–171.

Patricola, C.M. and Cook, K.H. (2010). 'Sub-Saharan Northern African climate at the end of the twenty-first century: Forcing factors and climate change processes', *Climate Dynamics*, Vol. 37, Issue 5–6, pp. 1165–1188.

Podesta, J. and Ogden, P. (2008). 'The Security Implications of Climate Change', *The Washington Quarterly*, Vol. 31, No. 1, pp. 115–138.

Raleigh, C. and Kniveton, D. (2010). 'Chronic Communal Conflict and Environmental Pressures', Paper presented at the conference "Climate Change and Security", Trondheim, Norway, 21st–24th June 2010.

Raleigh, C. and Urdal, H. (2007). 'Climate change, environmental degradation and armed conflict', *Political Geography*, Vol. 26, pp. 674–694.

Republic of Niger (2006). *National Adaptation Programme of Action*. In line with the UN Framework Convention on Climate Change. Available at <http://unfccc.int/resource/docs/napa/ner01e.pdf> (2.2Mb).

République du Mali (2000). *Convention Cadre Des Nations Unies Sur Les Changements Climatiques: Communication Initiale du Mali*. Available (in French) at [http://unfccc.int/essential\\_background/library/items/3599.php?rec=j&priref=2733#beg](http://unfccc.int/essential_background/library/items/3599.php?rec=j&priref=2733#beg).

République du Mali (2007). *Programme d'Action National d'Adaptation aux Changements Climatiques*. Available (in French) at <http://unfccc.int/resource/docs/napa/mli01f.pdf> (3Mb).

Rossi, A. and Lambrou, Y. (2008). 'Gender and equity issues in liquid biofuels production: Minimizing the risks to maximize the opportunities', Rome: Food and Agriculture Organization (FAO).

Rowell, D.P. and Milford, J.R. (1993). 'On the generation of African squall lines', *Journal of Climate*, Vol. 6, pp. 1181–1193.

Skinner, J., Niasse, M. and Haas, L. (Eds.) (2009). 'Sharing the benefits of large dams in West Africa', *Natural Resource Issues*, No. 19. London, UK: International Institute for Environment and Development.

Smit, B. and Wandel, J. (2006). 'Adaptation, adaptive capacity and vulnerability', *Global Environmental Change*, Vol. 16, pp. 282–292.

Smith, D. and Vivekananda, J. (2007). *A Climate of Conflict: The Links between Climate Change, Peace and War*. London, UK: International Alert. Available at <http://www.international-alert.org/resources/publications/climate-conflict>.

Suhrke, A. (1993). *Pressure points: Environmental degradation, migration and conflict*. Cambridge, Massachusetts: American Academy of Arts and Sciences.

Tarhule, A. (2005). 'Damaging rainfall and flooding: The other Sahel hazards', *Climatic Change*, Vol. 72, pp. 355–377.

Thébaud, B. and Batterbury, S. (2001). 'Sahel pastoralists: Opportunism, struggle, conflict and negotiation. A case study from eastern Niger', *Global Environmental Change – Human and Policy Dimensions*, Vol. 11, pp. 69–78.

Tschakert, P., Sagoe, R., Ofori-Darko, G. and Codjoe, S.N. (2010). 'Floods in the Sahel: An analysis of anomalies, memory, and anticipatory learning', *Climatic Change*, Vol. 103, pp. 471–502.

Turner, M.D., Ayantunde, A.A., Patterson, K.P. and Patterson III, E.D. (2011). 'Livelihood transitions and the changing nature of farmer-herder conflict in Sahelian West Africa', *Journal of Development Studies*, Vol. 47, pp. 183–206.

UNDP (United Nations Development Programme) (1994). *New Dimensions of Human Security – Human Development Report 1994*, Complete Report. New York and Oxford: Oxford University Press. Available at <http://hdr.undp.org/en/reports/global/hdr1994/>.

UNDP (2009a). 'Country fact sheet: Mali and climate change', UNDP website. Available at <http://content.undp.org/go/newsroom/2009/december/fiche-pays-le-mali-et-les-changements-climatiques.en>.

UNDP (2009b). *UNDP Resource Guide on Gender and Climate Change*. New York: United Nations Development Programme.

UNEP (United Nations Environment Programme) (2007). *Sudan Post-Conflict Environmental Assessment*. Nairobi and Kenya: UNEP. Available at [http://www.unep.org/publications/search/pub\\_details\\_s.asp?ID=3949](http://www.unep.org/publications/search/pub_details_s.asp?ID=3949).

University for Peace (2006). *Environmental Degradation as a Cause of Conflict in Darfur*, Conference Proceedings, Khartoum, December 2004. Switzerland: University for Peace. Available at [http://www.upeace.org/library/documents/darfur\\_cp.pdf](http://www.upeace.org/library/documents/darfur_cp.pdf) (1.2Mb).

USAID (United States Agency for International Development) (forthcoming). *Conflict Assessment Framework 2.0*. Washington DC: USAID.

Vincent, K., Wanjiru, L., Aubry, A., Mershon, A., Nyandiga, C., Cull, T. and Banda, K. (2010). *Gender, climate change and community-based adaptation*. New York: UNDP.

Watson, R.T. (Ed.) (2001). *Climate Change 2001: Synthesis Report*, Contribution of Working Groups I, II and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Published for the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press. Available at <http://www.ipcc.ch/pdf/climate-changes-2001/synthesis-syr/english/front.pdf> (79Kb).

Wolf, A.T. (1998). 'Conflict and cooperation along international waterways', *Water Policy*, Vol. 1(1998), pp. 251–265.

Yoshioka, M., Mahowald, N., Conley, A.J. et al. (2007). 'Impact of Desert Dust Radiative Forcing on Sahel Precipitation: Relative Importance of Dust Compared to Sea Surface Temperature Variations, Vegetation Changes, and Greenhouse Gas Warming', *Journal of Climate*, Vol. 20, Issue 8, pp. 1445–1466.

Young, H. and Osman, A.M. (2006). *Challenges to Peace and Recovery in Darfur: A Situation Analysis of the Ongoing Conflict and its Continuing Impact on Livelihoods*. Massachusetts: Feinstein International Center, Tufts University.

Zeitoun, M. and Warner, J. (2006). 'Hydro-hegemony – a framework for analysis of trans-boundary water conflicts', *Water Policy*, Vol. 8, pp. 435–460.

# ANNEX

Number of interviews and group discussions by case studies

|  | Mali         |                               |              | Nigeria                       |              |          | Total                      |         |
|--|--------------|-------------------------------|--------------|-------------------------------|--------------|----------|----------------------------|---------|
|  | Case Study 1 |                               | Case Study 2 |                               | Case Study 3 |          |                            |         |
|  | National     | Region/<br>Cercle/<br>Commune | Village      | Region/<br>Cercle/<br>Commune | Village      | National | State//Local<br>Government | Village |
| <b>Interviews</b>                                  |              |                               |              |                               |              |          |                            |         |
| Government officials                               | 4            | 3                             | 1            | 6                             |              | 4        | 10                         |         |
| NGOs, Donors                                       | 2            |                               |              | 1                             |              | 2        |                            | 5       |
| Other key informants                               | 3            | 4                             | 1            |                               |              |          |                            | 8       |
| Men (village individual in-depth interviews)       |              |                               | 5            |                               |              |          | 9                          | 14      |
| Women (village individual in-depth interviews)     |              |                               | 1            |                               |              |          | 1                          | 2       |
| <b>Village-based group interviews/ discussions</b> |              |                               |              |                               |              |          |                            |         |
| Women only   |              |                               | 1            |                               |              |          | 3                          | 4       |
| Men only   |              |                               | 4            |                               | 3            |          | 4                          | 11      |
| Mixed  |              |                               |              |                               |              |          | 1                          | 1       |
| (No. of settlements visited)                       |              |                               | (3)          |                               | (3)          |          | (3)                        |         |
| <b>Workshop group discussions</b>                  |              |                               |              |                               |              |          |                            |         |
| Total  | 11           | 7                             | 12           | 8                             | 3            | 8        | 12                         | 18 79   |

Note: Interviews were numbered in chronological order. The interview number appears in brackets where quotations from interviews are included in the text of the main report.



**U.S. Agency for International Development**  
1300 Pennsylvania Avenue, NW  
Washington, DC 20523  
Tel: (202) 712-0000  
Fax: (202) 216-3524  
[www.usaid.gov](http://www.usaid.gov)

**International Alert**  
346 Clapham Road, London  
SW9 9AP, United Kingdom  
Tel +44 (0)20 7627 6800  
Fax +44 (0)20 7627 6900  
[www.international-alert.org](http://www.international-alert.org)